

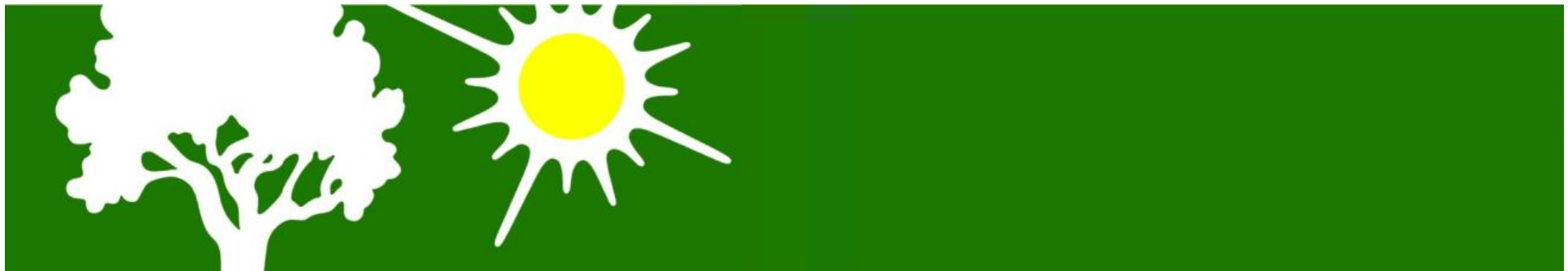
Draft Report Overview:
***Stock-take of Electric Vehicle Interface with Electricity and
Smart Grids Across APEC Economies with the Potential for
Harmonization***

APEC Electric Vehicle Connectivity Workshop

Wellington, New Zealand

20 June 2012

Ms. Alina Dini
Director, Verdant Vision



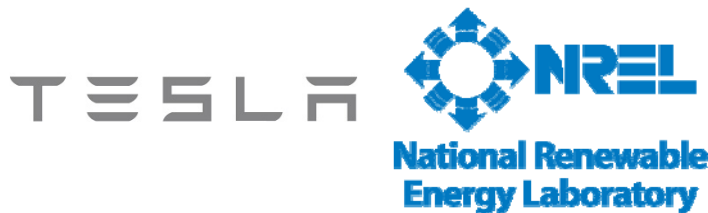
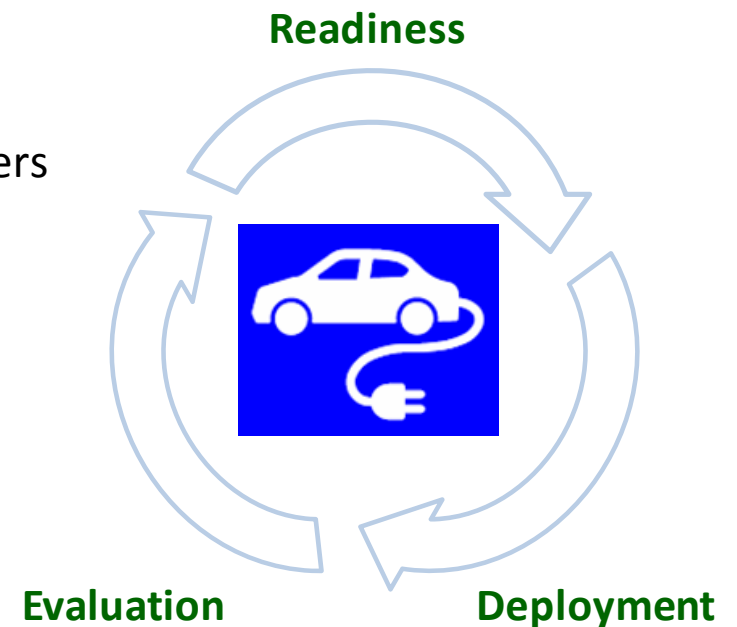
Outline

1. Introductions
2. EV Connectivity – What is it?
3. APEC – Overview and History
4. This Project and Our Approach
5. PEV Market Maturity Framework
6. Survey Results and “State of Play” in APEC
7. Q & A

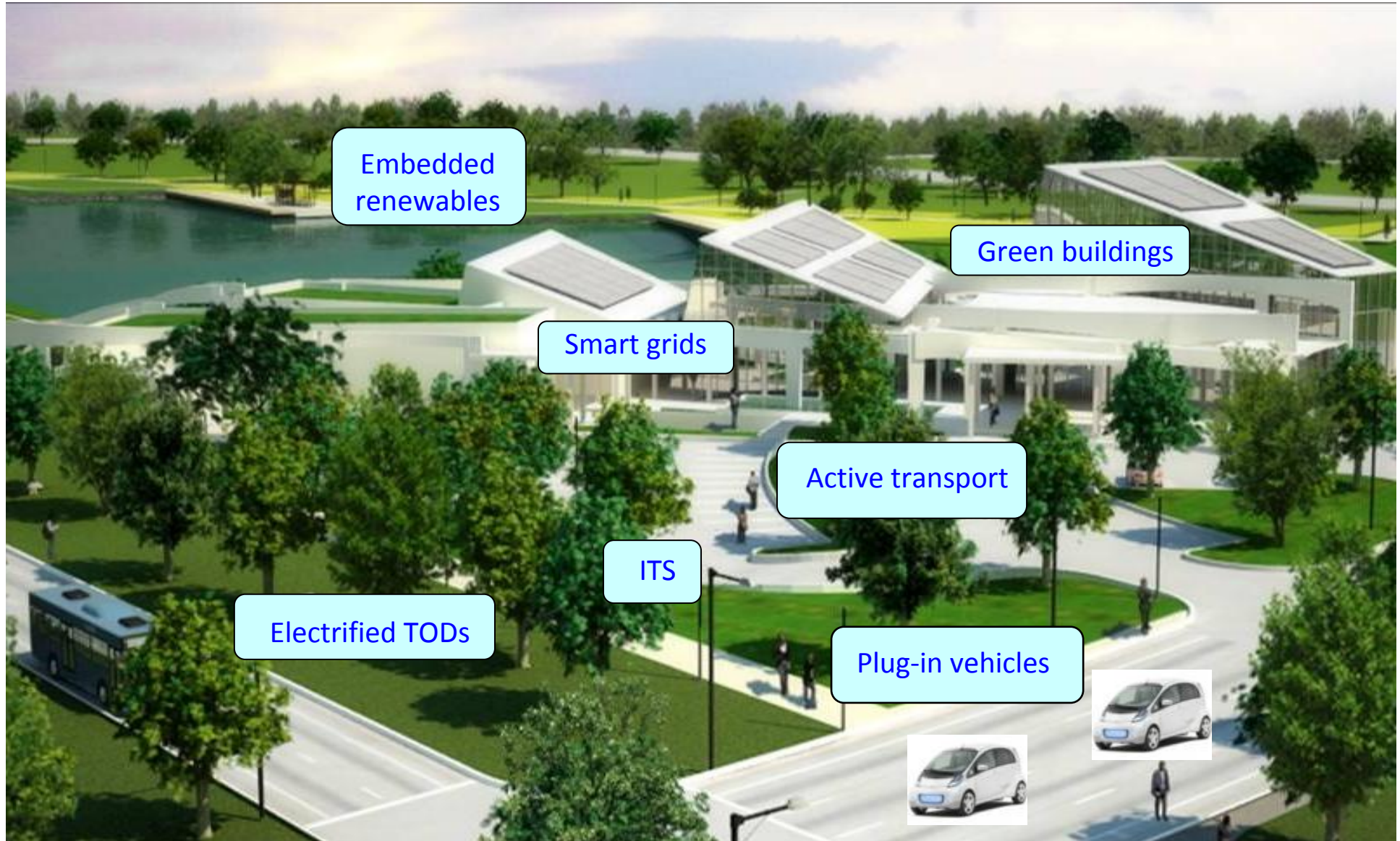
1) Introductions

Who We Are

- **Verdant Vision** is a leading provider of independent, expert services for electric vehicle readiness, deployment and evaluation in the Asia-Pacific.
- Service to all segments of the EV market
- Our clients include:
 - Vehicle Manufacturers and Component Suppliers
 - Local, State and Federal Government Agencies
 - Electric Utilities and Infrastructure Providers
 - Land Developers
 - Motoring Services
 - Non-Government Organisations
 - Other Consultants/Researchers



Our Verdant Vision



Project Sponsors



**Energy Efficiency and
Conservation Authority**
Te Tari Tiaki Pūngao



- Established up by the New Zealand Government and overseen by the Minister for Energy and Resources
- Promotes energy efficiency, energy conservation, and the use of renewable sources of energy
- Provides services to businesses and households, including programs to relating to electric vehicles and renewable energy deployments
- Various partnerships with private sector, community groups, industry associations, and central and local government bodies

2) EV Connectivity

What is Electric Vehicle (EV) Connectivity?

