Electric mobility and transformation

- effects on value creation and employment
- sustainable location strategy in transformation

IndustriALL Global Union

Expert Group on the Transformation of the Automotive Industry

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Market penetration scenarios for electro mobility

Effects on value added and employment using the example of Baden-Württemberg

Regional economic policy in the transformation process to electro mobility

Research project: Structural study on BW^{e} mobile 2019

DLR Institute on Vehicle Concepts
- Electrification, trend development, scenario analysis, VECTOR21

IMU Institut GmbH
- Manufacturing 4.0, sector structure, value creation, employment

BridgingIT GmbH
- Digitalization, high-level automation, autonomous driving

- Coordinator: Deutsches Zentrum für Luft- und Raumfahrt e.V.
- Customer: e-mobil BW GmbH
- Term: Okt. 2017 – Okt. 2018
- Objective: **Classification of structural change for Baden-Württemberg as an automotive location**


DLR Institut für Fahrzeugkonzepte


IMU Institut GmbH

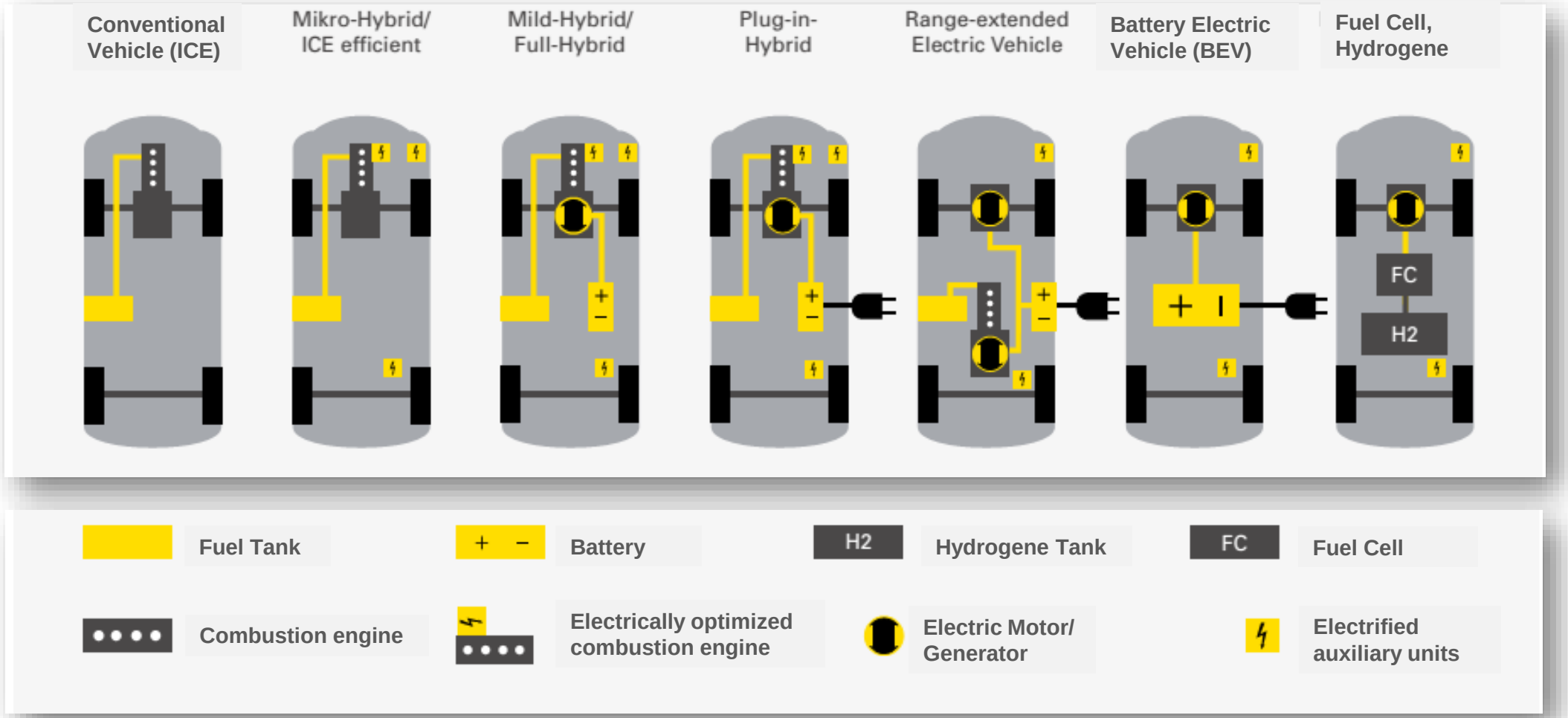

BridgingIT GmbH

Model region Baden-Württemberg

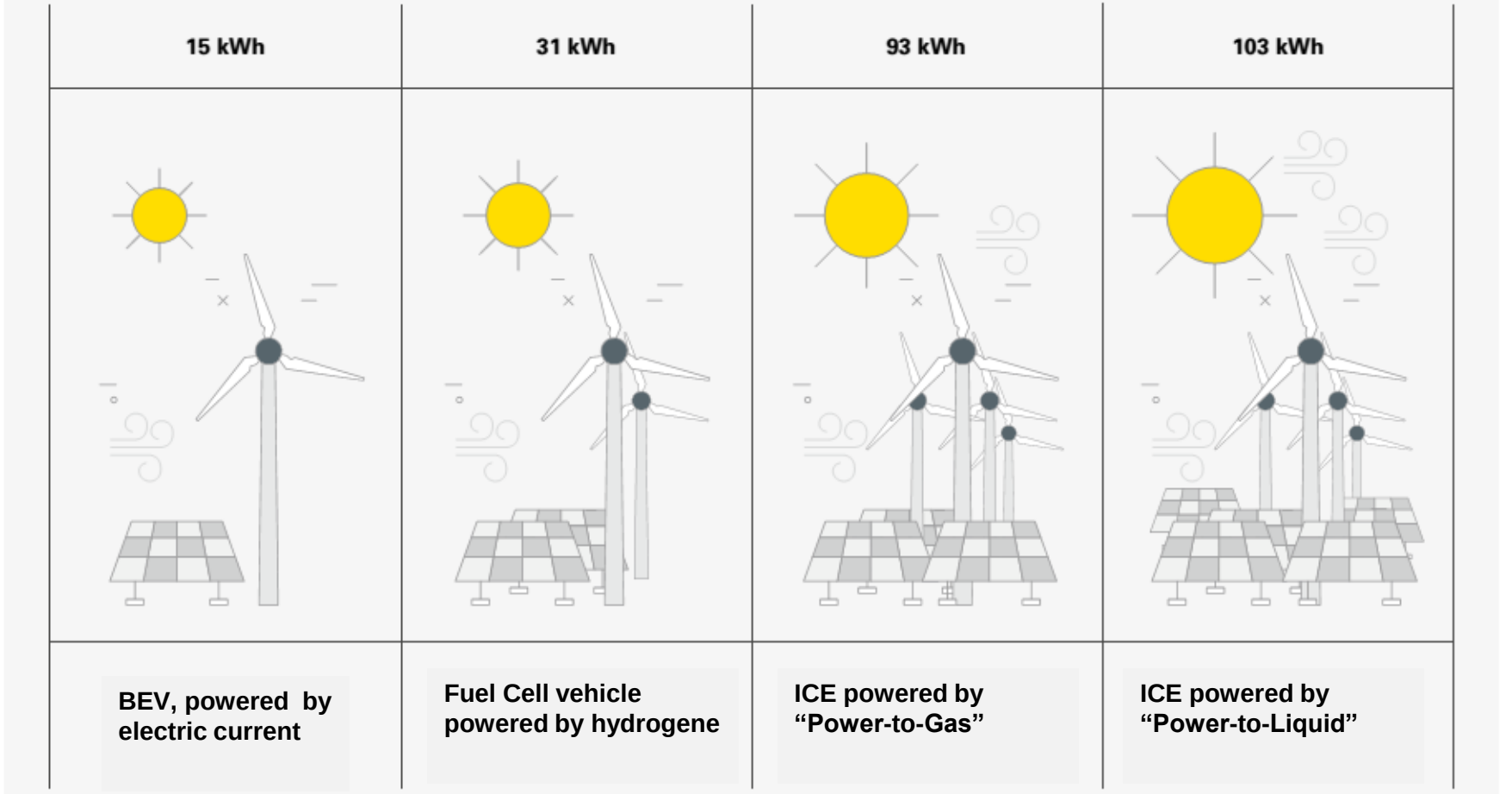
Baden-Württemberg
11 million inhabitants

