

Japan Position on Shorten Test Procedure (STP) for PEV

7th WLTP E-Lab. SG Meeting

9~11 MAR. 2015

Brussels, Belgium

Prepared by JAPAN

1. Why STP is necessary ?

Increase battery capability

Increase varieties of testing

(Auxiliary devices, low temp.,
MAC and so on)

Increase sales models

New feature of test data handling

→ **Increase testing burden**

i.e. Tesla Model S

It takes approximately 47hours within 5 days
to obtain City, L~H and L~exH phases

Data handling : indexes/normalization,,,

**WLTP should NOT be barrier for advanced technologies
and should be flexible for new features of test procedure.**

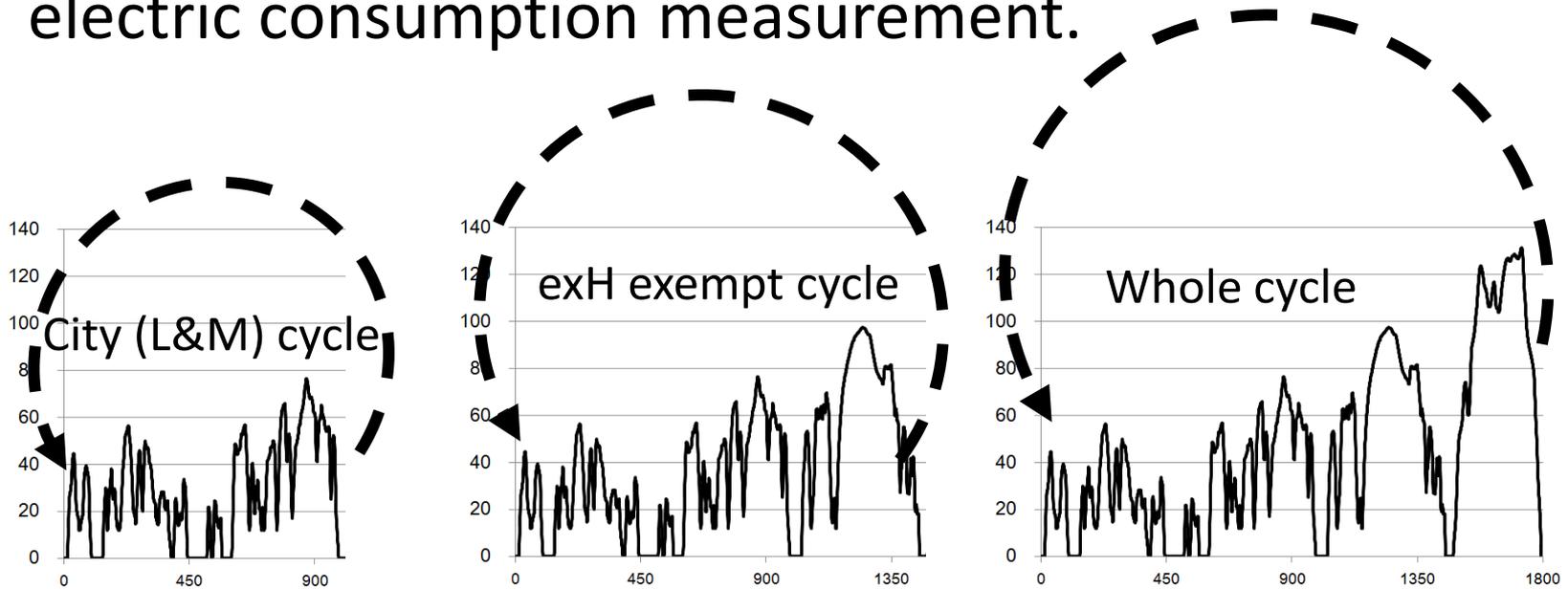
<reference>

US : already adopted, manufacture use STP without pre-approval by EPA

JPN : will be adopted on 26th March 2015, then can be used from April

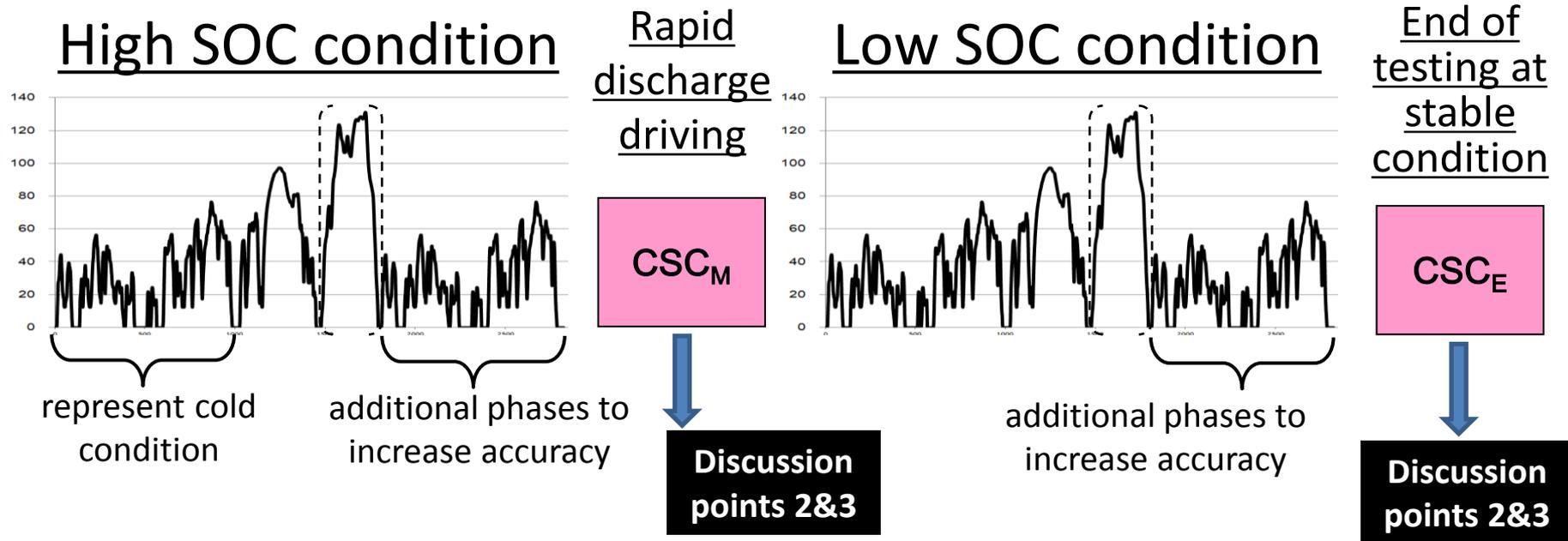
2. Concept of STP (1)

Current gtr requires multiple tests for range and electric consumption measurement.



Repeat until end of test criteria has reached

2. Concept of STP (2)



Measure energy consumption per phase, CSC_M and CSC_E .
 Then calculate “Usable Battery Energy (UBE)”

$$AER_{@phase(s)*} = \text{Distance}_{@phase(s)} \times \frac{UBE}{\text{Energy Consumption}_{@phase(s)}}$$