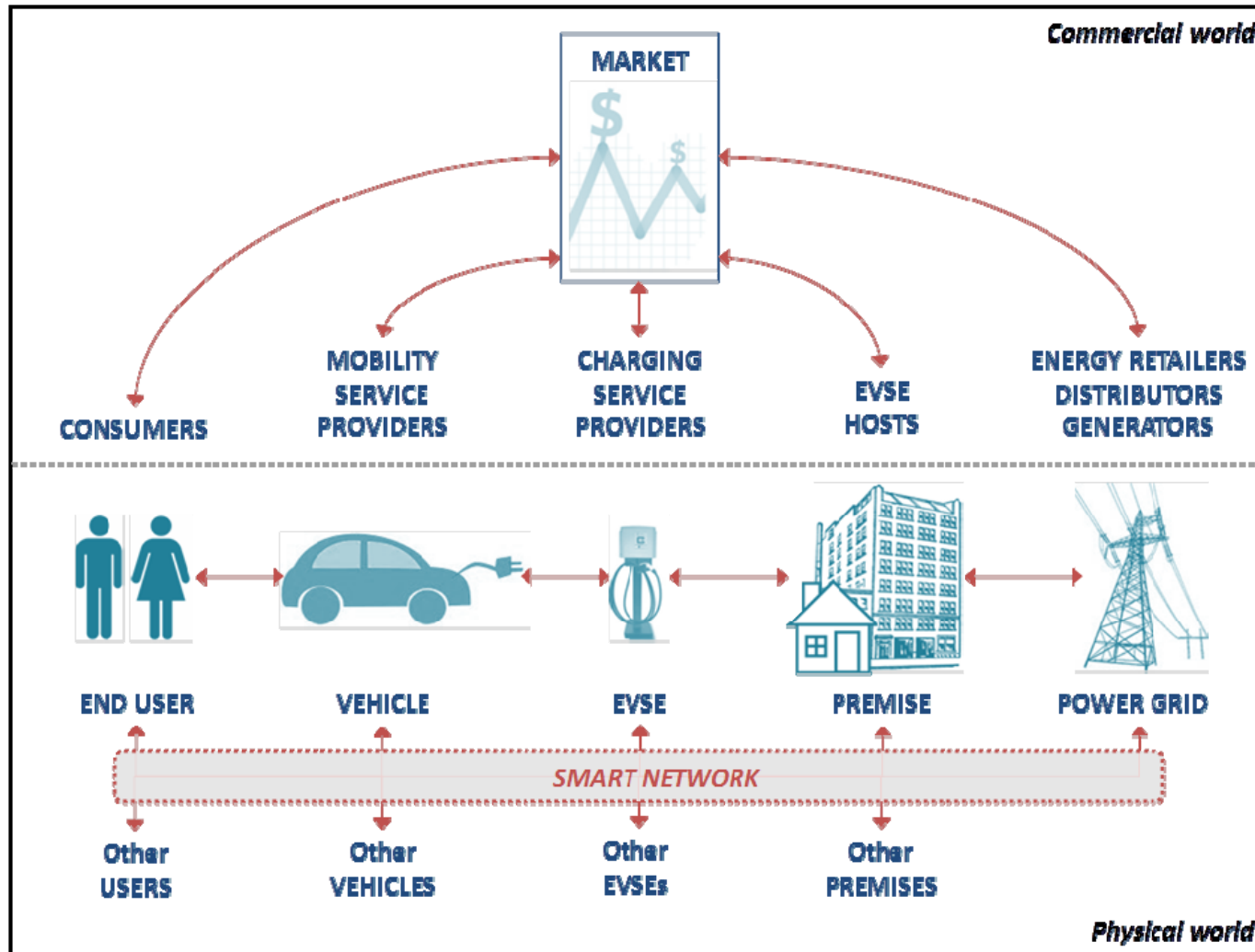


- Poles, wires, circuits, sockets
- Voltage, amperage, frequency, power quality, etc
- Energy market policies
- Tariffs
- Electrical codes & standards
- Regulations
- Hardware & software
- Data collection & sharing
- Product innovation

Grid Topology is Changing



EV Connectivity Landscape



3) APEC Overview and History

Asia-Pacific Economic Cooperation (APEC)

- The premier forum for facilitating economic growth, cooperation, trade and investment in the Asia-Pacific region
- 21 Members Economies
- 40% of the world's population
- 54% of world GDP
- 44% of world trade



**Asia-Pacific
Economic Cooperation**

21 Member Economies

Australia
Brunei Darussalam
Canada
Chile
People's Republic of China
Hong Kong, China
Indonesia
Japan
Republic of Korea
Malaysia
Mexico
New Zealand
Papua New Guinea
Peru
The Republic of the Philippines
The Russian Federation
Singapore
Chinese Taipei
Thailand
United States of America
Viet Nam



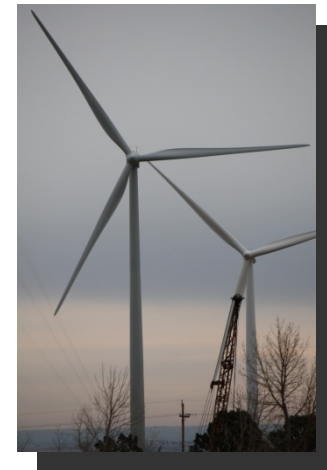
Energy Working Group and EGNRET

EWG

- Launched in 1990
- Voluntary, regional-based forum covering energy issues
- Seeks to:
 - maximize the energy sector's contribution to the region's economic and social well-being
 - Mitigate the environmental effects of energy supply and use

EGNRET

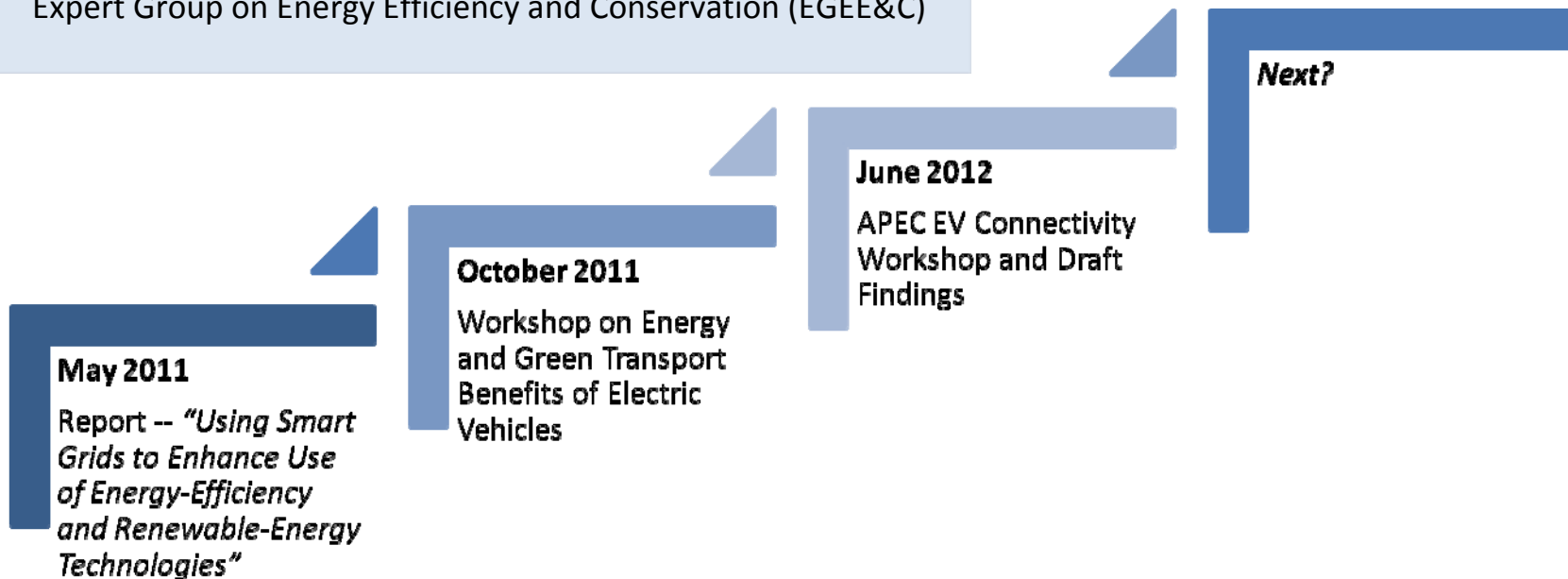
- A subgroup of the Energy working Group
- Stands for “Expert Working Group on New and Renewable Energy Technologies”



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Energy Working Group and Plug-in Electric Vehicles

- APEC Regulatory Cooperation Advancement Mechanism on Trade-Related Standards and Technical Regulations (ARCAM)
- APEC Energy Smart Communities Initiative (ESCI)
- APEC Smart Grid Initiative (ASGI)
- The Transportation Working Group (TPTWG)
- The Industrial Science & Technology Working Group (ISTWG)
- Subcommittee on Standard and Conformance (SCSC)
- The Asia-Pacific Energy Research Centre (APERC)
- Expert Group on Energy Efficiency and Conservation (EGEE&C)



4) This Project and Our Approach

Stock-take of Electric Vehicle Connectivity



Energy Efficiency and
Conservation Authority
Te Tari Tiaki Pūngao

Expert Working Group on New and Renewable Energy Technologies (EGNRET)