PORSCHE
DAIMLER
Audi
BOSCH
MAHLE
ZF
BOYSEN
INNOVATIONEN ABGASTECHNOLOGIE
elringklinger
MANN+HUMMEL
KOLBENSCHMIDT PIERBURG
GETRAG
Freudenberg
LUK
Valeo
Eberspächer
DÜRR
HELLER
NAGEL
HONEN SUPERFINISHEN
MAG
HERMLE
besser fräsen
Gehring

Powertrain concepts on electric mobility



Power requirement for different drive concepts per 100 km



OEM-Forecast

Calculation of Scenarios by DLR

External influences

Politics & legislation | Energy & commodity prices | Availability of infrastructure | Manufacturing Capacities

Product offer

Vehicles
with differing characteristics

Discrete Purchasing Decision

Customers choice:

- Maximization of utility function
- Cost based decision following the TCO-Approach

VECTOR21 scenario analysis software

Product demand

Customers
with differing

- socio-economic characteristics
- practices
- preferences

Results

Market share | Cost development | Technology diffusion | Energy consumption | Vehicle configuration | CO2 emissions

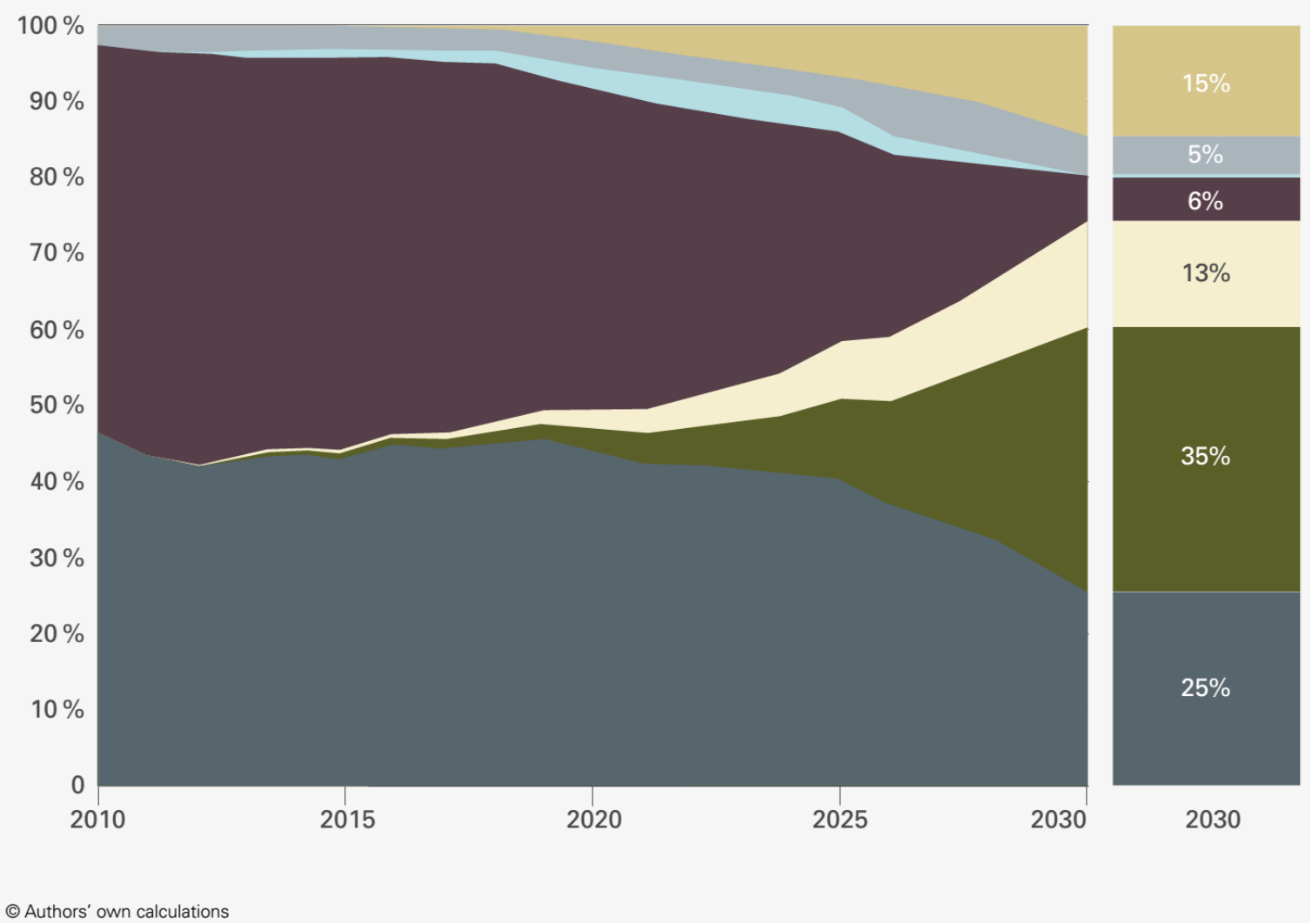
