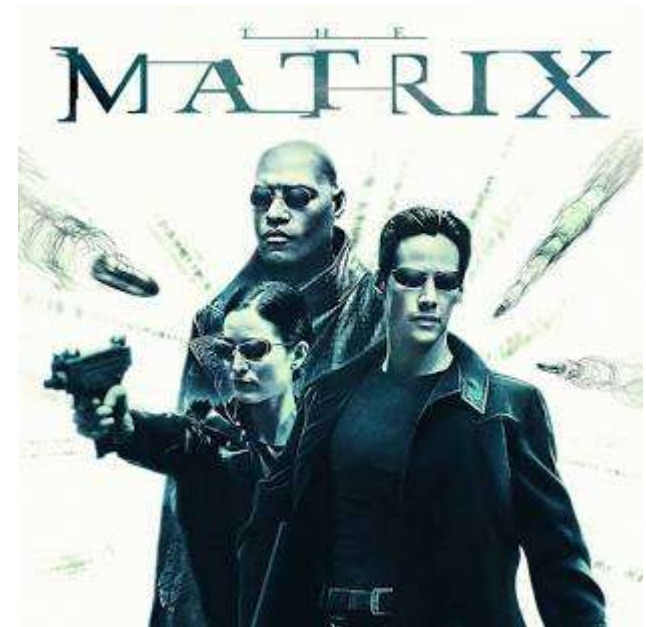




R&D in The Matrix

Dr George Gillespie
ECT-2026



The “Emissions” Matrix

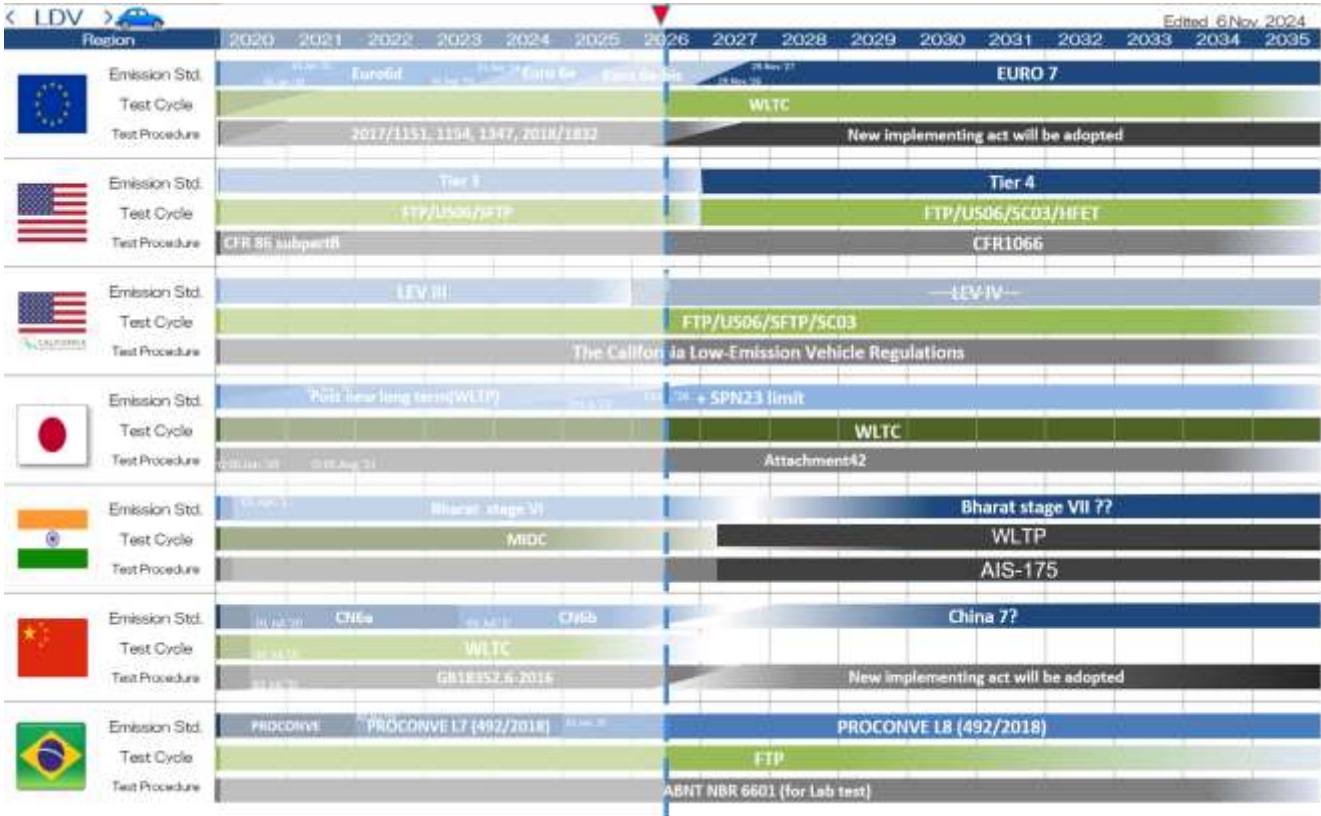
Breadth and complexity of powertrain solutions