*) phase(s) : each phase, City, exempt exH and whole cycle

Single test covers obtaining performance value under multiple cycles

3. Features of STP

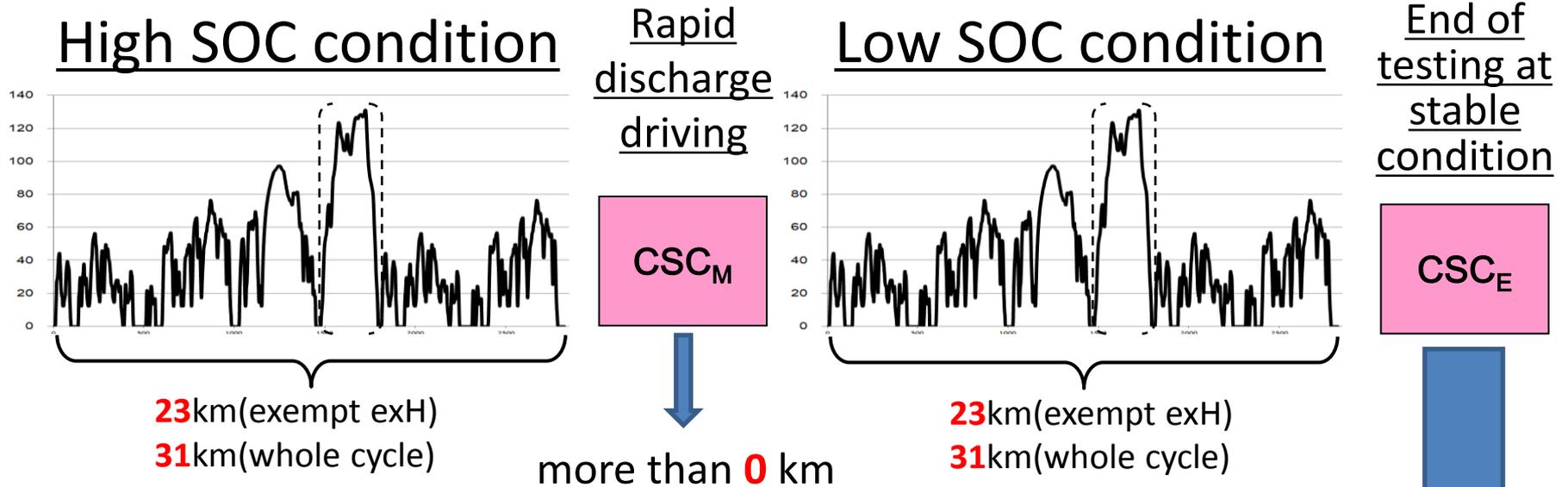
| | | Current | STP |
|---------------------------|---------------------------|--|--|
| 1. Accuracy | | △ final SOC is up to end of test unstable driving index/driver exhaustion/different drivers/driver break due to long test duration | ○ final SOC is stable better driving index/less driver exhaustion/a few break due to limited test duration |
| 2. Repeatability | | △ less repeatability due to uncertain factors(see above) | ○ better repeatability due to concentrated test and include multiple phase driving(L/M : 4, H/Ex-H : 2 times) |
| 3. Test duration | Each phase (L/M/H/exH) | ○ obtain from calculation (no test is required) | ○ single test covers all requirement (each phase range, combined phase range –L+M, L+M+H, L+M+H+Ex-H) (Tesla model S : approx. 3.5hours) |
| | L+M | × additional test is required (Tesla model S : approx. 25.0hours) | |
| | L+M+H | × additional test is required (Tesla model S : approx. 16.0hours) | |
| | L+M+H+Ex-H | △ Test (Tesla model S : approx. 5.5hours) | |
| 4-1. Combined approach | | △ no linear correlation between range and cycle energy | ○ easy to apply, linear correlation between UBE and cycle energy |
| 4-2. Normalization | | × not available | ○ easy to apply, UBE method is kind of normalization |

4. Japan position on Discussion points

| Discussion points | | US SAE J1634 | JPN TRIAS(Draft) | JAPAN Positions @ WLTP | |
|-------------------|-----------------------|--|---|---|---|
| | | | | exH exempt cycle | whole cycle |
| 1 | Minimum Range for STP | >60 mile | >approximately 70 km $= (JC08 \times 4) \times 2 + 5 \text{ km}$ $= 70.4$ | >55 km $(L/M/H/L/M \times 2) \times 2 + 5 \text{ km}$ $= 50.7$ | >70 km $(L/M/H/exH/L/M) \times 2 + 5 \text{ km}$ $= 67.2$ |
| 2 | CSC speed | 55mph | 81.6km/h | 80km/h | 100km/h |
| 3 | CSC Duration | CSC _E :20% or less than travel distance | CSC _E = 5km or 10% of total CSC CSC _M = total CSC - CSC _E | CSC _E = 5 ~ 15 km CSC _M = rest of phase driving and CSC _E | |
| 4 | Battery load at CSC | No description in the paper | N.A. | Discharge capacity doesn't rely on voltage and current (a few impact on UBE measurement under the different constant speed) | |
| 5 | Acceptable error | — | — | Data provided by ACEA and JAMA indicates that STP has good correlation with current test procedure. | |

5. Minimum Range for STP applicability

Exempt exH cycle : **no less than 55 km**
Whole cycle : **no less than 70km**



Two Requirements

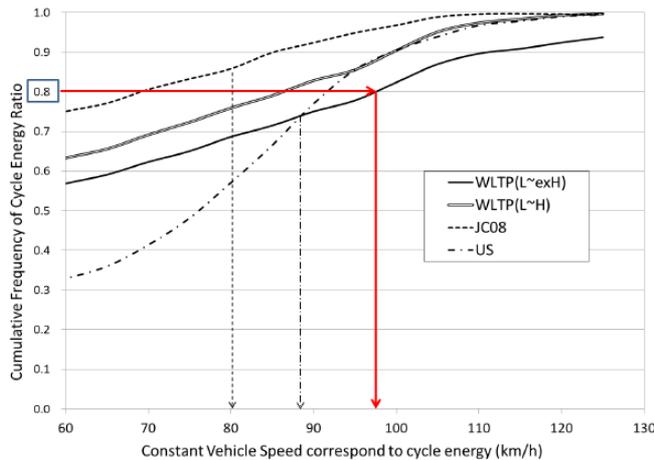
1. Test completion under the stable condition (**5km**~)
2. Represent Low SOC condition (~**15km**)

