



**Climate Neutral Germany 2045:
Challenges and Opportunities for the
Decarbonisation of Transport**

**德国2050年气候中和：
交通领域低碳化的挑战与契机**

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NDC-TIA, China Component
Beijing | November 23, 2021
北京 | 2021年11月23日

Agora Verkehrswende - Transforming Transportation

Agora - 交通转型



Who we are. 关于我们

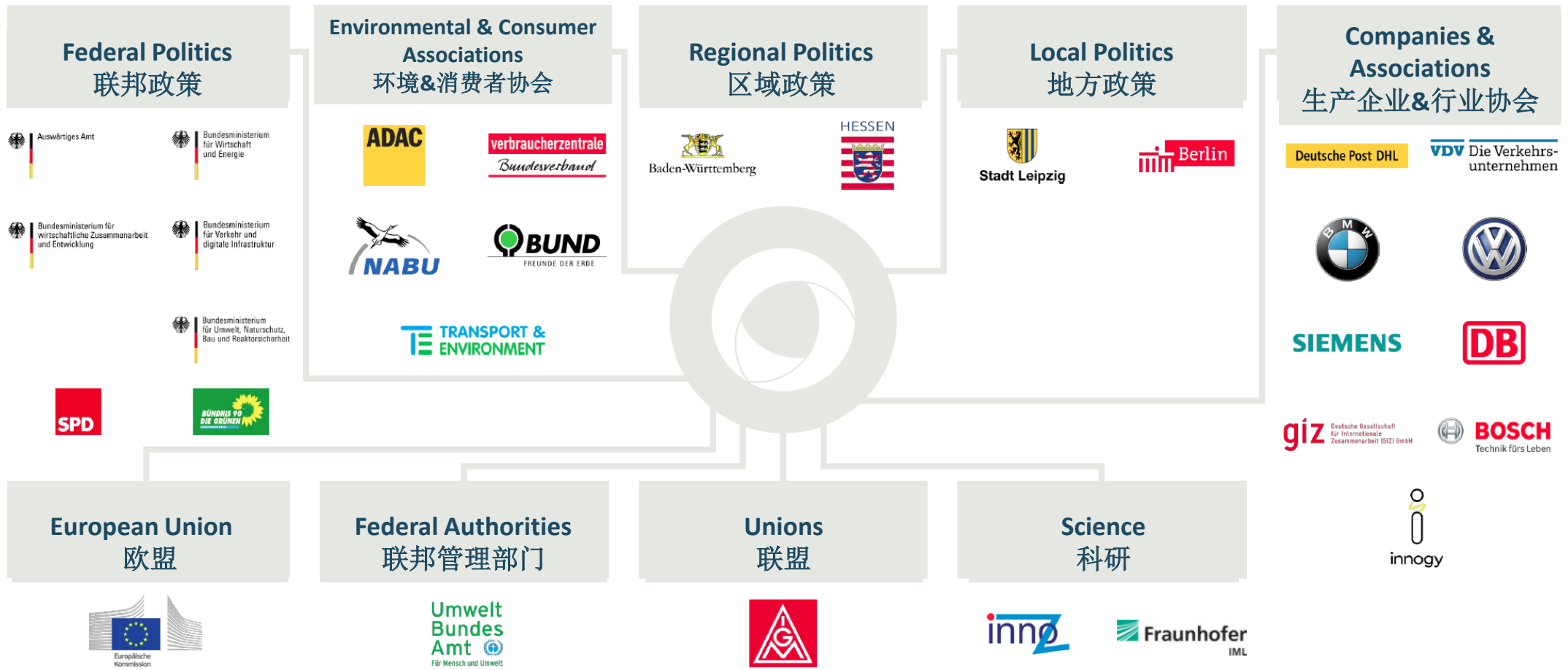


- Initiative by **Stiftung Mercator** and **European Climate Foundation**
- Independent **Think Tank** and high-level **Council of Agora**
- **Mission:** Scenarios, Discourse and Strategies for the **Decarbonisation of Transport** until 2050
- **Focus:** starting with national land-based transport in **Germany** in an European context
- 由墨卡托基金会和欧盟气候基金会联合发起
- 一家独立的智库机构且拥有高水平的专家咨询委员会
- 目标: 以2050年交通低碳化为目标, 开展情景分析、研究和战略措施推进
- 重点: 在欧洲以德国为起点, 重点促进公路交通低碳化

The Council of Agora Verkehrswende

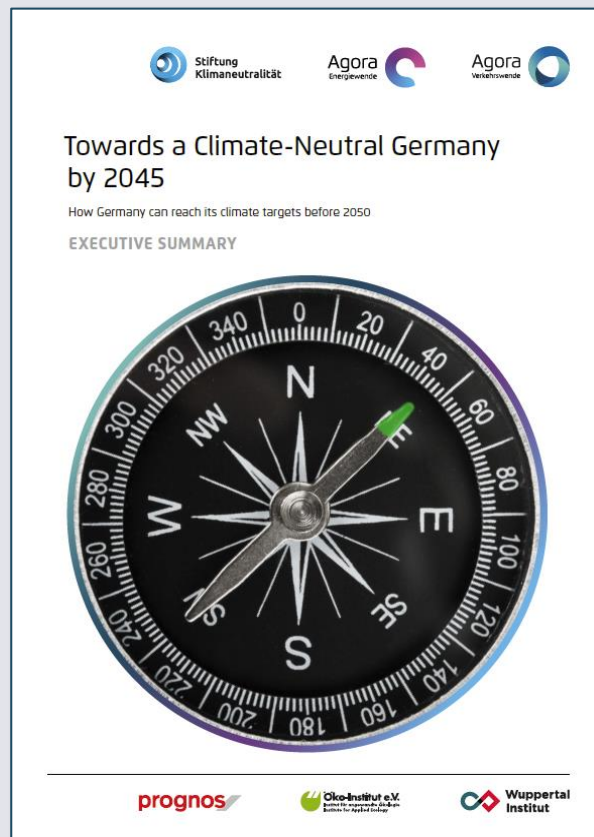
Agora交通转型顾问委员会

Transforming transport will only succeed as composite work!
只有全方位协作，才能实现交通领域的成功转型！



Towards a Climate-Neutral Germany 2045

迈向2045年气候中立的德国



- *Towards a Climate-Neutral Germany 2045* extends the logic of *Towards a Climate-Neutral Germany 2050* 德国2045气候中立的目标延伸了德国2050气候中立目标的逻辑
- Mission任务: Model an ambitious Climate Neutrality 2045 target for all sectors 为各部门设立了2045年气候中立的目标
- Goal目标: Present a path towards climate neutrality 2045 taking into account costs and acceptancy 在考虑成本和接受度的情况下，设计实现2045年气候中立的路径
- Published on 26 April 2021 2021年4月26日发表
- German constitutional court published its decision on the Climate Law 2019 on 29 April 2021, stating it unconstitutional with regards to the freedom of future generations 德国联邦宪法法院于2021年4月29日公布了对《2019年气候保护法》的裁定，指出该法侵犯了年轻人的自由，是违宪的。