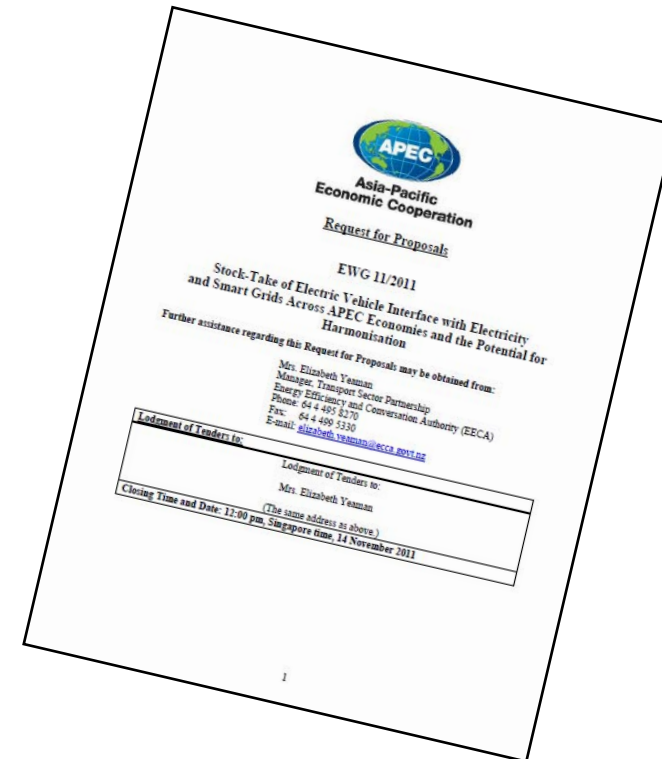


**Asia-Pacific
Economic Cooperation**

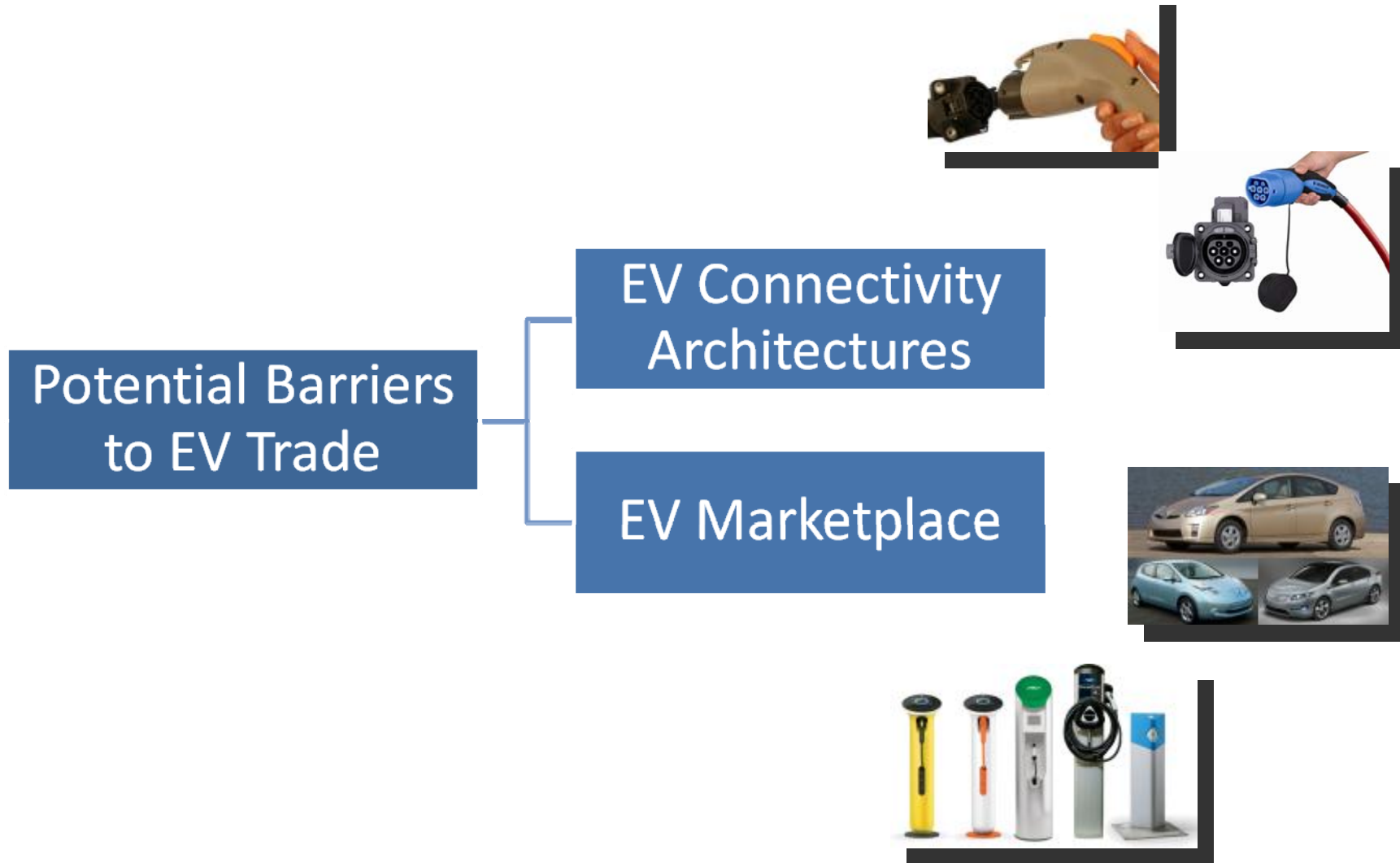
Stock-take of Electric Vehicle Connectivity

Key Project Objectives:

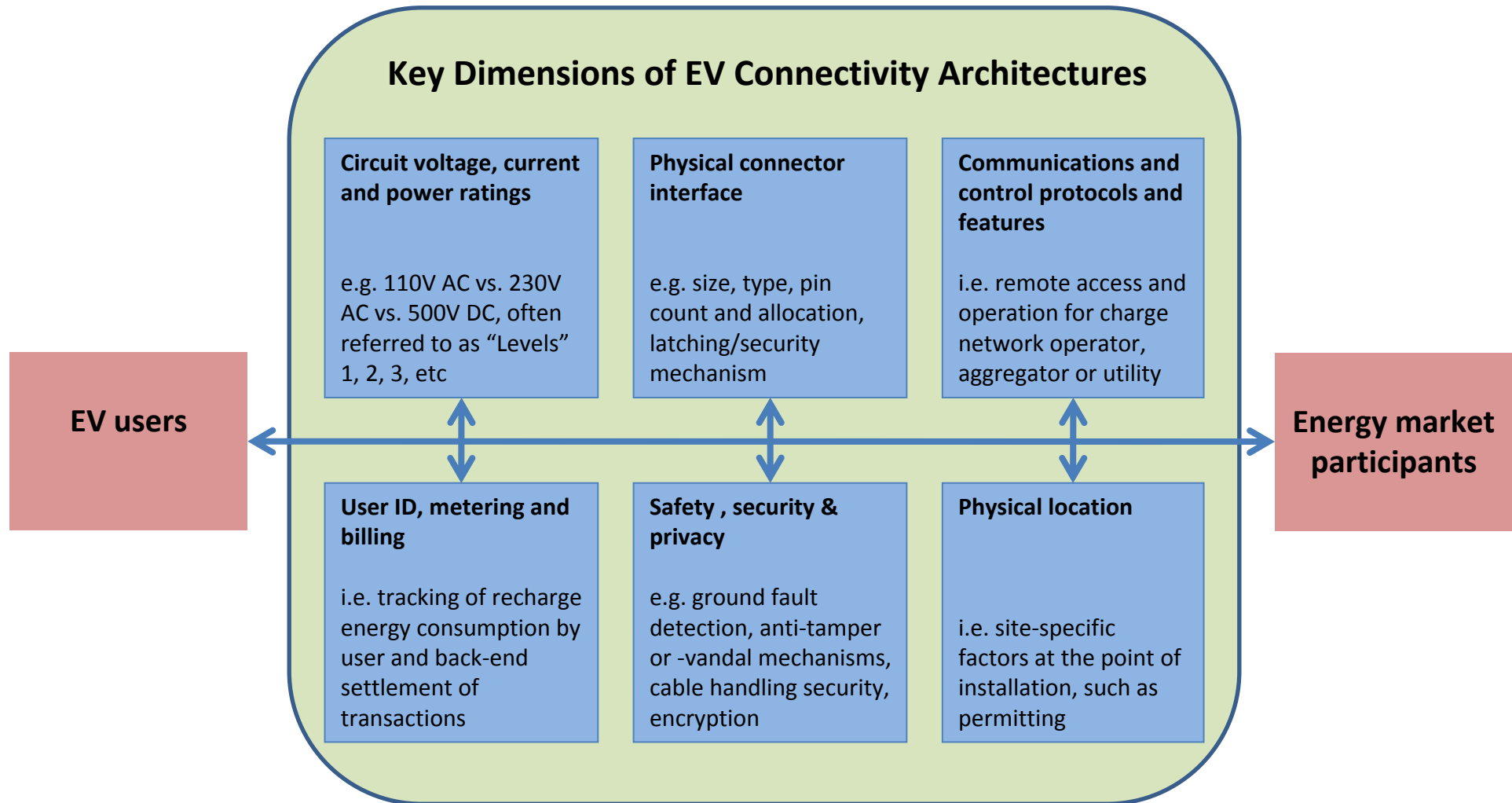
1. Survey and **summarize** plug-in electric vehicle (PEV) connectivity conditions
2. Identify potential **barriers** for trade
3. Identify **areas of cooperation** (i.e. reduction of trade barriers)



Scope of Work



EV Connectivity Architectures



Recharging Infrastructure



Level 1



Level 2



Level 3



Inductive

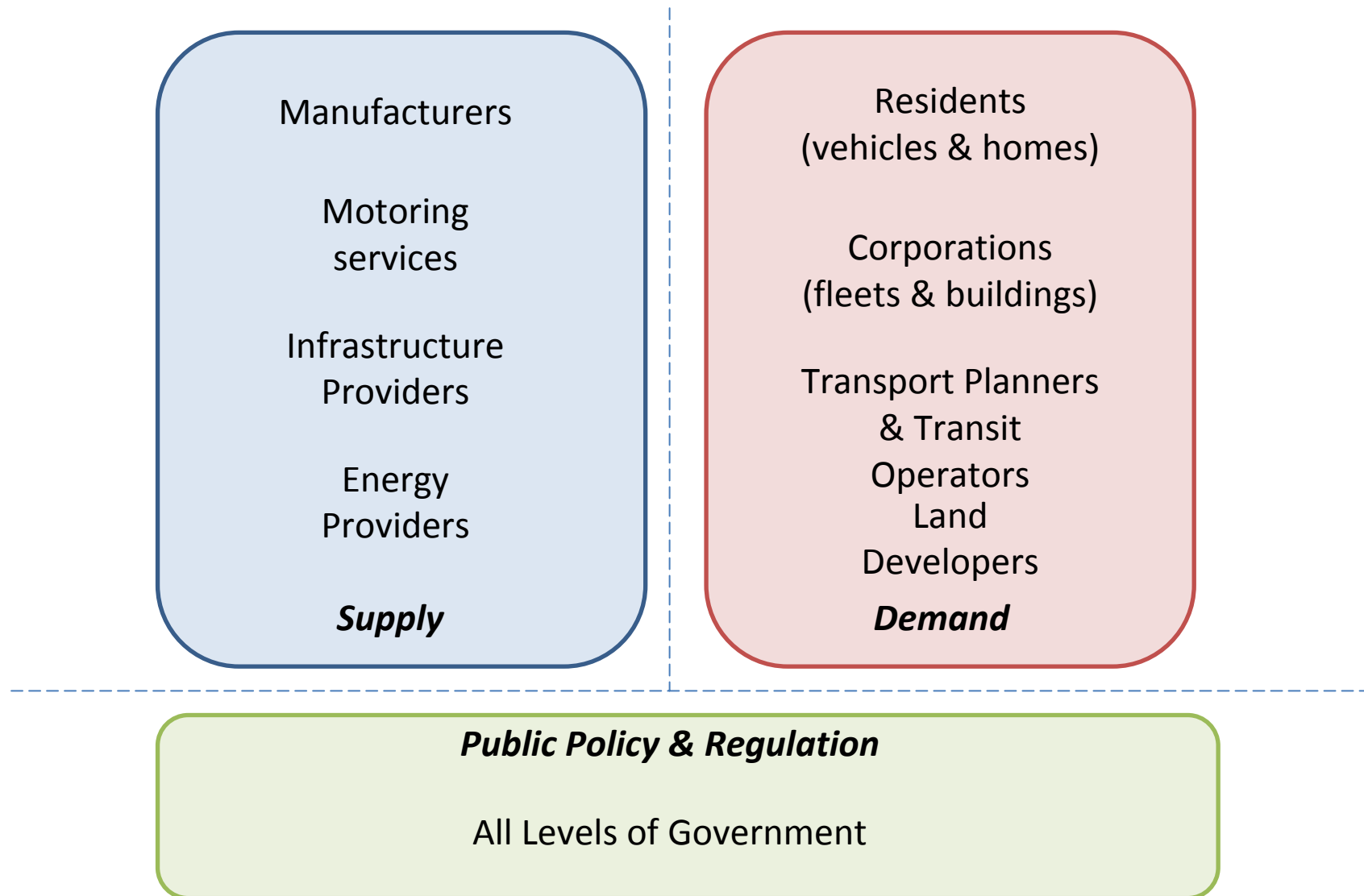
Charging Level	Circuit Rating (per phase)	Power (kW per phase)	Charging Rate* (km/h)	Charge Time* (mins. For 40km)
"Level 1"	AC - 230V / 15A	3.5	19	125
"Level 2"	AC - 230V / 30A	6.9	38	63
"Level 3"	DC - 500V / 125A	50	278	9