General Parameters

			2010	2015	2020	2030	Source
Energy price development (for both scenarios)	Oil price	€/bbl	59.5	67.2	74.9	90.3	[5]
	Gasoline price	€/l	1.41	1.46	1.52	1.63	Own calculation
	Diesel price	€/l	1.24	1.30	1.37	1.50	Own calculation
	CNG price	€/kg	0.94	1.11	2.06	2.17	[6]
	Electricity price	€/kWh	0.25	0.26	0.27	0.26	[7]
	H_2 price	€/kg	19.8	11.8	7.9	6.0	[8]
Availability of infrastructure (for both scenarios)	Fuel stations	%	100	100	100	100	Model assumption
	CNG stations	%	7	8	10	17	Model assumption
	H_2 stations	%	0	0	3	20	Model assumption

Parameters on scenarios

			2010	2015	2020	2030	Source
Specifics for business-as-usual scenario	Charging stations	%	0	5	31	58	Model assumption
	Maximum of BEV production	pcs./a	0	12,000	115,000	550,000	Model assumption
	CO_2 limit	g/km	–	130	95	67	[9]
Specifics for progressive scenario	Charging stations	%	0	5	35	75	Model assumption
	Maximum of BEV production	pcs./a	0	12,000	120,000	2,200,000	Model assumption
	CO_2 limit	g/km	–	130	95	50	Model assumption