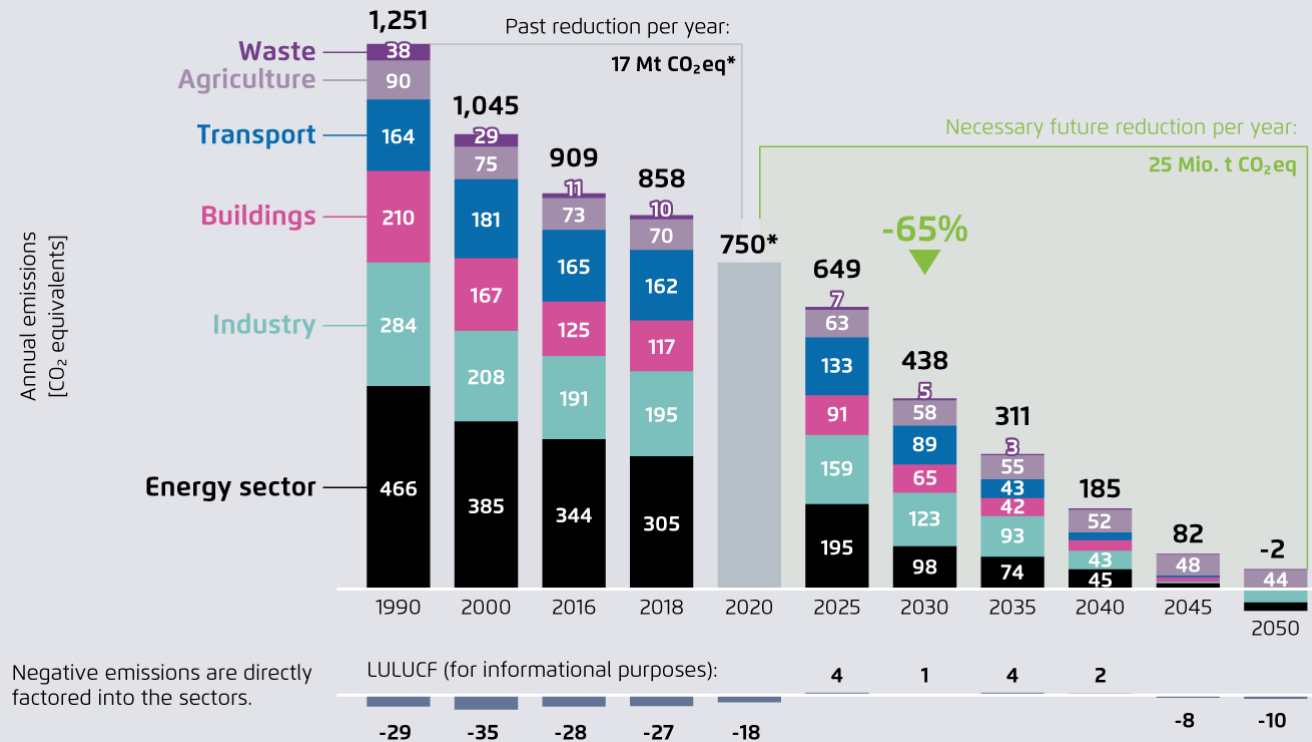
What we need to aim for given the latest EU and German climate policy announcements:

Climate Neutral Germany 2050 and -65% until 2030

我们的目标是为欧盟和德国提供最新的气候政策宣言：
德国2050年实现气候中和，2030年达到减排65%



Overview development of GHG emissions by sector 各领域温室气体排放发展概况



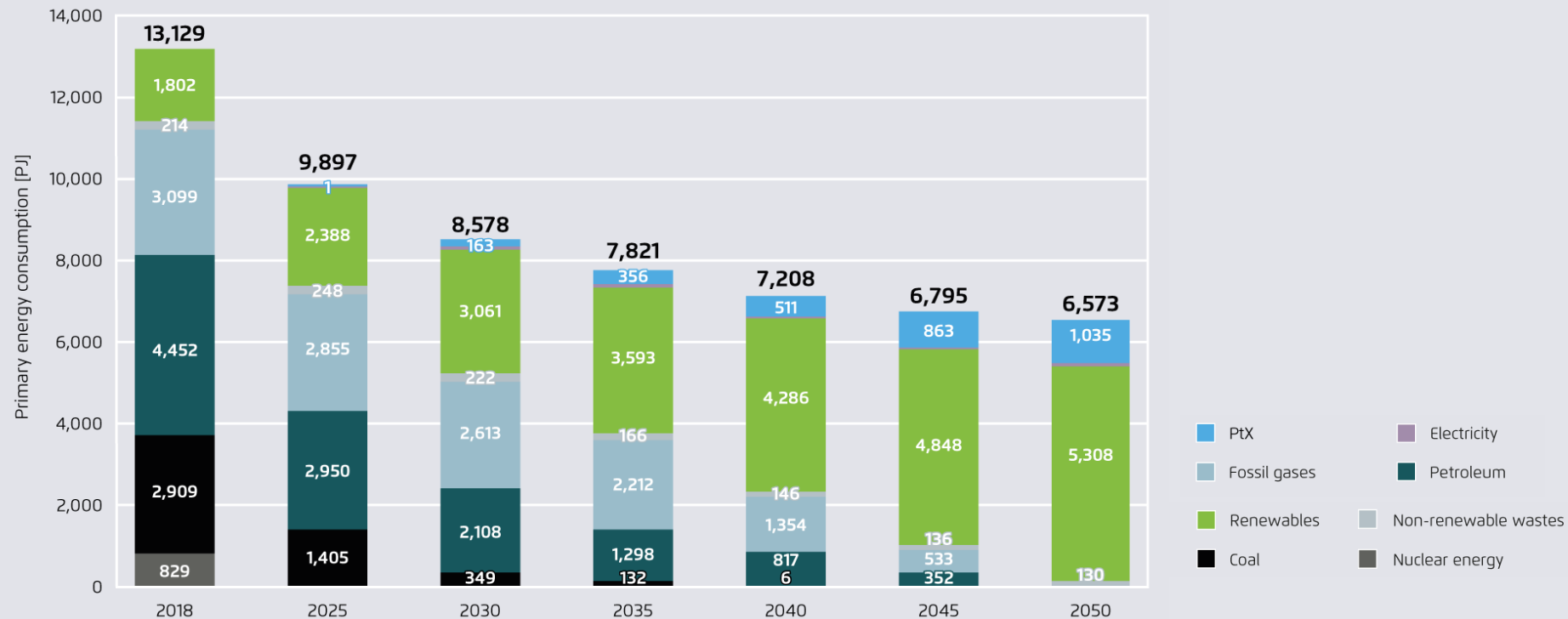
Source来源: Prognos, Öko-Institut, Wuppertal-Institut (2020): Towards a Climate-Neutral Germany. Executive Summary conducted for Agora Energiewende, Agora Verkehrswende and Stiftung Klimaneutralität. (《德国本世纪中叶迈向气候中和》研究报告)

Deep Dive Energy consumption: Primary energy consumption is halved by 2050 via efficiency and electrification

深度解析能源消耗量：通过提升能效和电动化，到2050年将一次能源消耗量降低一半



Primary energy consumption 一次能源消耗

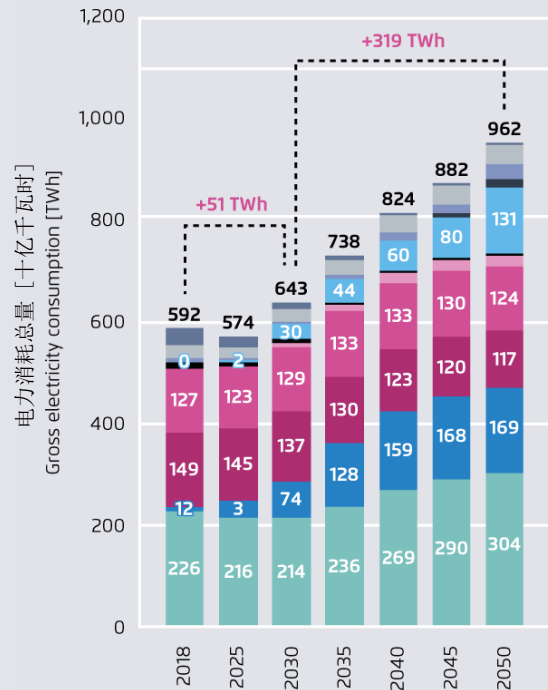


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Deep Dive Power consumption: Power consumption increases by 50% until 2050 to >960 TWh via electrification of transport, heating and industry

深度解析电力消耗量：到2050年电力消耗量增加50%达到>9600亿千瓦时，用于交通、供热和工业领域电动化

Gross power consumption 电力总消耗量



H₂/CO₂



27%的道路货运由电动化或有轨电网卡车运输，电动轿车达到1400万



2030

Production 19 TWh H₂
制氢消耗190亿千瓦时

5.6 million heat pumps, efficient electric appliances, efficient lighting, decline of direct electric heaters
560万台热泵、提升电器能效、提升照明能效、减少直接电加热器使用

Heat pumps, efficient lighting
热泵、提升照明能效

27% of road freight km via trucks powered by batteries and overhead lines, 14 M electric cars

Electrification of process heat, electricity-based steam production, efficient cross-cutting technologies

热处理、蒸汽产生的电气化以及提高切割技术能效

2050

84 TWh H₂, 19 Mt CO₂ DAC
制氢消耗840亿千瓦时
1900万吨直接空气CO₂捕集

13.8 million heat pumps, increasing for cooling and ventilation, efficiency with heat pumps, decline of direct electric heaters, efficiency with electric appliances
1380万台热泵、增加制冷和通风、提升热泵能效、减少直接电加热器、提高电器能效

Heat pumps, efficient lighting
热泵、提升照明能效

78% of road freight km via trucks powered by batteries and overhead lines, 30 M electric cars
78%的道路货运由电动化或有轨电网卡车运输，电动轿车达到3000万

Electrification of process heat, CO₂ capture, steam production in electric boilers and high-temperature heat pumps
热处理电气化、CO₂捕集、电蒸汽锅炉以及高温热泵

