

# **Electric Vehicle (EV) Reference Guide**

Draft 1 Summary & Discussion

Next Steps



**Agenda item 5a,b,c**

**7<sup>th</sup> Electric Vehicles and the Environment (EVE)  
Informal Working Group (IWG) meeting  
October 17 – 18, 2013  
Beijing, China**

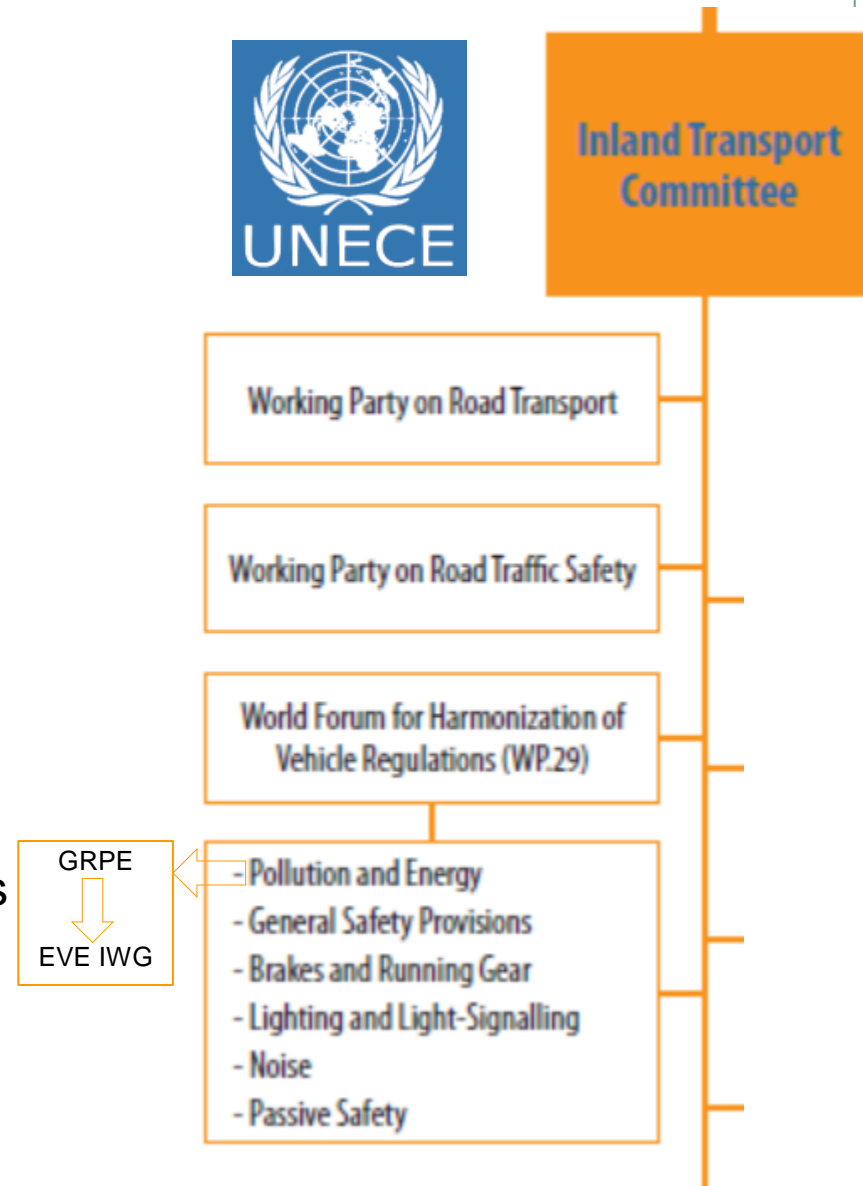
# Outline



- **Agenda item 5.a):** EV Reference Guide Development
  - Background
    - Electric Vehicles and the Environment IWG
    - Summary of EVE activities to date, meetings
    - EV Reference Guide development
      - Vehicle attributes, Guide outline, Questionnaire, Prioritization discussion points
  - Current Status of the Guide: Draft 1 summary and review
    - Review of submitted comments
    - Discussion questions
- **Agenda item 5.b):** Discuss next steps in roadmap
  - Guide development
  - Future meetings, other tasks
- **Agenda item 5.c):** Discuss potential extension of EVE mandate

## Electric Vehicles and the Environment IWG

- Established in 2012
- Chair: US EPA, Co-Chair: China, Japan, Secretary: EC
- **Objectives:**
  - (a) Exchange information on current and future regulatory requirements for EVs in different markets,
  - (b) Identify and seek to minimize the differences between regulatory requirements, with a view toward facilitating the development of vehicles to comply with such requirements,





## Summary of EVE activities to date

- 6 informal working group meetings since 2012
- **Specific EVE meeting objectives:**
  - a) Develop a priority list of topics to address the most timely and significant considerations before the EVE informal working group.
  - b) Understand and document the current consideration of EVs under the work of other established informal working groups: EVS, WLTP, HDH, EFV and VPSD.
  - c) Establish a mechanism for sharing ongoing research and information sharing on topics related to EVs and the environment.
  - d) Develop a reference guide for regulatory activities already established or being considered by contracting parties.



## Summary of EVE meetings

- EVE Session #2 – Baltimore (13-14.9.2012)
  - Finalized TOR, initial discussions to develop an EV reference guide.
- EVE Session #3 – Conference Call (27.11.2012)
  - Proposed a format for the reference guide and questionnaire.
- EVE Session #4 – Geneva (14.1.2013)
  - Confirmed the format for the reference guide and questionnaire, initiated information gathering.
  - Concurrence from GRPE on progress report and terms of reference
- EVE Session #5 – Tokyo (11-12.4.2013)
  - Completed information gathering, discussion of completed questionnaires by contracting parties and summary presentation.
- EVE Session #6 – Geneva (3.6.2013)
  - Sought input from CPs and other IWGs on list of priority issues to inform reference guide recommendations and guide potential future research/testing
  - All stakeholders invited to submit further literature/data.

