Infrastructure Working Council (IWC) Meeting Presentations

Day Two

March 31, 2016

Battery Technology Trends

Haresh Kamath
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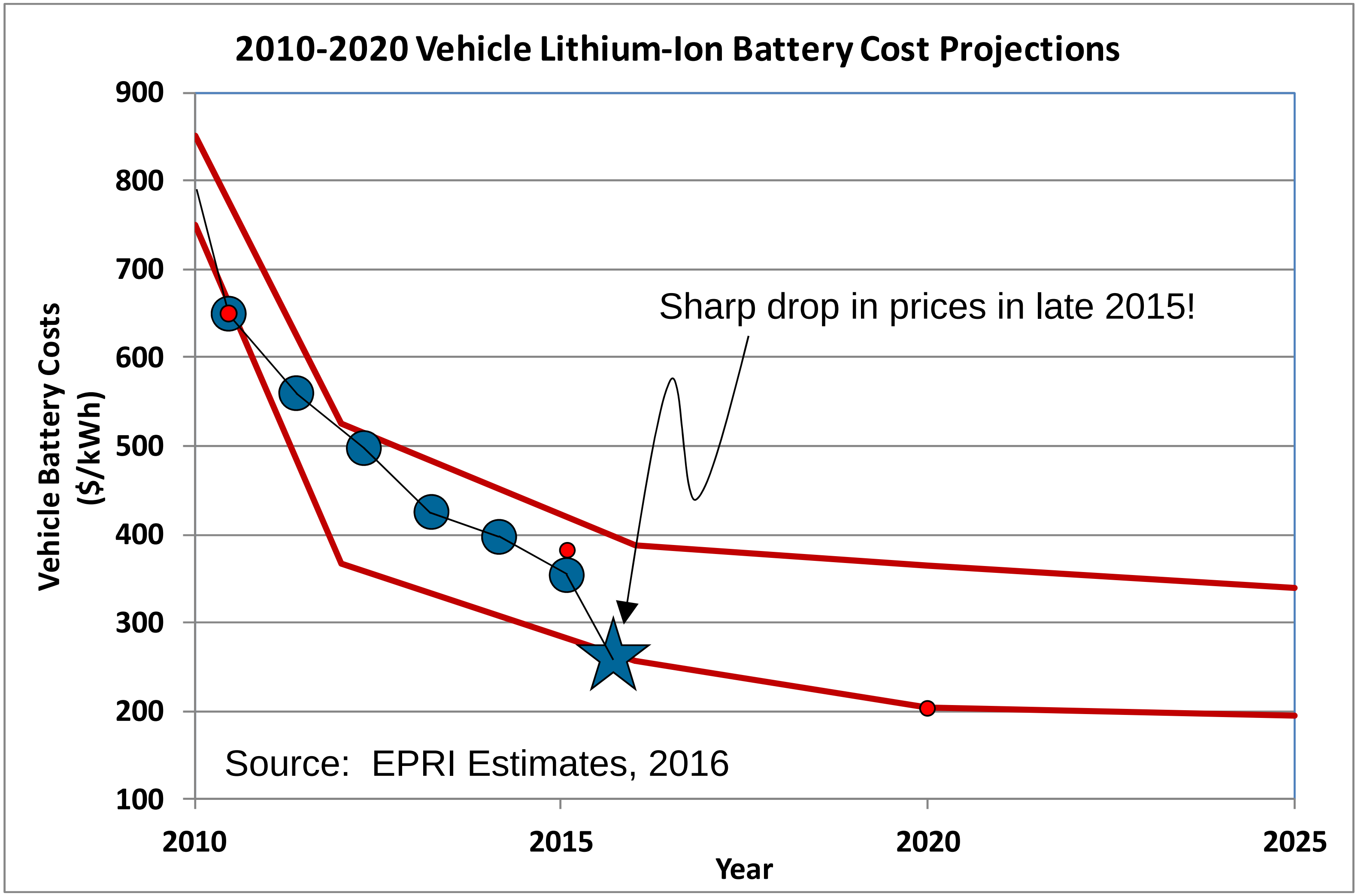
Infrastructure Working Council
31 March 2016

Outline

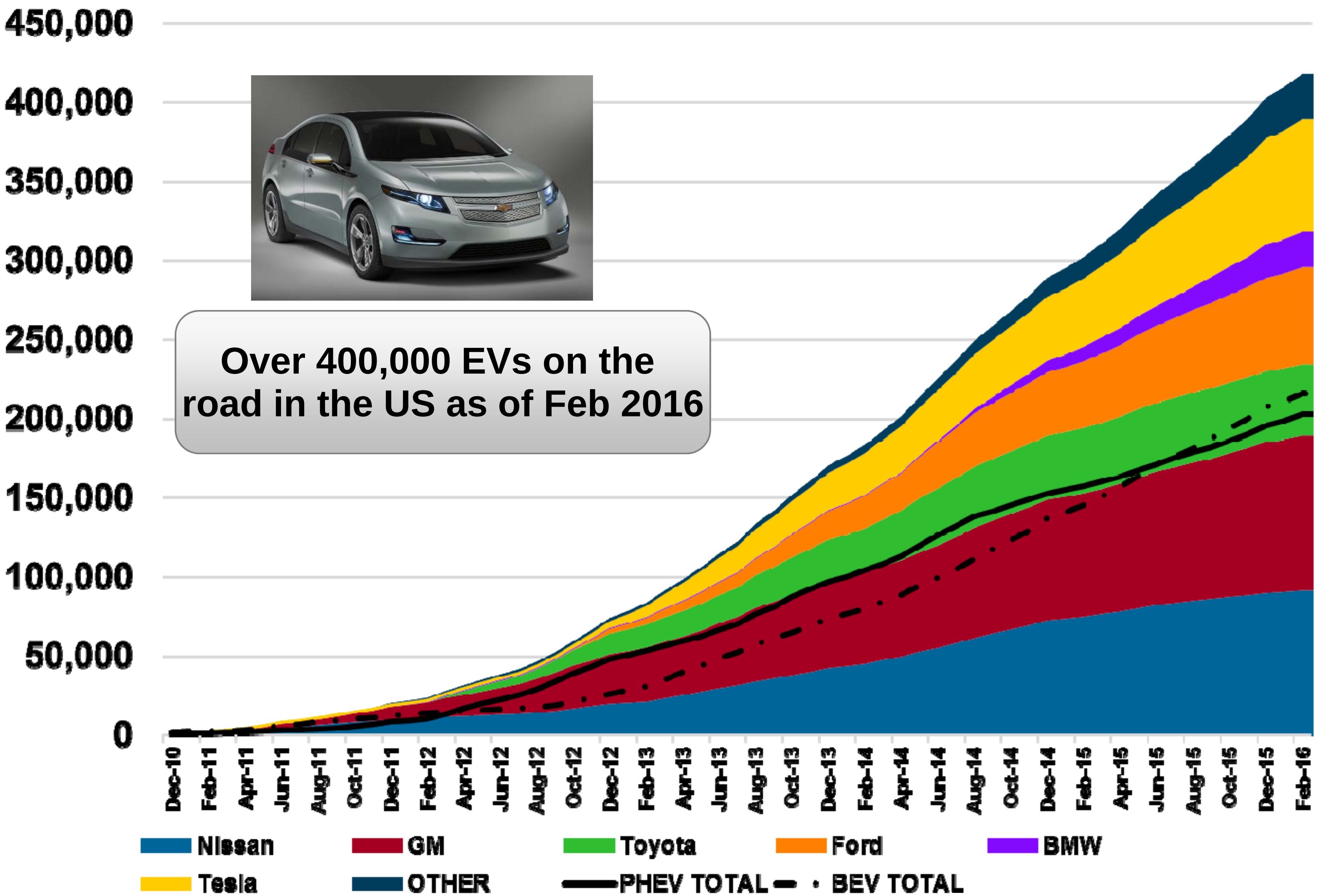
- Lithium Ion Batteries
  – Costs and Drivers
  – Technology and Performance Trends
- Future Technologies
  – Solid-state batteries
  – Metal-air technologies
  – Hydrogen fuel cells




How far have we come?