The “Emissions” Matrix

Breadth and complexity of powertrain solutions

Breadth and complexity of regulations



The “Emissions” Matrix

Breadth and complexity of powertrain solutions

Breadth and complexity of regulations

Reducing R&D Cycle times

Traditional development cycle

Typical time to launch a new vehicle (ICE / Hybrid)

~ **48**
months



Streamlined development cycle

With modern tools, better collaboration and integrated processes

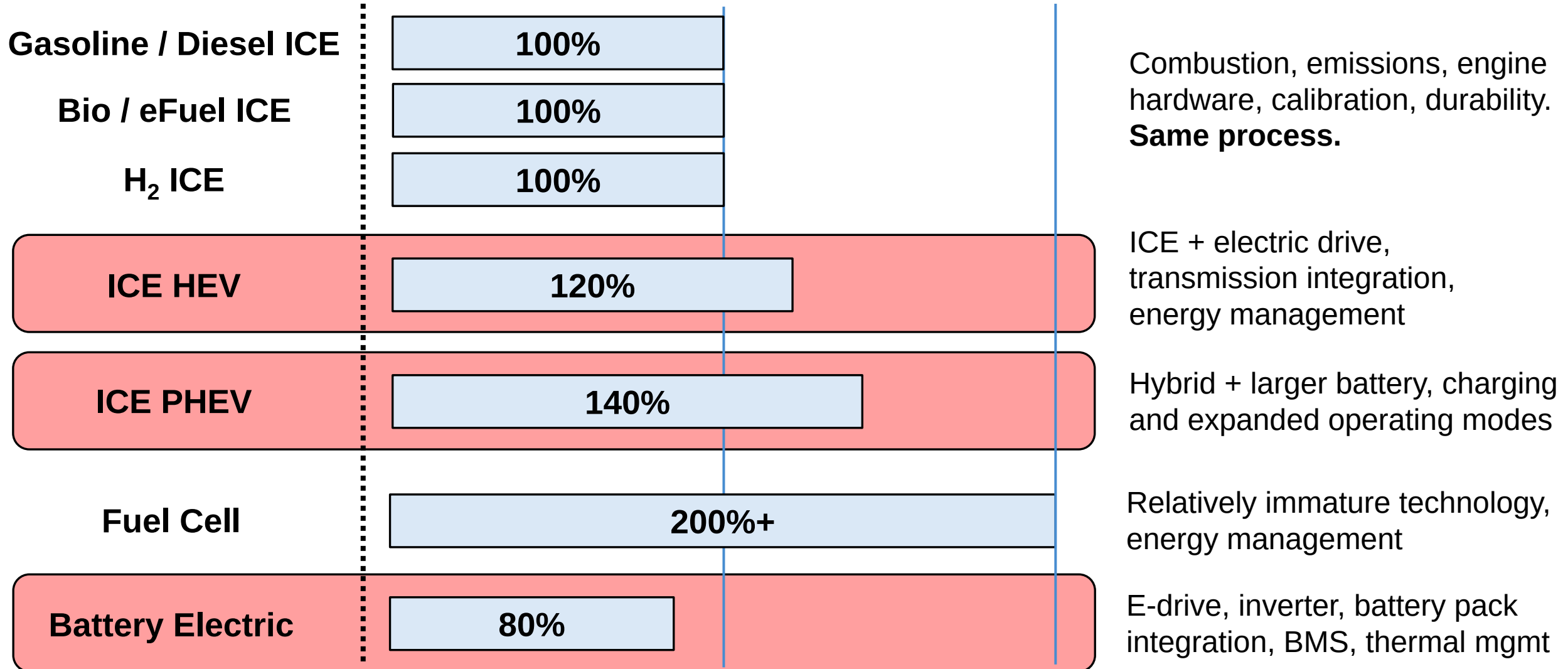
~ **30**
months
↓ **35%**



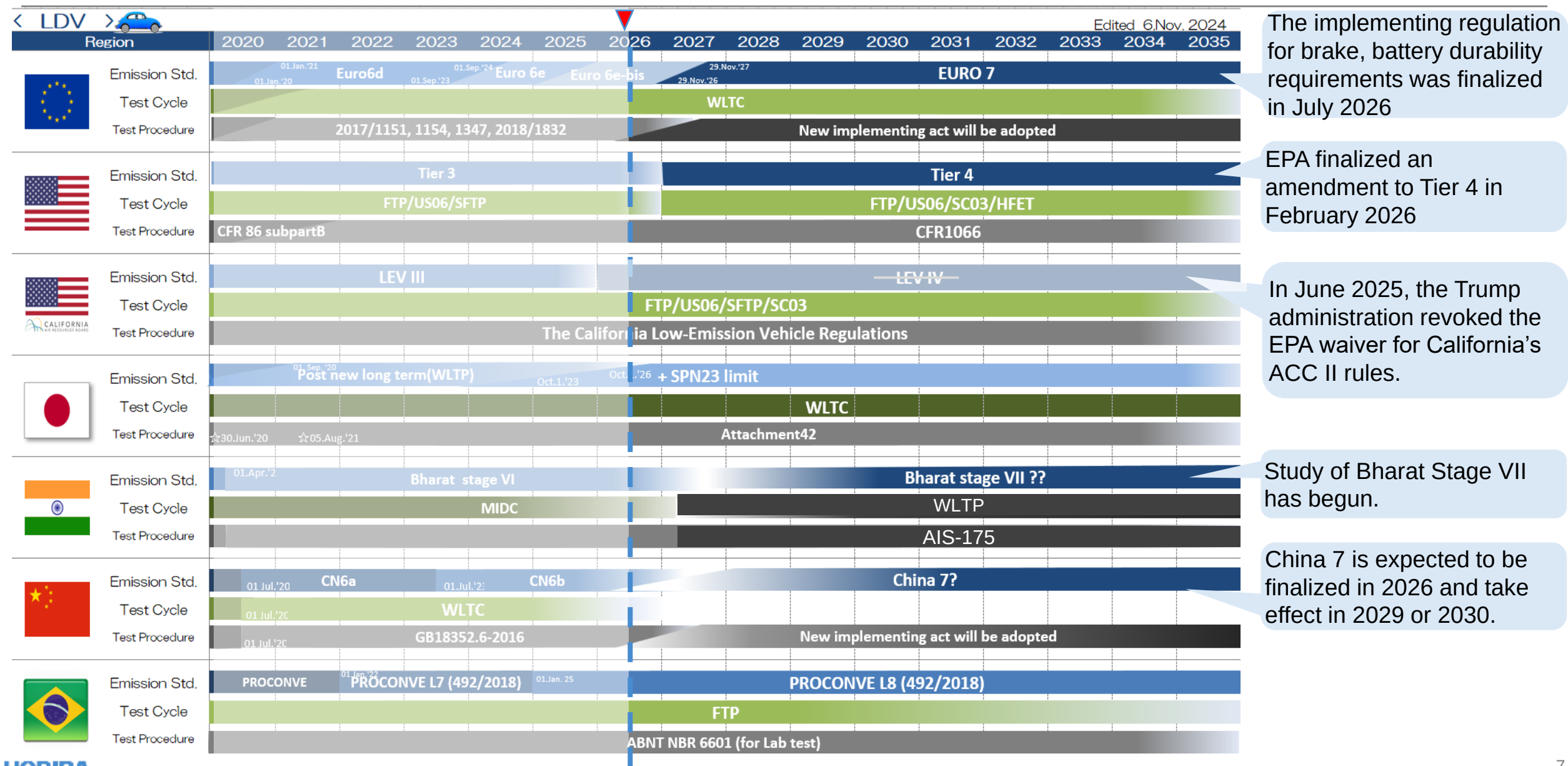
The “Emissions” Matrix



Powertrain Development Relative Effort Index (personal estimate)



Complexity of Light-Duty Vehicle (LDV) Emission Standards



Euro 7 requirements – growing complexity

1

**Laboratory
tailpipe emissions
limits**

2

RDE limits
(Real Driving Emissions)

3

**Low temperature
emission
+ range**

* LDV only

4

OBM (On-Board Monitoring)

- On-board emission monitoring
NOx, NH3* and PM *HD only

5

OBFCM

(On-board fuel/energy consumption meter)

- Real-world fuel/energy
consumption

6

Battery durability

7

Brake dust limits

8

Tyre abrasion limits

New requirements

EU7: A Step Change in Compliance Complexity

- **Key EU7 Changes**

- **Broader scope:** tailpipe, battery durability, brake and tyre emissions
- **Continuous compliance monitoring (OBM)** Longer durability requirements:
 - LD: 200k km / 10 years
 - HD: up to 15 years
- Tighter real-world compliance requirements

Durability and lifetime compliance are among the most consequential EU7 changes, fundamentally increasing development and validation effort.

