



Heavy-duty vehicle CO₂ emissions in the EU

欧盟的重型车CO₂排放

NDC Transport Initiative for Asia 2021 Event Series –
Decarbonising Transport

Stijn Broekaert & Georgios Fontaras

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Outline 提纲

- VECTO
 - Recent developments
 - In-progress developments
 - CO₂ standards
- VECTO
 - 近期的发展
 - 正在进行的发展
 - CO₂标准



Simulation tool to calculate the energy demand, fuel consumption and CO₂ emissions

计算能源需求、燃油消耗量和CO₂排放的模拟工具

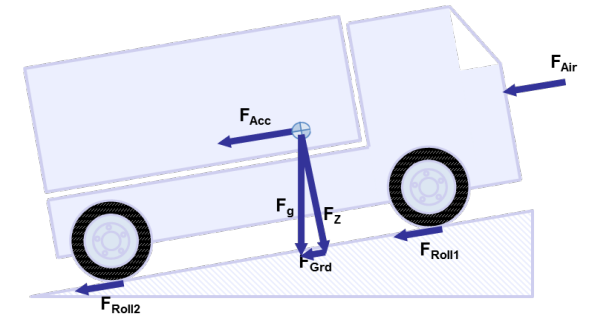
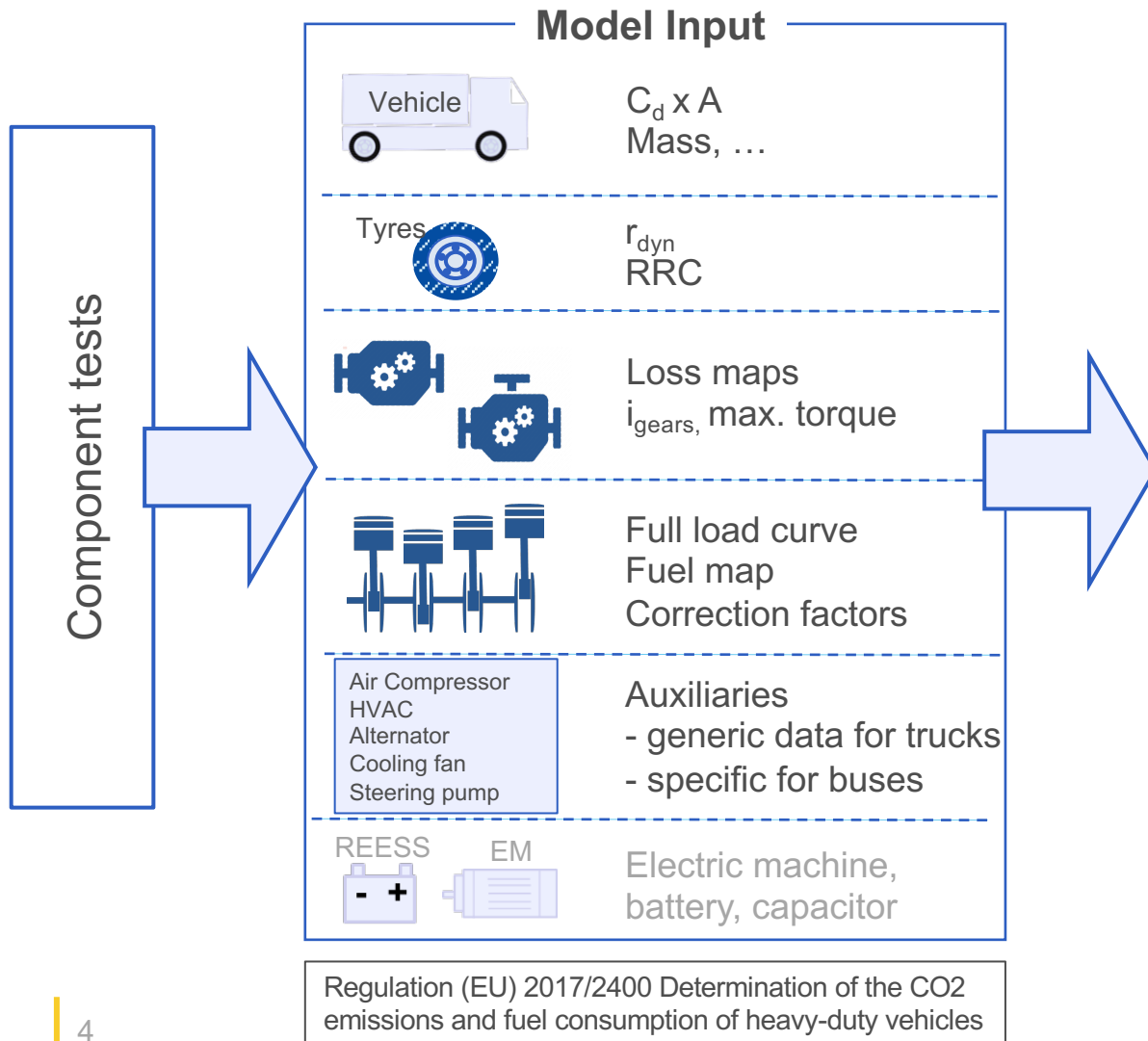