- Industry 工业
- Transport 交通
- District heat generation 区域供热
- ITS 智能交通
- Electrolysis (H₂) 电解氢
- Charge storage 充电
- PP on-site consumption PP现场消耗
- CCS 二氧化碳捕集和封存
- Grid losses 电网损耗
- Other converted energy 其他能源转换

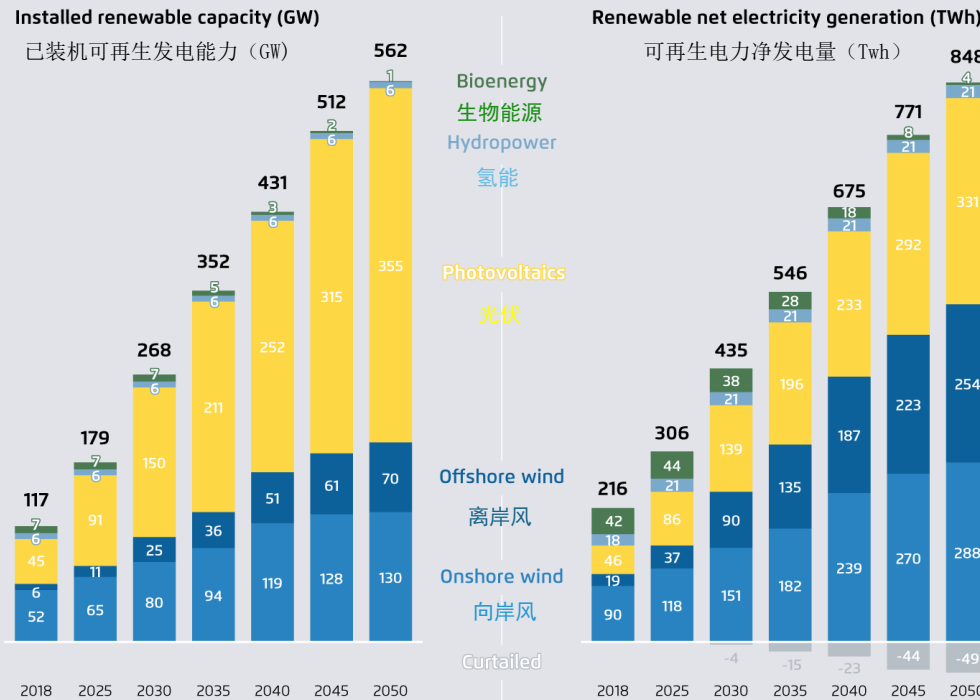
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...and this means a lot of new wind and solar power plants: Until 2030 10 GW solar, 5 GW wind onshore and 2 GW wind offshore need to be built annually.

…这意味着需要新增大量风能和太阳能电厂，2030年以前每年需完成建设太阳能发电能力1000万千瓦，向岸风发电能力500万千瓦，离岸风发电能力200万千瓦



Power generation 发电量



Needed average added capacity per year
Gross increase, for life spans of 25 years

每年需要增加的发电能力
25年寿命周期，总增量

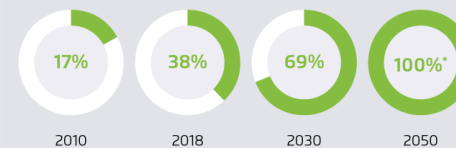
2021-2030



Past years with greatest added capacity:
Photovoltaics: 8 GW (2010, 2012)
Offshore wind: 2 GW (2015)
Onshore wind: 5 GW (2014, 2017)

Cumulative gross increase from 2021 to 2030:
Photovoltaics: 98 GW
Offshore wind: 17 GW
Onshore wind: 44 GW

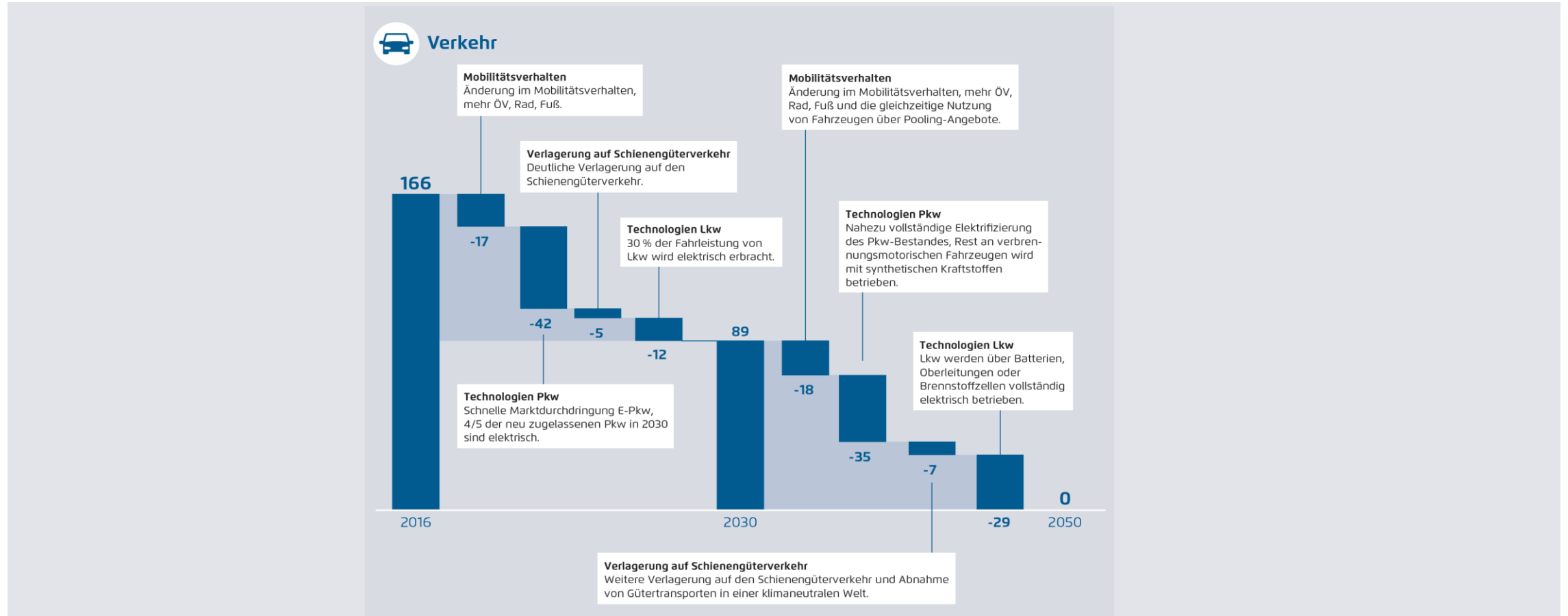
Share of renewable energy in gross electricity consumption



Source来源: Prognos, Öko-Institut, Wuppertal-Institut (2020): Towards a Climate-Neutral Germany. Executive Summary conducted for Agora Energiewende, Agora Verkehrswende and Stiftung Klimaneutralität. (《德国本世纪中叶迈向气候中和》研究报告)

Climate Neutral Germany on the Way: The Pathway for Transport Decarbonisation until 2045

德国的气候中和之路：2045交通领域低碳发展路径



Source来源: Prognos, Öko-Institut, Wuppertal-Institut (2020)

Content of the Fit for 55 package seen from a transport perspective

从交通视角看“Fit for 55（减碳55%）”一揽子计划的内容 (2/2)

14 legislative actions, 3 non-legislative actions 14 项立法行动, 3项非立法行动

Further relevant proposals from a transport perspective

- Strategic rollout plan to support rapid deployment of alternative fuels infrastructure
- Notification on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
- Amendment of the Effort Sharing Regulation

Other proposals

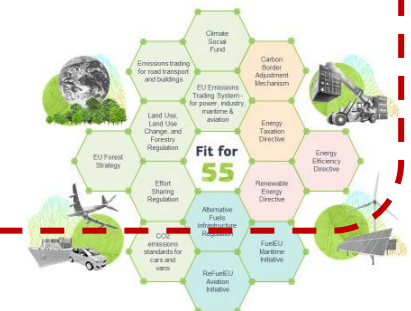
- Revision of the Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF)
- Proposal for a Directive on energy efficiency (recast)
- Proposal for a Carbon border adjustment mechanism (CBAM)
- Revision of the ETS Market Stability Reserve
- Communication: New EU Forest Strategy for 2030