# EV Reference Guide Development- *Vehicle attributes*

EVE-3 meeting (conference call, Nov 2012), Guide format proposed

EVE-4 meeting (Geneva, January 2013), Guide format approved

Illustration of Vehicle Attributes for EVE Reference Guide discussion



**Infrastructure:**

- Wireless charging
- On-board charging system
- Off-board charging standard related to the vehicle
- Vehicle as electricity supply

**Annex:**

- Financial incentives
- Consumer awareness
- Government purchasing



**Vehicle:**

- Electrified Vehicle range
- Energy consumption/efficiency
- Vehicle driver-user information
- Vehicle recycling and re-use
- Vehicle labeling



**Market Deployment Support:**

- Regulatory incentives



**Battery:**

- Battery performance
- Battery durability
- Battery recycling
- Battery re-use (post-mobility)

Within WP29 scope  
 Not sure if within WP29 scope  
 Likely not within WP29 scope

# EV Reference Guide Development- *Guide Outline*

EVE-3 meeting (conference call, Nov 2012), Guide format proposed

EVE-4 meeting (Geneva, January 2013), Guide format approved

**1. Introduction**

**1.1. Overview of EVE IWG**

1.1.1. Formation (link to EVS, other GRPE groups), objectives, structure, TORs

1.1.2. Goals and expected outcome of the EVE IWG, timeline

1.1.3. Summary of EVE activities

**1.2. Purpose of EV Reference Guide**

1.2.1. Aim of document, audience, how document fits into EVE IWG objectives/goals/outcome

1.2.2. Connection to WP.29 and potential GTR development

**1.3. Outline of EV Reference Guide**

1.3.1. Overview of guide components, logic for ordering of sections, etc.

**2. Guide design and methodology**

**2.1. Design of EV Reference Guide**

2.1.1. Rationale for guide organization: vehicle attributes  
Attribute: A characteristic, activity or requirement related to EVs and the environment.  
*See PowerPoint slide: Illustration of vehicle attributes.*

2.1.2. Scope of guide: which attributes are included/excluded, relationship to the environment  
Attributes related to EV safety were not included (i.e. crash testing; electrical safety standards for internal wiring, etc.). Attributes are grouped by those related to vehicle, battery, charging infrastructure and market deployment support. In order to remain within the scope of the WP.29 (vehicle-only related regulations), attributes related directly to the vehicle and battery are the focus of the guide. Although likely outside of the WP.29 scope, charging infrastructure attributes related directly to the vehicle and market deployment support attributes are included for completeness.

**2.2. Methodology for EV Reference guide information collection**  
*Information collected will be gathered through a questionnaire sent to WP29 working groups and contracting parties. Other stakeholders (non-contracting parties, i.e. vehicle industry, industry organizations, etc.) will be able to review the compiled questionnaire information in the form of a draft Guide once completed.*  
*See Questionnaire.*

**3. Summary of findings**  
*Information from the questionnaire completed by all stakeholders will be summarized for each attribute as follows:*

**WP.29:** Summary of WP.29 activities.  
**Countries:** Summary of findings from countries surveyed with the questionnaire.  
**Other stakeholders:** Summary of findings from other stakeholders.

**Vehicle**

**3.1. Electrified vehicle range:** The maximum distance an electric vehicle can travel using only battery power. In the case of plug-in electric vehicles (PHEV) also indicate the "total range". Vehicle range determination can include a specific drive cycle, test procedures and vehicle preconditioning. Please specify "end of test condition" used. Please include these elements in your answer, if applicable.

**3.2. Energy consumption/efficiency:** Energy required to travel X km in standardized conditions. Energy consumption/efficiency determination can include a specific drive cycle, test procedures and vehicle preconditioning.

**3.3. Electrified Vehicle driver-user information:** Standardized symbols for system warnings, charge systems, etc.

**3.4. Electrified Vehicle recycling and re-use** (excluding the battery): Requirements for recycling and/or reusing vehicle components and/or electric motors.

**3.5. Vehicle labeling:** Requirements for vehicle labelling, including the drive cycle and test procedure used to obtain information for the label. Labels may indicate, but are not limited to, fuel efficiency, emissions, range, total battery capacity (kWh), cost, etc.

**Battery**

**3.6. Battery performance:** Methods and conditions for testing and measuring battery power delivery capability, energy storage capacity, battery charge, etc.

**3.7. Battery durability:** Methods and conditions for determining average life cycle count, shock and vibration resistance, temperature, etc.

**3.8. Battery recycling:** Battery material recycling standards.

**3.9. Battery re-use** (post-mobility): Alternate uses for batteries after their useful life in vehicles.

**Infrastructure**

**3.10. On-board charging system:** Specifications and requirements for on-board charging system, including voltage, current, port for AC and/or DC power, etc.

**3.11. Off-board charging standard related to the vehicle:** Specifications and requirements for off-board charging system, including port for DC power, battery communication interface/battery management system communication interface, etc.

**3.12. Wireless charging:** Requirements and standards for wireless charging.

**3.13. Vehicle as electricity supply:** Vehicle-related specifications and requirements for transferring electricity from EVs to the grid.

**Market deployment support**

**3.14. Regulatory incentives:** Legal requirements that contain an incentive for deployment of electric vehicles. The term "legal requirements" is broad and can refer to any regulation, legislation, code, and/or standard that is rooted in law.

**4. Conclusions**

4.1. Analysis for areas of high "activity".

4.2. Analysis for areas of "lower activity" and gap identification.

4.3. Implications of the summary and analysis.

**5. Next steps**

5.1. Analysis of guide information in the context of potential GTR development.

**6. Annex**  
*Information from the Annex portion of the questionnaire completed by all stakeholders will be summarized. For each attribute as follows:*

**WP.29:** Summary of WP.29 activities.  
**Countries:** Summary of findings from countries surveyed with the questionnaire.  
**Other stakeholders:** Summary of findings from other stakeholders.

**6.1. Financial incentives:** Financial support provided by the government to vehicle manufacturers, businesses, organizations, and/or consumers for the purchase of an electric vehicle. Ensure to describe the terms of the financial support, specifying (if appropriate) where an incentive is applied, i.e. manufacturers, sales, infrastructure, etc.

**6.2. Consumer awareness:** Education and outreach activities supported by the government to increase awareness about electric vehicles.

**6.3. Government purchasing:** Requirements and/or financial incentives within government operations incentivizing the purchase and use of electric vehicles.



# EV Reference Guide Development- Questionnaire

EVE-3 meeting (conference call, Nov 2012), Questionnaire format proposed

EVE-4 meeting (Geneva, January 2014), Questionnaire format approved

EVE-5 meeting (Tokyo, April 2013), Questionnaire results discussed

## QUESTIONNAIRE TO SUPPORT THE DEVELOPMENT OF THE EVE REFERENCE GUIDE

### Introduction:

The Electric Vehicle and Environment (EVE) Informal Working Group is mandated by the WP.29 to develop an EV Regulatory Reference Guide (Guide).

The scope of this Guide covers all types of road vehicles (motorcycles, passenger cars, light, medium and heavy-duty vehicles) with electrical propulsion, including battery electric vehicles (BEV), hybrid electric vehicles (HEV) and plug-in hybrids (PHEV). The Terms of Reference of the EVE IWG can be found at:

<https://www2.unece.org/wiki/display/trans/EVE+2nd+Session>

Your input to the attached Questionnaire is critical to the delivery of this activity. We are counting on your support to complete this questionnaire by **March 11, 2013**. **Send your completed questionnaire electronically** to the EVE Secretary, [Stephane.Couroux@ec.gc.ca](mailto:Stephane.Couroux@ec.gc.ca). A summary of the information gathered will be presented at the EVE-05 session to be held April 11-12, 2013 in Tokyo, Japan.

Should you have any questions, or concerns, please do not hesitate to contact the EVE Secretary. Should you prefer to set-up a phone interview to complete the Questionnaire, please let the EVE Secretary know and we will set set-up a time.

Thank you for your contribution to this work.