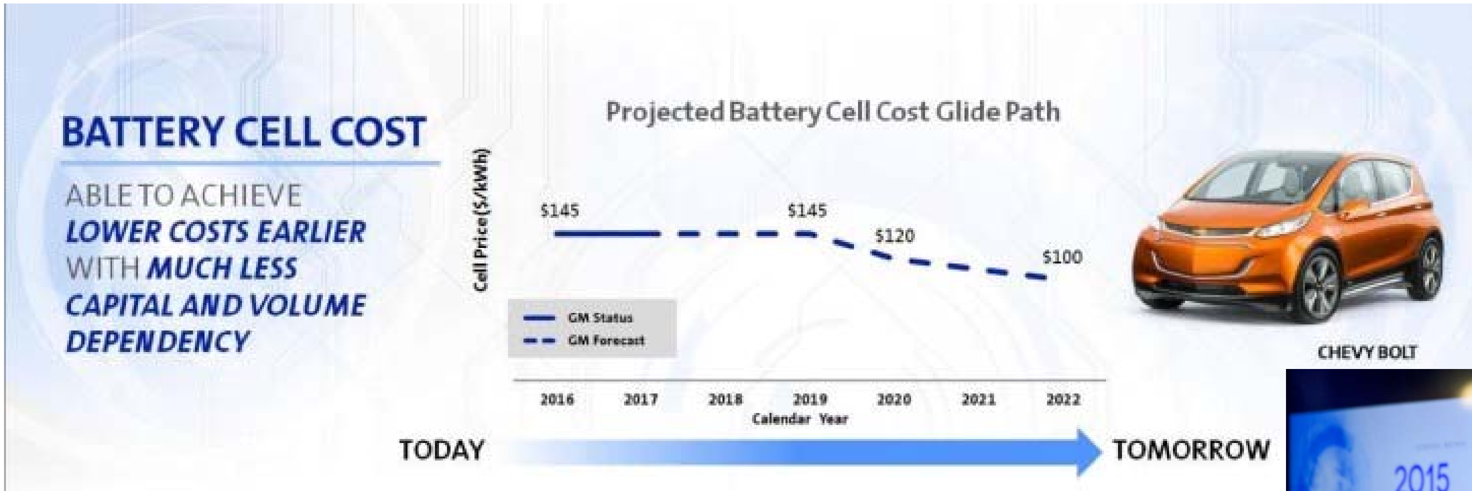


Electric vehicle sales volume is only part of the picture



EPRI ELECTRIC POWER RESEARCH INSTITUTE

The Incredible Shrinking Cell Price



Source: GM

Mary Barra, CEO of GM, 1 Oct 2015

- GM quotes \$145/kWh *at cell level* for 2016 Bolt
  - This seems to be significantly below LG Chem price to other customers
  - Projects cell level cost at \$100/kWh for 2022
- Tesla claims cell price of \$170/kWh today and \$100/kWh for 2020
- Not clear whether these price projections are reasonable and sustainable
  - Manufacturers may be selling below present cost
  - Supply chain may catch up to those costs

Cell and Battery Cost Projections

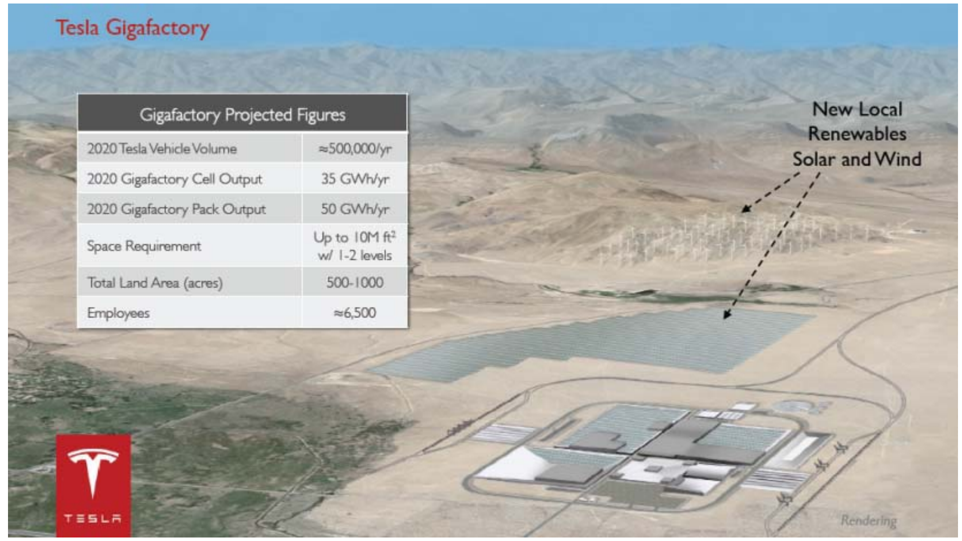
	2015	2020
Cell Level Cost	$160/kWh	$120/kWh
Battery Level Cost	$220/kWh	$180/kWh

	2015	2020
Cell Level Cost	$170/kWh	$100/kWh
Battery Level Cost	$250/kWh	$170/kWh

While general trend is lower costs, figures can be confusing – very little documentation for figures being thrown around

Gigafactories Galore

- Tesla is not alone in investing in large capacity
  - NEC, LG Chem, Panasonic, BYD and others already have large production facilities
- Production capacity alone does not explain cost reduction
  - Reductions to date are apparently due to learning curve effects
  - Most companies are counting on supply chain cost reductions



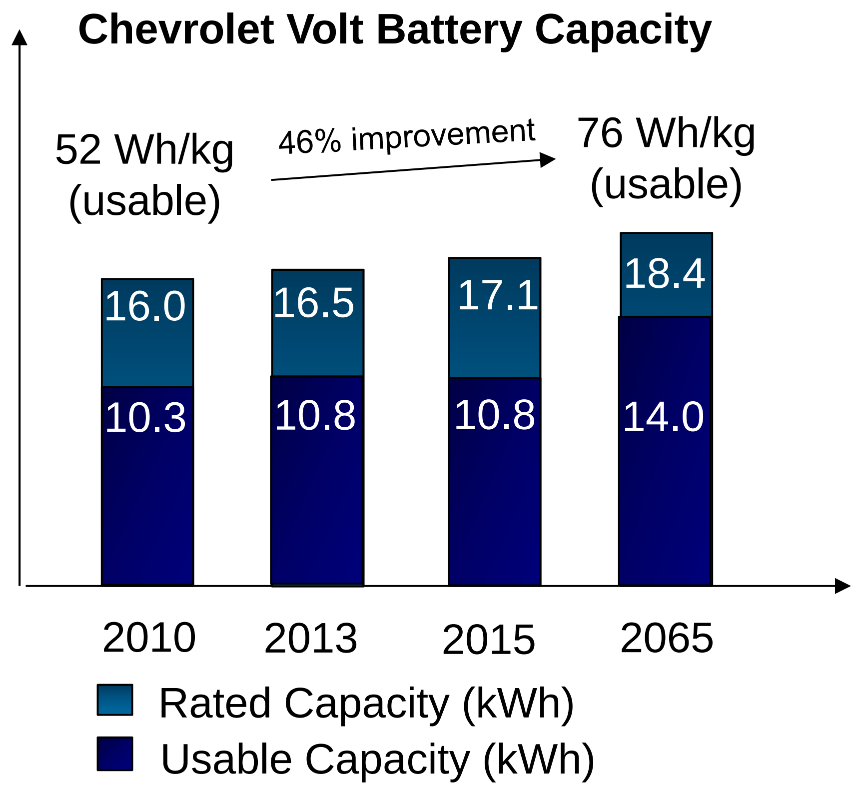
Source: Tesla Motors

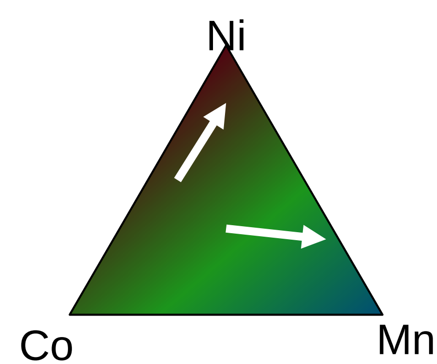
Source: LG Chem

ELECTRIC POWER RESEARCH INSTITUTE

Lithium Ion Technology

- Significant improvement in real performance (usable Wh/kg)
  - 46% improvement in usable capacity
  - Largely due to learning curve effects and more confidence in peformance
  - Improved cell chemistries have resulted in more energy, lower weight
- Lithium ion technologies have converged around lithium NMC technologies
  - Japanese companies (NEC, Panasonic) focusing on high nickel blends – higher energy density, shorter cycle life
  - Korean companies (LG Chem, Samsung) using low cobalt blends – lower energy density, longer life





General Technology and Cost Trends

- Chemistry
  - 2010-2013: Mostly LMO, with a few players using NCA
  - 2014-2016: Widespread introduction of NMC chemistries, silicon/graphene anodes
  - 2016-2022: Gradual adoption of layered-layered cathodes, silicon anodes, high voltage electrolytes
- Form Factors
  - 18650s still lower cost than prismatics and foil packs – but foil packs catching up quickly, probably crossing over in 2017-2018
  - Companies using cylindrical cells (i.e. Tesla) will probably move to larger cells (20750 cell?)
- Cost Trends
  - Cell costs still driven primarily by volume, but driven by technology by the end of the decade – cost per piece will saturate, cost per kWh will continue to fall
  - Many observers are expecting sharp price drop after 2020, but not clear this will happen
  - Lithium ion technologies will continue to be dominant well into 2020s, perhaps into the 2030s

Future Technologies: Horses and Unicorns

Horse	
Top Speed:	25 - 30 mph
Life:	25 - 30 years
Fuel:	Hay, grass
Emissions:	Manure

Unicorns	
Top Speed:	100 mph (projected)
Life:	300 - 400 years (projected)
Fuel:	Rainbows, morning dew
Emissions:	Butterflies

The projected claims for hypothetical technologies will *always* be better than real performance of existing technologies