Entire vehicle 整车
Cost effective 具有成本竞争力
Reproducible 具有可重复性
Flexible 灵活性较强



Regular updates 定期更新

VECTO method 方法论



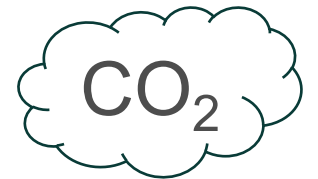
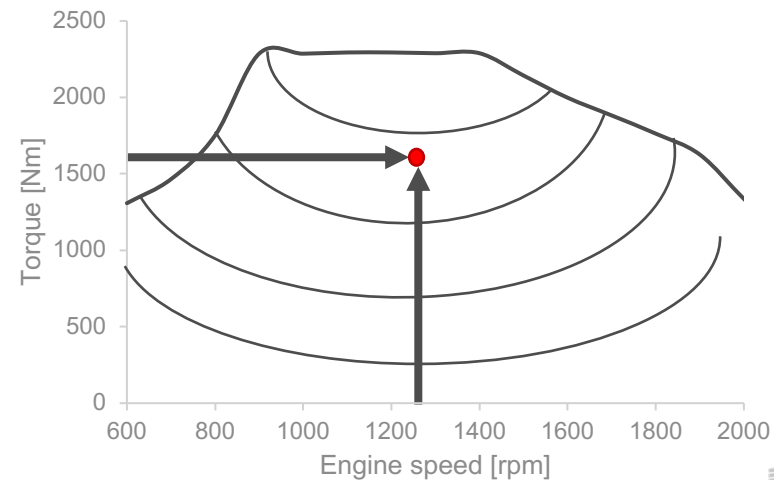
Engine power 发动机功率:

$$P_{Eng} = P_{Air} + P_{Roll} + P_{Grd} + P_{Acc} + P_{Losses} + P_{Aux}$$

Engine speed 发动机速度:

$$n_{Eng} = v \cdot i_{Axle} \cdot i_{Gear} \cdot \frac{60}{\pi \cdot D_{Wheel}}$$

Fuel consumption 燃油消耗量:



Process 过程

Input 输入

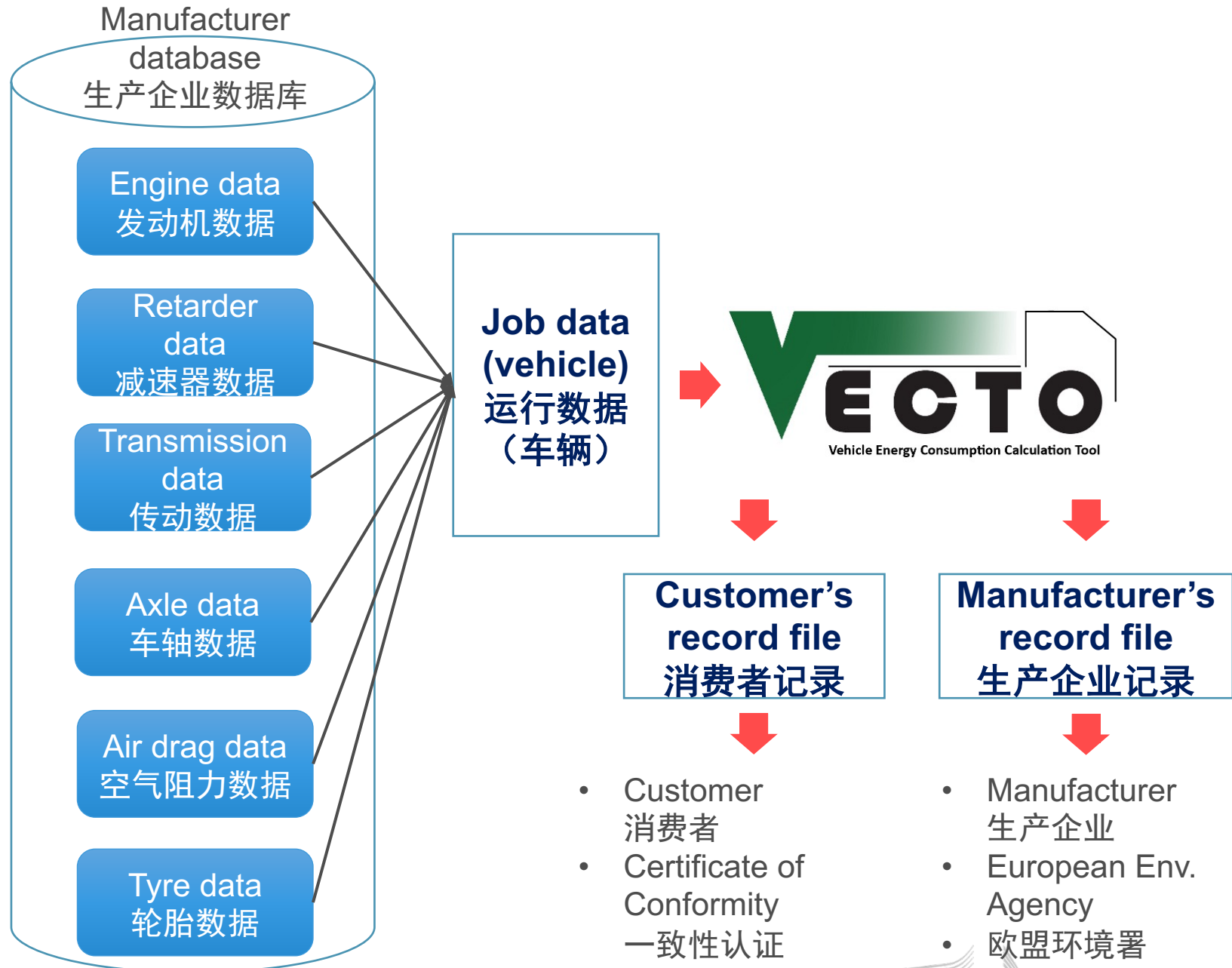
- Component data 零部件数据
- Hashing for integrity 散列整合

Results 输出

- Each vehicle 单车结果
- g/km, g/m³.km, g/ton.km or g/pass.km

Use 用途

- Certification 认证
- Monitoring 监测
- CO₂ Standards CO₂标准



Vehicle segmentation 车辆分类

Vehicle groups 车辆组别

- Axle configuration 轴结构
 - Chassis type 底盘结构
 - TPMLM 车重段
- 
- Mission profiles 任务特征
 - Payload 负载
 - Body/trailer 车身/挂车
 - Auxiliary power 辅助动力

Axle config.	Chassis config.	TPMLM [tons]	Vehicle group	Long haul	Long haul (EMS)	Regional delivery	Regional delivery (EMS)	Urban delivery	Municipal utility	Construction
4x2	All	> 7.5 – 10	1			R		R		
	All	> 10 – 12	2	R+T1		R		R		
	All	> 12 – 16	3			R		R		
	Rigid lorry	> 16	4	R+T2		R		R	R	
	Tractor	> 16	5	T+ST	T+ST+T2	T+ST	T+ST+T2	T+ST		
4x4	Rigid lorry	> 16	9	R+T2	R+D+ST	R	R+D+ST		R	
	Tractor	> 16	10	T+ST	T+ST+T2	T+ST	T+ST+T2			
6x4	Rigid lorry	All	11	R+T2	R+D+ST	R	R+D+ST		R	R
	Tractor	All	12	T+ST	T+ST+T2	T+ST	T+ST+T2			T+ST
8x4	Rigid lorry	All	16							R

Recent developments 近期的发展

2nd amendment of Reg. (EU) 2017/2400
→ expected in 2022

1. Extension of scope

- Medium lorries (5t < TPMLM ≤ 7.4t)
- Heavy buses (7.5t < TPMLM)
 - 2/3/4 axles, rigid & articulated, low floor & high floor, single decker & double decker
 - Primary or completed