* assumes typical electric vehicle consumption of 180 Wh/km



Battery swap

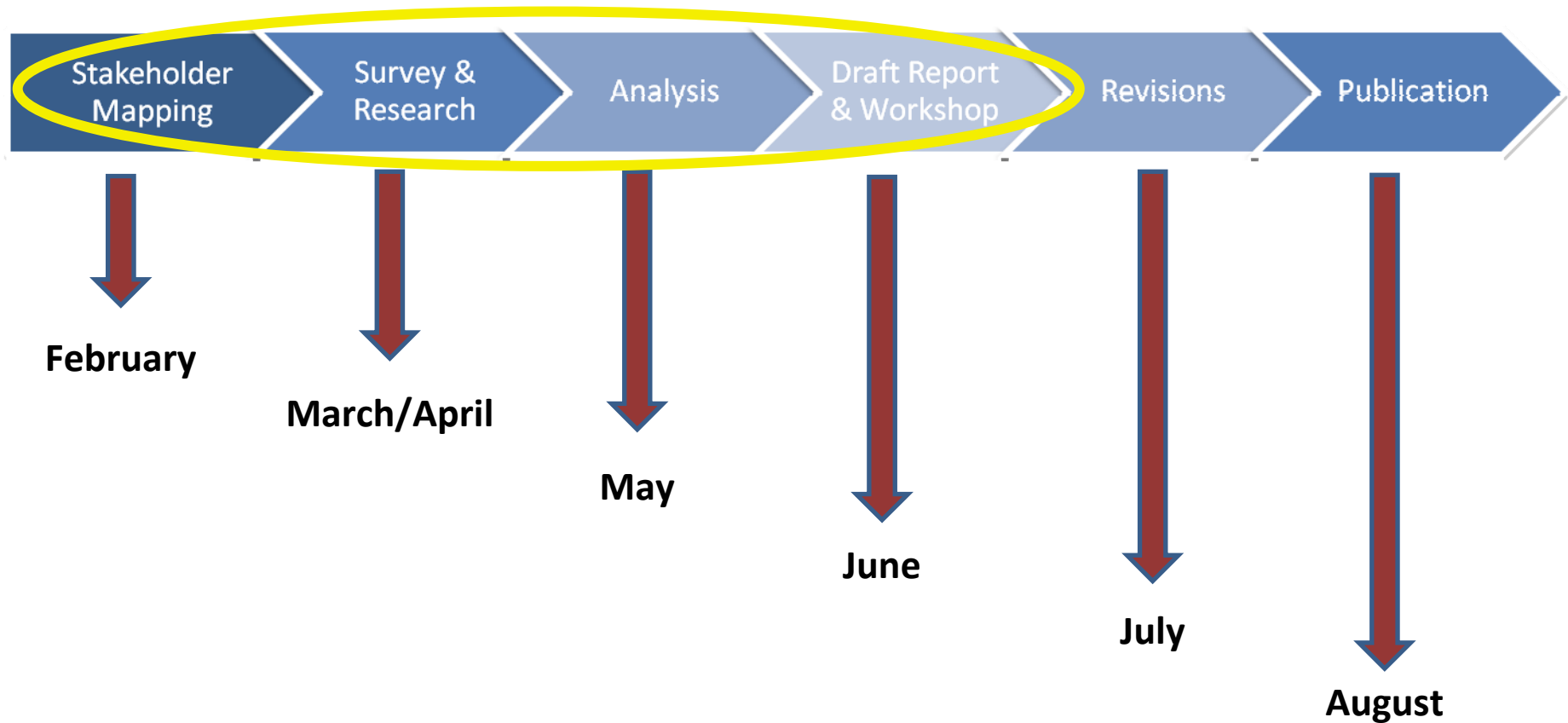
EV Marketplace



Plug-In Electric Vehicles



Project Timeline



5) PEV Market Maturity Framework

21 Member Economies

Australia
Brunei Darussalam
Canada
Chile
People's Republic of China
Hong Kong, China
Indonesia
Japan
Republic of Korea
Malaysia
Mexico
New Zealand
Papua New Guinea
Peru
The Republic of the Philippines
The Russian Federation
Singapore
Chinese Taipei
Thailand
United States of America
Viet Nam



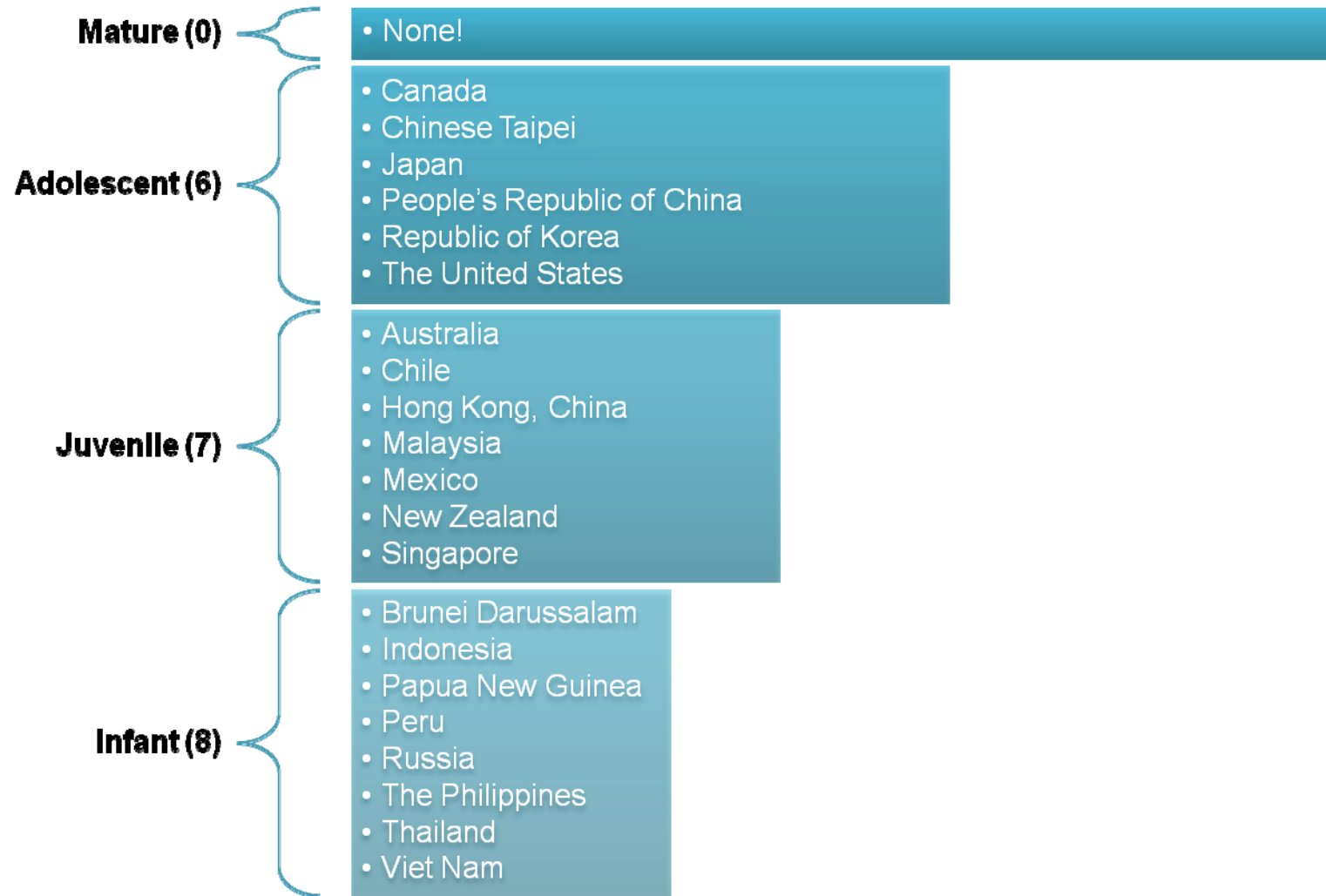
PEV Market Maturity: Criteria for Assessment

1. **Commonality of PEVs** compared to conventional vehicles
2. Status of **EVSE market development** and functionality
3. Status of **standards and regulations** for PEV and EVSE products and processes (i.e. installations)
4. Level of **visible Government support** for the PEVs and the PEV market