 Image Source: Wikimedia.org, used under CCA: I. Producer, Library of Congress, Pearson Scott Foresman

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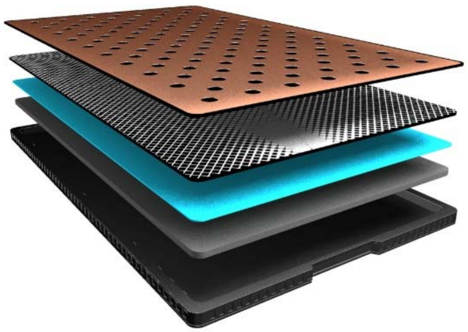
Future Technologies: Horses and Unicorns

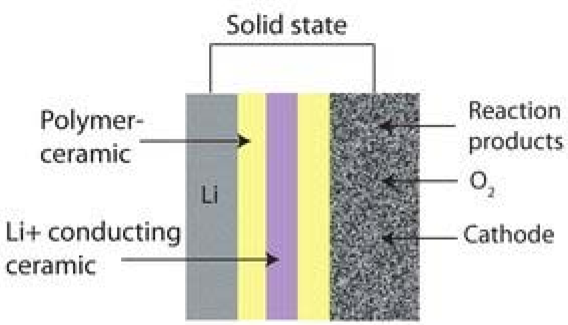
Unicorns	Rhinoceros
Top Speed: 100 mph (projected)	Top Speed: 25 -30 mph
Life: 300 - 400 years (projected)	Life: 40 - 50 years
Fuel: Rainbows, morning dew	Fuel: grasses and vegetation
Emissions: Butterflies	Emissions: Manure

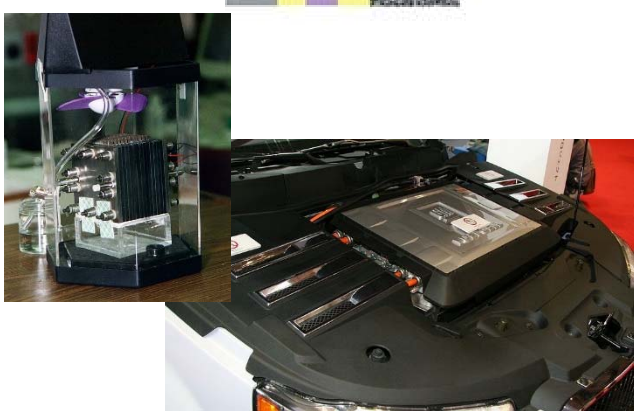
Real technologies have trouble living up to the mythologies built around them

Image Source: Wikimedia.org, used under CCA: Pearson Scott Foresman, U.S. Fish and Wildlife Service

Future Technologies?







- Metal-air (zinc-air, lithium-air)
  - Still seems more aspiration than genuine progress
  - Most investigators seem to be addressing problems that have already been solved (streetlight effect)
- Solid-state Batteries
  - Tremendous investment going into next generation (most into "stealth" companies)
  - Very little demonstrated progress
- Hydrogen Fuel Cells
  - Huge investment, especially from a few automotive OEMs
  - Results have been mixed – much progress but still many fundamental technology challenges in generation, storage, distribution and use of hydrogen

Summary and Conclusions

Rapidly declining costs for lithium ion batteries arising from a combination of scale production, learning curve effects, and vicious competition among players. Most players are counting on supply chain management for further cost reduction

Lithium ion will continue to be the dominant battery technology at least for the next decade and perhaps even beyond 2030. Continuing advances in cathode technologies, high-voltage electrolytes and silicon/graphene anodes may allow for another doubling of energy density without significant changes to the fundamental chemistry or operation.

Future technologies still face major challenges though research continues and revolutionary advance is still possible. Most technologies are awaiting fundamental materials breakthroughs to address challenges; while such breakthroughs are possible and even probable, it is difficult to put a timeline to when they may occur.

Together…Shaping the Future of Electricity

The Electric Circuit

Vincent-Michel Duval
Hydro-Quebec
Transportation Electrification

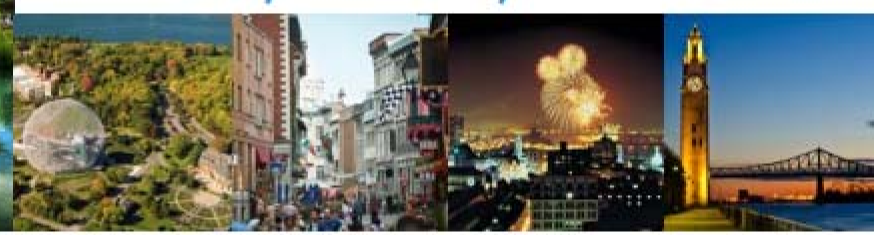
Agenda

1. The Electric Circuit an overview
2. Surrounding juridictions
3. Curbside EVSEs
4. DCFC station of the future
5. To rate or not to rate base…

DRIVE ELECTRIC INNOVATION

June 19-22, 2016

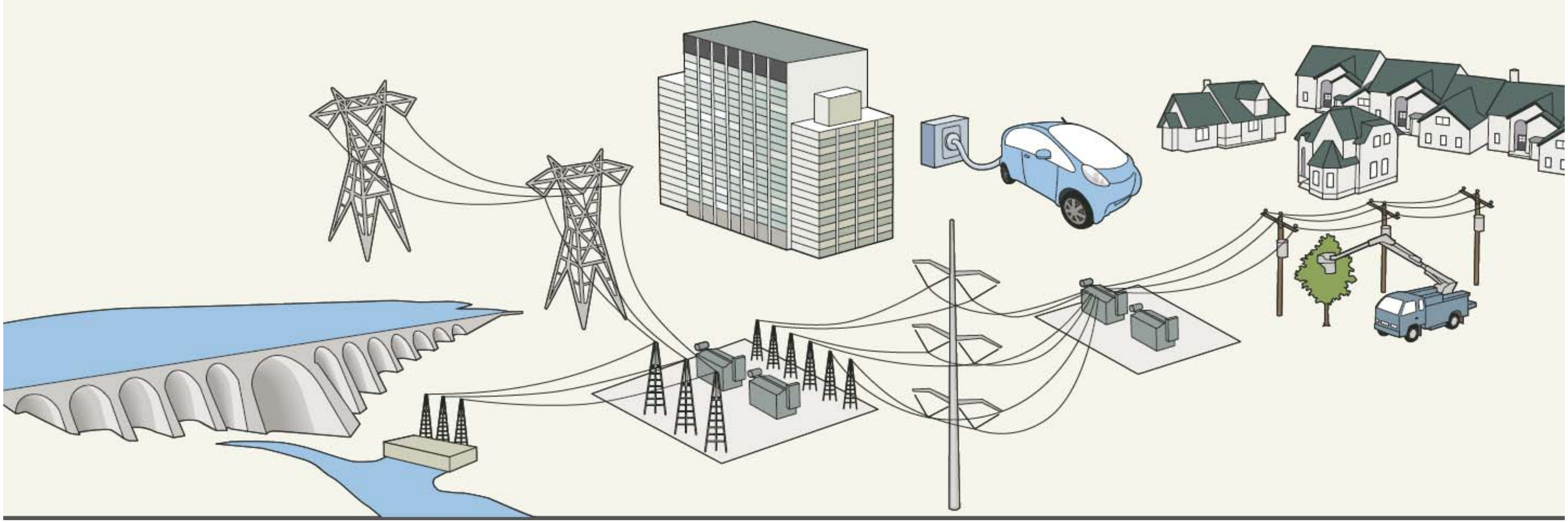
Montréal, Québec, Canada



29th International Electric Vehicle Symposium & Exhibition

Hydro-Québec at a glance

- Among the largest electric utilities in Canada ($13,6 billion sales)
- More than 99% renewable energy
- Generates, transmits and distributes electricity
- Québec Government sole shareholder
- Involved in electric mobility for over 25 years
- Leader in Canada with several EV pilot projects and the deployment of the largest charging network in Canada



Quebec's Government Targets for 2020

- **100 000** Electric and Plug-in Electric Vehicles registered.
- **150 000** tonnes of GHG emissions reduction in transportation sector.
- **66 million** of liters of fuel saved annually.
- **$500 million** of investment and **5 000** jobs in the electric vehicle industry.

Action Plan 2015-2020

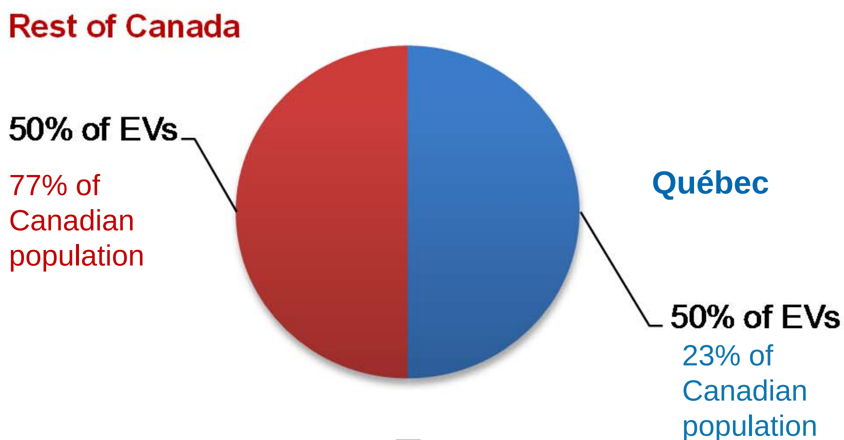
- Budget : **$420.75 million**
- **3 strategic orientations:**
  - Promote Electric Transportation;
  - Develop the Industry;
  - Create a favourable Environment.
- **35 measures**, including most probably a ZEV mandate and EV incentives of up to 8000$.