6. CSC speed

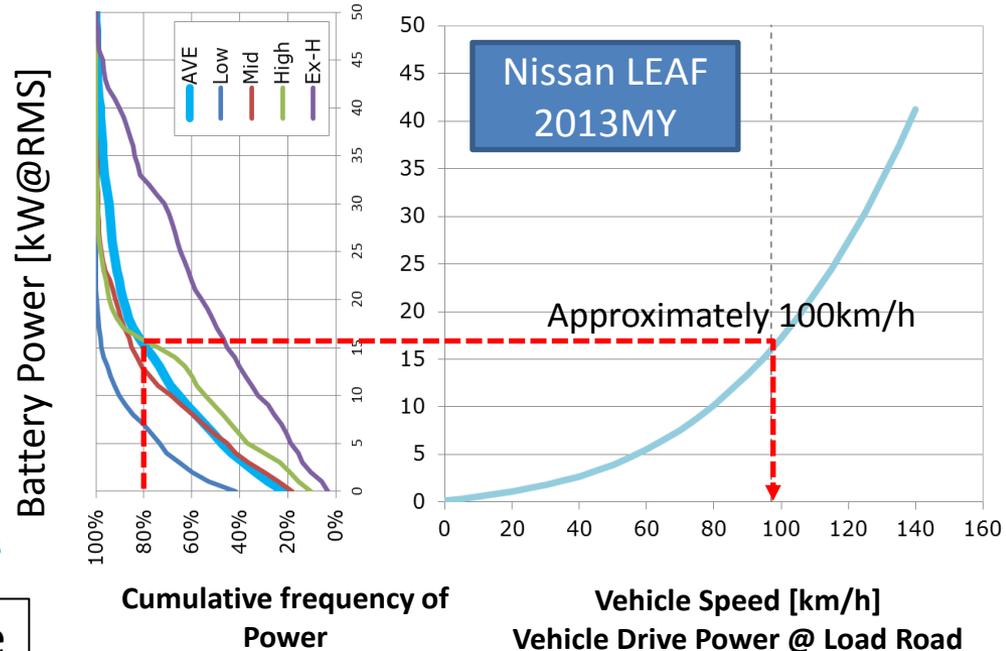
Exempt exH cycle : **80km/h**
 Whole cycle : **100km/h**

↙ correspond to approximately 80% of cycle energy
 ||
 satisfy “rapid discharge” and “representativeness”

CSC defined in SAE and possible TRIASE is set @ approximately 80% of cycle energy point.



Slide_6



WLTP-SG-EV-06-10 Shorten test procedure

6. CSC speed (alternative)

Possible alternative CSC speed

1. Manufacture recommended speed

2. $CSC_M : CSC_E - 10, CSC_E, CSC_E + 10$ km/h

$CSC_E : 100$ for whole cycle, 80 for exempt exH

3. $CSC_M : 2^{nd}/3^{rd}/4^{th}$ highest reference speed

$CSC_E : 3^{rd}$ highest reference speed

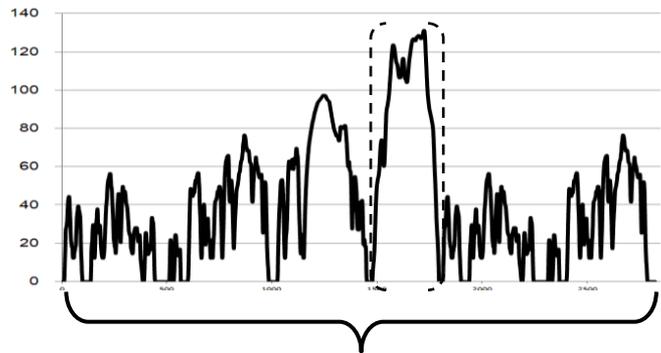
4. others

7. CSC Duration

CSC_E : **5 ~ 15 km**

CSC_M : rest

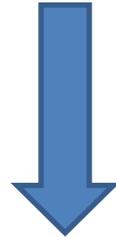
High SOC condition



23km(exempt exH)
31km(whole cycle)