2. New technologies

- Hybrid and battery-electric vehicles
- Waste heat recovery & dual-fuel engines
- ADAS in-the-loop

欧盟法规2017/2400的第二次修订 →
预期在2022年进行

1. 扩大管理覆盖范围

- 中型货运卡车 (5t < TPMLM ≤ 7.4t)
- 重型公交客车 (7.5t < TPMLM)
 - 2/3/4轴, 整体式&铰接, 低底盘&高底盘, 单层&双层
 - 主要车型或全部车型

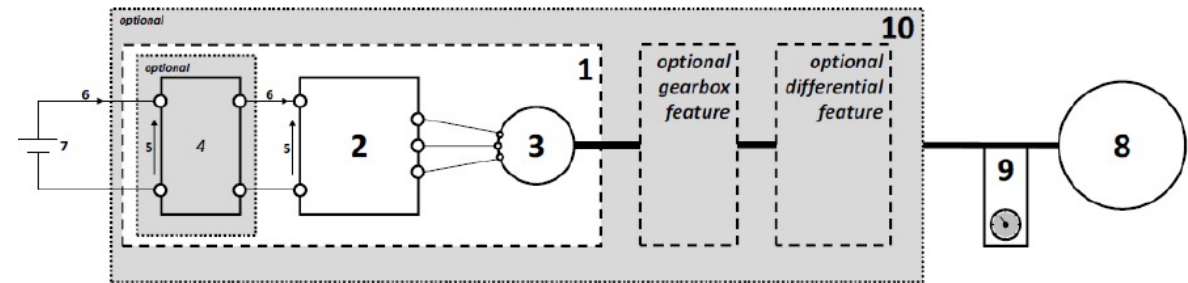
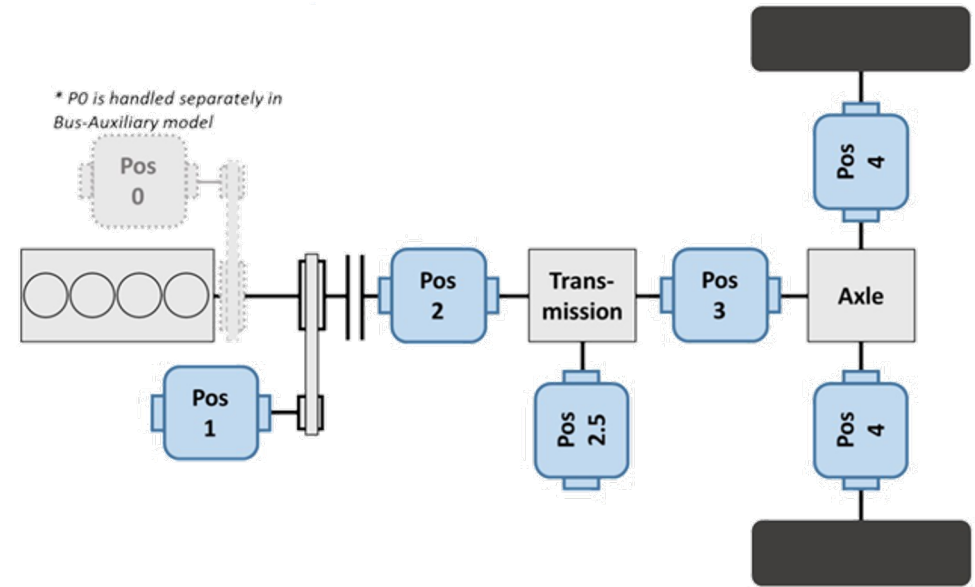
2. 新技术

- 混合动力和纯电动汽车
- 废热回收 & 双燃料发动机
- ADAS辅助系统

Hybrid and battery-electric vehicles 混合动力和纯电动汽车

Electrified vehicles 电动化汽车

- Architectures: serial & parallel 结构：序列&平行
- Models 型号：
 - Battery model 电池型号
 - Capacitor model 电容器型号
 - Electric machine 电机
 - Integrated component 整合部件
- Thermal de-rating 降低热级别
- Control: Equivalent Consumption Minimization Strategy
控制：等效消耗最小化战略