ENSEMBLE on fait avancer le Québec

Québec

The Electric Circuit : A success story

Quebecers like EVs



Source: *Crosschasm, February 2016*

… and EVSEs !

- **625 Charging stations**
- **135 host partners (cities, companies, institutions)**
- **50 000 charges in 2015**
- **13 000 charges in first 2 months of 2016**
- **93% - Level of satisfaction by members**

Electric Circuit
POWERED BY HYDRO-QUÉBEC

Important price gap between electricity and gas

	Consumption/100 km	Price	Cost	60 miles
Gas	2.28 gallons	X $3.60 / gallon	= $8.2	
Electricity	18 kWh	X $0.0989 / kWh	= $1.78	

Scenario

- Average residential electricity rate for a client consuming 1,000 kWh per month including taxes
- Price at the pump, regular gasoline (March 2016, Montreal region)

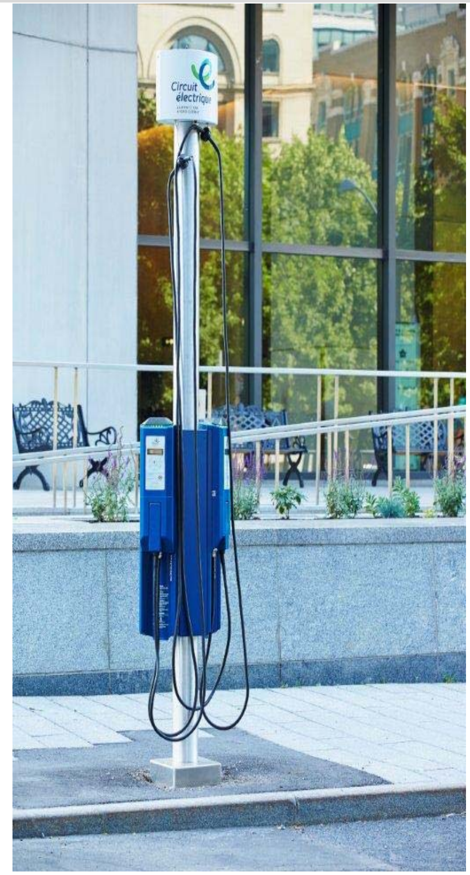
↳ **Peak of $5.5 per galon (April 2014 in Montréal)**

Annual savings of $1,500 to $2,000

Various type of charging stations

240V charging stations
(600+ in service)

DC fast charging stations
(30 in service)



Curb side charging stations
(20+ in service)

The Basic Principles

For partners

- Public-private partnership for cost sharing
- Environmentally responsible positioning (helping reduce GHGs)
- EVSE supplier selection by HQ based on best technology at best price

For EV drivers

- Peace of mind
- Open access to easy to use public charging service
- Single flat rate
- Easy-to-use stations resistant to harsh winter conditions

First step : Level 2 (2012 and on-going)

THE BUSINESS MODEL

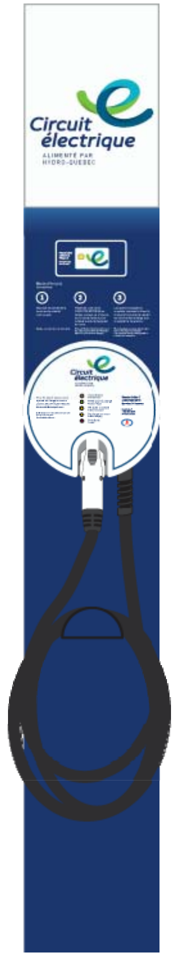
Hydro-Québec handles

- Selection of technology through RFPs and climatic testing at Research institute
- Recruitment of partners (5 founders)
- Coordination of rollout
- CAA-provided 24/7 helpline
- Visibility and advertising

Partners pay for

- Stations
- Installation
- Related services (telecommunications, management, warranties, etc.)
- Gets all revenues

RFP 2011



RFP 2013

Second step : Fast charging (2014 and on-going)

THE BUSINESS MODEL

Hydro-Québec handles

- Selection of technology through RFPs and climatic testing at Research institute
- Recruitment of partners
- Coordination of rollout
- CAA-provided 24/7 helpline
- Visibility and advertising
- Pays for 50 % of the project costs (station, installation and related services) up to a maximum
- Agreement with Nissan for the first 25 DCFCs

Partners

- Pay for the remainder of the project costs

Revenues are shared in proportion with the partners' investments

Environmental testing

Bids evaluated through a stringent process based on several criteria including robustness, price, user-friendliness and customer service.

All charging stations underwent rigorous environmental testing at IREQ (-40°F, 122°F, ice, heavy rain, corrosion, etc.)

Heavy rain test

10 mm of ice

Required Equipment and installation example

Required equipment

Grid connection and dedicated electric meter

Transformer 347/600V > 120/208V or 277/480V

Protection devices

Outdoors or indoors

Manual switch device in close proximity of the charging station for maintenance purposes

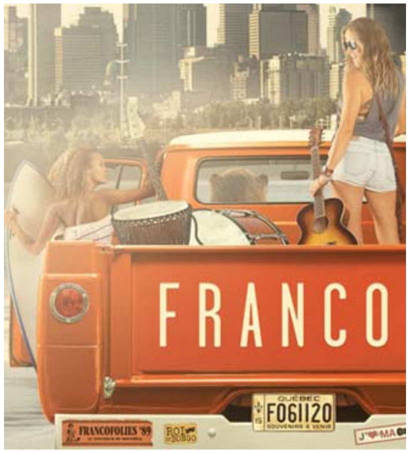
Outdoors configuration

2016 objectives

- **740+ L2 EVSE in service before December 31th 2016**
- **Deploy a DCQC infrastructure on the main highways and in downtown areas**
- **60+ DCQC in service before December 31th 2016**

Enjoy Montréal in June !

International Beer Festival:
8-12 June



FrancoFolie:
6 June – 18 June

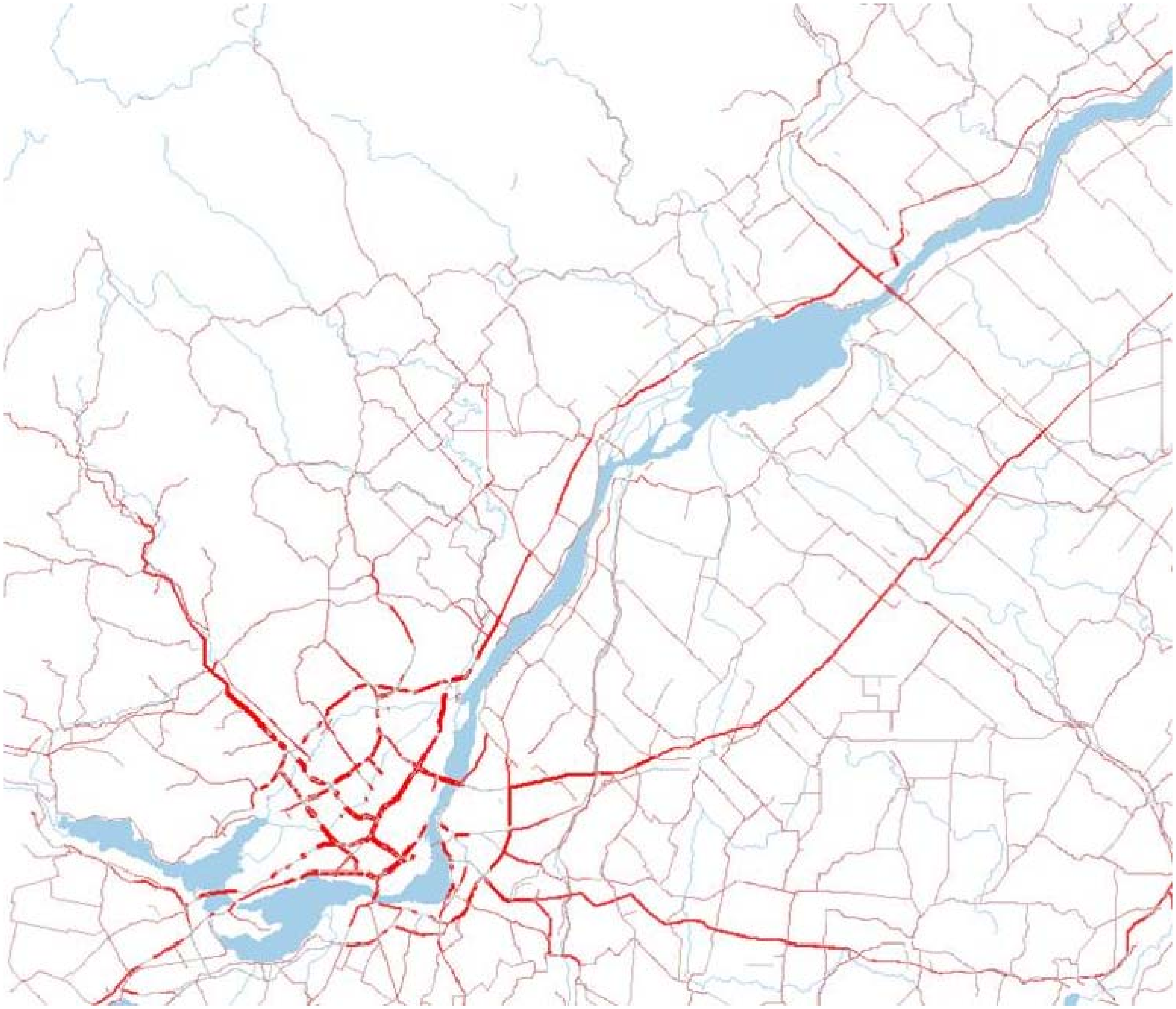
International Jazz Festival:
29 June – 9 July