Rapid discharge driving

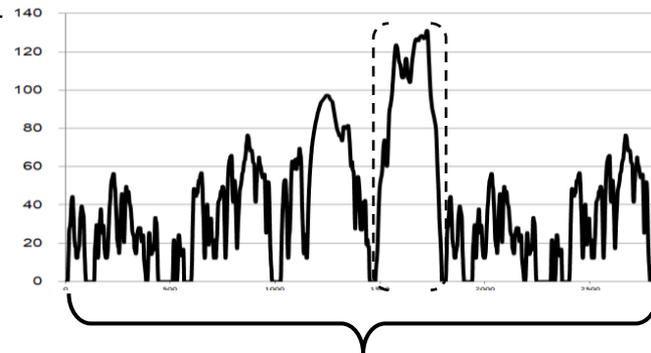
CSC_M



No specific requirement

Total range – Cycle Driving – CSC_E
In case of multiple speeds,
set same distance @ each speed.

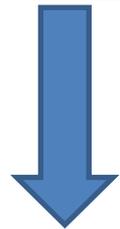
Low SOC condition



23km(exempt exH)
31km(whole cycle)

End of testing at stable condition

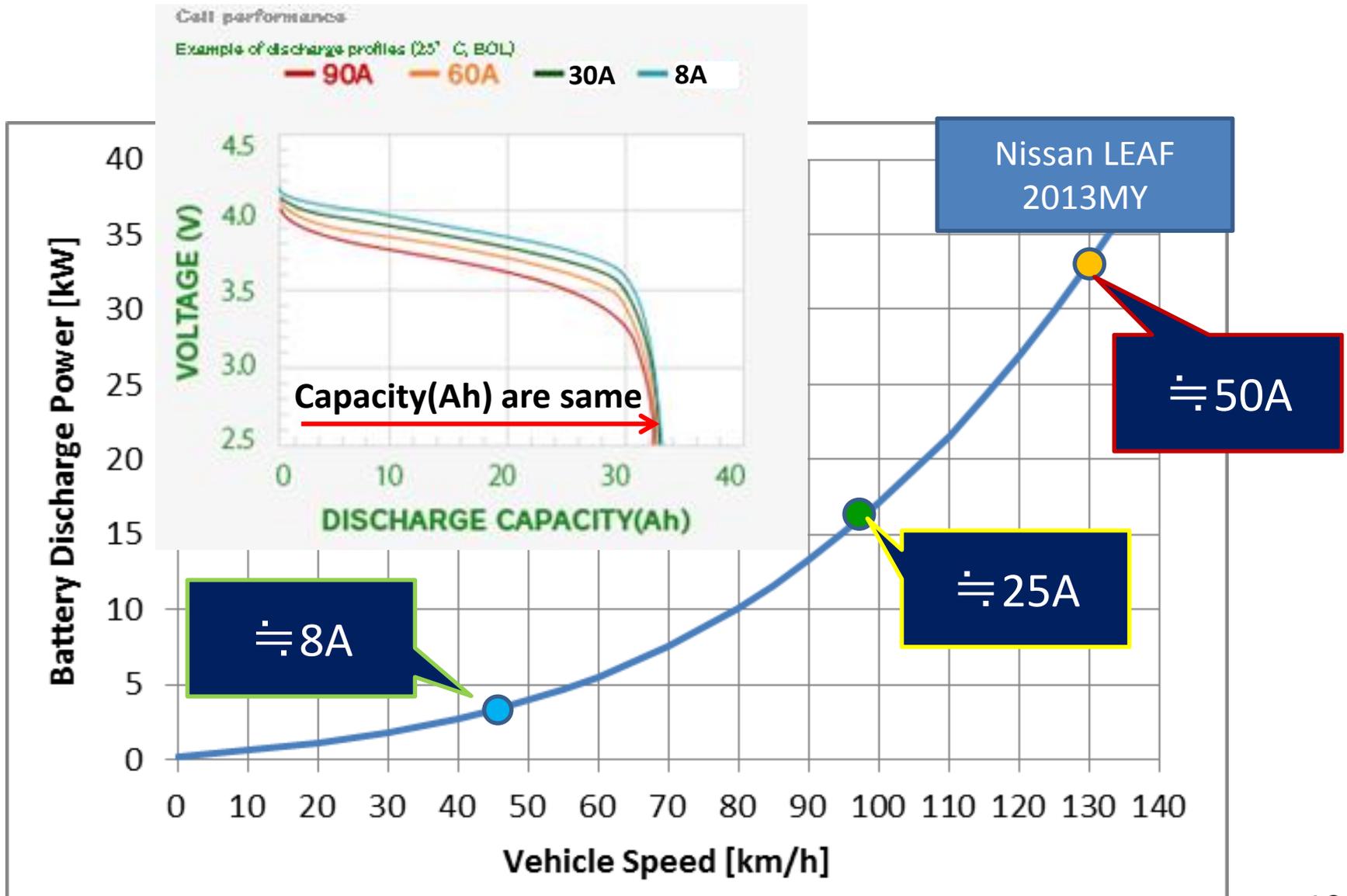
CSC_E



Two Requirements

1. Test completion under the stable condition (**5km**~)