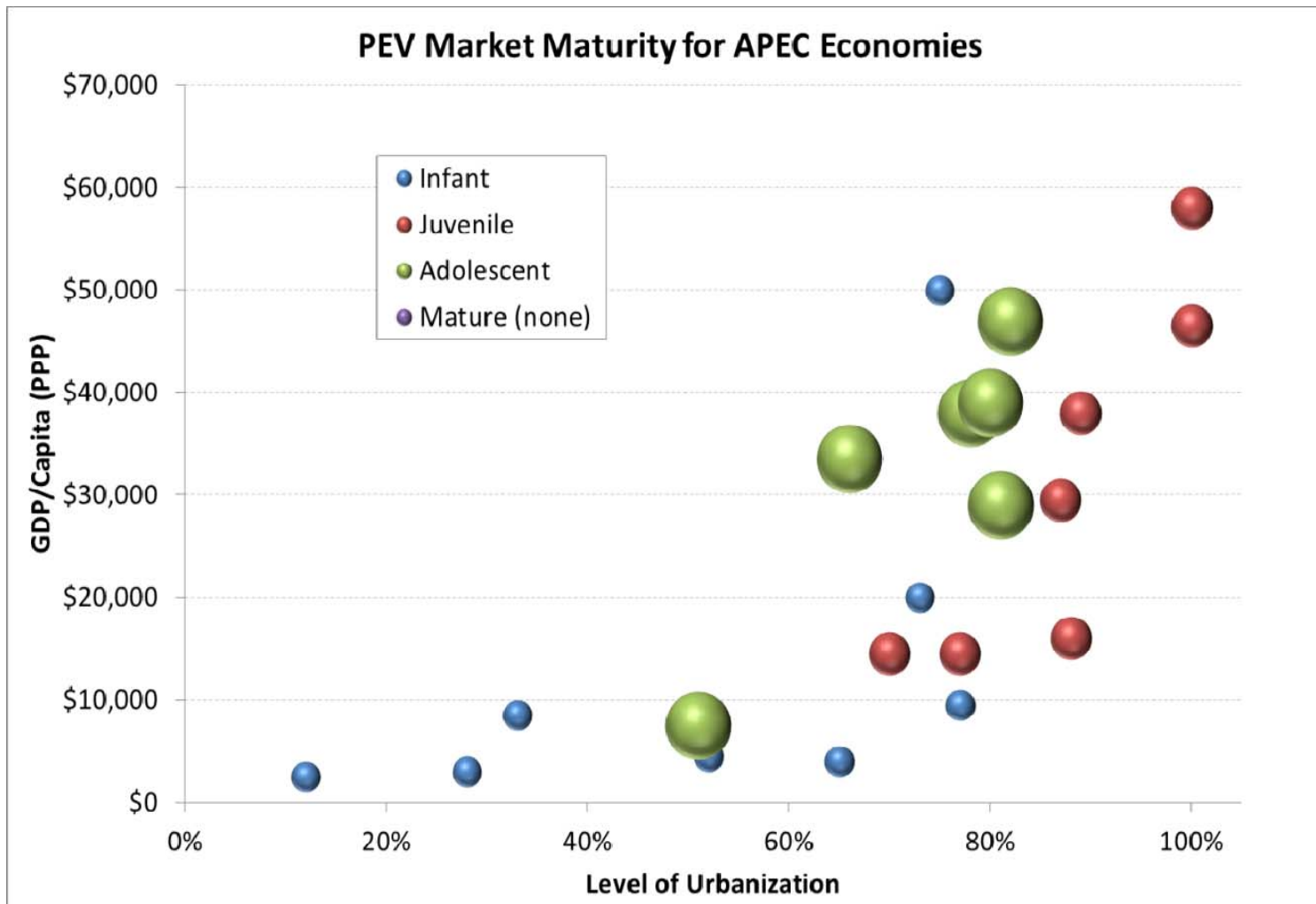
Market Maturity Framework



APEC Economy Rankings



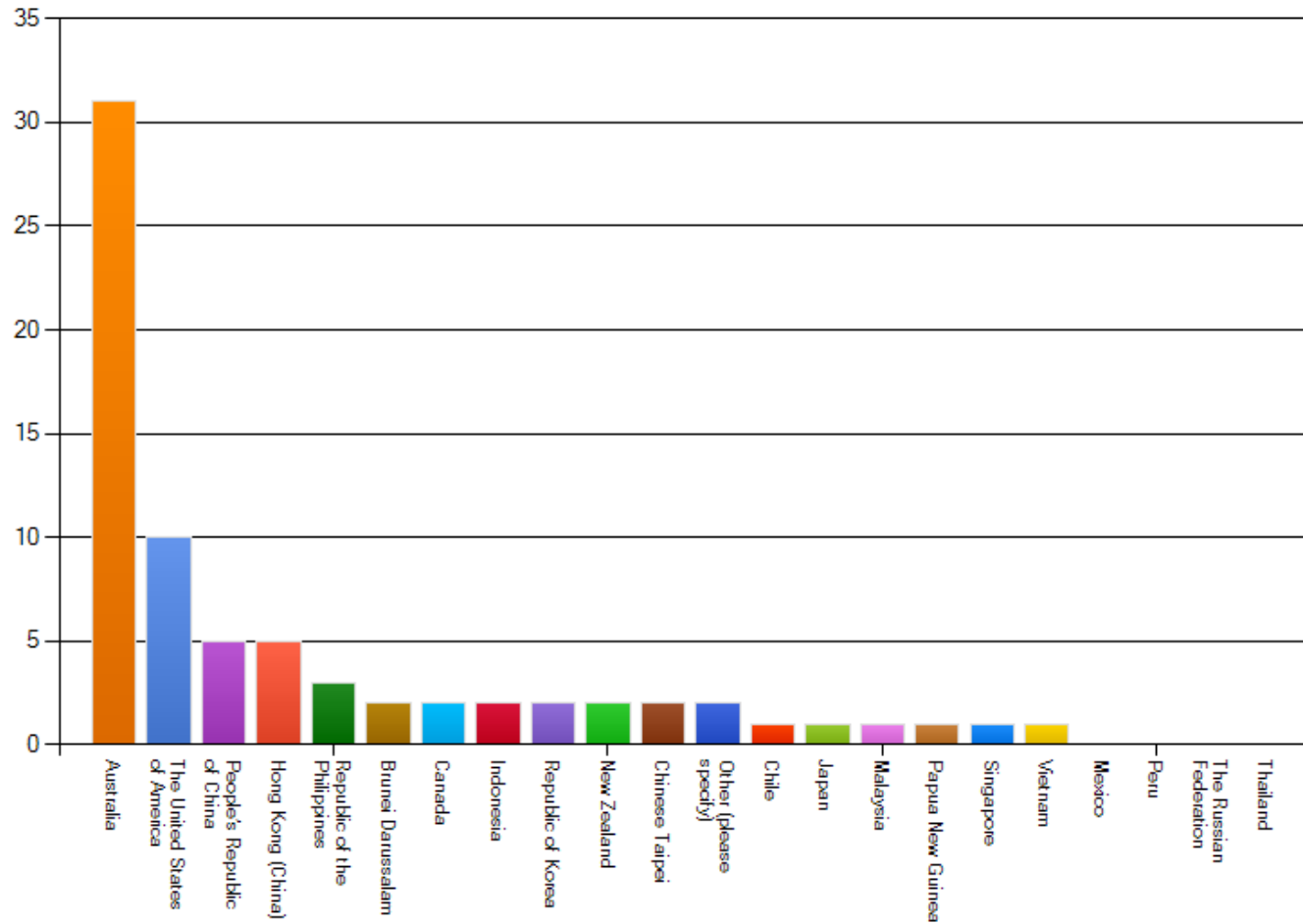
Market Maturity assessed by GDP (per capita) and Urbanization



6a) Survey Results and State of Play: *Plug-in Vehicles and Policies*

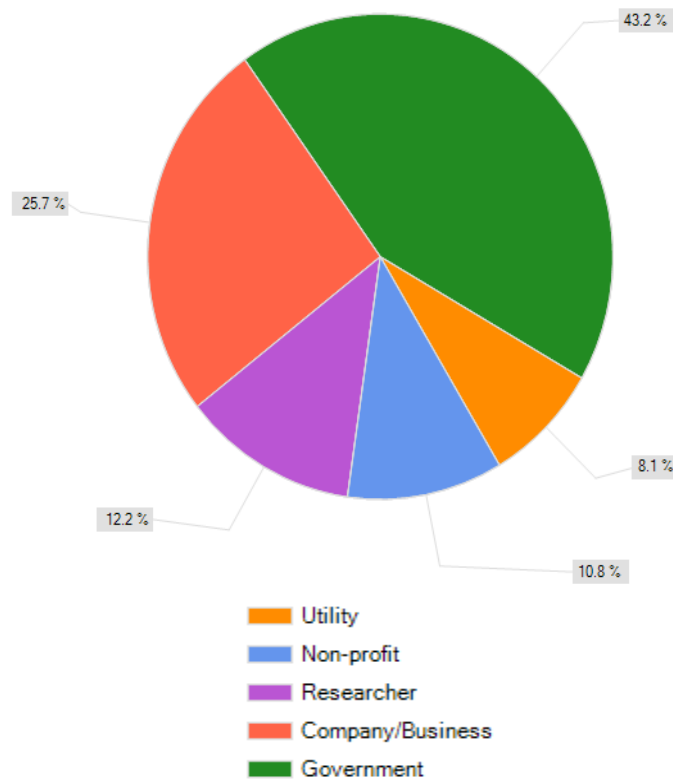
Survey Responses

Survey Respondents by APEC Economy (Draft)