### The EVE Leadership Team

### Background:

Requirements in the Guide will be organized by *attribute*, which is a characteristic, activity or requirement related to EVs and the environment; an example of an EV attribute is 'electrified vehicle range'. This approach was agreed upon by EVE IWG members and was taken to minimize confusion in interpretation of wording, such as regulation, legislation, etc. Each attribute is defined, and definitions established in Gtrs (2, 4, 10, 11), under development in other WP.29 working groups (EVS, VPSD, WLPT, HDH), found in WP.29 documentation (R.E.3, S.R.1), and established by other organizations (ANSI, ISO, IA-HEV) were scanned for relevance to this work and are used where appropriate.

During the 3<sup>rd</sup> EVE IWG meeting in November 2012, it was agreed to use a questionnaire to seek information on attributes from Contracting Parties and other WP.29 working groups for input into the Guide. Although in the questionnaire each attribute is defined, it is recognized that Contracting Parties and other relevant WP.29 working groups may have slightly different definitions. They are encouraged to contribute information for each attribute regardless of the exact definition. The structure of the questionnaire was available for review by EVE members and finalized at the 4<sup>th</sup> EVE IWG meeting.

Other stakeholders, like vehicle manufacturers, will be given the opportunity to provide comments on drafts of the Guide once information is compiled.

**Instructions:** For *each* EV Attribute presented below, please provide answers to the questions. We realize there may be overlap in requirements for multiple attributes; if this is the case, include information in each attribute even if repetitive.

<p><b>1. Electrified Vehicle Attribute:</b> Electrified vehicle range</p> <p><b>Attribute Definition:</b> The maximum distance an electric vehicle can travel using only battery power. In the case of plug-in electric vehicles (PHEV) also indicate the "total range". Vehicle range determination can include a specific drive cycle, test procedures and vehicle preconditioning. Please specify "end of test condition" used. Please include these elements in your answer, if applicable.</p> <p><b>Question 1.</b></p> <p><b>Requirements:</b> Do you have requirements (voluntary, regulatory, etc.) in regards to the attribute?</p> <p>The term 'requirements' is broad and can refer to any practise, regulation, legislation, code, and/or standard. Please keep in mind the different vehicle types (i.e.: passenger cars, heavy-duty trucks, motorcycles, etc. and HEVs, PHEV, BEVs), specifying requirements by vehicle type for Attribute X if appropriate.</p> <p>If yes, answer the questions below. If no, move onto answering the questions for the other attributes.</p> <p><b>a.</b> Describe the requirements, stating its objective and goal. Indicate if the requirement is established/active or under development. If the requirement is under development, what is the expected timeline for its adoption? Finally, if a definition for the attribute is included in the requirement, please provide this information.</p> <p><b>ANSWER:</b></p> <ul style="list-style-type: none"> <li>- Description:</li> <li>- Objective and goal:</li> <li>- Established/active or under development:</li> <li>- If under development, timeline for adoption:</li> <li>- Attribute definition found in the requirement:</li> </ul> <p><b>b.</b> Are any standards (i.e.: SAE, ISO, UL, national, international, voluntary, industry etc.) referenced in the requirements? If yes, list the standards referenced.</p> <p><b>ANSWER:</b></p> <p><b>c.</b> Where are these requirements stipulated (i.e.: Law, Act, other,...)?</p> <p><b>ANSWER:</b></p> <p><b>d.</b> Describe who is responsible for implementing the requirements (i.e.: government agency, other,...)?</p> <p><b>ANSWER:</b></p> <p><b>e.</b> Are there variations in these requirements within your jurisdiction? This could include state, municipal or other regional requirements.</p> <p><b>ANSWER:</b></p> <p><b>f.</b> Is there any other relevant information you would like to include about the attribute and related requirements?</p> <p><b>ANSWER:</b></p>
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# EV Reference Guide Development- *Prioritization discussion points*

## EVE-6 meeting (Geneva, June 2013), priority issues list approved



EVE Informal Working Group Prioritization Discussion Points			
Issue	Information re: Substantive impacts	Addressed by regulations?	Is another WP-29 group addressing this issue?
<b>1) Vehicle Energy Efficiency/Range</b>			
a) Cabin Heating	EVE-04-05e submitted by Dr. Tober: The total add. energy req. for climate control @ +10°C: 10 - 20 %, @ -10°C: 40 - 55%. Elements to form recommendation in EV Reference Guide: - Pre-conditioning prior to vehicle usage would decrease effect on range though not necessarily total energy usage from the grid - Heated seats & steering wheel - Advanced technologies (Infra-red panels & heat pumps) - Accounting for these parameters in a test cycle to justify higher cost of advanced technologies	US/Can/S.Korea for public health pollutants; US/Can for label	Possible WLTP phase 2 (2014-2018)
	EVE-04-05e submitted by Dr. Tober: The total add. energy req. for climate control @ +10°C: 10 - 20 %, @ -10°C: 40 - 55%. Elements to form recommendation in EV Reference Guide: - Pre-conditioning prior to vehicle usage would decrease effect on range though not necessarily total energy usage from the grid - Advanced technologies: such as heat pumps and electrified compressors - Zeolite	US/Can/S.Korea for public health pollutants; US/Can for label	MACTP developing methods for internal combustion engine vehicles
c) Potential battery temperature effect on capacity and efficiency	Meyer, N et al (2012) "The Impact of Driving Cycle and Climate on Electrical Consumption and Range of Fully Electric Passenger Vehicles" reports a 15-20% loss of range for a variety of test cycles comparing 20 C and -20 C; and two tests indicate a relatively small difference in efficiency but it is not clear whether these are within the variation of the testing procedure Elements to form recommendation in EV Reference Guide: - End-of-range is believed to occur sooner in cold temperatures, but it is uncertain what portion of the lost range is due to actual lost energy (i.e. reaching minimum SOC faster due to reduced discharge and regen efficiency) vs depressed voltage triggering an end-of-range condition at a higher SOC while energy still resides in the battery. The first case means an increase in energy consumption while the second does not (the unused energy will become accessible as the battery rests/warms, or will reduce the energy needed to recharge). - Vehicle thermal management systems differ greatly	No (except India example)	Possible WLTP phase 2 (2014-2018)
	Elements to form recommendation in EV Reference Guide: - Potential for energy loss with increased demand from the BMS (battery management system). There may be increased cooling demands as well as cell balancing demands in the case of Li-ion batteries.	No	No such efforts known
d) Potential battery state of charge effect on efficiency?	EVE-04-05e: A +2% Road Gradient results in 30%-50% higher energy consumption. The energy saving at -2% is nearly as high as the higher energy demand at +2%.	No	No such efforts known
e) Road gradient	Elements to form recommendation in EV Reference Guide: - Regenerative braking efficiency	No	No such efforts known
f) Energy equivalency conversion methods?	Elements to form recommendation in EV Reference Guide: - Comparison on an energy or an energy-fuel basis - Future need to regulate energy efficiency (ie minimum kWh per km)		
<b>2) Battery performance/durability</b>			
a) Battery durability effect on range	Highly chemistry dependent, some research is available from Nissan: <a href="http://www.mynissanleaf.com/assets/Arnk20open%20letter%20to%20Nissan%20LEAF%20owners%20from%20Car%20to%20Balo_FINAL.pdf">http://www.mynissanleaf.com/assets/Arnk20open%20letter%20to%20Nissan%20LEAF%20owners%20from%20Car%20to%20Balo_FINAL.pdf</a> Elements to form recommendation in EV Reference Guide: - Chemistry variations - Battery management system control of depth of charge and recharging rates - Thermal management systems	No	Possible WLTP Phase 2 (2014-2018)
	Elements to form recommendation in EV Reference Guide: - Chemistry specific effects - Surface-film	No	
b) Potential battery durability effect on kWh/km	Elements to form recommendation in EV Reference Guide: - Chemistry specific effects - Surface-film	No	
c) Battery performance effect on emissions	Elements to form recommendation in EV Reference Guide: - Reduced all electric range for PHEVs resulting in ICE starting sooner & running longer	Limited, such as US EPA hybrid (inc. plug-ins)	
d) Battery management system performance	Elements to form recommendation in EV Reference Guide: - Cell-balancing - Thermal management draw - Other parasitic losses		
<b>Information Sharing Items (Outside of WP-29)</b>			
3) Regulatory incentives	Elements to form recommendation in EV Reference Guide: - HOV lane use - Manufacturer credits	Yes	no
4) Regulatory Standards - Incorporating EVs into fuel economy standards		Addressed in Japan's standard, US CAFE & Canadian LRV regulations	No
5) EV charging	Elements to form recommendation in EV Reference Guide: - Charge rate vs charger efficiency - Level 2 home charging stations are not made by the same manufacturer of the vehicle and efficiency could vary between manufacturers - Effects of various cell-balancing mechanisms	Generally industry standards; EU may legislate	No