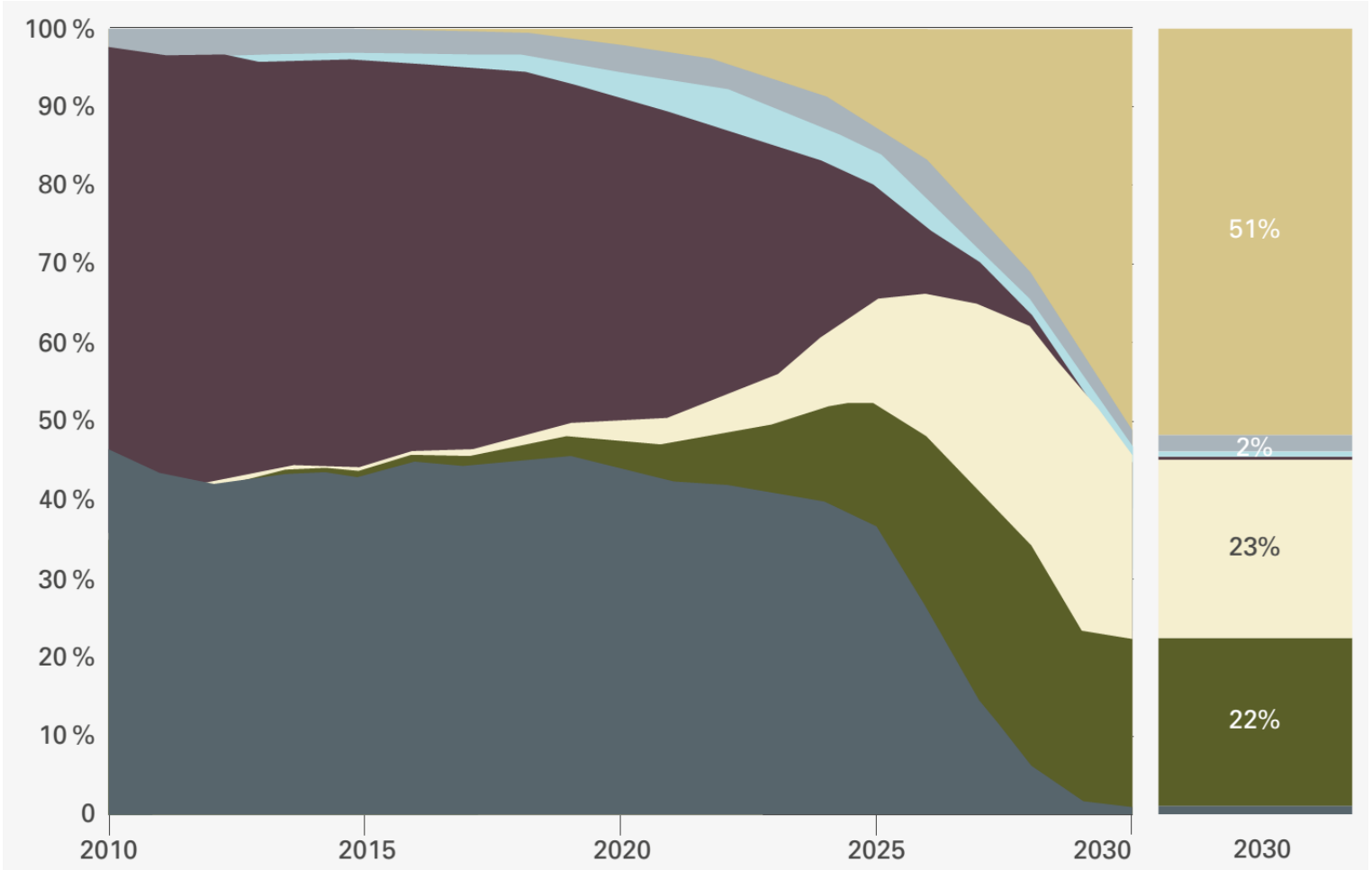
Business as usual scenario



© Authors' own calculations

DLR VECTOR21 scenario (business as usual) for the first-time registrations of passenger cars on the European market by 2030