2. Represent Low SOC condition (~**15km**)

8. Battery load at CSC



9. Acceptable Error

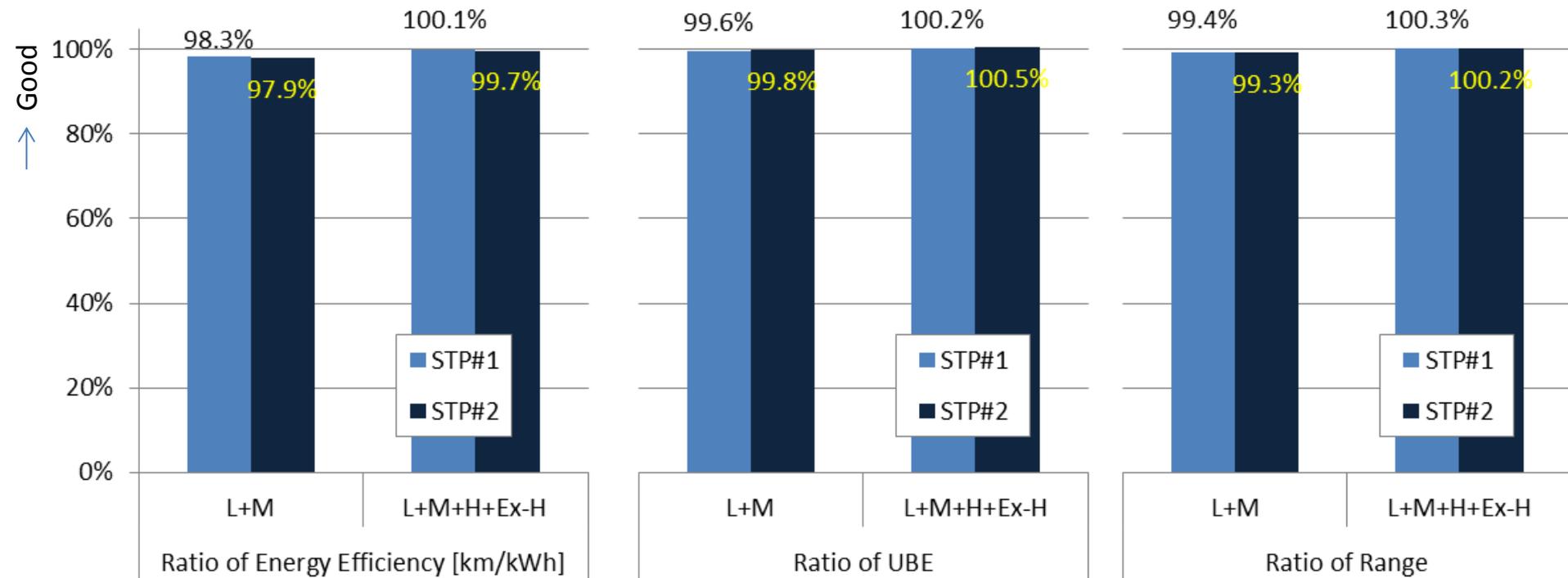
**Previous study indicates that
Shorten Test Procedure works well for WLTP**

(please refer WLTP-DTP-E-Labproc_082
WLTP-DTP-E-LabProc_088
WLTP-SG-EV-04-10
WLTP-SG-EV-06-09rev1)

(ref.) Validation Results_1

Conditions : CSC Speed : $CSC_M = CSC_E = 97\text{km/h}$
CSC_E Duration : 55km
CSC_M Duration : 25km