# EV Reference Guide Development- *Prioritization discussion points*

## EVE-6 meeting (Geneva, June 2013), priority issues list approved

EVE Informal Working Group Prioritization Discussion Points			
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<b>1) Vehicle Energy Efficiency/Range</b>			
<b>a) Cabin Heating</b>	<p>EVE-04-05e submitted by Dr. Tober: The total add. energy req. for climate control @ +10°C: 10 - 20 %, @ -10°C: 40 - 55%.</p> <p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Pre-conditioning prior to vehicle usage would decrease effect on range though not necessarily total energy usage from the grid</li> <li>- Heated seats &amp; steering wheel</li> <li>- Advanced technologies (Infra-red panels &amp; heat pumps)</li> <li>- Accounting for these parameters in a test cycle to justify higher cost of advanced technologies</li> </ul>	US/Can/S.Korea for public health pollutants; US/Can for label	Possible WLTP phase 2 (2014-2018)
<b>b) A/C</b>	<p>EVE-04-05e submitted by Dr. Tober: The total add. energy req. for climate control @ +10°C: 10 - 20 %, @ -10°C: 40 - 55%.</p> <p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Pre-conditioning prior to vehicle usage would decrease effect on range though not necessarily total energy usage from the grid</li> <li>- Advanced technologies: such as heat pumps and electrified compressors</li> <li>- Zeolite</li> </ul>	US/Can/S.Korea for public health pollutants; US/Can for label	MACTP developing methods for internal combustion engine vehicles
<b>c) Potential battery temperature effect on capacity and efficiency</b>	<p>Meyer, N et al (2012) "The Impact of Driving Cycle and Climate on Electrical Consumption and Range of Fully Electric Passenger Vehicles" reports a 15-20% loss of range for a variety of test cycles comparing 20 C and -20 C; and two tests indicate a relatively small difference in efficiency but it is not clear whether these are within the variation of the testing procedure</p> <p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>-End-of-range is believed to occur sooner in cold temperatures, but it is uncertain what portion of the lost range is due to actual lost energy (i.e. reaching minimum SOC faster due to reduced discharge and regen efficiency) vs depressed voltage triggering an end-of-range condition at a higher SOC while energy still resides in the battery. The first case means an increase in energy consumption while the second does not (the unused energy will become accessible as the battery rests/warms, or will reduce the energy needed to recharge).?</li> <li>-Vehicle thermal management systems differ greatly</li> </ul>	No (except India example)	Possible WLTP phase 2 (2014-2018)
<b>d) Potential battery state of charge effect on efficiency?</b>	<p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>-Potential for energy loss with increased demand from the BMS (battery management system). There may be increased cooling demands as well as cell balancing demands in the case of Li-ion batteries.</li> </ul>	No	No such efforts known
<b>e) Road gradient</b>	<p>EVE-04-05e: A +2% Road Gradient results in 30%-50% higher energy consumption. The energy saving at -2% is nearly as high as the higher energy demand at +2%".</p> <p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Regenerative braking efficiency</li> </ul>	No	No such efforts known
<b>f) Energy equivalency conversion methods?</b>	<p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Comparison on an energy or an energy-fuel basis</li> <li>- Future need to regulate energy efficiency (ie minimum kWh per km)</li> </ul>		

# EV Reference Guide Development- *Prioritization discussion points*

## EVE-6 meeting (Geneva, June 2013), priority issues list approved



2) Battery performance/durability			
<b>a) Battery durability effect on range</b>	<p>Highly chemistry dependent, some research is available from Nissan:  <a href="http://www.mynissanleaf.com/assets/An%20open%20letter%20to%20Nissan%20LEAF%20owners%20from%20Carla%20Bailo_FINAL.pdf">http://www.mynissanleaf.com/assets/An%20open%20letter%20to%20Nissan%20LEAF%20owners%20from%20Carla%20Bailo_FINAL.pdf</a></p> <p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Chemistry variations</li> <li>- Battery management system control of depth of charge and recharging rates</li> <li>- Thermal management systems</li> </ul>	No	Possible WLTP Phase 2 (2014-2018)
<b>b) Potential battery durability effect on kWh/km</b>	<p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Chemistry specific effects</li> <li>- Surface-film</li> </ul>	No	
<b>c) Battery performance effect on emissions</b>	<p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Reduced all electric range for PHEVs resulting in ICE starting sooner &amp; running longer</li> </ul>	Limited, such as US EPA hybrid (Inc. plug-ins)	
<b>d) Battery management system performance</b>	<p>Elements to form recommendation in EV Reference Guide:</p> <ul style="list-style-type: none"> <li>- Cell-balancing</li> <li>- Thermal management draw</li> <li>- Other parasitic losses</li> </ul>		



## Current Status of the Guide: Draft 1 summary and review

- Prepared by FEV, Inc. – contractor hired by US EPA
- Document has 6 sections:
  1. Introduction
    - Overview of EVE IWG, Purpose of Guide, Outline of Guide
  2. Reference Guide Design & Methodology
    - Guide organization, scope, rationale
  - 3. Summary of Findings
    - EV attributes discussed in groups: vehicle, battery, infrastructure, market deployment
  - 4. Conclusions
    - High and low activity, Gaps and implications of analysis
  - 5. Next steps
    - Potential areas for future work, gtr recommendations
  6. Annex
    - Other EV attributes (i.e. financial incentives, etc.)