- **Technical Impact**

- **Light Duty** => PN10, wider GPF adoption, Lambda=1 operation
- **Heavy Duty** => -55% NOx limits, N₂O regulation, increased SCR demands

- **R&D & Calibration Implications**

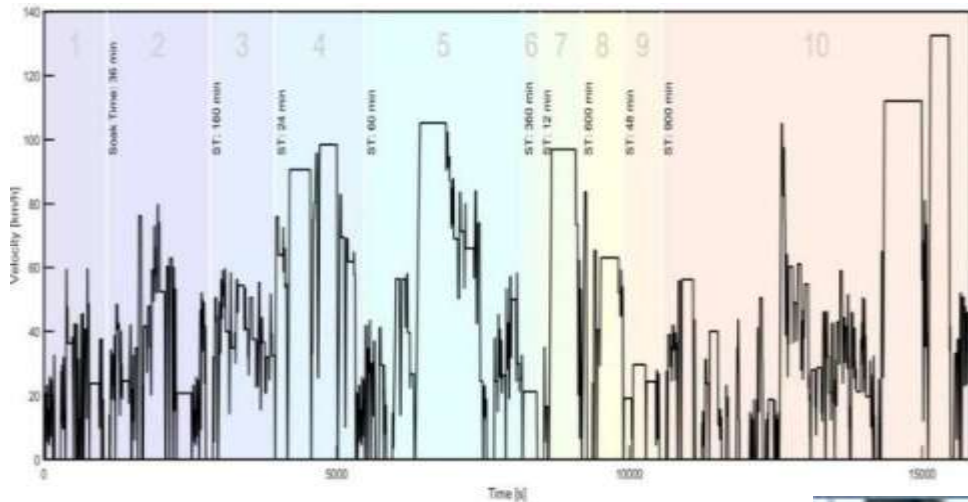
- Higher aftertreatment and sensor requirements
- Increased calibration complexity - combined with hybridisation
- Greater durability & lifetime validation testing
- Increased compliance and warranty risk

Brake Particle Test Methods (UN GTR No.24)

- The brake unit is tested, and PM and PN emissions are measured separately for the front and rear brakes
- After corrections such as the regenerative-braking ratio are applied, total vehicle emissions are calculated.