Progressive scenario



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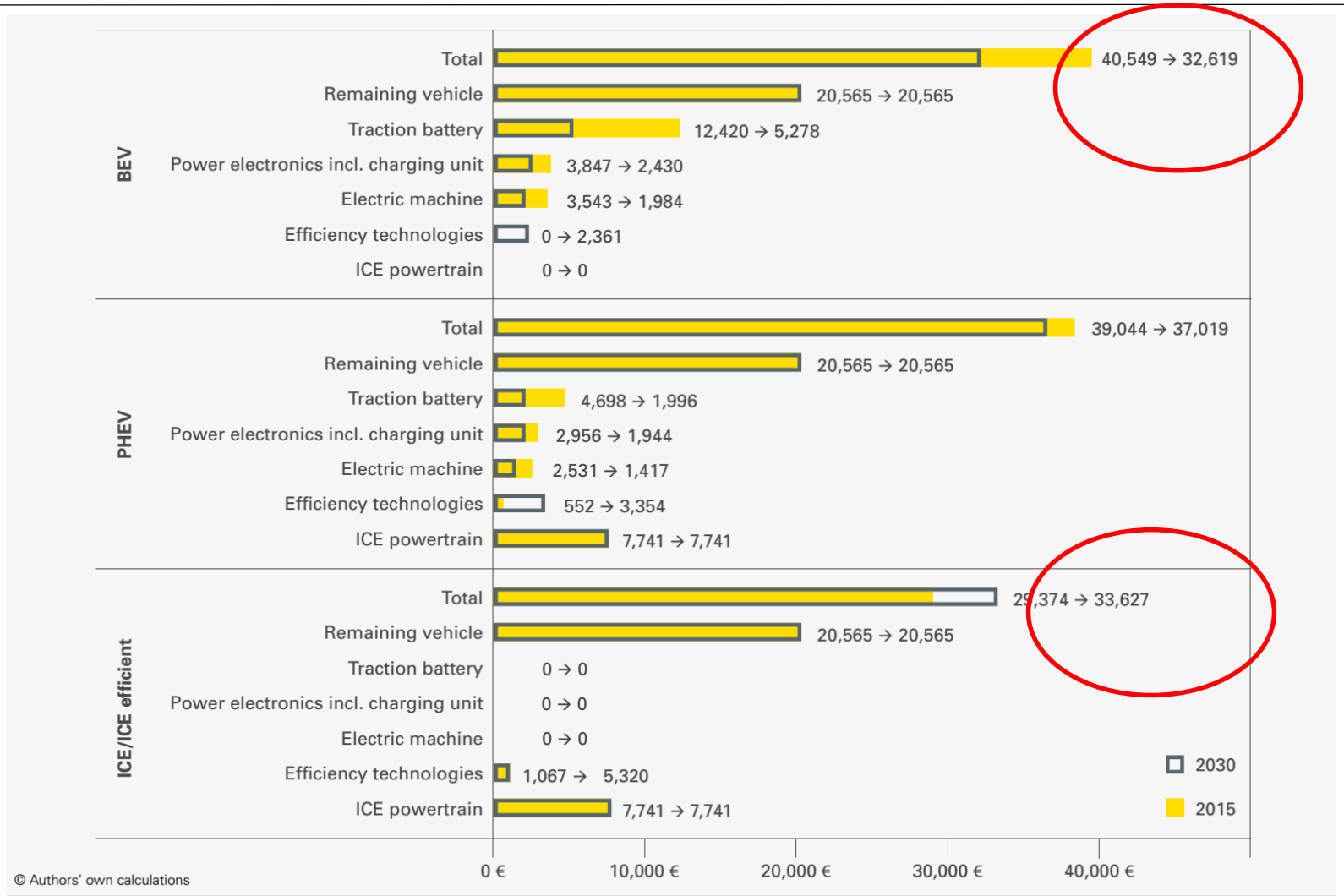
DLR VECTOR21 scenario (business as usual) for the first-time registrations of passenger cars on the European market by 2030

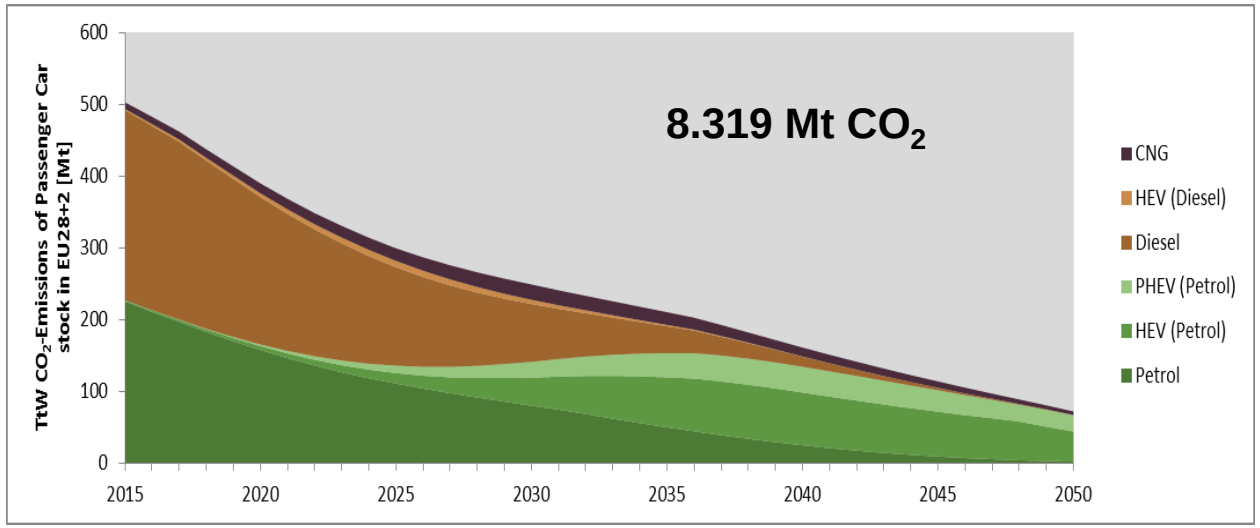
In progressive scenario BEV 2030 more favorable than ICE