# Current Status of the Guide: Draft 1 summary and review

## 3. Summary of Findings: Vehicle Attributes



Figure 7 : Vehicle attributes, global snapshot

# Current Status of the Guide: Draft 1 summary and review



## 3. Summary of Findings: Battery Attributes

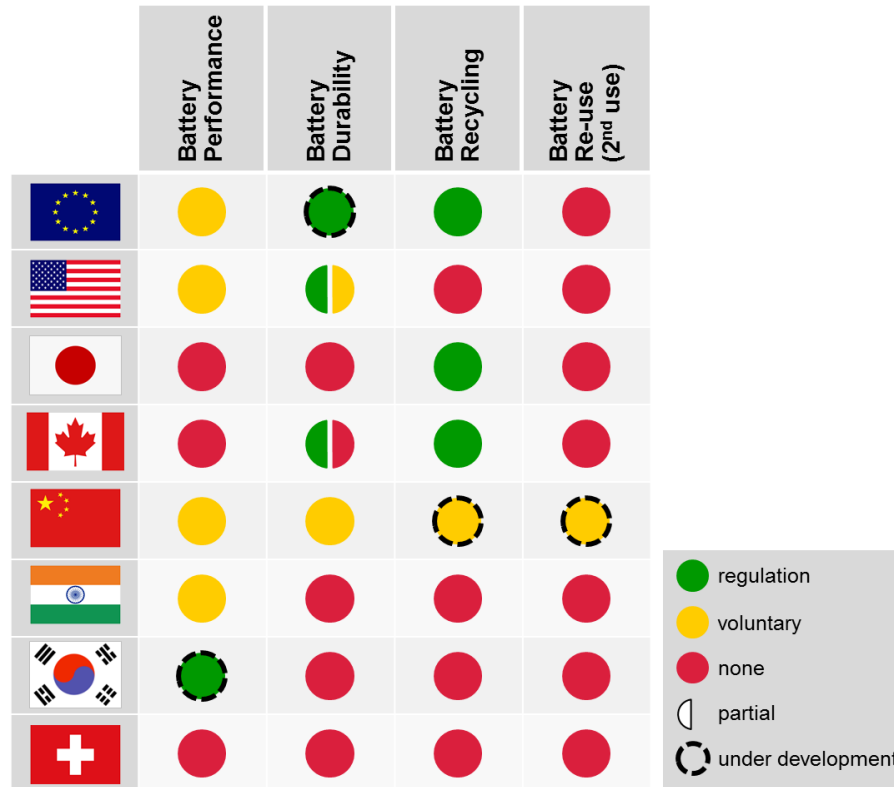


Figure 13 : Battery attributes, global snapshot

## Current Status of the Guide: Draft 1 summary and review

### 3. Summary of Findings: Infrastructure Attributes

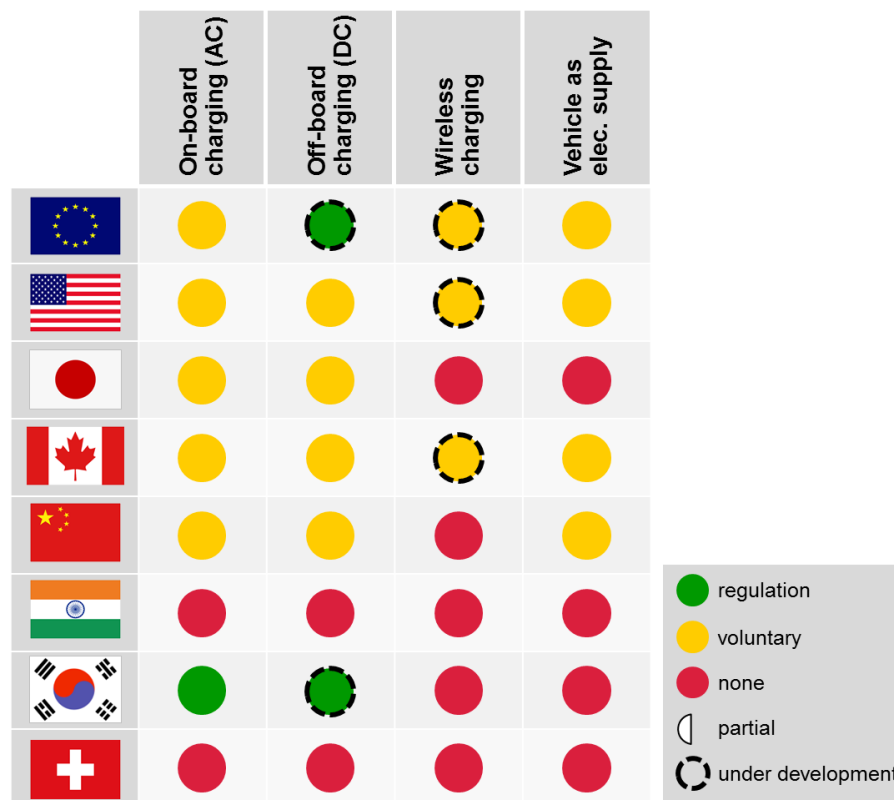


Figure 19 : Infrastructure attributes, global snapshot

# Current Status of the Guide: Draft 1 summary and review

## 3. Summary of Findings: Market deployment Attributes

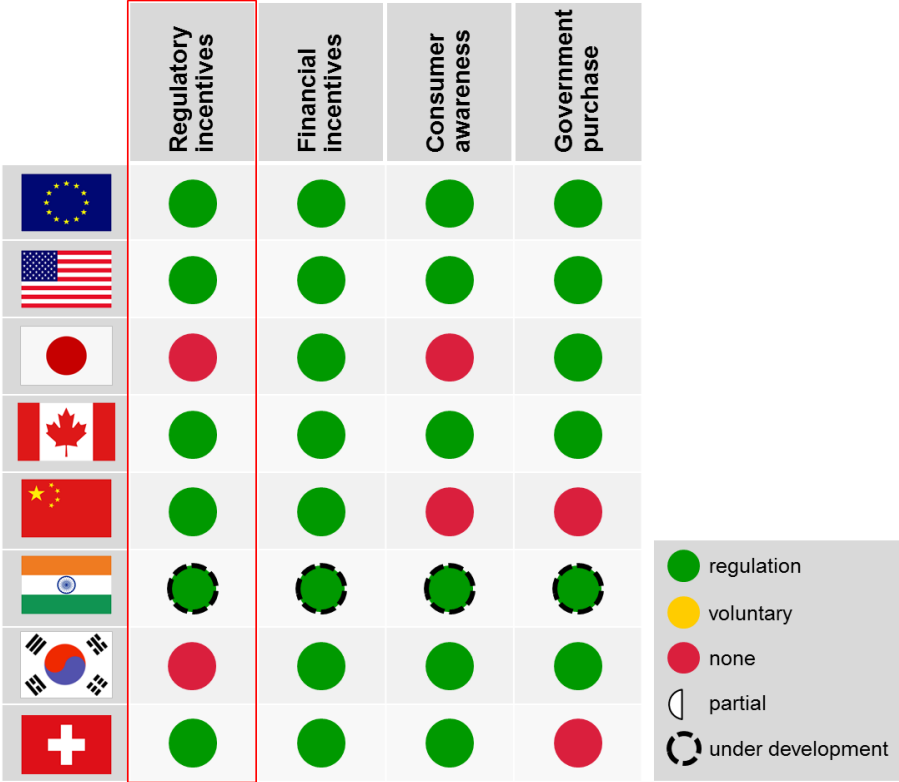