F1 Montreal Grand Prix: 10-12 June

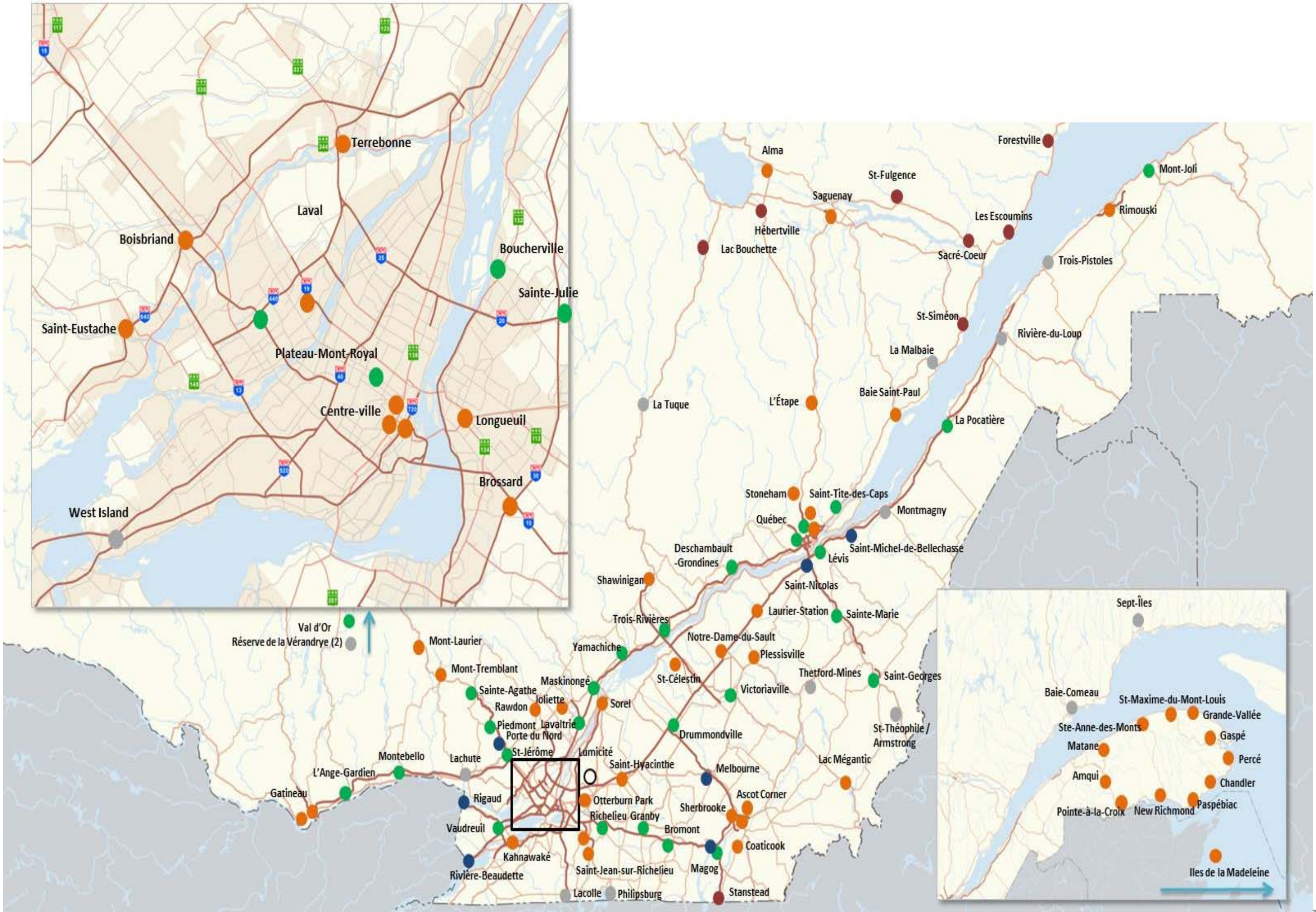
AND of COURSE
EVS29:
19-22 June

The key to electromobility: DCFC corridors

Localisation based on daily traffic on main roads



The key to electromobility: DCFC Corridors



Surrounding jurisdictions

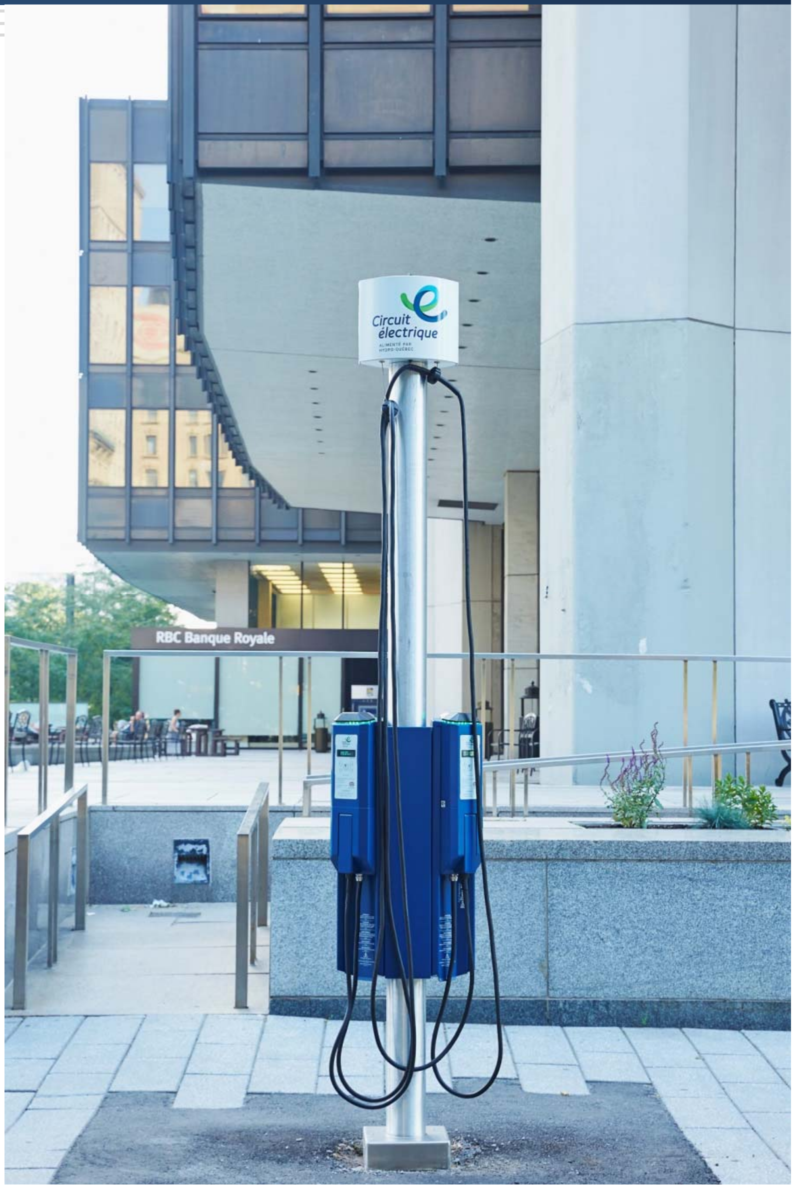
- Limited infrastructure in the surrounding States (except VT) and Provinces
- Discussion to accelerate EVSE penetration are underway

Curbside EVSEs

Curbside EVSEs

Curbside EVSEs

- 1000+ curbside station will be installed by the City of Montréal
- Large interest from cities in Québec, but also from other Provinces
- 20 EVSEs already installed in downtown Montreal
  - Utilisation factor is high (60-100 events/month) and shows rapid growth (100% 2014 vs 2015)
- A woodpole mounted solution with cable management would greatly facilitate urban integration and reduce significantly installation cost



DCFC station of the future

- Multi DCFC station
  - Scalable (between 4 to 8)
  - Adaptable (50kW, 100kW, …)
- Combined with a battery to shave peak demand
- Working group includes IREQ, Esstalion (Joint venture between Sony and HQ), The Electric Circuit
- Operational in early 2017

To rate or not to rate base

Rate base would allows rapid growth of EVSE infrastructure, thus allowing The Electric Circuit to help acheiving the Quebec government's objectives of 100 000 EVs by 2020.