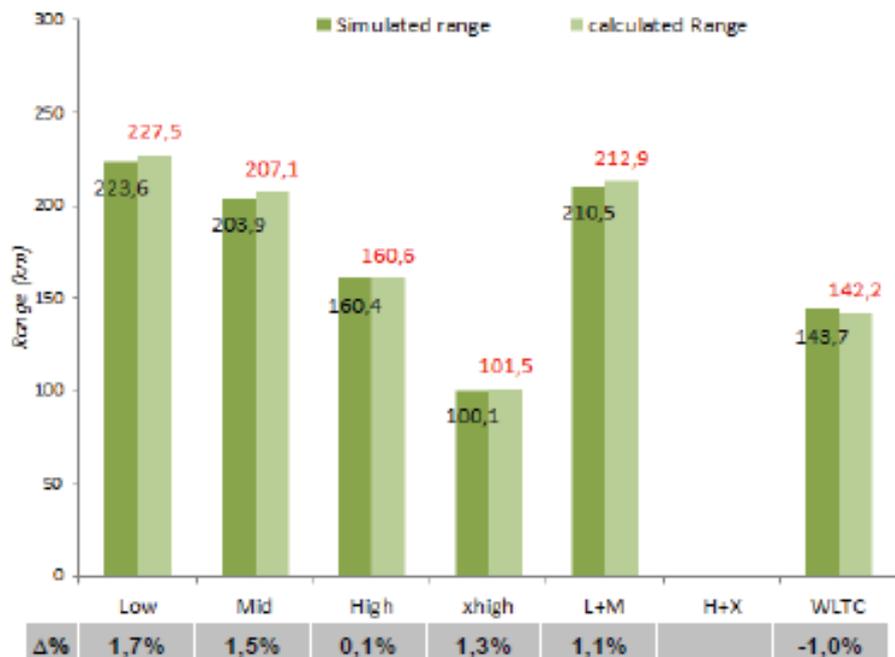
Test vehicle: 2013MY Nissan LEAF



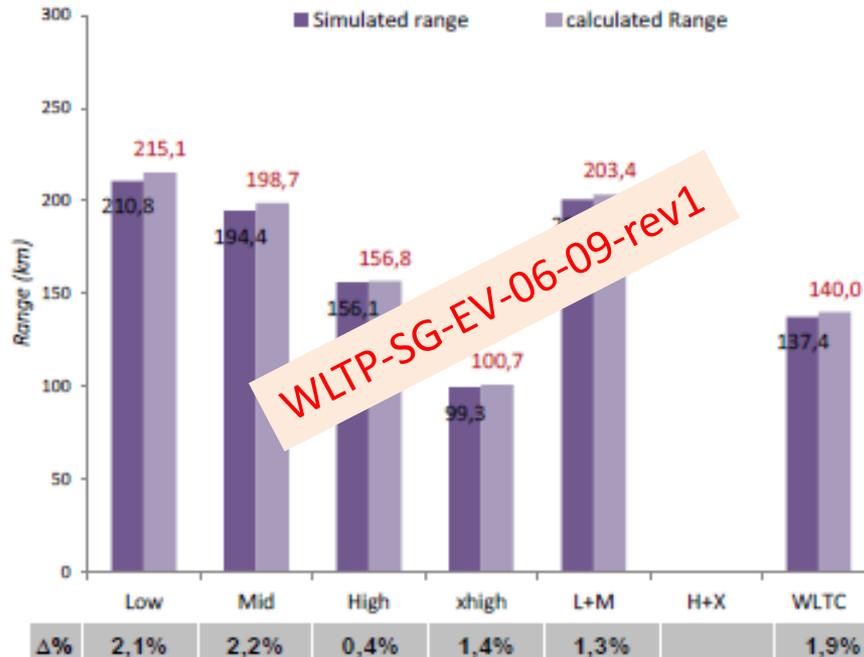
(ref.) Validation Results_2

3 Shortening of test procedure : : Kangoo ZE Simulation results

• Test mass Low: 1722 kg



• Test mass High: 1939 kg

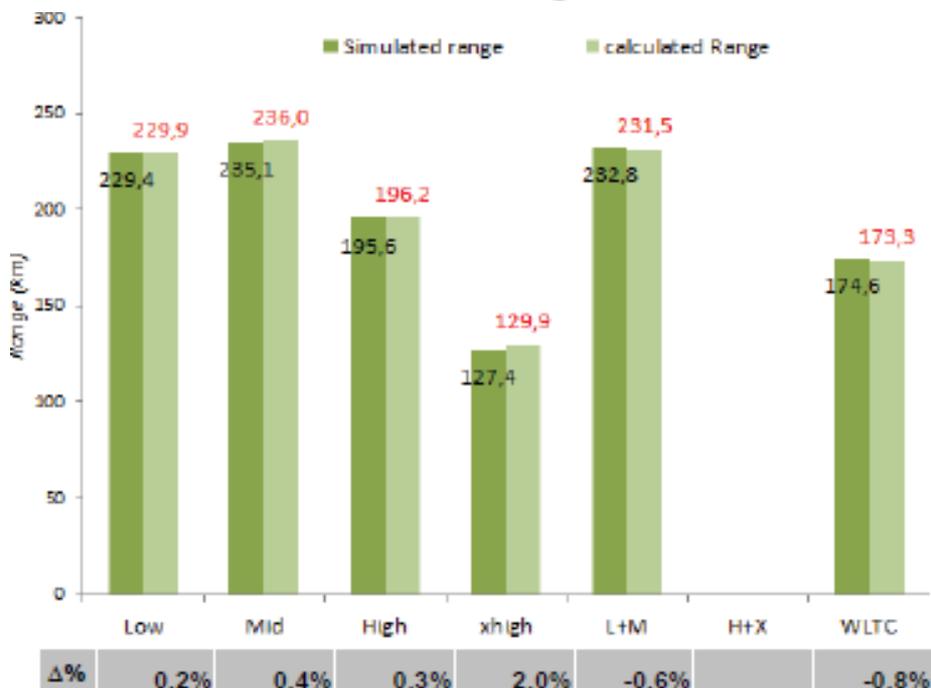


- Test time reduce from 180 minutes to 140 minutes (-22%)
- The 'scaling factor' is not used for 'city cycle range' and 'complete WLTC range' estimation