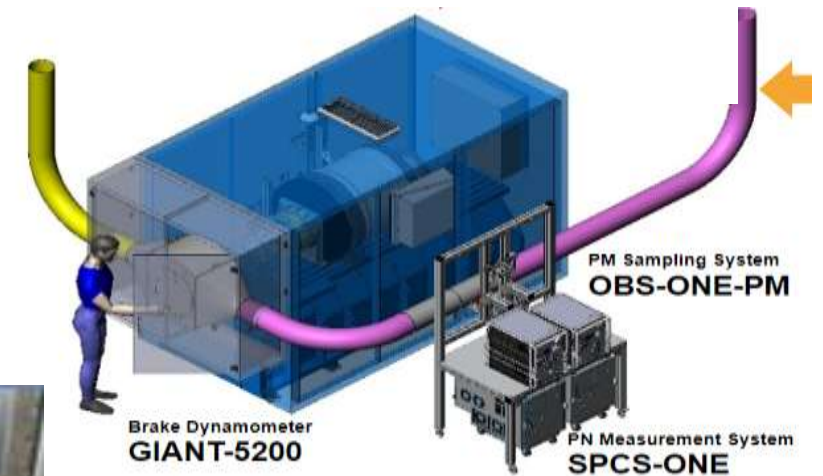
Brake Test Cycle

192 km、More than 4.5 hours

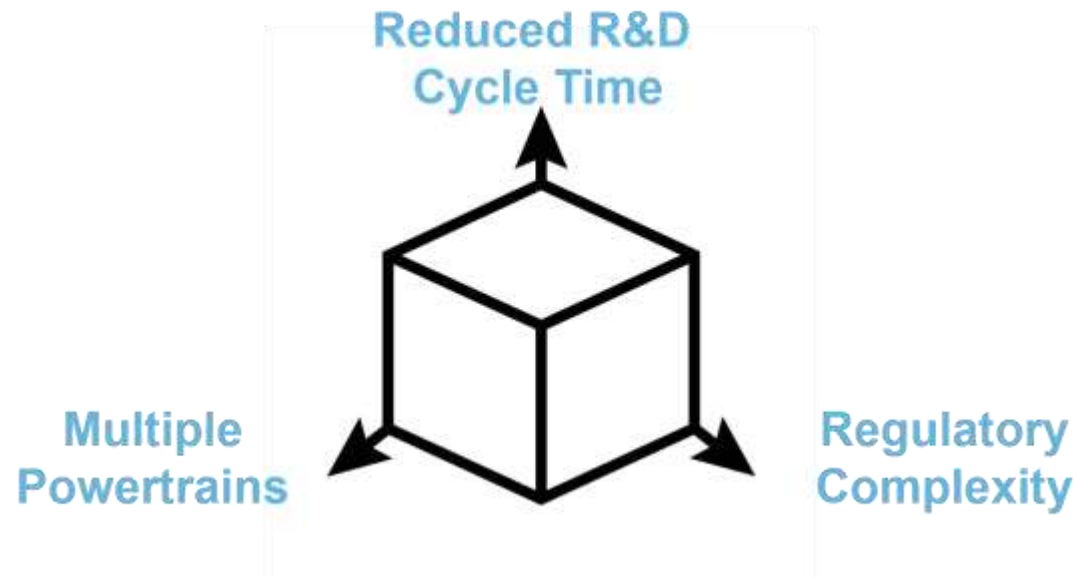


Brake Test System

It consists of a brake dynamometer, cooling air to the brakes, and PM/PN measurement



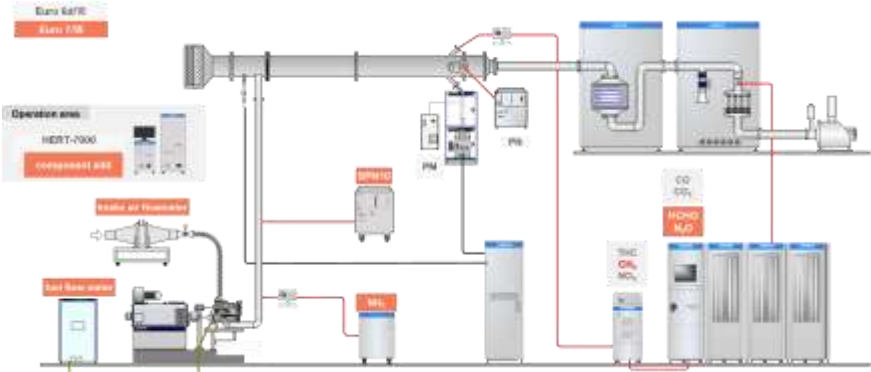
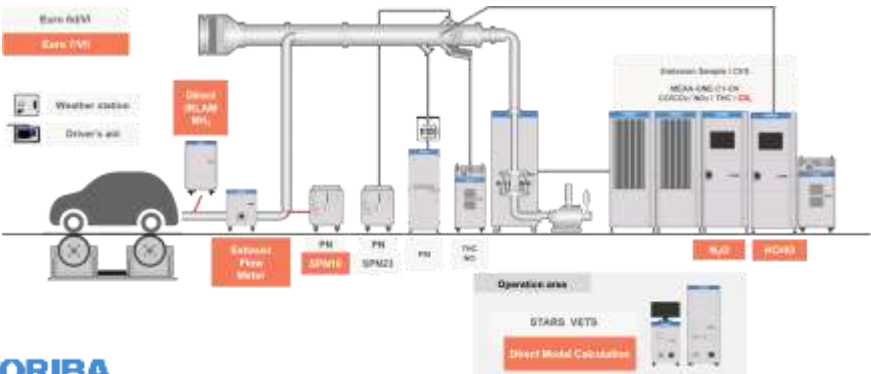
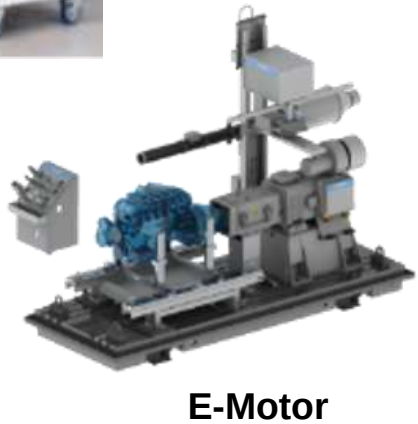
The “Emissions” Matrix