No action taken yet as we are still debating some aspects:

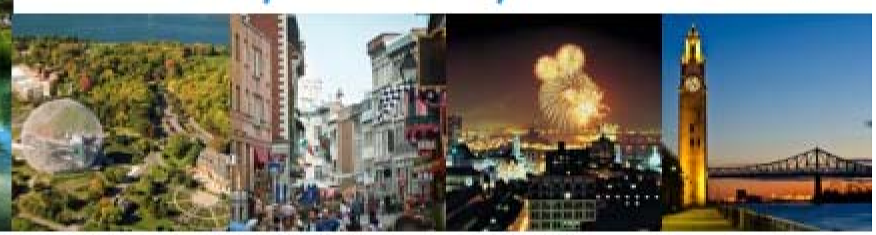
- Should it be applied to L2 as well as DCFC? DCFC only? What about Curb-side EVSEs?
- Are we not better of using different Government funds(Green fund or other) and use an RFP approach such as in California?
- Bottom line, what is the best solution for EV drivers?


EVS 29

DRIVE ELECTRIC INNOVATION


June 19-22, 2016

Montréal, Québec, Canada



29th International Electric Vehicle Symposium & Exhibition

Thank you!

Open Vehicle-Grid Integration Platform

Frequently Asked Questions

Sunil M. Chhaya PhD
Principal Technology Leader

IWC, Phoenix AZ
3/31/16

OVGIP FAQs

- Does this distract us from a standard?
  - Which standard?
    - Incorporates *all* standards and prevailing methodologies - IEEE 2030.5 (SEP2), OpenADR 2.0b, SAE J2847/1, /2 and IEC/ISO 15118.
      - Need to allow all actors to engage in PEV charging management ecosystem:
    - Is no prevailing single standard that utility industry, automotive industry and the charging infrastructure / equipment providers will adopt

- How do you handle localized controls?
  - Specific Use Cases that address integration with local Energy Management Systems
    - Residential and commercial / facility level, and local charging network operator
    - Ensure orderly prioritized management of vehicle charging
    - Keep vehicle owner informed and allow preferences to influence charging priorities

OVGIP FAQs

- What if you don't have telematics?
  - Myth that is promulgated about OVGIP is that its purpose is to push forward telematics as the primary vehicle communications pathway,
    - Incorrect - Phase 1 demonstrated all pathways and standards of communications
    - Telematics is evolving into 4G hotspot based wireless communications
  - Alternatives to telematics
    - Control vehicles through
      - (a) On-vehicle PLC link (Present on all DC charging capable vehicles)
        - Requires EVSE manufacturers to cooperate - supports IEC/ISO 15118 or IEEE 2030.5 (both demonstrated during Phase 1 demo).
        - EVSE manufacturers in general show no inclination to support PLC to the PEV
      - (b) EVSE using PWM pilot (J1772)

OVGIP FAQs

- Need to address local association (PEV to Circuit)
  - Association requires an EVSE PLC link - anathema to most EVSE manufacturers
    - PLC link allows utility data to flow directly to PEVs without EVSE's
    - EVSE business models centered on smart EVSEs with subscriptions
      - Implementation may require EPRI, utility and automotive industries to encourage the EVSE manufacturers.
  - OVGIP Use Cases focus on both residential and aggregated load management program implementation
    - Working with individual utilities to implement specific association methodologies that enable M&V based on the Use Case

OVGIP FAQs

- Latency
  - Parameter to be assessed for performance evaluation of different pathways.
    - 1-5 seconds or less required for most stringent fast response regulation services
    - Latency dependent on ancillary service required (seconds vs minutes)

- Consumer voice
  - **Purpose of OVGIP to provide customer 'voice' and 'say' in how vehicle charging is handled**
    - Provide customer with information in a timely manner to make a decision to participate or not participate - ensure opt out preference is honored to extent allowable
    - OVGIP pilot goal to enlist, with OEMs, real PEV drivers for collecting participation data and preference data.
      - Not in scope to collect comprehensive customer detailed data or to analyze it.
      - Platform can be utilized to collect more extensive data – within legal restrictions

OVGIP FAQs

- DR only or will you use it for more than that?
  - The use cases cover DR (residential or aggregated) as the leading application,
    - DER integration is next priority application
    - Ancillary services is future application - based on valuation, and what volume of PEVs and what communications technologies are deployed.
  - Platform to allow OEMs and service providers to offer varied services to EV customers using same connectivity
    - Is to enable information to flow from the source to the recipient for improving value of the PEVs to the end customers and to the grid

OVGIP FAQs

- Deployment cost / benefit: Major selling points of platform are
  - Encompasses entire installed base including vehicles already in the field, through server software upgrade - no costly vehicle upgrades
  - Only platform planned to have corresponding software upgrades to support participating vehicle manufacturers offering added services going forward for PEVs
  - Works with existing infrastructure - no costly retrofits or specialized infrastructure needed
    - Exception where utility insists on having association capability between EV and EVSE (PLC link required) or
    - OEMs requiring specialized standards at EVSE (IEC/ISO 15118)
  - Deployment cost minimized because OVGIP is cloud based and can operate with Amazon or similar web services interface.
    - In technology development phase - costs will be evaluated based on final implementation

OVGIP FAQs

- Who will own the central server
  – Idea is OVGIP will be standalone entity – provides single intermediary to support/manage relationship/services between Utilities and OEMs
    - Equity interest may be held by OEMs and developer – are expending funding and in kind resources for platform development.

- Will OEMs have uniform response to DR signal or a customized vehicle response?
  – OVGIP design intent is to provide response to the utility in same manner (in terms of standards based communications, e.g., IEEE 2030.5 or OpenADR 2.0b)
  – OVGIP function is to translate disparate and diverse methods from the utility side to enable a unified response
    - Will the utilities have a uniform way to send the DR signal? Today utility method to send DR messages are diverse.

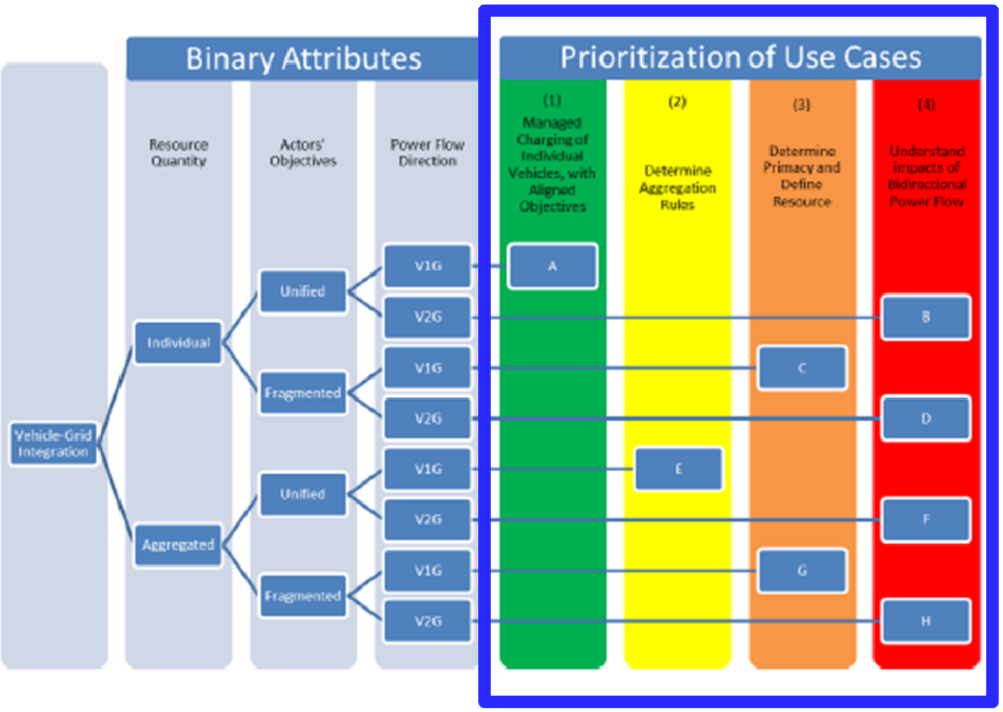
OVGIP FAQs

- Who is the customer from utility perspective? Flow of benefits?
  - Customer depends on particular program. Can be an individual customer and can be workplace (commercial) and industrial (public charging) entities.
  - Flow of benefits: purpose of platform is to pass benefits / incentives to the vehicle owners
    - Make ownership of PEVs more attractive and appealing to the end customers.
    - Platform will need revenue allocation to cover its costs or may require maintenance fee
      - Business details are pure conjecture - not worked out