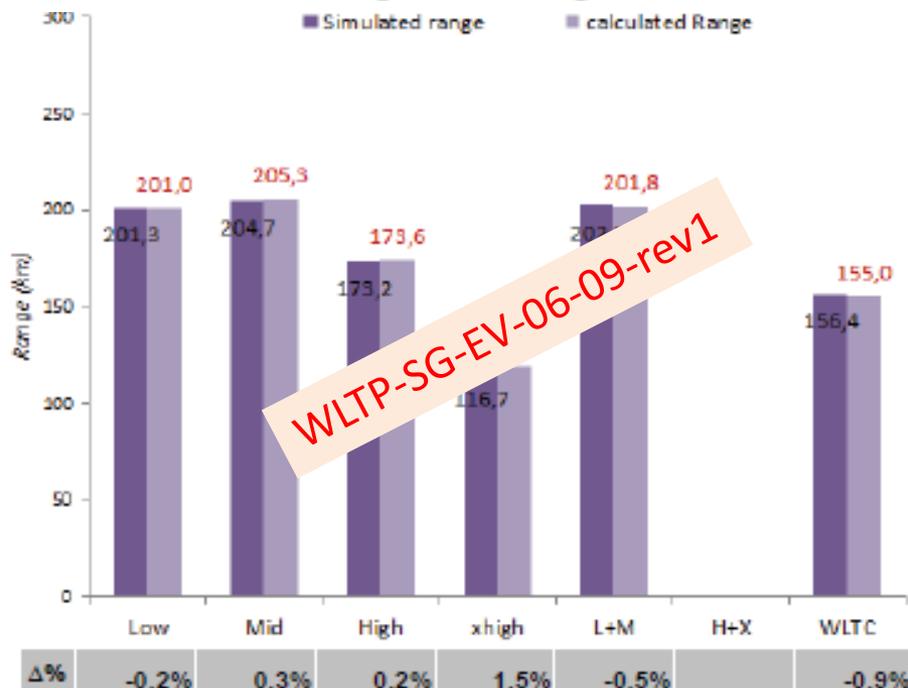
(ref.) Validation Results_3

3 Shortening of test procedure: : Zoe Simulation results

- Test mass Low: 1593 kg



- Test mass High: 1674 kg



- Test time reduce from 230 to 160 min (-31%)
- The 'scaling factor' is not used for 'city cycle range' and 'complete WLTC range' estimation

Conclusion :

**Shorten Test Procedure for PEV
is ready to be adopted
due to its efficiency and accuracy.**