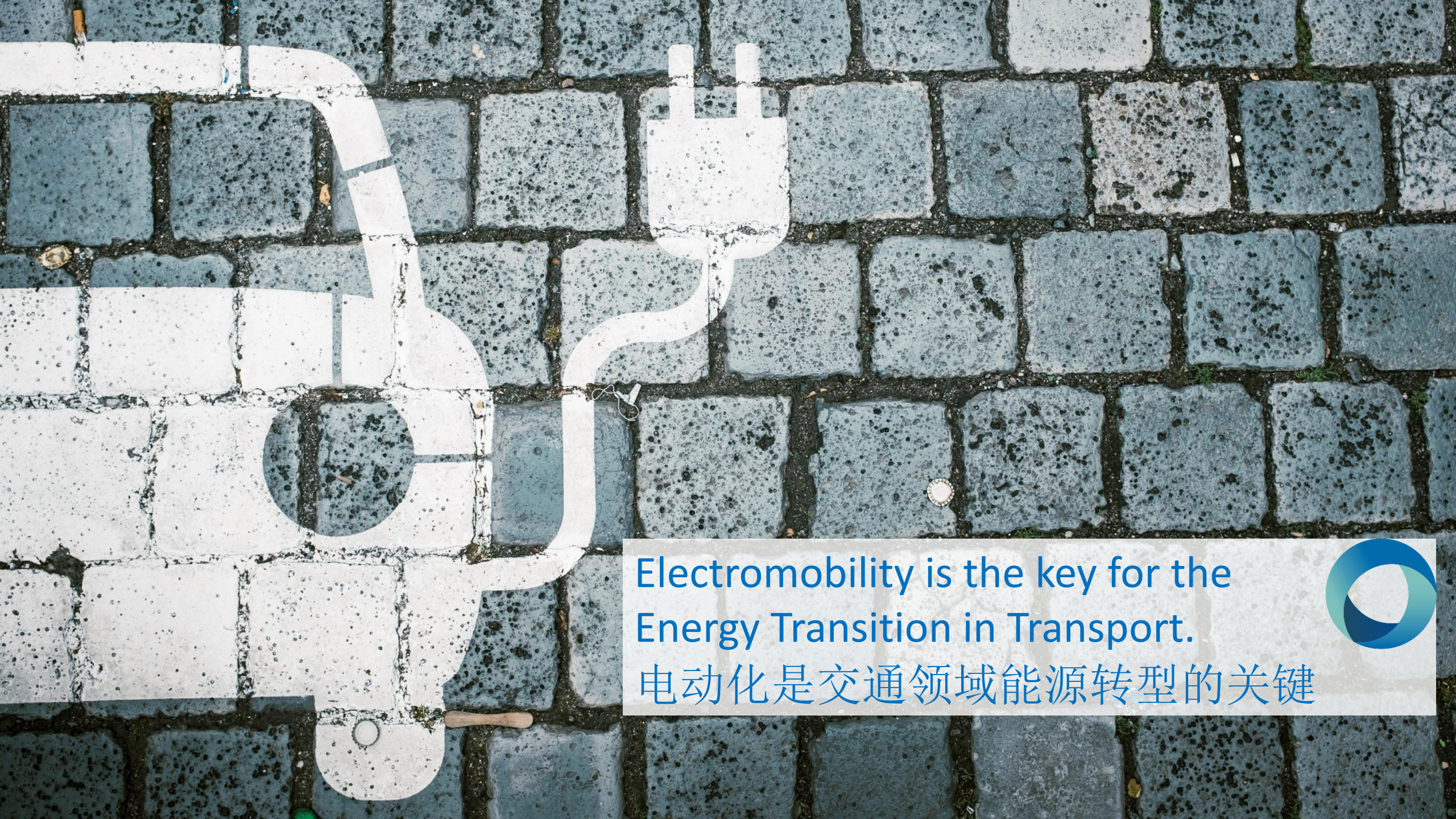
交通视角的进一步相关提案

- 实施战略推广计划，以支持替代燃料基础设施的快速发展
- 发布《国际航空碳抵消和减排计划》（CORSIA）通知
- 修改《减排责任分担机制》

其他提案

- 修订关于将土地利用、土地利用变化与林业（LULUCF）产生的温室气体排放纳入气候框架的条例
- 能源效率指令提案（彻底改变）
- 碳边境调节机制（CBAM）提案
- 修订碳排放权交易体系的市场稳定储备机制
- 沟通：欧盟2030年新的森林战略





Electromobility is the key for the
Energy Transition in Transport.

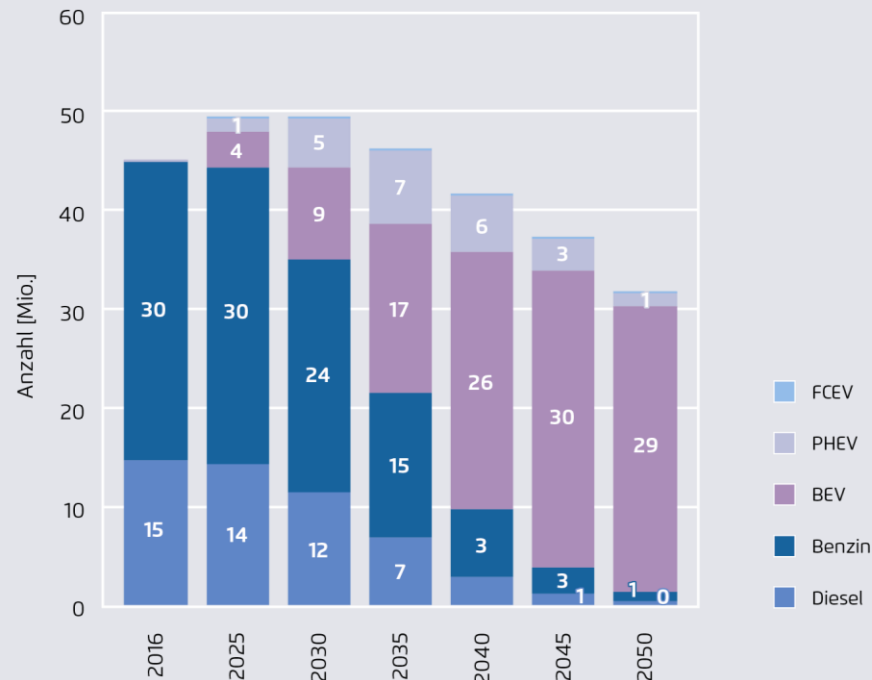
电动化是交通领域能源转型的关键



LDV: Phase-Out of ICE in New-Sales-Fleets not later than 2035

轻型车：2035年前在新销售车辆中淘汰内燃机车辆

Vehicle Fleet 车队

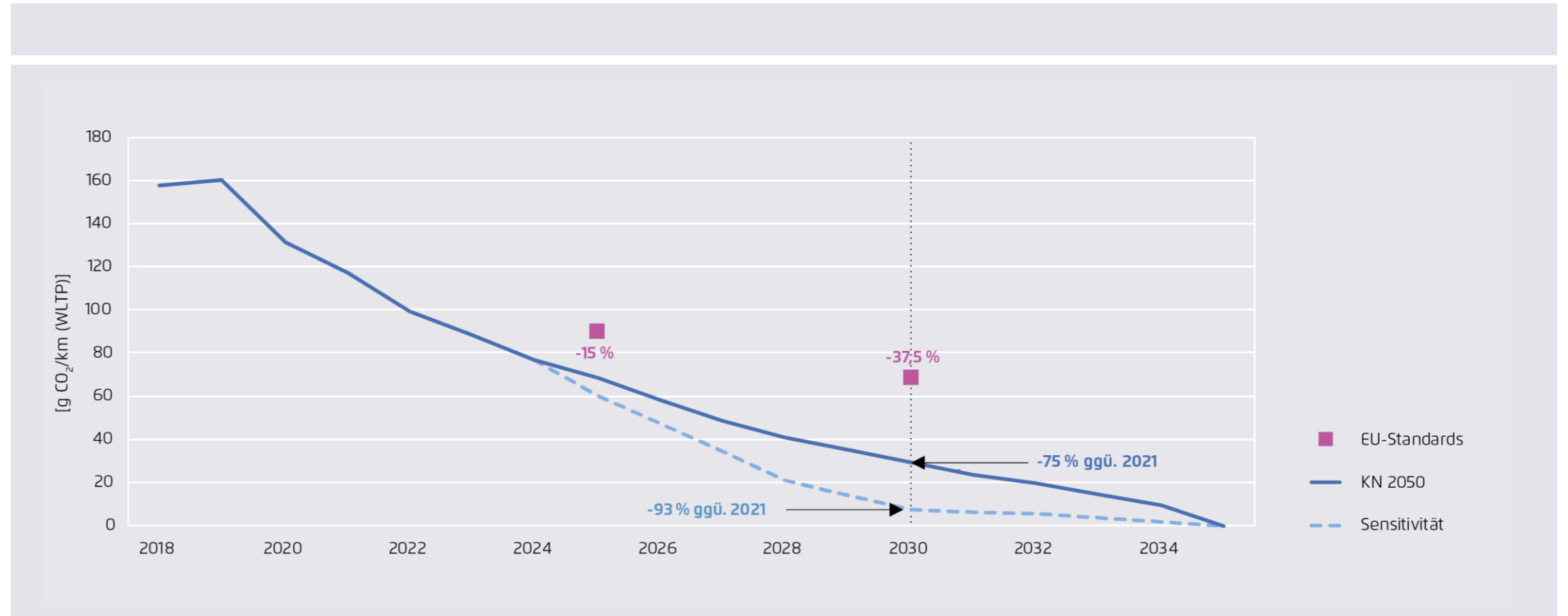


Source来源: Prognos, Öko-Institut, Wuppertal Institut (2020)