Survey: Demographic Highlights

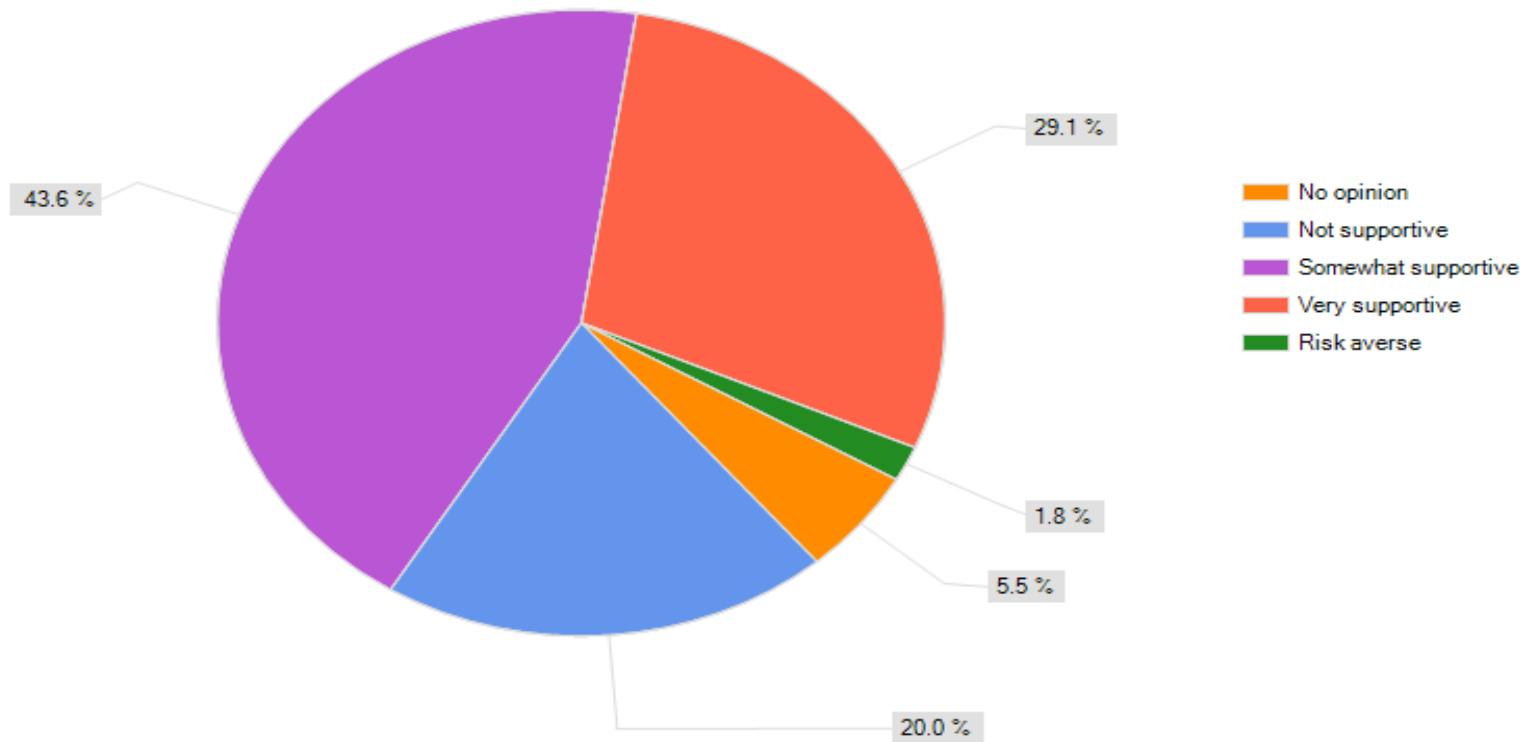
Respondents by Representative Organization Type (Draft)



- PEVs in operations 1-2 years
- GHGs and air quality largest policy drivers
- Most common PEVs:
 - Passenger cars
 - Motorbikes/scooters
 - Bicycles
- Pure battery PEVs most common (53%)

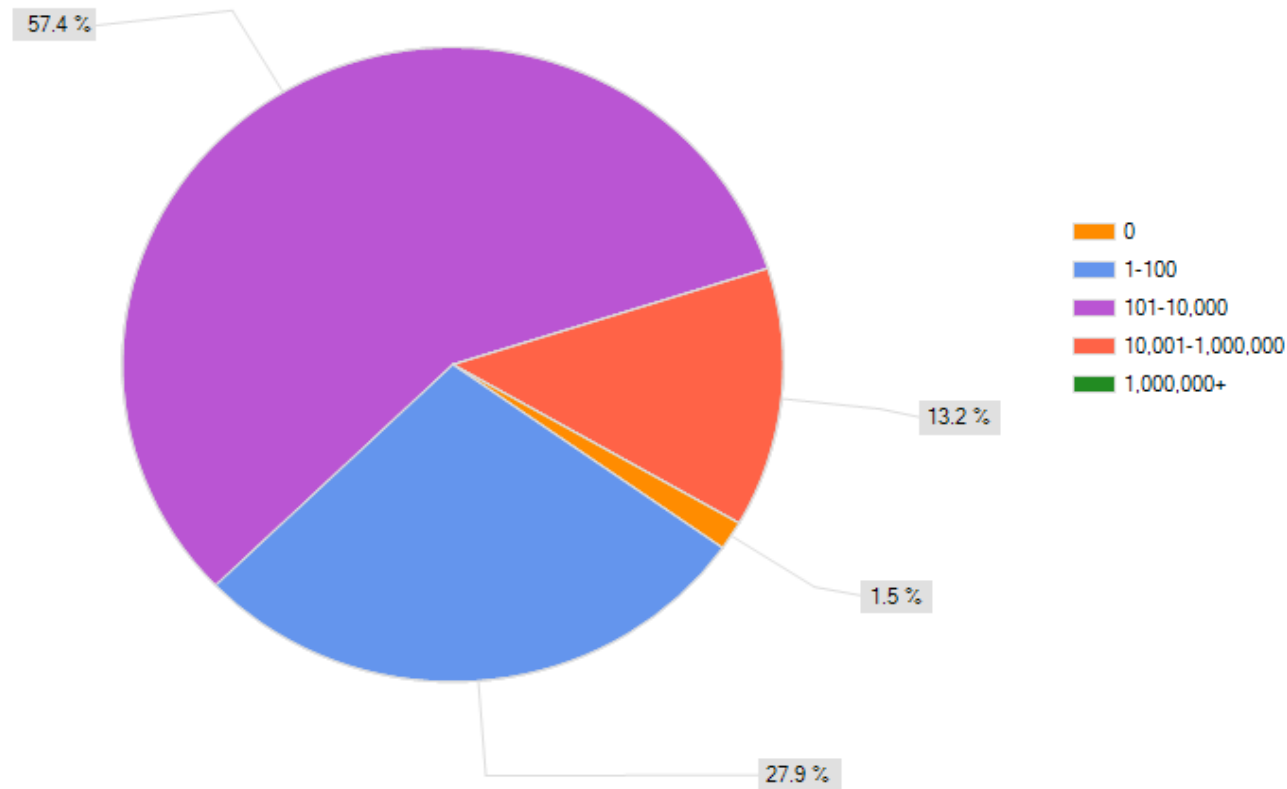
Perceived Policy Support

Government Support for PEVs in APEC Economies (Unweighted Draft)



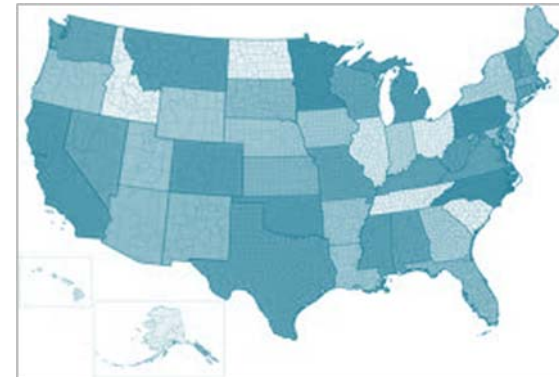
Deployments

Current Number of PEVs in Operation in APEC Economies
(Unweighted Draft)



Adolescent Market Case Study: USA

- Support for PEVs significant since 2008
- Driven by objectives to reduce dependence of foreign oil and remain economically competitive in the automotive and clean technology sectors
- Federal subsidy up to US\$7500 (vehicle) and US\$2000 (home recharging)
- Commercial charging infrastructure through Department of Energy's Clean Cities Program
- EV Project, federally-funded global PEV trial which to date has installed upwards of 6100 EVSEs
- 2013 financial year budget includes \$650 million for additional vehicle and battery technology development



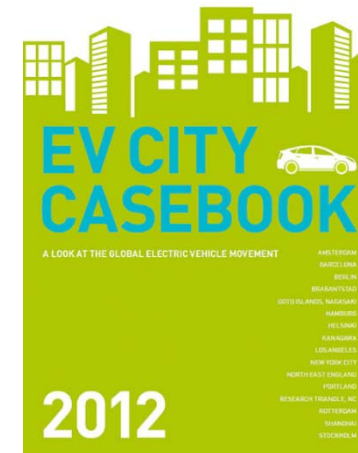
Juvenile Market Case Study: New Zealand

- Extend PEV exemption of road user charges until 2020
- Released “Deploying electric vehicles in New Zealand: A guide to the regulatory and market environment”
- Vehicle label for PEVs
- Wellington City Council trialed 8 Mitsubishi i-MiEVs in partnership with Meridian Energy, Mitsubishi Motors, New Zealand Post Group and The Wellington Company for two years