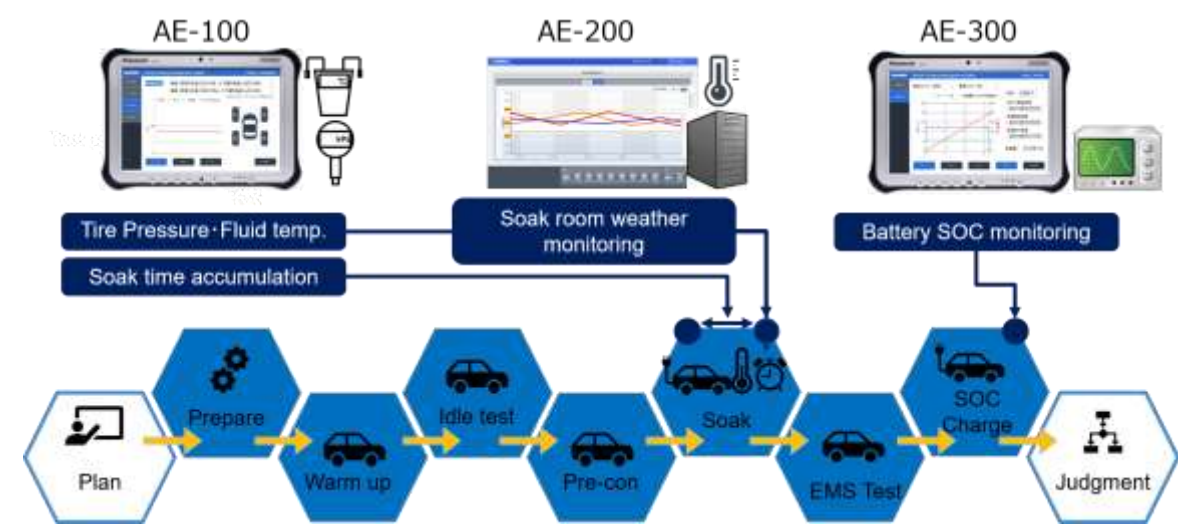
HORIBA – here to support you in **The Matrix**

- => Measurement
- => Integrated Solution Toolsets
- => Integrated R&D Environment

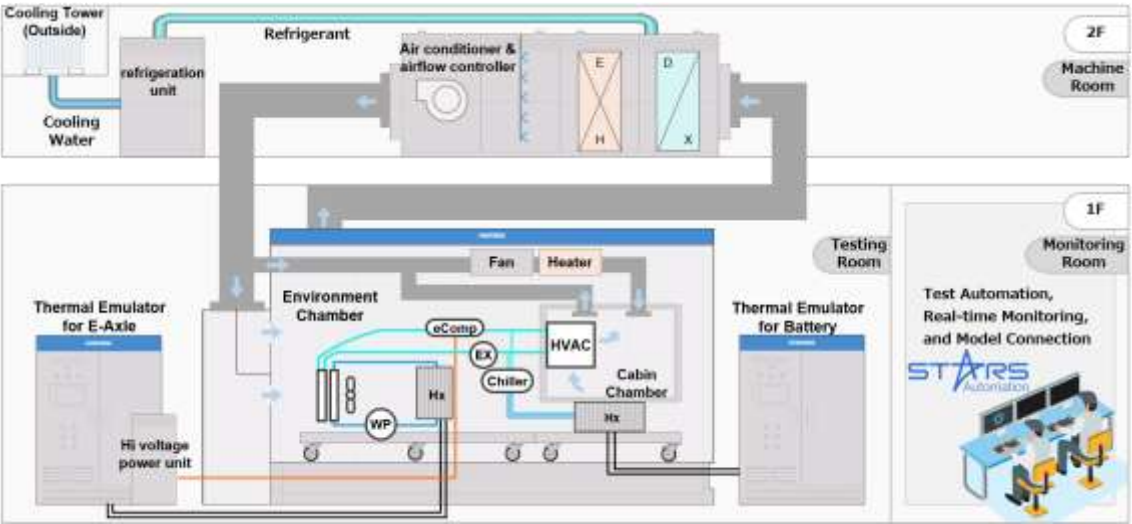
Solving the “Emissions” Matrix – Measurement