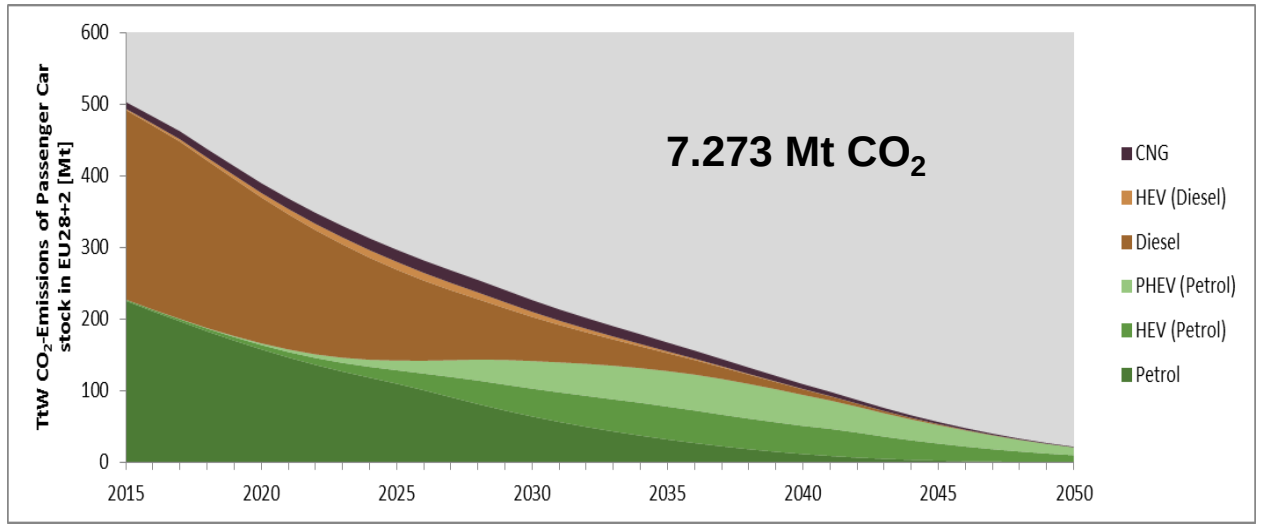
Example of (net) changes in costs of various mid-range vehicle types by 2030

CO_2-Emissionen of PC fleet Europe, EU28, Tank-to-Wheel 2050 (PC only, EU28)

Business-as-usual



Progressive



The EU 2050 CO2 targets can be achieved with the progressive scenario only, given that ...

- Strong CO2 reductions on ICE
- HP per PC remains unchanged
- Mileage per PC remains unchanged
- Other transport sector show an equal positive development.

That is highly unlikely!

Stopp climate change through a new culture of mobility

Electric mobility alone will not be able to stop climate change.

But without electro mobility the climate catastrophe will not be preventable!

The CO2 targets from the Paris Climate Agreement can only be achieved through a major change in the mobility culture. I.e. expansion of public transport and reduction of private transport!

- Strong expansion of e-mobility (progressive scenario).
- Car-Sharing und neue mobility services.
- Massive expansion of railways (passengers and cargo)!
- Expansion of public transport in cities.
- New public transport concepts for rural areas.

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Effects on value creation

Each engine type has different:

- components
- value creation
- labor impact

Components \ Engine types	ICE	HEV	PHEV	REEV	BEV	FCEV
	Changes to the systems by 2030					
Internal combustion engine	modified	modified	modified	modified	n.a.	n.a.
Starter and generator	modified	modified	modified	modified	n.a.	n.a.
Exhaust/ventilation system	modified	modified	modified	modified	n.a.	modified
Fuel supply	modified	modified	modified	modified	n.a.	modified
Gears	modified	modified	modified	modified/ n.a.	modified/ n.a.	modified/ n.a.
Electric drive	n.a.	new	new	new	new	new
Battery system	n.a.	new	new	new	new	new
Power electronics	n.a.	new	new	new	new	new
Internal charging system	n.a.	n.a.	new	new	new	n.a.
Fuel cell system	n.a.	n.a.	n.a.	n.a.	n.a.	new