Figure 25 : Market deployment attributes, global snapshot



# Current Status of the Guide: Draft 1 summary and review



## 4. Conclusions: High activity areas

Figure 27 :  
Activity chart,  
**Overall**

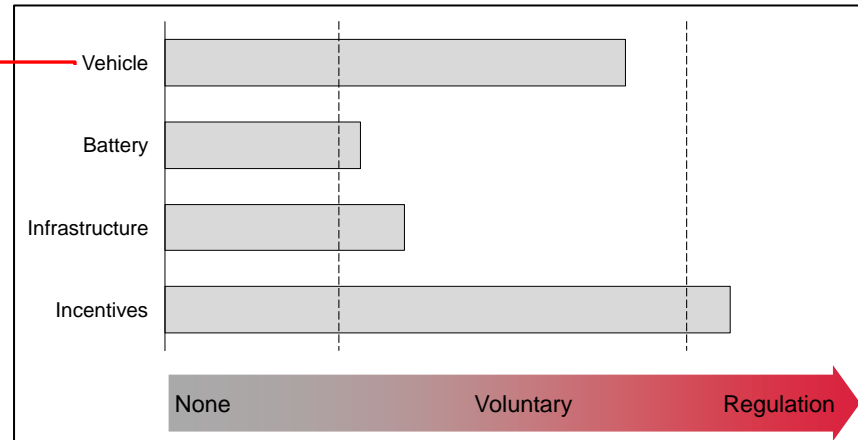
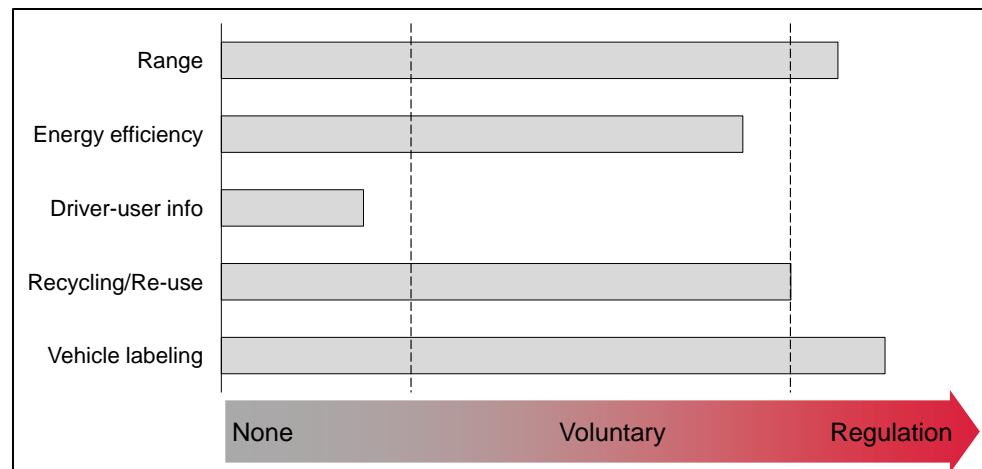


Figure 28 :  
Activity chart,  
**Vehicle attributes**



# Current Status of the Guide: Draft 1 summary and review

## 4. Conclusions: High activity areas

Figure 29 :  
Activity chart,  
**Infrastructure**  
attributes

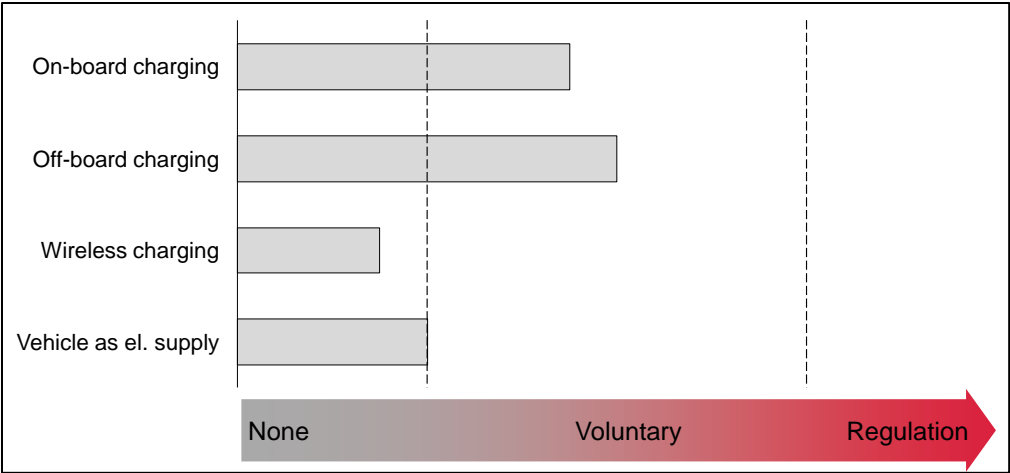
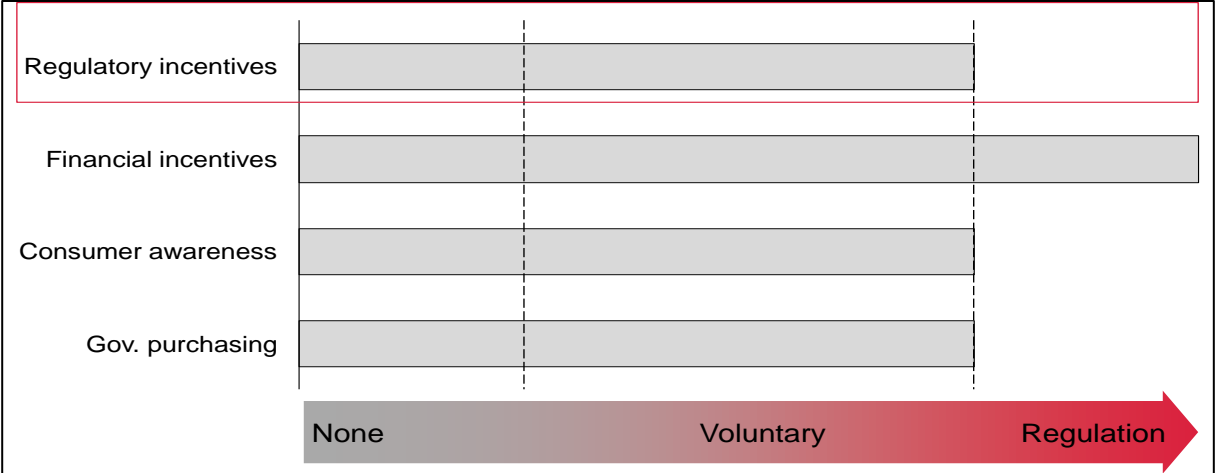