Solving the “Emissions” Matrix – Integrated Solution Toolsets



Automated Vehicle Soak & SOC

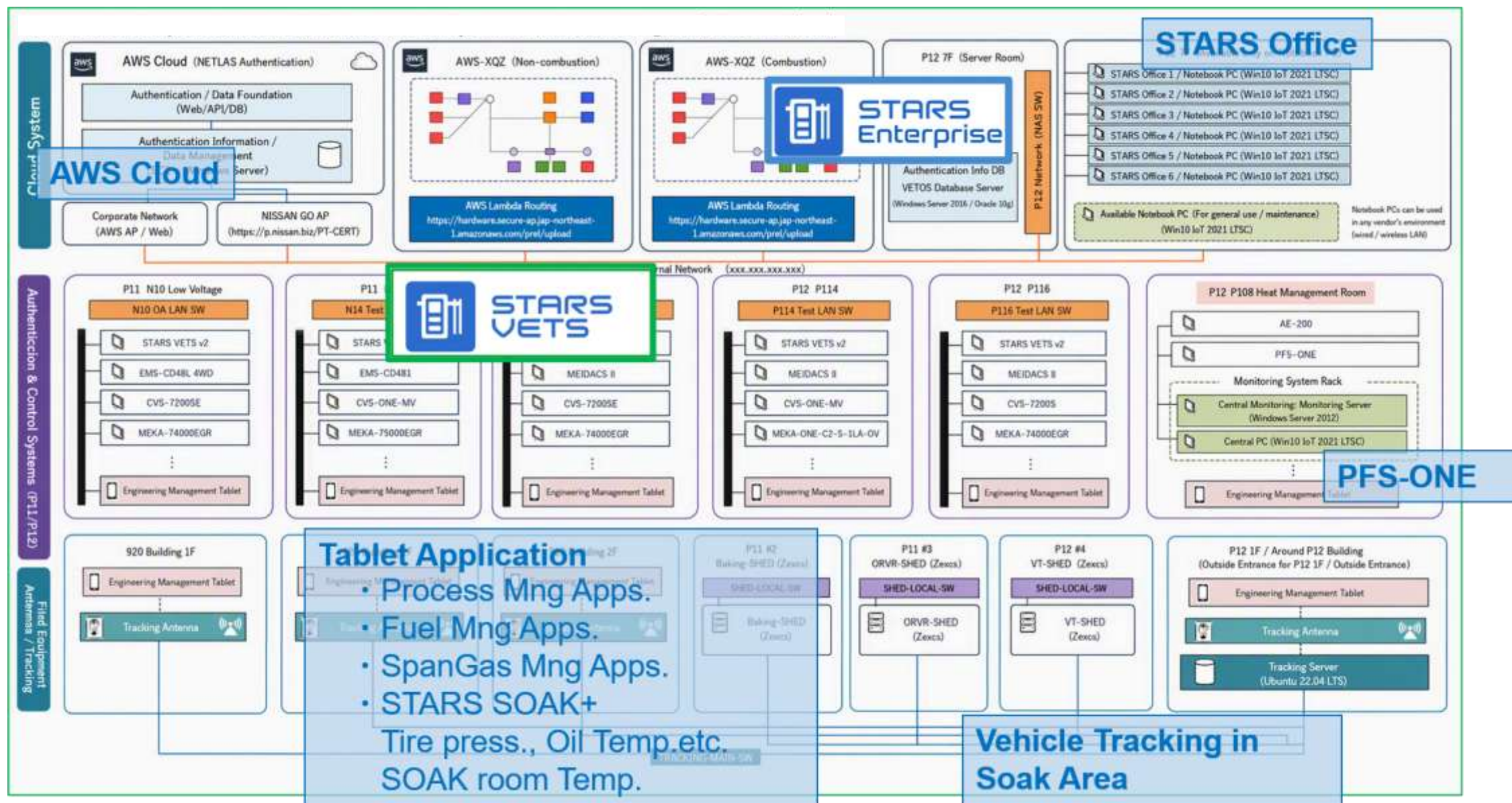


VTMS: Vehicle Thermal Management System

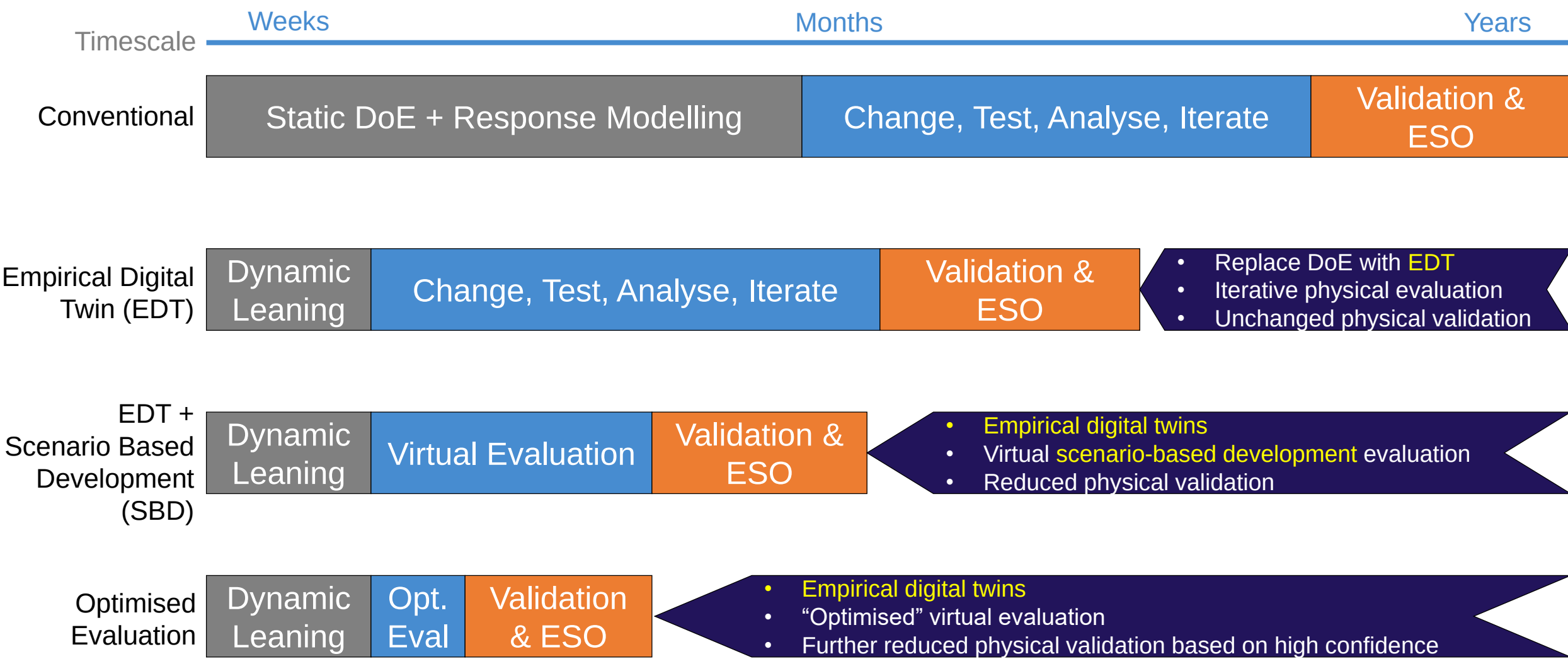


Automated BEV Range Test

Solving the “Emissions” Matrix – Integrated R&D Environment



Powertrain Development Effort Reduction Roadmap



Life in The Matrix – exciting

- A multitude of renewable energy vectors and new propulsion solutions
- An amazing collection of new tools and processes

Energy

There are a myriad of new “fuels”, each with their own optimal applications.

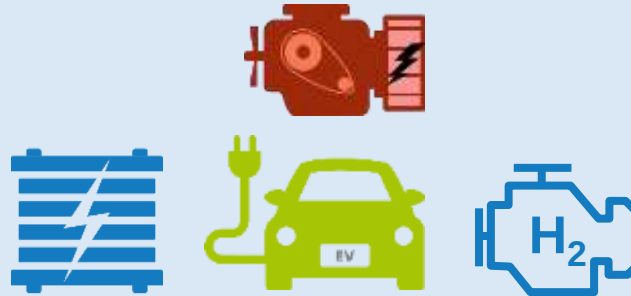
All options are supported



Propulsion

Propulsion technologies exist in readiness to exploit all energy vectors and comply with air-quality regulations

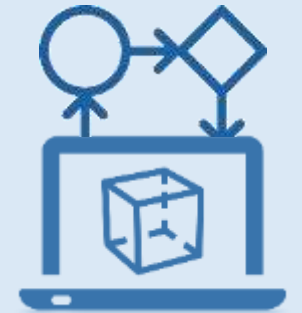
All options are supported



Development

Development capability exists to deliver New Product Introduction (NPI) in all sectors

Digital Engineering methods deliver accelerated NPI



Each solution needs the best energy & propulsion, and a fast road through development

It is the **Most Exciting Time!**

HORIBA is with you on this journey

Omoshiro-okashiku
Joy and Fun

おもしろ可笑

THANK YOU

Terima kasih 谢谢
Gracias
Tack ska du ha
Danke
Grazie
Σας ευχαριστώ πάρα πολύ
धन्यवाद
شُكْرًا
ขอบคุณครับ
Большое спасибо
Cảm ơn
감사합니다
Dziękuję
Obrigado
Merci

HORIBA