- xEV 2030: 14 Mio. Vehicles in Stock, about 80% of the New Sales are xEV
- Efficiency Improvement of conventional ICE-LDV until 2030 by 28%
- CO₂-Emissions from newly registered LDV drop by 75% in 2030 (compared to 2021)
- Number of LDV in stock decrease significantly until 2050 (Shift to Public Transport and Pooling)
- 2030年电动汽车保有量1400万，占新车销售的80%左右
- 到2030年传统内燃机轻型车能效提升28%
- 2030年新登记注册轻型车的CO₂排放比2021年降低75%
- 到2050年轻型车保有量显著降低（推进公共交通和共享出行）

The European Green Deal requires an Ambitious Revision of the CO₂ Standards for PC/LDV until 2030

欧盟绿色协议要求将2030年以前的乘用车/轻型车CO₂排放标准修改的更为严格



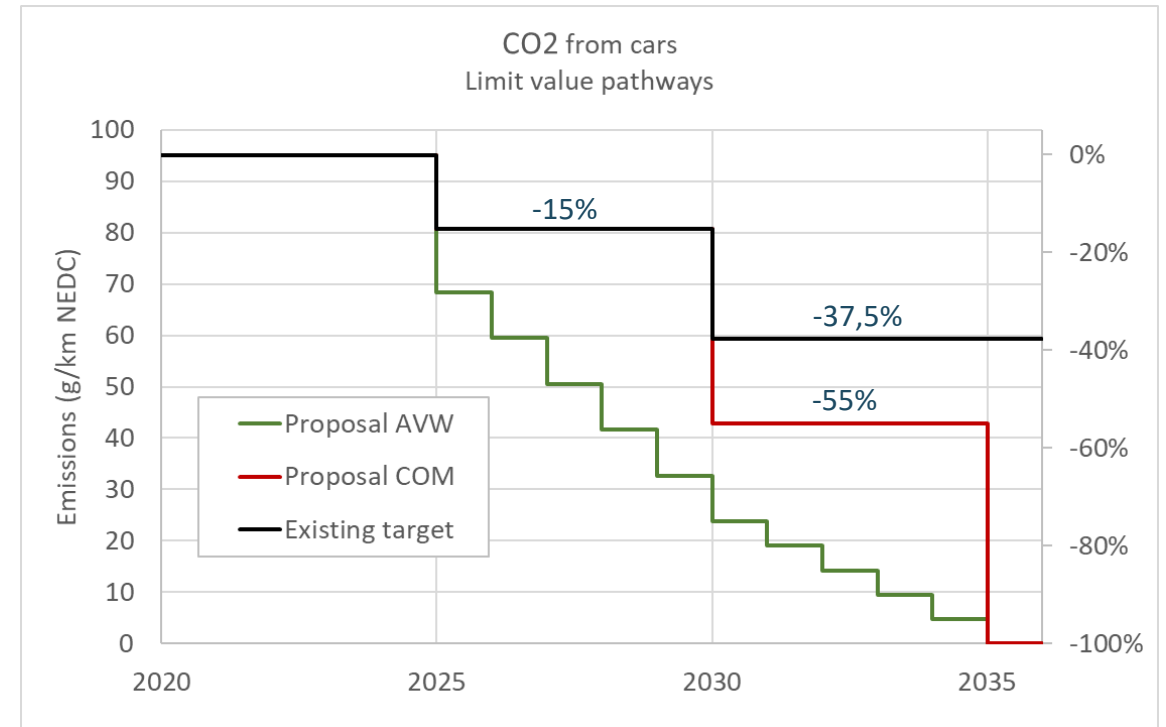
Source来源: Prognos, Öko-Institut, Wuppertal Institut (2020)

Vehicle emissions 车辆尾气排放 (1/2)

Revision of the CO₂ emission standards for passenger cars and light commercial vehicles 修订乘用车和轻型商用车的二氧化碳排放标准

	Existing 现有标准	Proposed 建议标准
LV 2025 2025年限值	-15%	Unchanged 不变
LV 2030 2030年限值	-37,5%	-55%
LV 2035 LV 2035年限值	-	-100%

**The end date for the
combustion engine
(new registrations)
新注册内燃机汽车
的禁售日期**

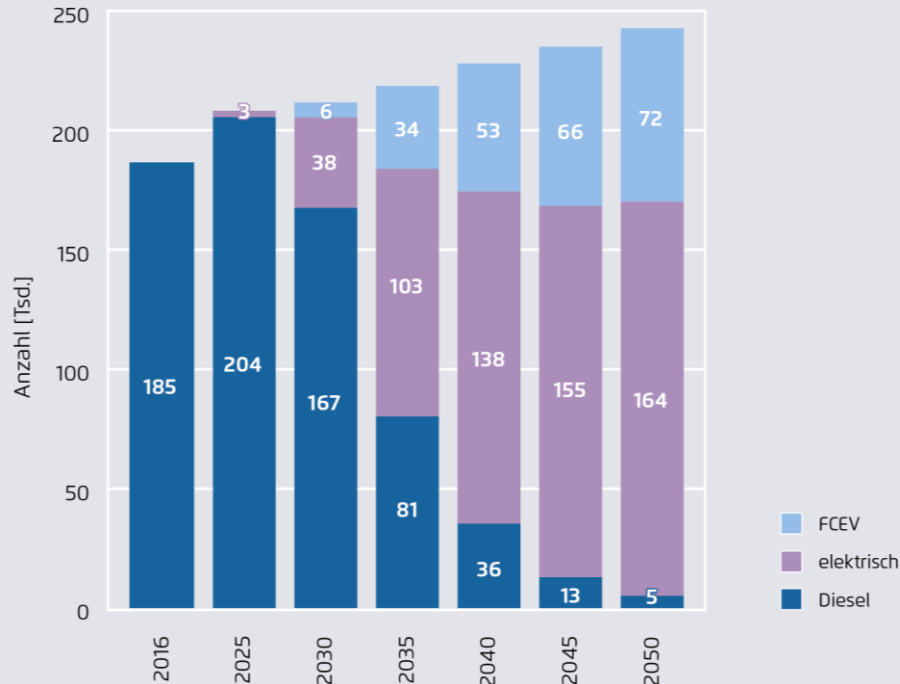


Tractor-Trailer-Trucks: Open Race? - Technology-Mix BEV, Catenary-System and H2-FC-HDV.

全挂车货车：仍在博弈？混合电池电动技术、接触网技术和氢燃料电池



Bestand Last- und Sattelzüge



Prognos, Öko-Institut, Wuppertal Institut (2020)

- It still seems to be an open question which will be a dominant technology for TTT
- 对于全挂货车而言，未来究竟应当选择何种主流技术仍在探讨中
- **By 2030:** 1/3 of the Road Freight Volume will be electric.
- 到2030年：1/3的道路货运应实现电动化
- **By 2050:** Technology-Mix: 2/3 electric (BEV and/or Catenary) & 1/3 H2-FC-HDV.
- 到2050年：混合型技术：2/3电动化（电池及/或接触网）&1/3氢燃料电池重型车

3.3 - Renewable energy in the transport sector (3/3)