- | | | |
|----------------------------------|----------------------------------|---|
| 1 ... Electric machine system | 5 ... Inverter input voltage | 9 ... Speed/torque measurement |
| 2 ... Inverter | 6 ... Inverter input current | 10 ... IEPC (optional instead of electric machine system) |
| 3 ... Electric machine | 7 ... Power supply to inverter | |
| 4 ... DC/DC converter (optional) | 8 ... Dynamometer (load machine) | |

In-progress developments 正在进行的发展

3rd amendment of Reg. (EU) 2017/2400 欧盟法规2017/2400的第3次修订

1. Hydrogen internal combustion engine
氢燃料内燃机
→ Based on ECE-R49 基于ECE-R49
2. Hydrogen fuel cell
氢燃料电池
→ Elaborating component test procedure
详细说明零部件测试规程
3. Wheel bearings 车轮轴承
→ Elaborating component test procedure
详细说明零部件测试规程
4. In-use charging e.g. pantograph
使用过程中充电，例如受电弓
→ Defining generic efficiencies
规定通用效率
5. Platooning and automated driving
列队行驶和自动驾驶
→ Defining CdxA reduction
定义CdxA降低

In-progress developments 正在进行中的发展

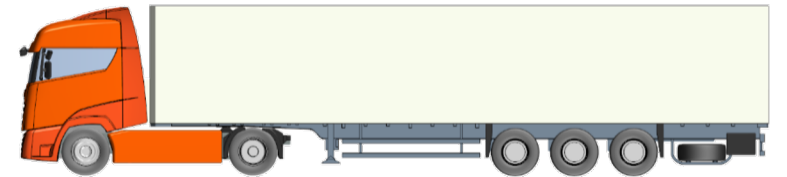
Trailers and real body 挂车和车身

- Regulation expected 管理预期
- Goal = Capture real trailer and body properties
目标=切实获取挂车和车身的实际属性

- Air drag (aero devices) 空气阻力
- Rolling resistance 滚动阻力
- Mass & dimensions 质量&尺寸

- Simulation of trailer/body with generic vehicle 采用通用车辆模拟挂车/车身

→ Efficiency factor 效率参数 = $\frac{CO_{2specific\ trailer/body}}{CO_{2reference\ trailer/body}}$



