Additional input on V2X virtual mileage

For discussion at 50th EVE IWG

23 June 2021

Presented by USA

Selected proposal (EVE 50 Day 1)

Option	Steps	Remarks
US Informal discussion	• $\boldsymbol{Virtual\ km} = \left(\frac{\text{total discharge energy in V2X mode } [Wh]}{\text{certified energy consumption [Wh/km]}}\right)$ • Include vehicle in Part B • Vehicle km for Part B = Odometer km + ***Virtual km***	• Converts V2X usage to virtual mileage • Other energy usage while parked considered to be normal usage (e.g. BMS activity or battery thermal control, cabin preconditioning) • Requires one counter
OICA(a)* EVE47-05e and as shown at EVE 48	• $\boldsymbol{Virtual\ km} = \text{Odometer km} \times \left(\frac{\text{total discharge energy } [Wh]}{\text{total discharge energy while driving [Wh]}}\right)$ • Exclude vehicle from Part B if ***Virtual km*** exceeds Odometer km by [x] thousand km	• Counts all energy usage while parked toward a virtual mileage allowance • Requires two counters
OICA(b) EVE46-10e and EVE46-10-Rev1e	• $\boldsymbol{Expected\ discharge\ energy}\ [\boldsymbol{Wh}] = \text{certified energy consumption } \left[\frac{\text{Wh}}{\text{km}}\right] \times [100\text{K or } 160\text{K km}]$ • Exclude vehicle from Part B if total discharge energy [Wh] exceeds [1XX%] of ***Expected discharge energy***	• Counts all energy usage while parked, and extreme use cases (frequent towing, energy demand for autonomous driving, etc) toward an excess energy allowance • Requires one counter

Open issues

- Clear definition of V2X usage
  - Japan to propose concrete text at EVE 51
  - Additional discussion is offered here
- Appropriate denominator for virtual mileage formula
  - Several options for energy consumption (EC) in denominator
  - Implications on stringency
  - Availability of the selected quantity on the vehicle

Definition of V2X usage

- Varieties:
  - V2L = vehicle to load (discharge) – irregular, episodic [e.g. power tools at work sites]
  - V2G = vehicle to grid (discharge + recharge) – daily, frequent, shallow
  - V2H = vehicle to home
    - Power outages (discharge) – irregular, episodic
    - Solar/supplementary grid (daily discharge + charge activity) [e.g. solar energy storage buffer]
- Questions:
  - Should all of these varieties be included in V2X definition?
  - How specific must the text of the GTR be?
  - Is it possible and practical for the vehicle ECU to recognize and quantify all forms of V2X usage?
  - Can onboard record of V2X usage be verified?