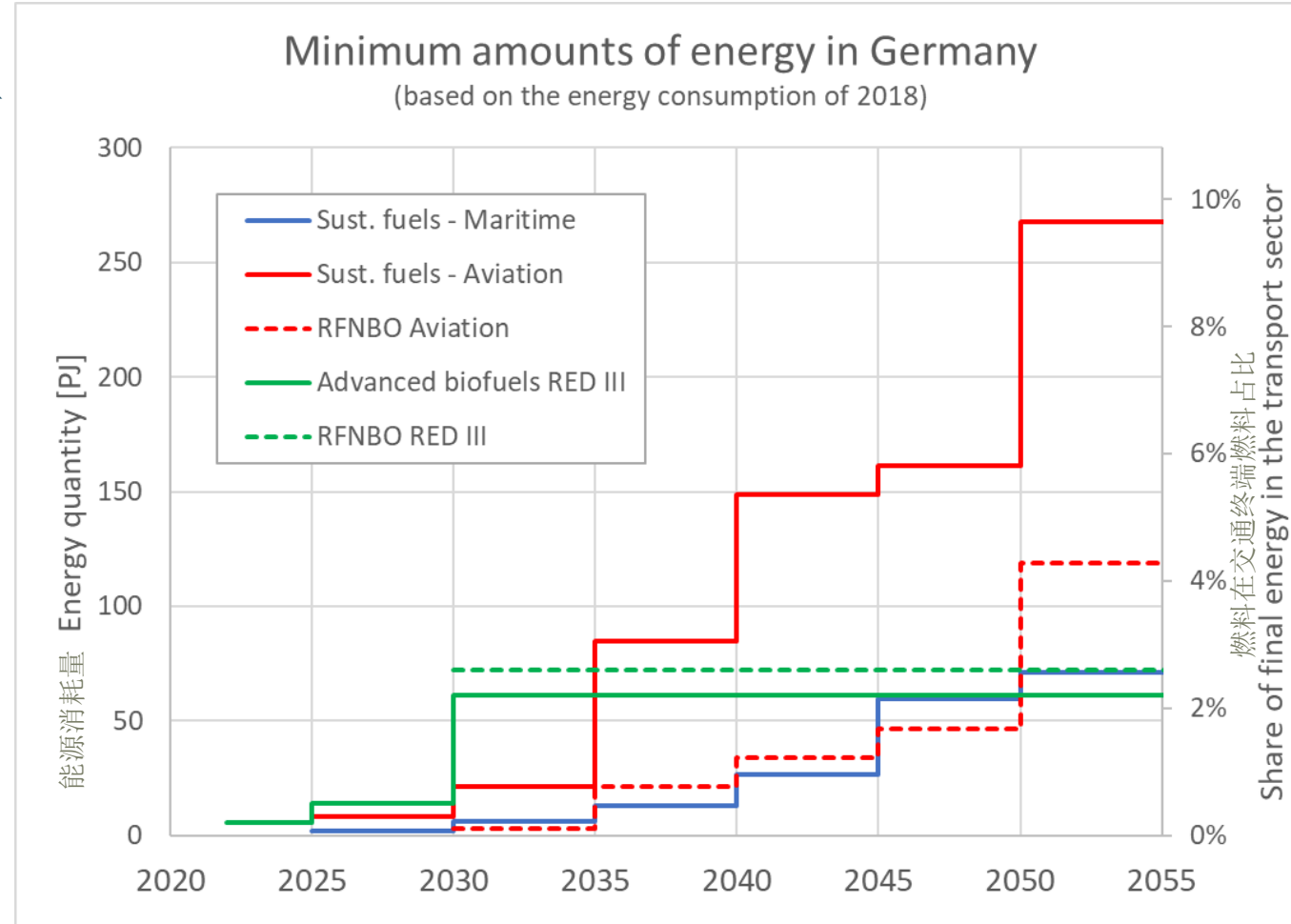
交通部门的可再生能源

Comparing the 3 instruments 三种措施的比较

- Calculation for Germany 针对德国进行的计算
- Calculation on the basis of 2018 data 在2018年数据基础之上进行的计算
- LNG in shipping is ignored 航运业采用的液化天然气忽略不计

Highlights 亮点

- Time horizon 时间范围
 - for RED III – 2030 可再生能源指令RED III—2030年
 - for aviation and shipping – 2050 航空与航运—2050年
- Real action in aviation and shipping from 2035 onwards 2035 年以后航空和海运业的实际行动
- Advanced biofuels and RFNBO play a small role 先进生物燃料和非生物来源的可再生燃料（RFNBO）扮演着角色有限

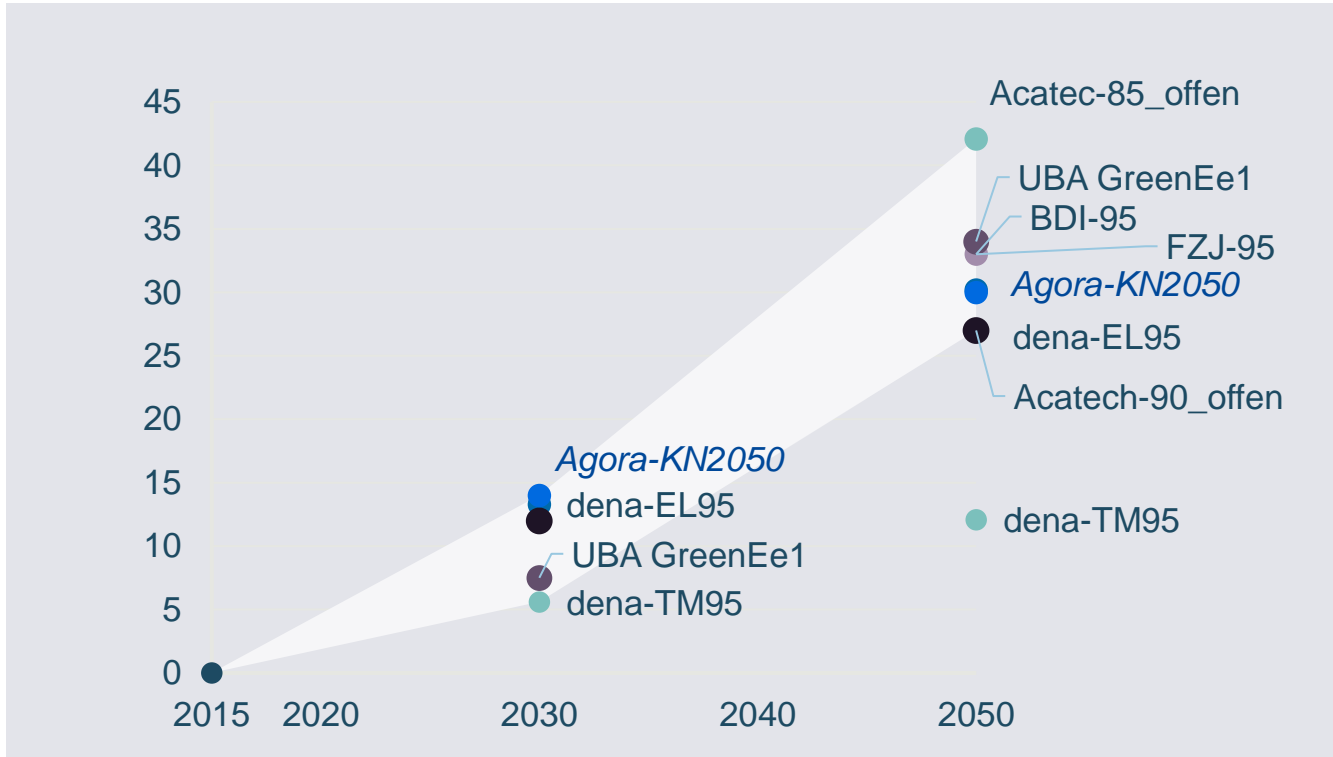


In 2050, most scenarios assume full electrification of cars, but the size of the fleet depends on the success of the Mobility Transition.

2050年，在大多数情景下均假设实现轿车全电动化，但车队规模取决于交通转型的成功程度



Size of the BEV Fleet in different Studies 不同研究中的纯电动汽车车队规模



Source来源: Different Studies 多方研究

→ "Climate Neutral Germany" assumes that almost exclusively BEVs will be registered from 2035. A steadily decreasing proportion of internal combustion vehicles will remain in the fleet until the passenger car fleet in 2050 consists almost entirely of around 30 million BEVs.