CO₂ performance standards

CO₂性能标准

Reg. (EU) 2019/1242 欧盟法规 2019/1242

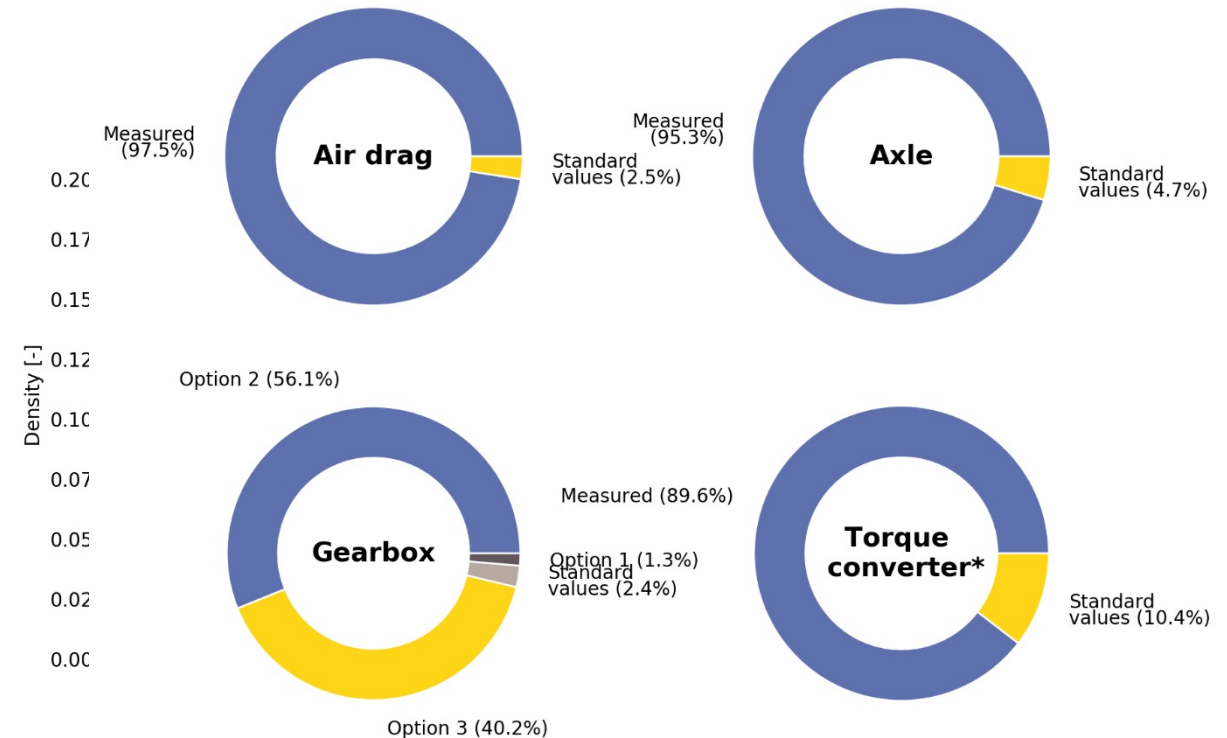
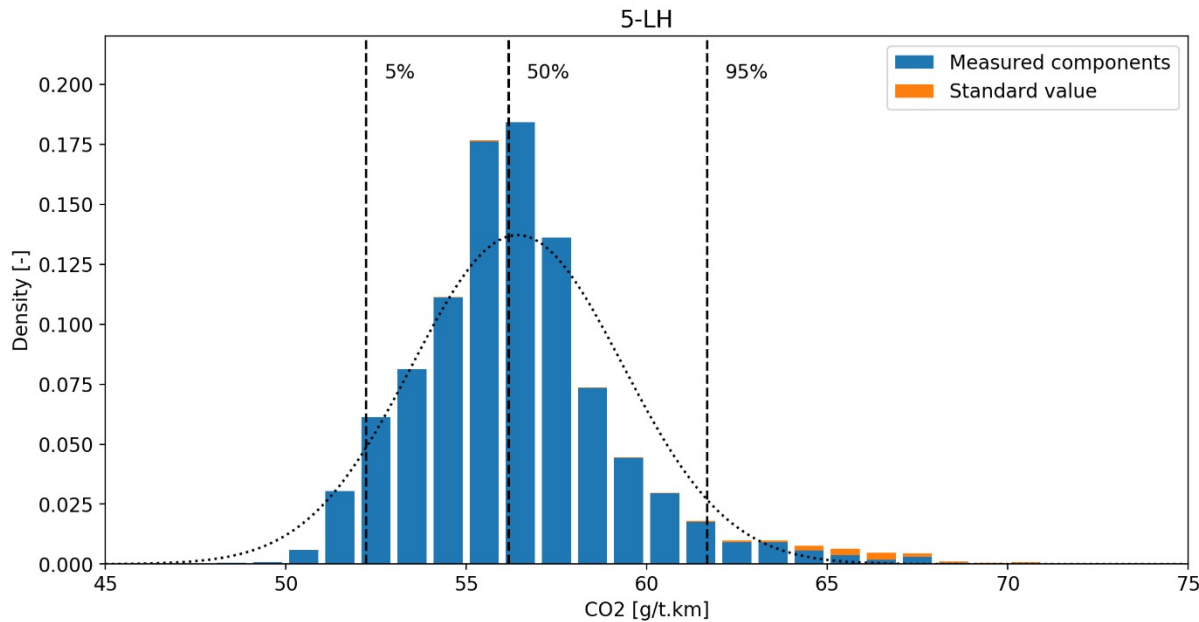
- Reduction targets for manufacturer's average CO₂ emissions [g/t.km]
 - 加严生产企业的平均CO₂排放目标 [g/t.km]
 - Reduction of **15%** by 2025
 - 到2025年降低**15%**
 - Reduction of **30%** by 2030
 - 到2030年降低**30%**
- Compared to 2019-2020 fleet average
与2019-2020车队平均目标相比
- Vehicle groups 4, 5, 9 & 10 车辆组别4, 5, 9 & 10
 - Incentives zero/low emission vehicles 零排放/低排放
 - Banking of credits & debts 积分储存&借贷

CO₂ performance standards

CO₂性能标准

Robustness of reference CO₂ emissions 参考CO₂排放的鲁棒性

- JRC analysis JRC分析



CO₂ performance standards

CO₂性能标准

Reg. (EU) 2019/1242 review in 2022 =
assessment of

- Extension to other vehicle categories
- Current and new targets
- Zero/low emissions incentives
- Possibility to include life-cycle emissions
- Possibility to include pooling between manufacturers