- What will OEMs filter out of data stream?
  - No data stream has been specified by the utilities- No unanimity from utilities on what information is of value.
  - OEMs are prohibited from forwarding specific customer names, locations, addresses and other private data - are bound to keep confidential due to applicable laws and regulations

OVGIP Use Cases Directly Address CPUC VGI Roadmap Priorities

CPUC VGI Roadmap Priorities



OVGIP Use Cases

1 Automated Utility Electricity Rate Tariff Processing

2 Locational Demand Response; Balancing Resource

3 Interface with Home Energy Management System / ESI

4 Interface with Building Energy Management System

5 Pricing Signal Events

6 Interface with EVSE Network Provider

7 Optimized Load Management (ISO/IEC 15118)

8 Vehicle Roaming

9 Metering and Data Exchange

10 Enrollment and Customer Administration

11 Association and Measurement & Verification

EV Charging Infrastructure Technology

Charlie Botsford

March 31, 2016

Topics

- IEEE 2030.5 (SEP2) EVSE and Communications Conformance Testing by UL/Quality Logic
- Advanced EVSE Networked Functions
- EVSE Current Sharing to Mitigate Demand Charges
- Bluetooth Access Control for Non-networked EVSE

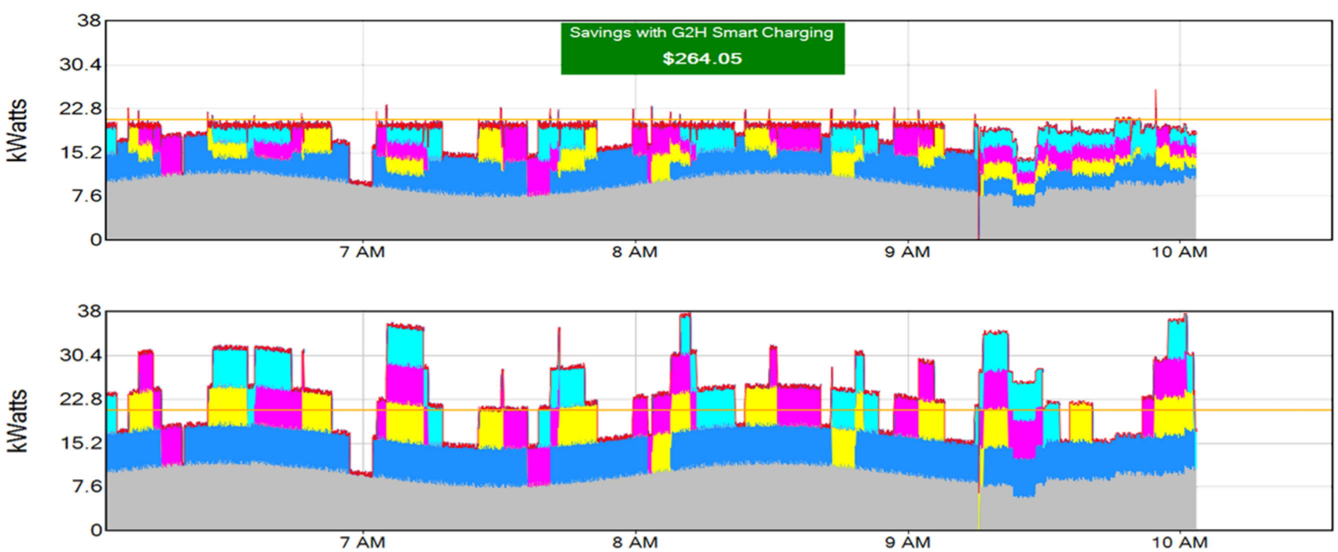
IEEE 2030.5 (SEP2) Conformance Testing

- SEP2.0 Specification Release 1.0 by ZigBee/HomePlug – April 2013
- Released as IEEE 2030.5 – October 2013
  - Next Release Fall/2016
- Included in the SGIP Catalog of Approved Standards
- CSEP (Consortium for SEP)
  - Alliance of Alliances (WiFi, ZigBee, Bluetooth, HomePlug)
  - PICS and Test Specification complete
  - Certification Test set approved – Quality Logic
  - Conformance Testing authority authorized – UL
  - Conformance Testing cycle started – December 2015
    - Three products approved, including AV EVSERS – Networked product
    - Including Kitu IEEE2030.5 Server which is the basis for EVSE Network Solution

Preproduction model shown. Final production model may vary

Networked AV EVSE Advanced Utility Capabilities

- Load Sub-Metering
- Demand Charge Control
- Utility DR Load Control (OpenADR2.0b and IEEE2030.5)
- ISO Frequency Regulation



Dual Port EVSE on Single Circuit to Mitigate Demand Charges

Dynamically allocates power between the two EVESs to keep the total allowed at 32 Amps (single 40A circuit). If one car drops to 6 Amps, the other would get 26 Amps.

Bluetooth Access Control for Non-networked EVSE

Commercial/workplace charging station with Bluetooth enabled access control via smartphone app.

Open Charge Alliance update

Electric Power Research Institute's Infrastructure Working Council Meetings
Phoenix, AZ – March 30 & 31, 2016

OPEN CHARGE ALLIANCE

www.OpenChargeAlliance.org

Content

- Short introduction of OCA
- Status Formal Standardization
- Status Compliance tool for self testing

History of the Open Charge Alliance (OCA)

Elaadnl

- ElaadNL is a Dutch non-profit organization founded by Dutch DSOs in 2009
- ElaadNL initiated the development of an open protocol, and many companies and countries joined the effort
- First releases in 2010-2013
- Managing and developing the OCPP within an International Alliance was seen as the way forward

OCPP

OPEN CHARGE ALLIANCE

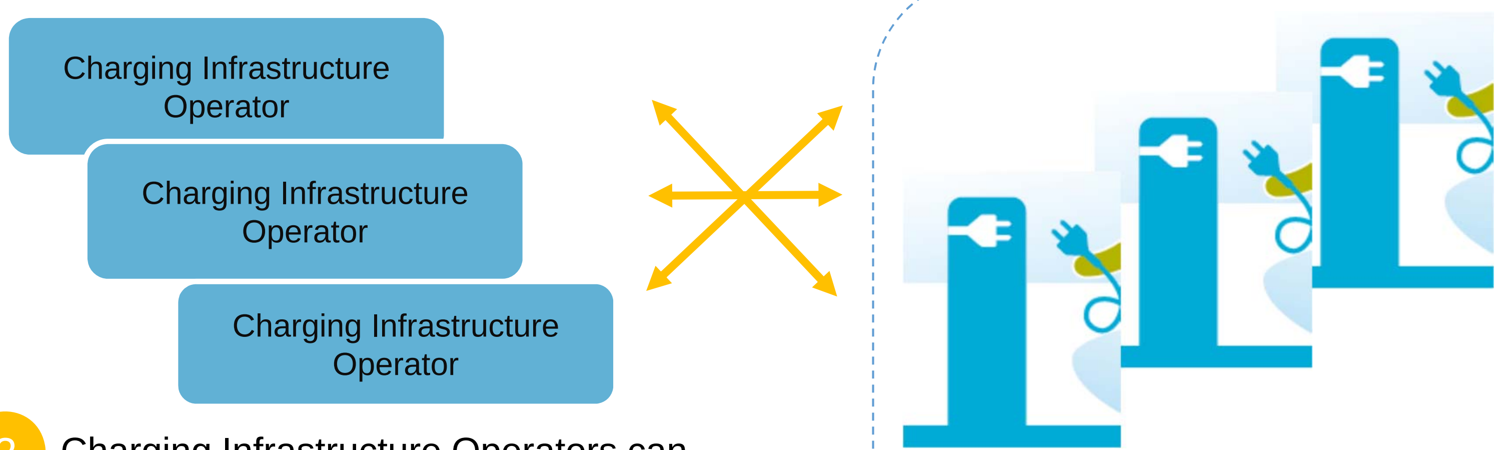
OCA
- A non-profit organization
- Founded in January 2014
- 60 members currently
- Everyone is welcome to join

OCA activities
- Development of the OCPP protocol
- Development of compliancy testing and certification
- Promotion of OCPP

What are the benefits of an open protocol for EVSE to back office system communication?