→ 《德国迈向气候中和》报告中假设自2035年起，几乎所有登记注册的车辆均为电动汽车，内燃机车辆的占比将稳步下降，直至2050年完全退出乘用车车队，届时电动汽车约达3000万辆。



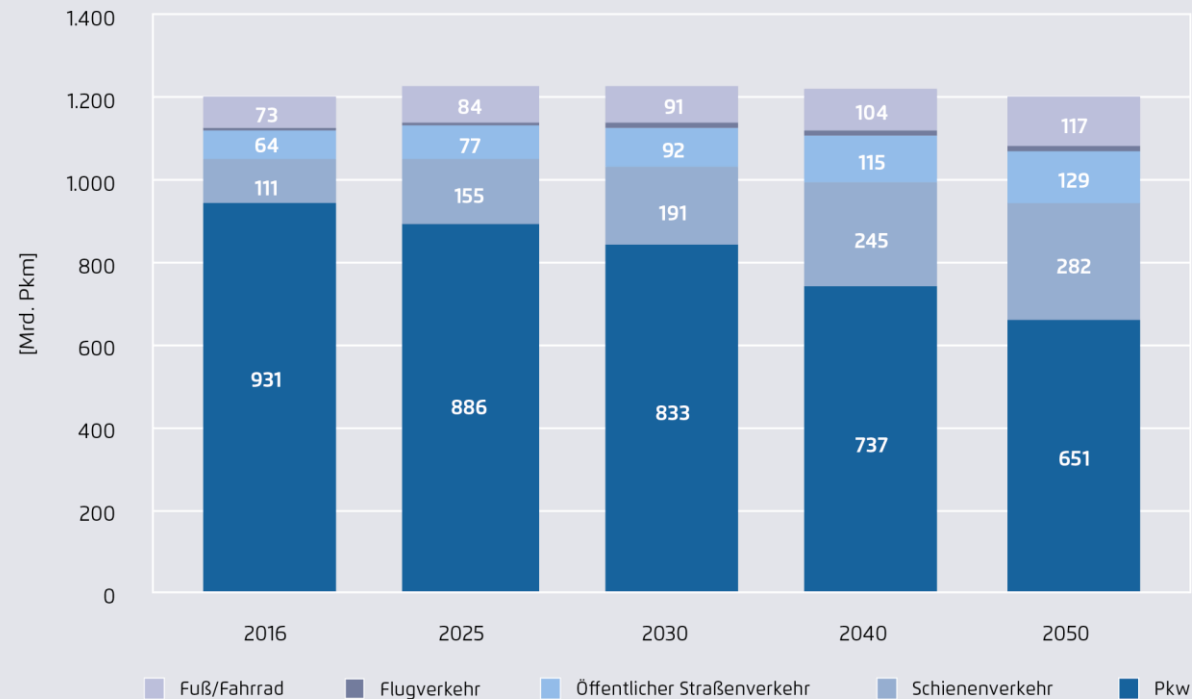
In cities, the mobility transition
has already begun.
在城市中，出行革命已经开始



Passenger Transport: Fundamental Mobility Transition is Key to Success

乘用交通：基本出行转型是获得成功的关键

Personenverkehrsnachfrage



Source来源: Prognos, Öko-Institut, Wuppertal Institut (2020)

- Passenger Transport Demand remains more or less stabil until 2045
- Public Transport needs to be doubled by 2035 together with an increase of cycling and walking.
- Pooling will increase the Occupancy Rate of Vehicles.
- LDV Transport Volume -13% until 2030 and -40% until 2045?
- 2050年以前的乘用交通出行需求基本稳定
- 到2035年，公共交通出行量需翻番，同时增加推广骑行和步行
- 共享出行将提高车辆的利用率
- 轻型车交通出行量到2030年降低13%，到2050年降低40%？

The Mobility Alliance 出行联盟



- Public Transport 公共交通
 - Suburban train 郊区火车
 - Underground 地铁
 - Tram 有轨电车
 - Bus 公交车
 - Taxi 出租车
- Non-motorised Transport 非机动车出行
 - Bicycle 自行车
 - Pedestrians 步行
- Collaborative Mobility 共享出行
 - Carsharing 共享汽车
 - Ridesharing 拼车出行
 - Bikesharing 共享单车

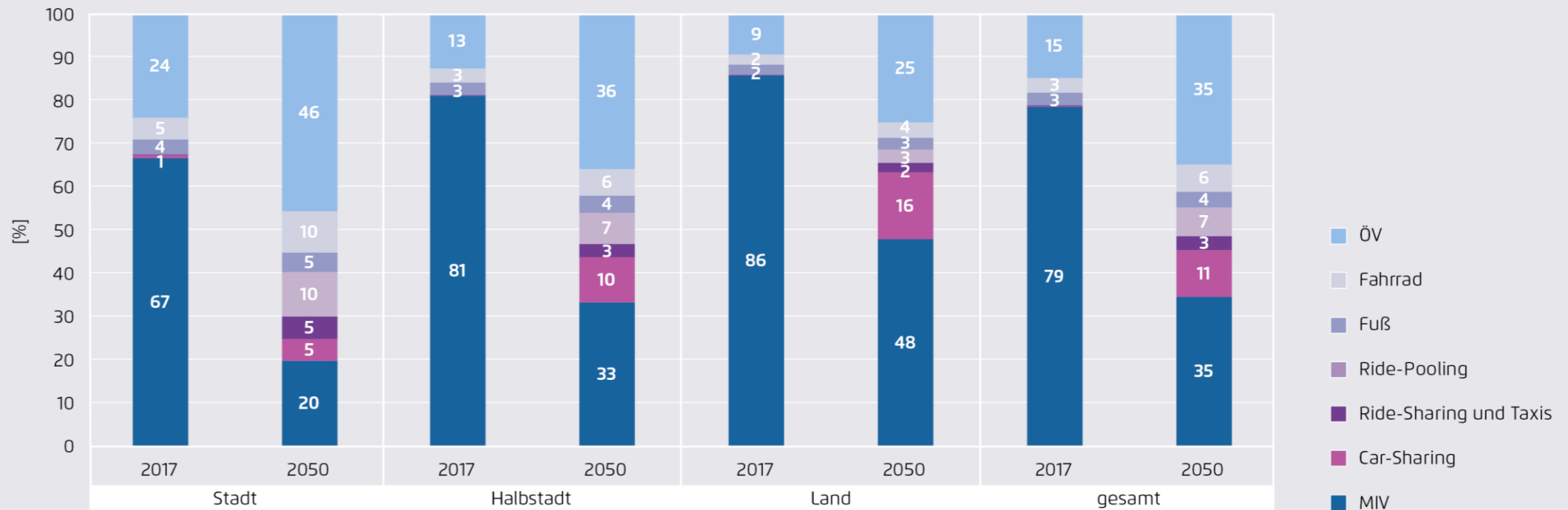
Shifting from Car Ownership to Public Transport, Pooling & Sharing!

At least in Metropolitan Areas.

从私人轿车向公交、拼车&共享汽车转型
至少在特大城市地区实现上述目标



Modal-Split for Cities and Rural Areas - 2017 and 2050. 城乡模式划分—2017年和2050年

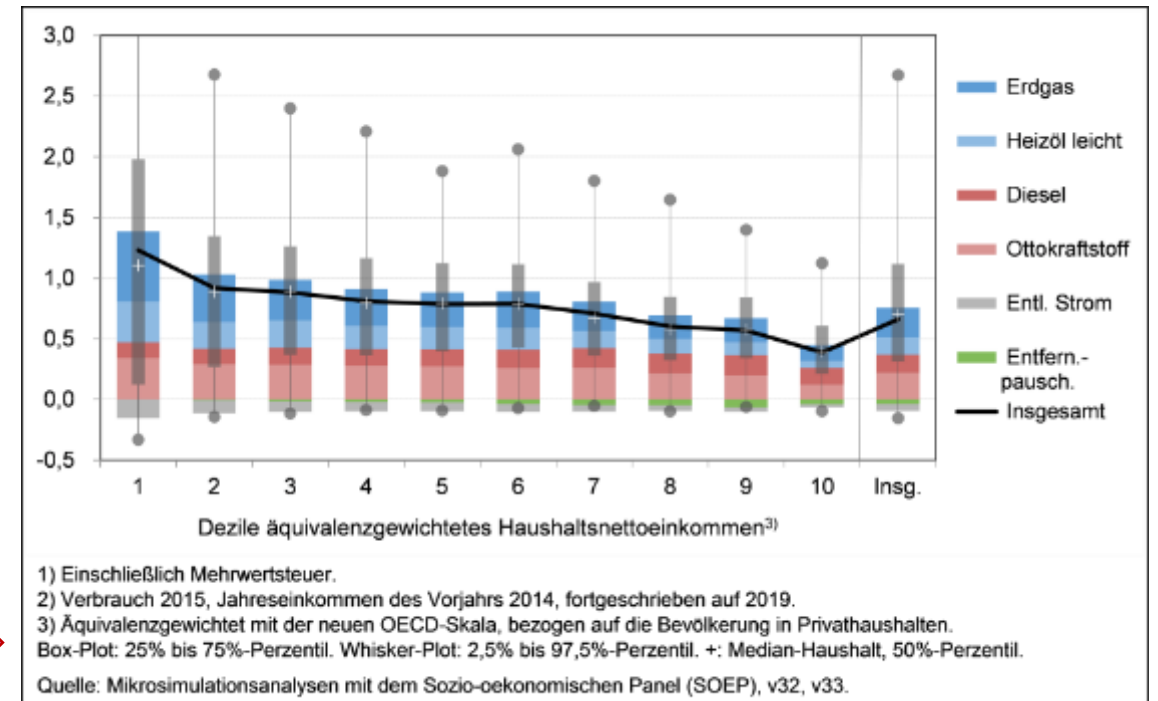


Source来源: Prognos, Öko-Institut, Wuppertal Institut (2020)