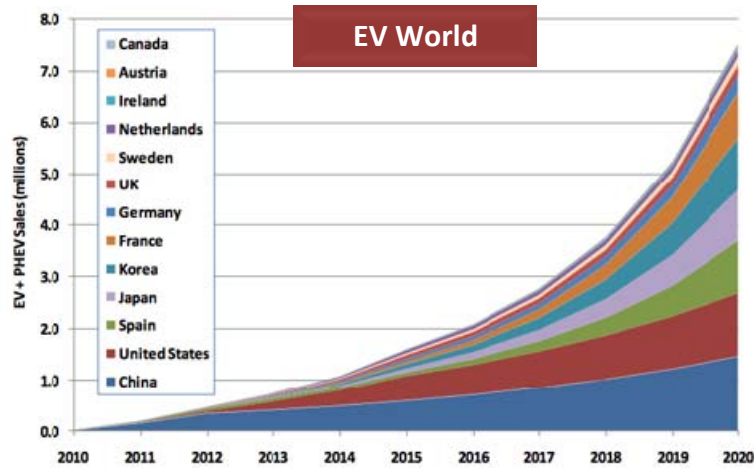


Infant Market Policies

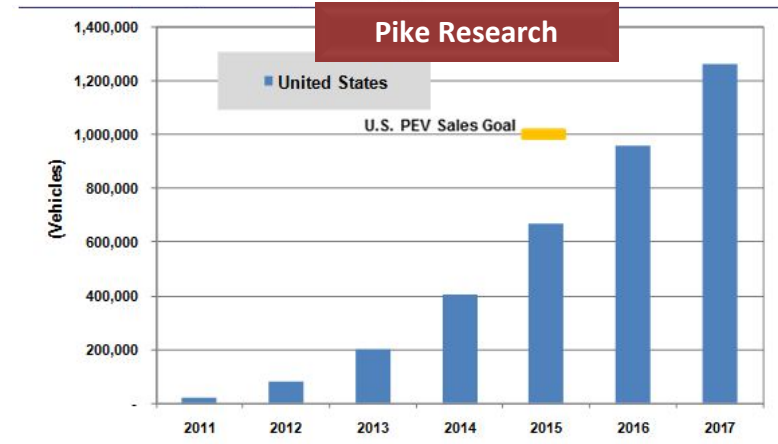
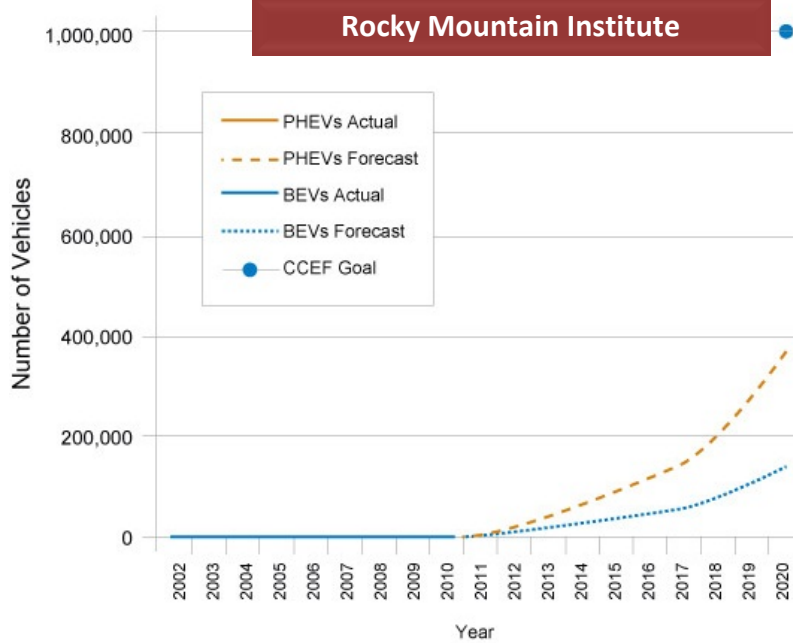
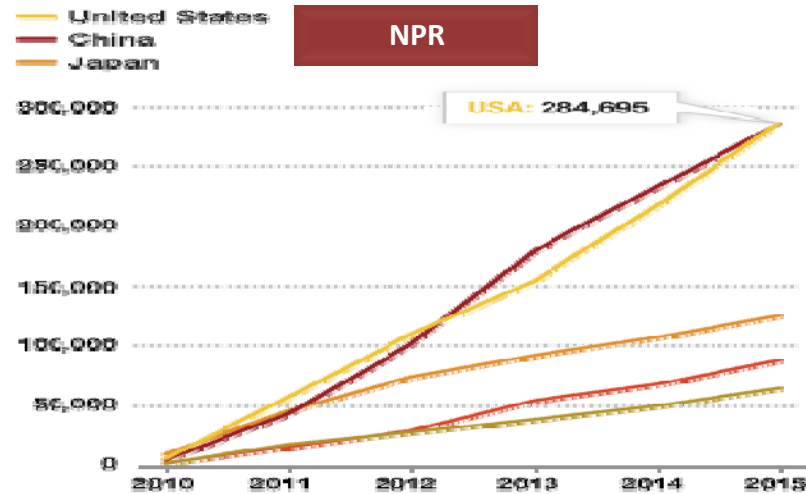
- Little policy progress in infant markets
- IEA released *Technology Roadmap for Electric and plug-in hybrid electric vehicles* in June 2011 and the *EV City Casebook* in May 2012
- Asia Development Bank has funded an introductory PEV deployment in the Philippines for e-trikes with a possibility for extension into other developing Economies in future pending trial outcomes
- The World Bank argues that a new global value chain for PEVs may reach US\$250 billion by 2020



More EVs to Come



Projected EV and PHEV sales through 2020, based on announced national targets.



(Source: Pike Research)

6b) Survey Results and State of Play: *Recharging Infrastructure*

Recharging Infrastructure Types

Technical Type

- Conductive
 - Alternating Current (AC)
 - Direct Current (DC) aka “fast”
- Inductive
- Battery Swap
- V2G/V2H



Geographic Type

- Home
- Public/Commercial
- Workplace

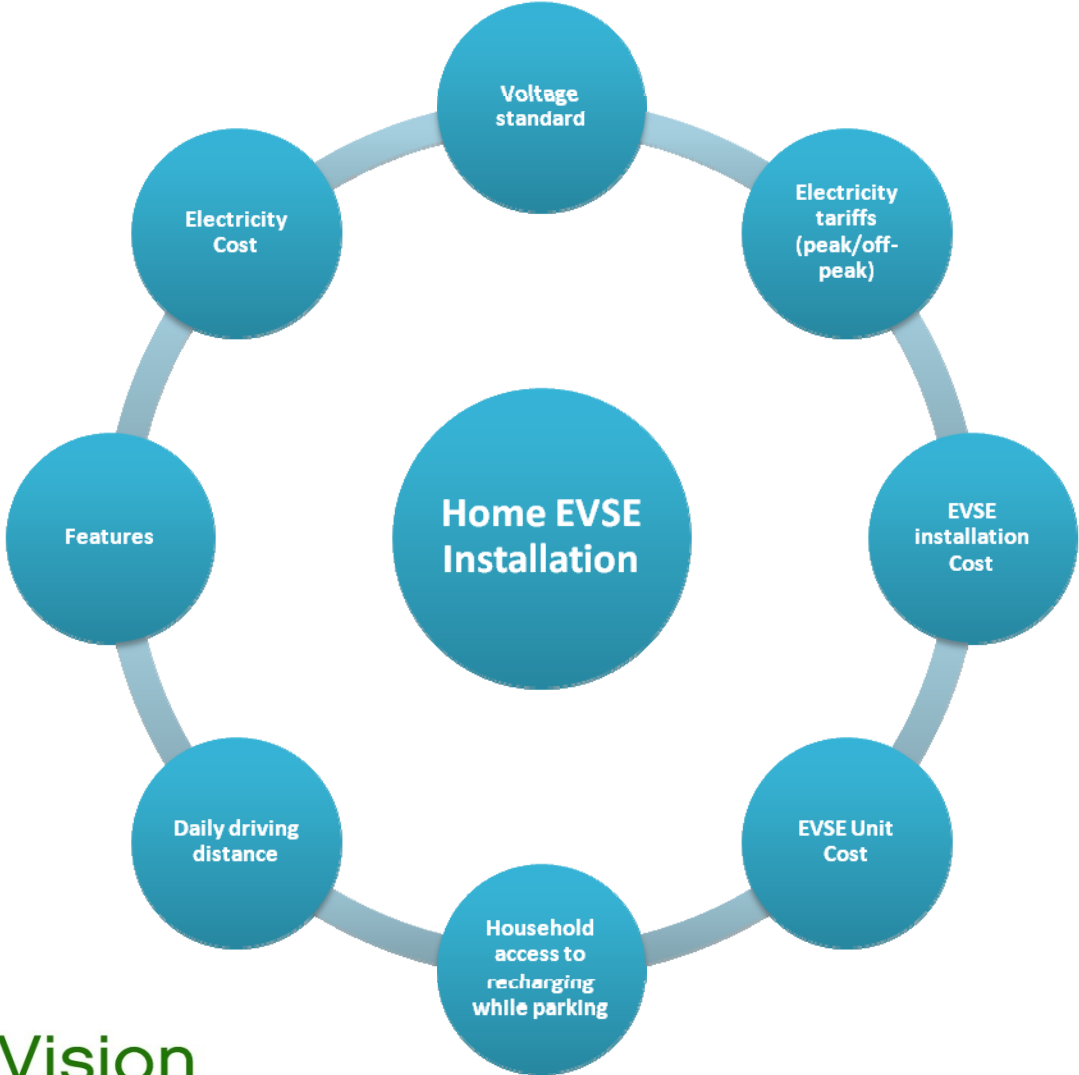


Conductive AC

- Can be used at any location – home, public/commercial, workplace
- GPO or “smarter charging” with EVSE
- 98% (home) and 96% (public)
- 64% of respondents expected GPO use at home
- More recharging at work than public spots
- Equal amount of GPO to “smart” workplace recharging

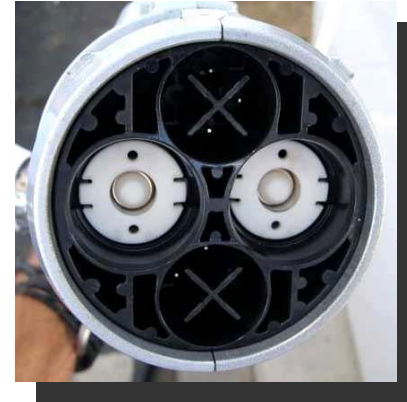


PEV Motorist Considerations for Home Charging Installation



Conductive DC

- Many cars equipped
- Perceived demand/need
- Few installations in APEC
- Respondents said will be used “on occasion”
- CHAdeMO incumbent standard



KEY PLUG-IN ELECTRIC VEHICLE CHARGING STANDARDS

SAE Standards for Recharging

- J1772 - Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler
- J2836 - Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
- J2847/3 - Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow
- J2931/2 - Inband Signaling Communication for Plug-in Electric Vehicles
- J2953 - Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)
- J2954 - Wireless Charging of Electric and Plug-in Hybrid Vehicles

ISO/IEC

- IEC 62196 -- Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles
- IEC 61851 - Electric vehicle conductive charging system
- IEC TC 69 - Electric road vehicles and electric industrial trucks (superseded)
- IEC SC 23H - Industrial plugs and socket-outlets (superseded)
- ISO 15118-1 - General information & use-case definition
- ISO 15118-2 - Protocol definition & OSI-layer requirements
- ISO 15118-3 - Wired physical & data link layer requirements

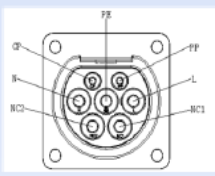



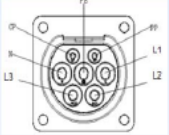
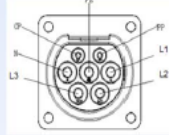
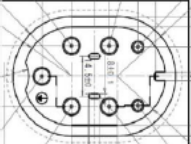
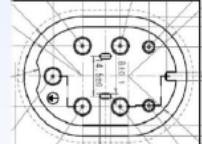
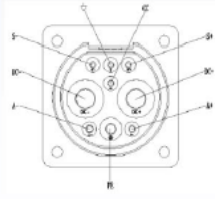
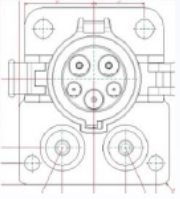