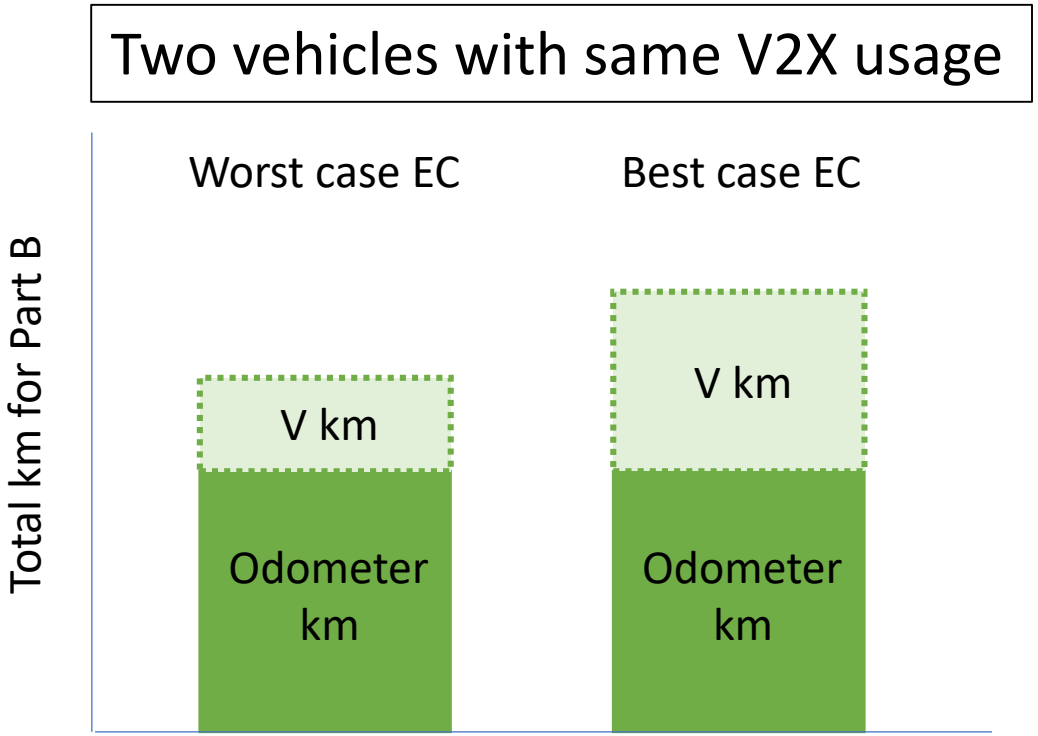
Denominator for virtual mileage formula

- $$\boldsymbol{Virtual\ km} = \left(\frac{\text{total discharge energy in V2X mode } [Wh]}{\text{"appropriate measure" of energy consumption } [\text{Wh/km}]}\right)$$

- Larger EC = fewer virtual km allowed = more stringent

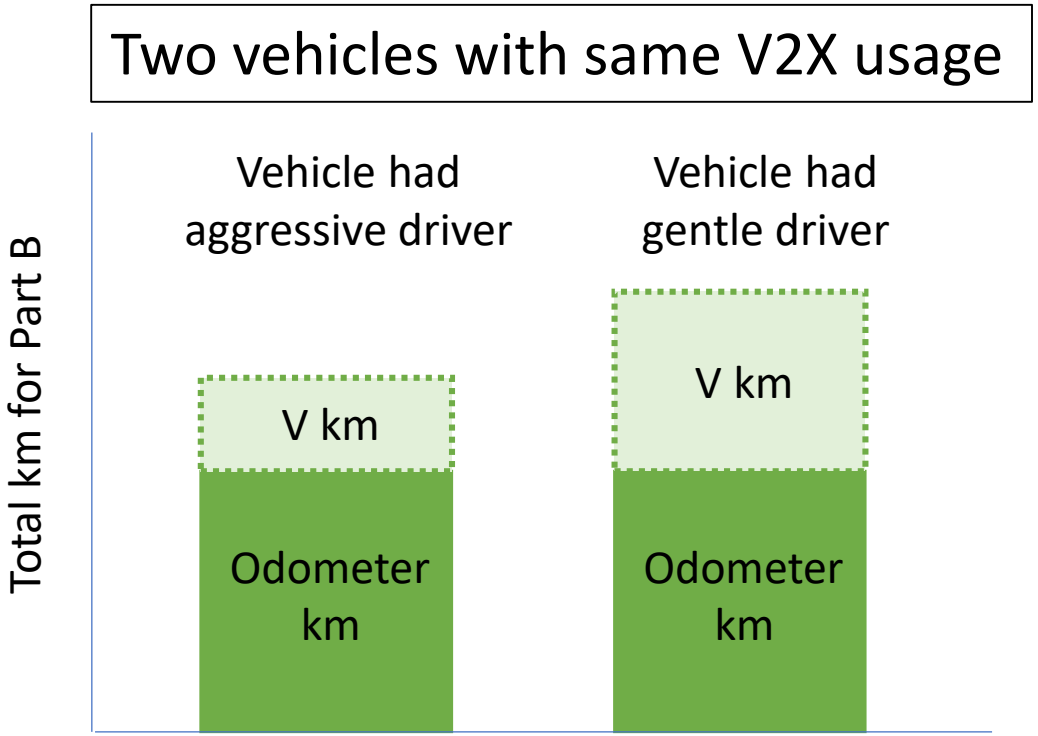
- Possible options for denominator:
  - Predetermined fixed value:
    - The certified/declared EC of the subject vehicle
    - The highest certified/declared EC of the available configurations of the subject vehicle model
    - The highest certified/declared EC within the subject vehicle's Part B family
    - A figure determined by the OEM to best represent equivalent degradation rate of V2X
  - Onboard value, collected over lifetime of vehicle:
    - The individual vehicle's actual energy consumption per km driven

Implications of using a fixed EC value in denominator



- Higher EC value ("worst case" EC) results in less virtual km
- Favors greater stringency
- This may be particularly appropriate if V2X usage is "easier" on battery life than normal driving

Implications of using an onboard “actual” EC in denominator



- Vehicle with gentle driver is credited with more V2X miles than vehicle with aggressive driver, even though V2X likely had the same effect on both vehicles
- Gently used vehicle already is likely to experience the least “driving” degradation, and now it gets the most allowance for V2G usage too

Other practical considerations

- If an onboard value is used, the manufacturer must collect and maintain the data, and it must be verifiable
- If a fixed value is used, the value must be established at time of production so the vehicle can “know” the value
- Can the fixed value be determined unambiguously?
  - Ideally, it would be a published certification value for the subject vehicle
  - However, declared EC value may be based on a different vehicle in the family
  - EC of specific vehicle configurations might not be available as a predetermined value