1 Asset owners (utilities, municipalities, private companies) can migrate from one CI Operator to another more easily whilst keeping EVSE's operational

Asset Owner / Site owner



2 Charging Infrastructure Operators can integrate more easily with multiple brands of EVSE's

3 EVSE manufacturers can integrate more easily with multiple CI Operators

OPEN CHARGE ALLIANCE

OCPP content and development roadmap

'10

1.2

- First release
- SOAP

'13

1.5

- Improved spec

October '15

1.6

- General corrections
- Additional support for JSON over web sockets
- Smart Charging added
- Enhanced Security

'17

2.0

- Restructured
- IEC/ISO 15118 support
- Enhanced Configuration, Commissioning and Control
- Further alignment with Standards for Demand response
- Enhanced Security

OCA intends to release OCPP 2.0 under

OASIS

OPEN CHARGE ALLIANCE

OCA has selected OASIS as the formal SDO with an end goal of IEC

- Given the fact that OCPP is increasingly being adopted worldwide, OCA recognizes that the confidence of the market in OCPP would benefit from the transfer of OCPP to a formal Standards Development Organization.
- In October 2015 OCA decided to standardize OCPP within OASIS whilst at the same time prepare the route to IEC.
- OASIS is a global SDO, providing an open and expedited standards development process
- OCA targets a development period of 18-24 months
- Alignment with IEC is in scope of the development process

Current Status on OCPP Standardization

- OCA and co-proposers have completed the “Discussion Draft” of the OASIS OCPP Technical Committee (TC) Charter
- TC Charter to be used in pre-engagement discussions with potential participants – includes OCA members, utilities, IWC participants, etc.
- Feedback from potential participants will be used to evolve the TC charter before establishing the OASIS OCPP TC

OPEN CHARGE ALLIANCE

OASIS OCPP Technical Committee (TC)

- Discussion Draft of OCPP TC Charter includes:
  - Proposed work scope
  - Deliverables
  - List of TC proposers
  - Liaison and collaboration with International Electrotechnical Commission (IEC) SDO

- Pre-engagement outreach activities by both OASIS and OCA initiated
  - Solicit feedback in the coming weeks on the draft TC charter before finalizing it and setting up an OCPP TC.

If you would like to receive the OASIS OCPP Draft for Discussion Outreach Charter, please contact either OASIS or OCA

carol.geyer@oasis-open.org

info@openchargealliance.com

OCA is developing an OCPP Compliance Test Tool for self testing

- This tool can be used to test OCPP implementations for OCPP version 1.6 compliance
- Support for:
  - SOAP / JSON
  - Central System & Charge Point
- Tool will be delivered in 2 parts:
  - Core profile (42 test cases)
  - Additional profiles (25 test cases)
- Both happy as well as non happy flows

Benefits

- Can be used for validation of OCPP version 1.6 implementations
- Makes implementing OCPP version 1.6 easier
- Helps with integrating OCPP 1.6 implementations of different vendors

Tool can be purchased by OCA members and non members

- Toolkit development has been funded by OCA and its members
- OCA members get a discount
- Test tool has been validated against first 1.6 implementations
- Planned release core profile May 2016

If you would like more information about the OCPP 1.6 conformance tool for self testing:

info@openchargealliance.com

OPEN CHARGE ALLIANCE

www.OpenChargeAlliance.org

IEC STANDARDS FOR EV CHARGING

EPRI IWC

March 30, 2016

IEC Project Stages and Timetable for Standards Development

Project Stage	Associated Document Name	Abbreviation	Minimum Timeline (for comment and/or voting)
Proposal stage	New Work Item Proposal	NWIP	3 months for voting
Preparatory stage	Working draft	WD	12 months recommended
Committee stage	Committee draft	CD	2-4 months for comment
Enquiry stage	Enquiry draft	IEC/CDV ISO/DIS	5 months for translation (2), comment and voting (3)
Approval stage	Final Draft International Standard	FDIS	2 months for voting
Publication stage	International Standard	IEC or ISO/IEC	1.5 -2 months

IEC TC69 Charging Station (EVSE) Standards

Projects: Key: In Publications, Published, New, Status Change, Delay

IEC	Edition	Stage						
		NWIP	Working Draft	CD	NEXT CD (CD#)	CDV	FDIS	Publication
61851-1	3	-					2016-04	2016-07
61851-21-1	1	-	2012-07	(3rd) 2014-09	2014-11	2015-08	2016-02	2016-09
61851-21-2	1	-	2012-07	2012-08	(3rd) 2015-11			2017-03
61851-22	1	To be withdrawn – Consolidated into 61851-1						
61851-23, 61851-24	2	MT5	(3rd) 2016-01	2016-07		2017-03	2017-12	2018-04
61851-3-1, -2	1	2013-01	2014-08		(2nd) 2015-10			TS 2016-10
61851-3-3, -4, -5, -6, -7	1			2016-02				TS 2016-06

IEC 61851-1, 3rd Edition

- **CDV Accepted**
- **Vote: Yes 73%, No 19% (US, Canada, Denmark, Italy Netherlands, Switzerland, voted NO)**
- **FDIS in preparation, final vote on FDIS pending (two month vote).**

- **Issues:**
- Cord and plug connected wall box requirements – Maintained in Standard.
- EV Cord Sets (Cord & plug, in-line PPS & CP box, EV connector) now covered by IEC 62752.
- CCID/GM vs. RCD (IEC 62752 to be published).
- Change to higher ambient temperature (+35 °C vs. 25 °C) - North America deviation.

IEC 61851-23 & 61851-24, 2rd Edition

3nd Working Draft, January, 2016 (under review)

Meeting to review comments: June, 2016, Toronto, Canada

- **Issues & New Items:**
- Organization of Standard to follow 61851-1
- Overcurrent & Short Circuit protection
- Bi-directional power flow – now included
- Automated connection system for DC Charging (new work project 69/405/NP) – Netherlands
- Isolation monitoring for multi-outlet DC chargers
- Conversion Box (connects EV connectors and inlets from different systems).

IEC 61851-3 series, 1st Editon

Covers:

- **61851-3 (series): Electric Vehicles conductive power supply system**
- **Part 3-1: General Requirements for Light Electric Vehicles (LEV) AC and DC conductive power supply systems**
- **Part 3-2: Requirements for Light Electric Vehicles (LEV) DC off-board conductive power supply systems**
- **Part 3-3: Requirements for Light Electric Vehicles (LEV) battery swap systems**
- **Part 3-4: Requirements for Light Electric Vehicles (LEV) communication**
- **Part 3-5: Requirements for Light Electric Vehicles (LEV) communication - Pre-defined communication parameters**
- **Part 3-6, Requirements for Light Electric Vehicles (LEV) communication - Voltage converter unit**
- **Part 3-7, Requirements for Light Electric Vehicles (LEV) communication - Battery system**

- **Documents are at different stages, some CD's are out for comment.**
- **Major issues:**
- Scopes overlap other parts of 61851.
- Voltage and current ranges for DC charging overlap Part 23
- AC output ratings not used (now includes 480VAC, 3Ø)
- Differences in construction not defined to distinguish from Part 1 or Part 23.
- May be of double/reinforced insulated construction
- Output may be at Safety Low Voltage level (≤ 60VDC)
- Proposals limited to one construction, other options not permitted by convenor
  (Reason: EN wants one solution but this is Int'l Standard)
- Parts 3-5, 3-6 and 3-7 not authorized by original work proposal.
- **Work not progressing until IEC TC69 resolves these questions/issues.**

IEC 61980 series Wireless Charging

IEC	Edition	Stage						
		NWIP	Working Draft	CD	NEXT CD (CD#)	CDV	FDIS	Publication
61980-1	1							Published 2015-08
61980-2	1	2012-12	2013-08	2015-08		2016-04		2016-07
61980-3	1	2012-12	2013-08	2015-08		2016-04		2016-07

- 61980-1: Electric vehicle wireless power transfer systems (WPT) - Part 1: General requirements
- 61980-2: Electric vehicle wireless power transfer (WPT) systems - Part 2 specific requirements for communication between electric road vehicle (EV) and infrastructure with respect to wireless power transfer (WPT) systems
- 61980-3: Electric vehicle wireless power transfer (WPT) systems - Part 3 specific requirements for the magnetic field power transfer systems.

ISO 15118 series - Vehicle To Grid Communications Interface

ISO	Edition	Stage						
		NWIP	Working Draft	CD	NEXT CD (CD#)	CDV	FDIS	Publication
15118-1	1							Published 2013-04
15118-2	1							Published 2013-03
15118-3	1							Published 2015-05
15118-4	1			(3nd) 2015-03				
15118-5	1			2014-08	(2nd) 2015-06			
15118-6	1			2014-07	(2nd) 2015-09		2016-03	2016-10
15118-7	1			2015-06	(2nd) 2015-12			
15118-8	1			2015-05	(2nd) 2015-09			

ISO 15118 series

- **ISO 15118-1: Road vehicles - Vehicle to grid communication interface - Part 1: General information and use-case definition**
- **ISO 15118-2: Road vehicles – Vehicle to Grid communication Interface - Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements**
- **ISO 15118-3: Road Vehicles - Vehicle to grid communication interface - Part 3: Physical layer and Data Link layer requirements**
- **ISO 15118-4 Ed.1: Road vehicles — Vehicle to grid communication interface — Part 4: Network and application protocol conformance test**
- **ISO 15118-5 Ed.1: Road vehicles - Vehicle to grid communication interface - Part 5: Physical and data link layer conformance test**
- **ISO 15118-6 Ed. 1.0: Road vehicles - Vehicle to grid communication interface - Part 6: General information and use-case definition for wireless communication**
- **ISO 15118-7 Ed. 1.0: Road vehicles - Vehicle to grid communication interface - Part 7: Network and application protocol requirements for wireless communication**
- **ISO 15118-8 Ed. 1.0: Road vehicles - Vehicle to grid communication interface - Part 8: Physical layer and data link layer requirements for wireless communication**