Figure 30 :  
Activity chart,  
**Market**  
deployment  
attributes



# Current Status of the Guide: Draft 1 summary and review



## 4. Conclusions: Low activity areas

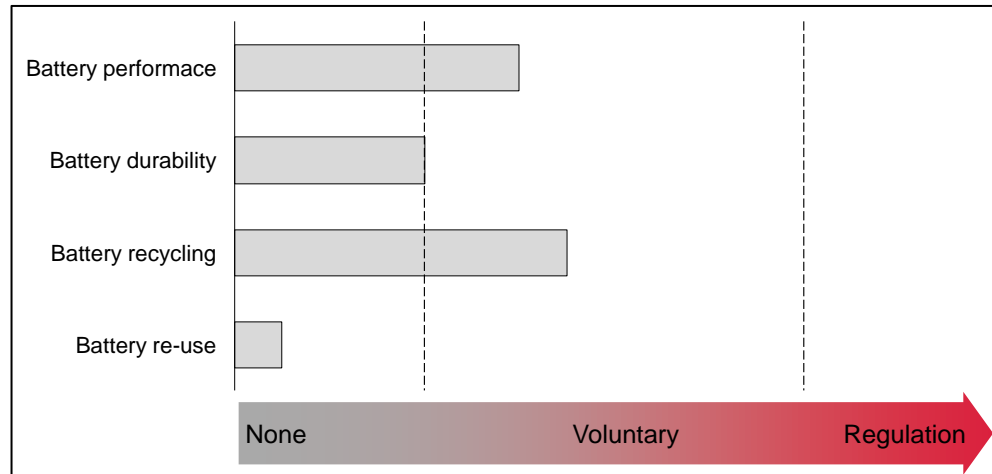


Figure 31 : Activity chart, **Battery attributes**



## Current Status of the Guide: Draft 1 summary and review

### 4. Conclusions: Gaps and Implications of the Analysis

#### • Vehicle attributes

1. Energy efficiency and range are critical input parameters to other key events- there is a lack of global uniformity in regards to drive cycle and test procedures for determination of key vehicle performance criteria.
  - This disconnect was identified by the UNECE and is the subject of Phase 1 of a GTR being developed under the framework of WLTP working group.
2. A gap still exists in accounting for the use of accessories, in particular air conditioning, cabin heating, and vehicle exterior lighting.
3. General lack of provisions corresponding to advanced thermal management systems such as heat pumps or infra-red heating.
4. Active battery management systems employed by different OEMs / battery pack manufacturers as well as driver selectable operating modes (sport, eco etc. ) are also aspects that are generally not yet addressed.
5. Vehicle labeling, while widely practiced globally (high activity), overwhelmingly excludes electrified vehicles (US is the exception), representing another significant gap.



## Current Status of the Guide: Draft 1 summary and review

### 4. Conclusions: Gaps and Implications of the Analysis

- **Battery attributes**

1. Battery performance determination is largely non-standard, with a mix of voluntary standards (USABC, SAE, ISO, IEC) and some country-specific ones existing or in development (China, South Korea).
2. Battery recycling by virtue of its widely differing requirements globally can be considered to be gapped as well. There are also a number of countries that simply do not have any requirements in place pertaining to battery recycling.
3. Battery re-use post mobility represents a wide gap that will be challenging to govern given the highly variable nature of battery wear and inherent differences in chemistry, construction, and power management.



## Current Status of the Guide: Draft 1 summary and review

### 4. Conclusions: Gaps and Implications of the Analysis

- **Minimal gaps Infrastructure and Market deployment attributes**
- Infrastructure attributes
  - The gap here is one that is temporary and continuing to close with time.
    - A roadmap of ISO/IEC standards governs the systems and communication protocols and there is a generally well harmonized set of standards that govern the connectors.
- Market deployment attributes
  - There are no gaps that exist in the context of regulatory incentives.



## Current Status of the Guide: Draft 1 summary and review

### 5. Next steps: **Vehicle range & efficiency testing**

1. It is recommended that testing procedures for EVs include cold ambient temperature testing with cabin heating in operation and testing at elevated ambient temperatures with air conditioning in operation.
  - Phase 2 of the GTR being pursued by the WLTP working group aims to address low temperature ambient conditions; if this recommendation goes beyond the scope of WLTP, **a separate GTR could be considered.**
2. It is recommended that information on battery durability, which will be part of the WLTP GTR and subsequently adopted into EC law (2015/2016), be leveraged to **develop correction factors** that can be used to project range and energy efficiency over the operating lifecycle of the corresponding electric vehicles that receive these batteries.

## Current Status of the Guide: Draft 1 summary and review



### 5. Next steps: **Vehicle labeling (outside WP.29 scope)**

1. It is recommended that an **effort to harmonize vehicle labeling** world-wide be considered. Two phases of adoption are proposed:
  - A. Phase 1 – Adoption of a world-wide label that lists the following critical attributes:
  - B. Phase 2 – Phase 1 but with the following amendments: WLTC test procedure, Summer and Winter sets of values
    - Future phase - include deterioration factors





## Current Status of the Guide: Draft 1 summary and review

### 5. Next steps: **Battery performance**

1. it is recommended that uniform propulsion battery test procedure be **pursued through a GTR.**
  - This would be in line with current plans to pursue a battery durability standard via WLTP GTR and would more fully complete the definition of requirements for propulsion batteries.
  - It is recommended that currently available international standards be used as references in this work, in particular ISO 12405-1 and 12405-2 which are the most elaborate of the standards that have been released to-date.

# Current Status of the Guide: Draft 1 summary and review



## 5. Next steps: **Battery performance**

Figure 33 :  
Overview of  
major battery  
performance  
standards.