3.4 - Price setting for CO2 und energy carriers 二氧化碳和能源的价格设定(1/4)

General background 背景

- Fiscal policy at EU level is subject to **unanimity** in the Council
欧盟层面的财政政策须经欧盟理事会**一致同意**
- Therefore, **fiscal policy tends to be a national prerogative**
因此**财政政策往往是一种国家特权**
- **Emissions trading** is considered an environmental measure, not a fiscal measure, therefore subject to **qualified majority voting** in the Council
碳排放权交易 是一项环境措施，而非财政措施，因此须在欧盟理事会进行**特定多数表决**
- Economic measures in environment policy are often **socially regressive**
环境政策中的经济措施通常是**社会上产生累退效应**



3.4 - Price setting for CO2 und energy carriers 二氧化碳和能源的价格设定(2/4)

Beware of the Yellow Vests 请注意黄背心时间

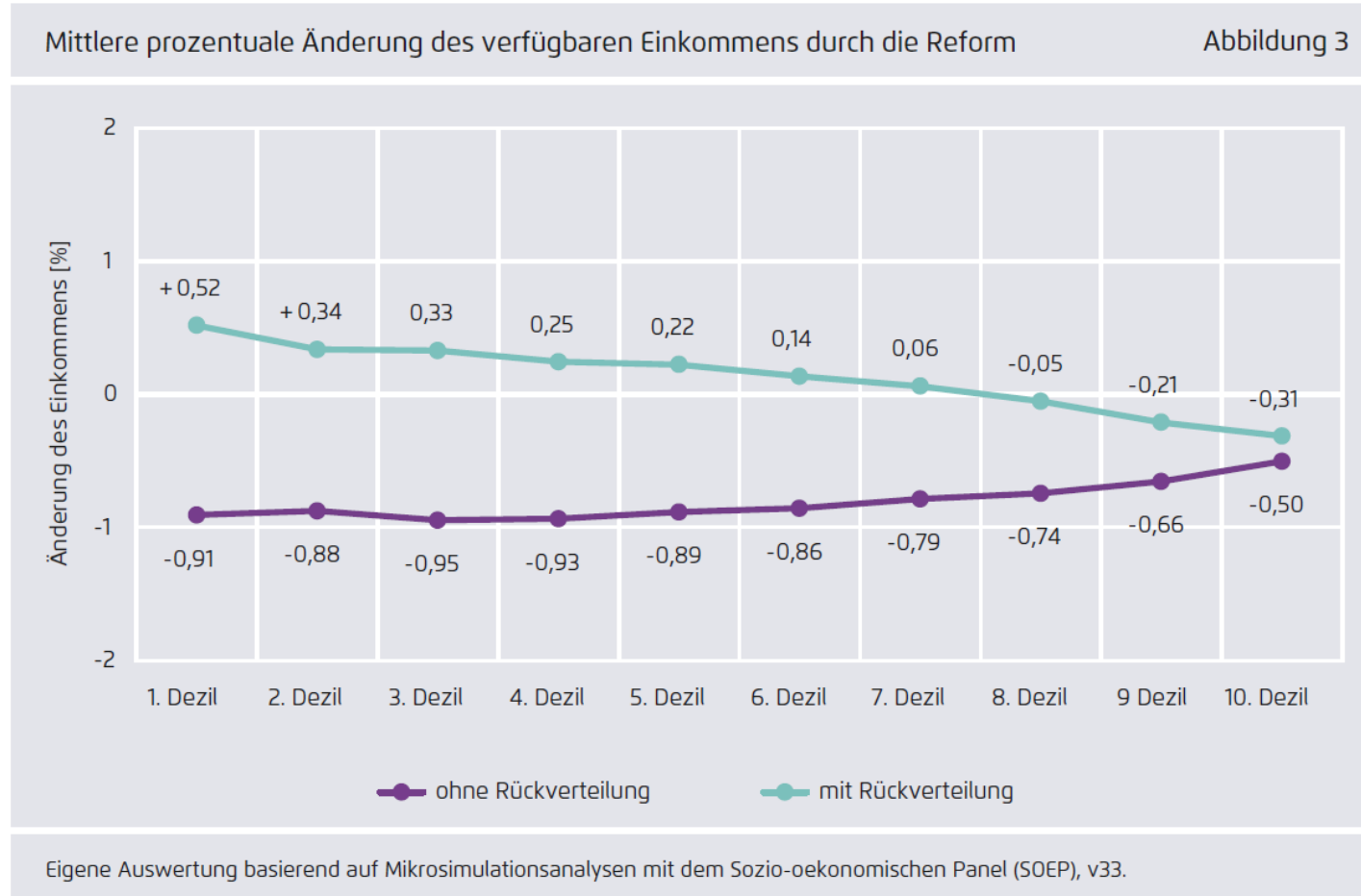


- October 2018: protests against fuel price rises in France caused by a green tax at a time of rising oil prices; also against speed limit reductions 2018年10月: 法国民众抗议政府在油价上涨时征收环保税导致燃料价格上涨; 同时也抗议降低道路的车辆限速。
- Quickly morphed into protest against social inequality, also in some other European countries 在欧洲其他一些国家还很快演变成对社会不平等现象的抗议
- Focused minds on the social implications of policies, notably environmental policies 抗议者关注政策（尤其是环境政策）的社会影响

3.4 - Price setting for CO2 und energy carriers 二氧化碳和能源的价格设定(3/4)

Redistributing the revenue of CO2 prices can turn regressive instruments into progressive ones

对碳价收入的重新分配，可以将其“累退（对低收入收取更多费用）”的特点转为“累进”。



3.4 - Price setting for CO2 und energy carriers 二氧化碳和能源载体的价格设定(4/4)

Proposed price instruments in the FF55(1/2)

- **Review of the EU Emissions Trading System (EU-ETS)**
 - Tightening of the emissions ceiling, faster down-ramp
 - **Inclusion of international shipping** in the scope
- New, parallel **ETS2 for road transport and buildings**
- Aviation
 - Domestic aviation: full auctioning from 2027
 - International aviation: implementation of CORSIA

FF55一揽子计划中建议的定价方法(1/2)

- **审核欧盟碳排放权交易体系 (EU-ETS)**
 - 收紧排放上限，加快排放下降速度
 - **将国际航运纳入**欧盟碳排放权交易体系范围之内
- 针对**公路交通与建筑**，设立新的、平行的碳交易体系 **ETS2**
- 航空碳交易
 - 国内航空：2027年起全面采用拍卖机制
 - 国际航空：执行《国际航空碳抵消和减排计划》（CORSIA）

3.4 - Price setting for CO2 und energy carriers 二氧化碳和能源载体的价格设定(4/4)

Proposed price instruments in the FF55(2/2)

- **Energy tax Directive:** unified minimum rate per energy 10,75 €/GJ (ca 350 €/1000 l)
 - No substantial change of minimum taxes for petrol and diesel
 - Would end the “diesel privilege”
- **Social climate fund**
 - Aims at energy-poor and rural car-dependent households
 - Size: ca 25% of the revenue expected from ETS2
 - 72,2bn € for 2025-2032
 - Member States must draw up social climate plans
 - At least 50% funding from MS (ETS revenue)
 - The Fund covers the rest

FF55一揽子计划中建议的定价方法(2/2)

- **能源税指令:** 每种能源的统一最低税率为10.75 欧元/GJ（约350欧元/1000升）
 - 汽油和柴油的最低税没有重大变化
 - 将终结“柴油特权”
- **社会气候基金**
 - 面向缺乏能源和依赖汽车的农村家庭
 - 激进规模：ETS2收入的约 25%
 - 2025-2032年基金规模为722亿欧元
 - 各成员国必须制定社会气候计划
 - 至少50%的资金由ETS 收入提供
 - 其余资金由“基金”提供。

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**Thank you very much for your
attention! 感谢您的聆听!**

Comments or Questions? – Please do not hesitate
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Agora Verkehrswende is a joint initiative of Stiftung Mercator
Foundation and the European Climate Foundation (ECF).