➔ **WORK IN PROGRESS**

欧盟法规2019/1242的2022年修订=评估以下内容：

- 扩展覆盖其他车辆类型
 - 当前目标和新目标
 - 零排放/低排放激励措施
 - 纳入全生命周期排放的可能性
 - 生产企业资源集中的可能性
- ➔ 正在进行的工作

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Thank you

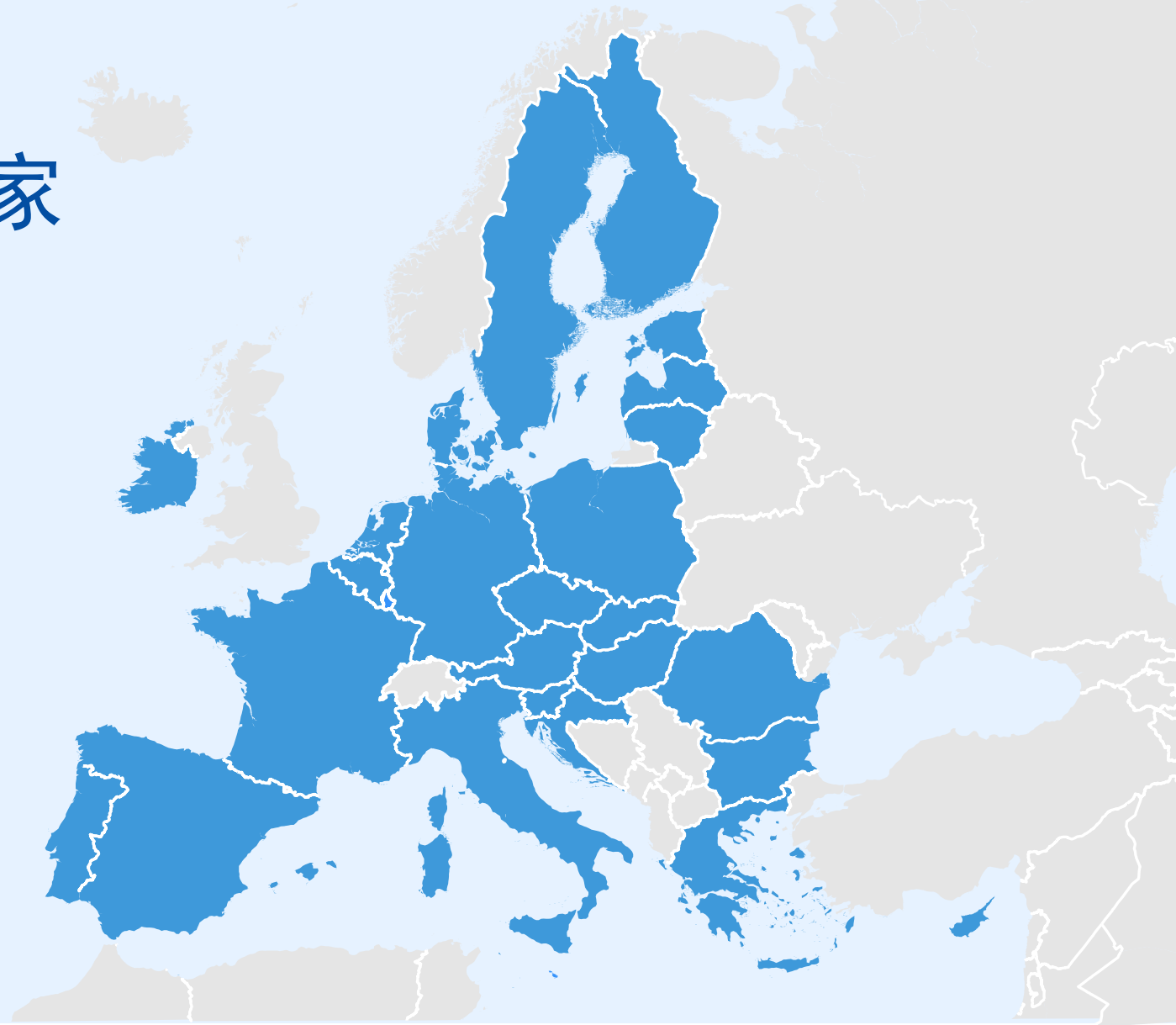
谢谢



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EU countries 欧盟国家



0 250 500 1,000 Km

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