PARAMETER TESTS	EV/PHEV			HEV	
	IEC 61982-3	ISO 12405-2	QC/T 743-2006	ISO 12405-1	VDA
Standard Cycle		C/3 RT	C/3 RT	1C RT	1C RT
Capacity/Energy	Dynamic cycle RT	C/3, 1C, 2C -25, -10, 0, RT, 40 °C	20 °C: C/3, 1.5C (high energy), 4C (high power) -20 °C: C/3 55 °C: C/3	1C, 10C, 20C - 18, 0, RT, 40 °C	1C, 10C, 20C -25, RT, 40 °C
Power/Resistance		$I_{\text{disch-max}} \leq 400 \text{ A}$ Pulse: 0.1, 2, 10, 18, 18.1, 20, 30, 60, 90, 120 s SOC: 90, 70, 50, 35, 20% -25, -18, -10, 0, RT, 40 °C	N.A.	$I_{\text{disch-max}} \leq 400 \text{ A}$ Pulse: 0.1, 2, 10, 18 s SOC: 80, 65, 50, 35, 20% -18, 0, RT, 40 °C	$I_{\text{disch-max}} \leq 400 \text{ A}$ Pulse: 2, 10, 18 s SOC: 80, 65, 50, 35, 20% -10, 0, RT, 40 °C
Self discharge with out load		48, 168, 720 h SOC: 100% RT, 40 °C	(1) SOC: 100% 20 °C 28 day (672h) (2) SOC: 100% 55 °C 7 day (168h)	24, 168, 720 h SOC: 80% RT, 40 °C	1, 6, 24, 48, 168 h; SOC: 70% 0, RT, 40 °C
Self discharge during Storage	N.A.	N.A.	SOC: 100% 20 °C 90 day (2160 h)	N.A.	N.A.
Efficiency	SOC: 100 - 0%	Fast charge efficiency: Charge: 1C, 2C, $I_{\text{max}}$ 0 °C, RT	N.A.	Profile: Disch: 20C, 10 s + Rest: 40 s + Charge: 20 C, 10 s 0, RT, 40 °C SOC: 35, 50, 65%	Discharge: 1C, 10C, 20C -25, RT, 40 °C

## Current Status of the Guide: Draft 1 summary and review



### 5. Next steps: **Battery recycling and reuse (outside WP.29 scope)**

1. It is recommended is that **resources be allocated to evaluate** the value of developing manufacturing-for-recyclability battery requirements.
  - Global battery recycling requirements are largely non-existent, but given the diversity of global recycling practices and attitudes, pursuit of a GTR is **not** recommended at this time.
  
2. **A study to look at issues surrounding battery reuse post-mobility** (i.e. durability behavior of batteries at to understand battery characteristics below the mobility-feasible threshold)
  - The challenge here is in ensuring consistent performance from used battery packs that have been subjected to a variety of duty cycles and driving behaviors during their mobility life. A GTR is **not** recommended at this time.
  - The findings of such a study could then be considered in developing requirements for re-use.

## Review of submitted comments:





## Discussion Questions:

- Under Next Steps, should recommendations be defined as “overall future work” and “for future work under GRPE/WP.29” ?
- Additional recommendations?



## Agenda item 5b-

### Next steps in EVE IWG roadmap: Guide development

- Comments on the Guide can be submitted to [Erin.Marchington@ec.gc.ca](mailto:Erin.Marchington@ec.gc.ca) until **October 25, 2013**
- The Guide will be revised (draft 2) and submitted as an informal document to GRPE by **Dec.1, 2013** for discussion and comments at the Jan 2014 GRPE
- EVE #8 – Geneva, 2:30-5:30 p.m., January 7, 2014 GRPE- accept comments on Guide
- EVE #9 – To be decided, February 2014- revise Guide based on GRPE comments and finalize (draft 3)
- The Guide will be revised (draft 3) and submitted as an formal document to GRPE by **March 1, 2013** for anticipated approval at the June 2014 GRPE
- EVE #10 – Geneva, June 2014 GRPE- wrap-up meeting
- Seek final approval of the Guide at Nov. 2014 WP.29 following GRPE concurrence

# Agenda item 5b- Next steps in EVE IWG roadmap: Future meetings, other tasks



Updated EVE Roadmap - October 2013



Task	start date	end date	status	EVE-01	--	EVE-02	EVE-03	--	EVE-04	--	EVE-05	EVE-06	--	EVE-07	--	EVE-08	EVE-09	--	EVE-10	--	--		
				Jun-12 GRPE	Jun-12 WP.29	Sep-12 USA	Nov-12 Webex	Nov-12 WP.29	Jan-13 GRPE	Mar-13 WP.29	Apr-13 Japan	Jun-13 GRPE	Jun-13 WP.29	Oct-13 China	Nov-13 WP.29	Jan-14 GRPE	Feb-14 TBD	Mar-14 WP.29	Jun-14 GRPE	Jun-14 WP.29	Nov-14 WP.29		
<b>1.0 Adopt EVE Terms of Reference</b>	Jun-12	Sep-12	completed	←																			
1.1 Submit to GRPE			completed						✓														
1.2 Submit to WP.29 (expect: June 2013)													✓										
<b>2.0 Exchange of information (regulatory frameworks, other IWG, etc....)</b>				←																			
2.1 Research and information sharing	Jun-12		on-going	←																			
2.2 Discuss potential research gaps and agree on test plan	Apr-13	Oct-13	started																				
2.3 Conduct research/test plan	Oct-13	Jun-14																					
<b>3.0 Reference Guide Development</b>																							
3.1 Establish list of vehicle attributes	Nov-12	Jan-13	completed																				
3.2 Develop questionnaire	Nov-12	Jan-13	completed																				
3.3 Send questionnaire to EVE members (after EVE-04)	Feb-13	--	completed																				
3.4 EVE & GRPE members fill-in questionnaire	Feb-13	Apr-13	completed																				
3.5 Compile information into report	Apr-13	Dec-13	started																				
3.6 Develop recommendations on potential future gtr development	Apr-13	Dec-13																					
3.7 Circulate 1st draft Reference Guide to EVE for comments	--	Sept. 30																					
3.8 Revise Draft Reference Guide based on EVE comments	Oct-13	Dec. 1																					
3.9 Submit 2nd draft to GRPE for comments (submit a few weeks before)	--	Dec. 1																					
4.0 Revise Draft Reference Guide based on GRPE comments	Jan-14	March. 1																					
4.1 Submit 3rd draft Reference Guide to GRPE (submit >12 weeks before)	--	March. 1																					
4.2 Approval of Reference Guide by GRPE	--	Jun-14																					
4.3 Submit Reference Guide to WP.29 (submit >12 weeks before, Secretariat's d	--	Aug. 1																					
4.4 Approval of Reference Guide by WP.29	--	Nov-14																					
-- Current EVE mandate ends (summary report of activities)																							

prepared by: EVE Secretary, October 2013



## **Agenda item 5c- Discuss potential extension of EVE mandate**

- Current EVE mandate until November 2014
- Guide will be approved at the WP.29 session in November 2014
- Work effectively completed upon submission of the Guide to the GRPE on March 1, 2014 for formal approval at the June 2014 GRPE session
- The last EVE meeting (EVE-10) is currently scheduled for June 2014 in Geneva

### **Consider:**

- Guide recommendations, potential for gtr development
- Upcoming GRPE sessions: Jan 2014, June 2014
- Upcoming WP.29 sessions: Nov 2013, March 2014, June 2014, Nov 2014

### **Proposed Process:**

- Informally discuss option to extend mandate at GRPE in January 2014
- If agreed by EVE at GRPE, EVE mandate extension proposal could be submitted concurrent with reference guide at GRPE session of June 2014
- The GRPE Chair would then report to WP.29 about the GRPE agreement to extend the mandate concurrent with submission of report in November 2014