CHAdeMO

- DC Fast Charger

UL

- UL62 - Standard for Safety of Electric Vehicle Cable
- UL2202 - Standard for Safety of Electric Vehicle (EV) Charging System Equipment
- UL2231 - Standard for Safety of Personnel Protection Systems for EV Supply Circuits
- UL2251- Standard for Safety of Plugs, Receptacles, and Couplers for EVs
- UL Subject 2594, the Subject Standard for Safety of Electric Vehicle (EV) Supply Equipment
- UL Subject 2735 - Subject Standard for Safety of Electric Utility (Smart) Meters
- UL Subject 458A - Subject Standard for Safety of Power Converters/Inverters for Electric Land Vehicles
- UL Subject 1004-1 -Subject Standard for Safety of On-board Electric Vehicle Equipment Traction Motors
- UL Subject 2580 - Subject Standard for Safety of Batteries for Use in Electric Vehicles
- UL Subject 2733 - Subject Standard for Safety of Surface Vehicle On-Board Cable
- UL Subject 2734 - Subject Standard for Safety of Connectors for Use with On-Board Electrical Vehicle (EV) Charging Systems

PEV Charging Connector Landscape

		China	US	Japan	EU (IEC-62196)	
AC	Single Phase	 Type 2	 J1772	 J1772	 J1772-Type 1	
	1 Phase or 3 phase				 Type 2 Mode 1	 Type2 All Modes
	1 Phase or 3 phase				 Type 3 Mode 1	 Type3All Modes
DC 200A 350A 400A		 Mode 3	 J1772 "Hybrid"	 CHAdeMo	Type 2 "Hybrid"	

Where do we (APEC) stand?



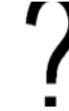
SAE J1772

- Canada
- Japan
- Republic of Korea
- The United States of America



IEC 62196 (Type 2)

- China
- Chinese Taipei (homologated with China)



Undecided/Unknown

- Australia
- Brunei Darussalam
- Chile
- Hong Kong, China
- Indonesia
- Mexico
- Malaysia
- New Zealand
- Papua New Guinea
- Peru
- The Philippines
- Russia
- Singapore
- Thailand
- Viet Nam

Universal or “Combo” Connector



- Introduced in May 2012 at EVS26
- Not yet balloted
- 2 versions – SAE and European
- What about CHAdeMO?
- Is this the best option?
- Timing

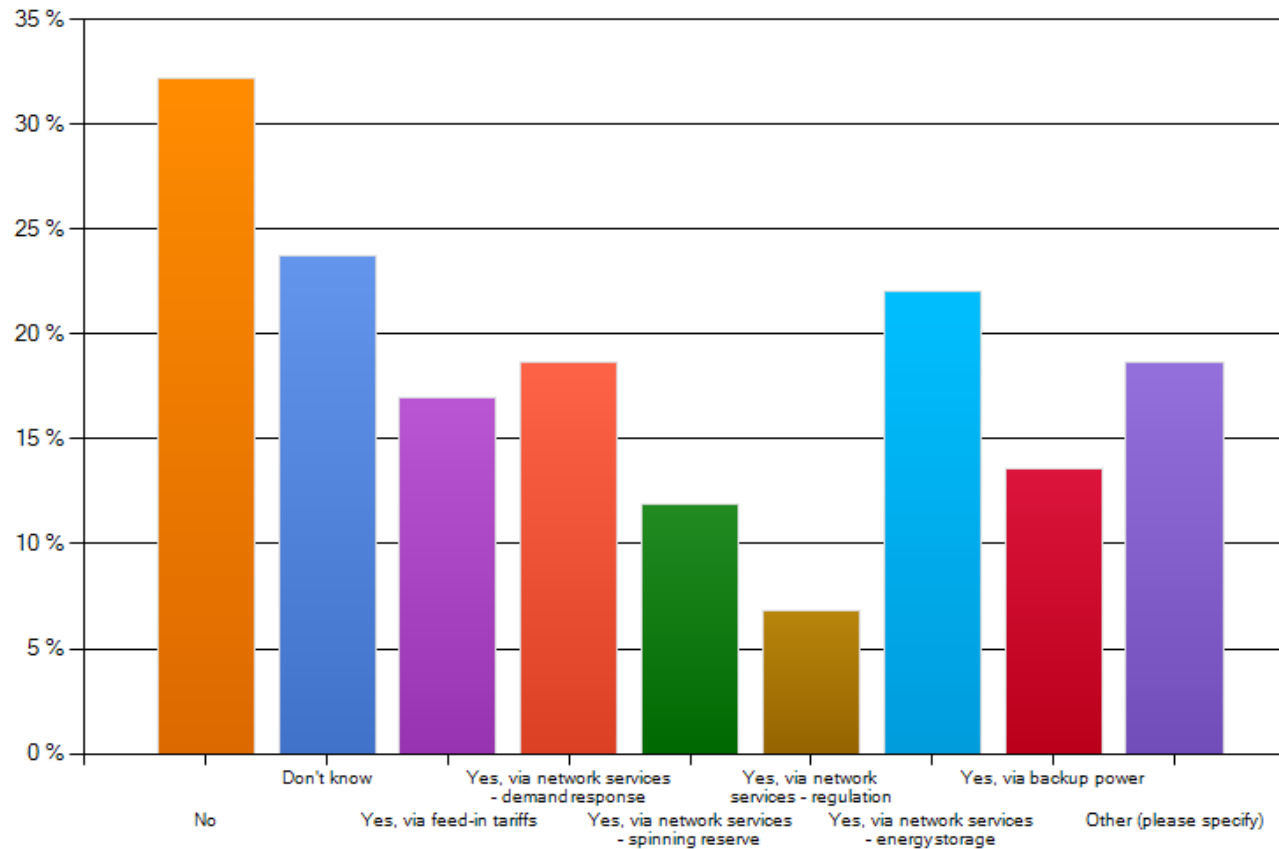
Inductive & Battery Swap



- **Inductive**
 - Safer
 - Less efficient
 - Not currently used
 - Investment increasing
- **Battery Swap**
 - Better Place / Renault Fluence Z.E.
 - Trial in Japan very successful
 - Difficult to customize
 - Cost effective?

Vehicle-to-Grid (or X)

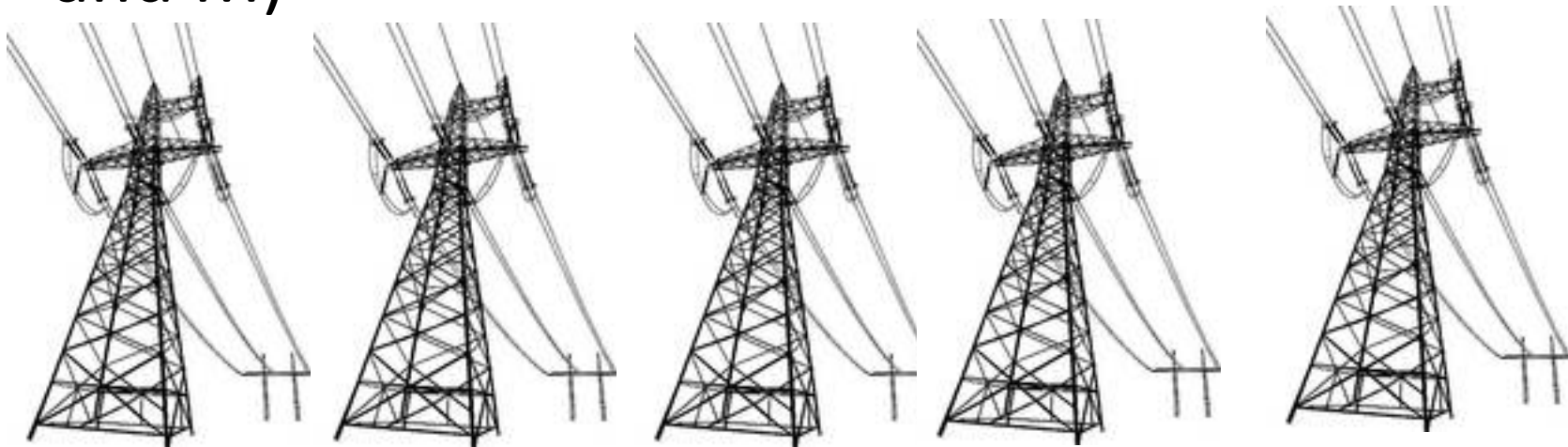
Areas in Which APEC Economies Believe PEVs Can Earn Revenue in Local Energy Markets (Unweighted Draft)



6c) Survey Results and State of Play: *Grid Characteristics*

Grid and Energy Market Differences

- Reliability of electricity supply solid.
- Main difference is voltage – 76% on 220-240v
- 8 different plug/socket types (A, B, C, F, G, I, L and M)

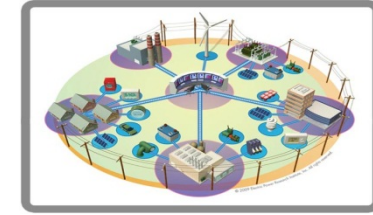


Peak Demand

- Concern about PEV load, especially at peak times
- Peaks vary economy-to-economy (e.g. winter peaks vs summer peaks)
- PEV volumes considered still too low
- Treatment of PEVs in energy market – different or like any other appliance?



Smart Grid



- APEC Regulatory Cooperation Advancement Mechanism *on Trade-Related Standards and Technical Regulations (ARCAM)* leading for APEC
- Most economies active in smart grid, progress varies

Examples of Progress

- **Australia:** AU\$100 *Smart Grid, Smart City*, demonstrating a commercial-scale smart grid and collecting data to analyze benefits and costs
- **Republic of Korea:** Korea established the Korean Smart Grid Institute in 2010 and has since led substantial investment in smart grid both locally and internationally. Korea has authored a roadmap for smart grid technological integration
- **Singapore:** The Energy Market Authority in Singapore has led a smart meter trial and is planning a larger-scale smart grid deployment to test fully the commercial feasibility of various smart grid technologies
- **The United States of America:** To date, the US Government has investment more than US\$4 billion to demonstrate smart grid technologies and support modernization of the existing system

6) Questions?