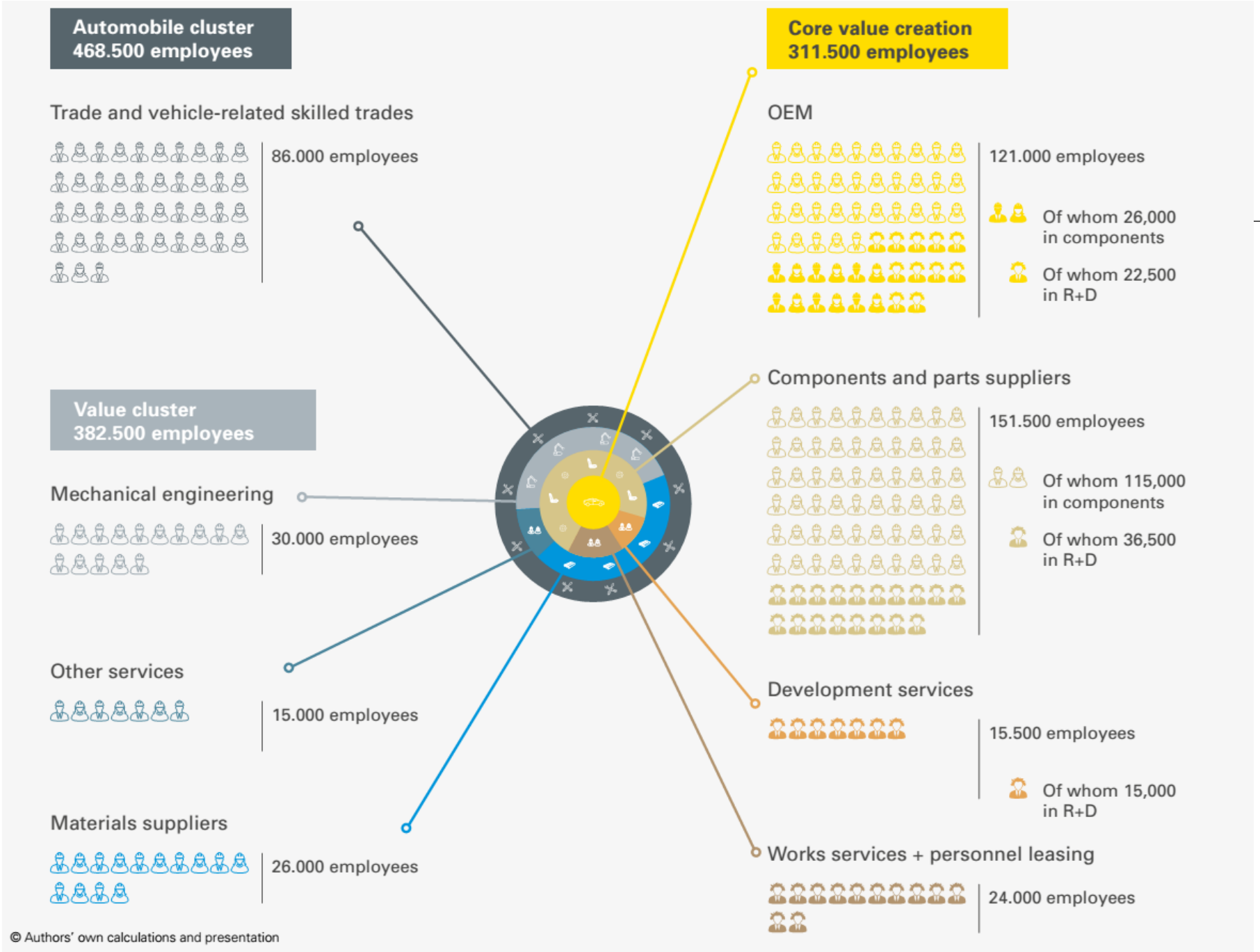
Overview of new, modified and no longer needed components, broken down by engine type

Findings from the ELAB 2 study show the labor impact for each type of power train (Petril ICE = 100%):

- Diesel 127 %
- Hybrid 121 %
- BEV 26 %

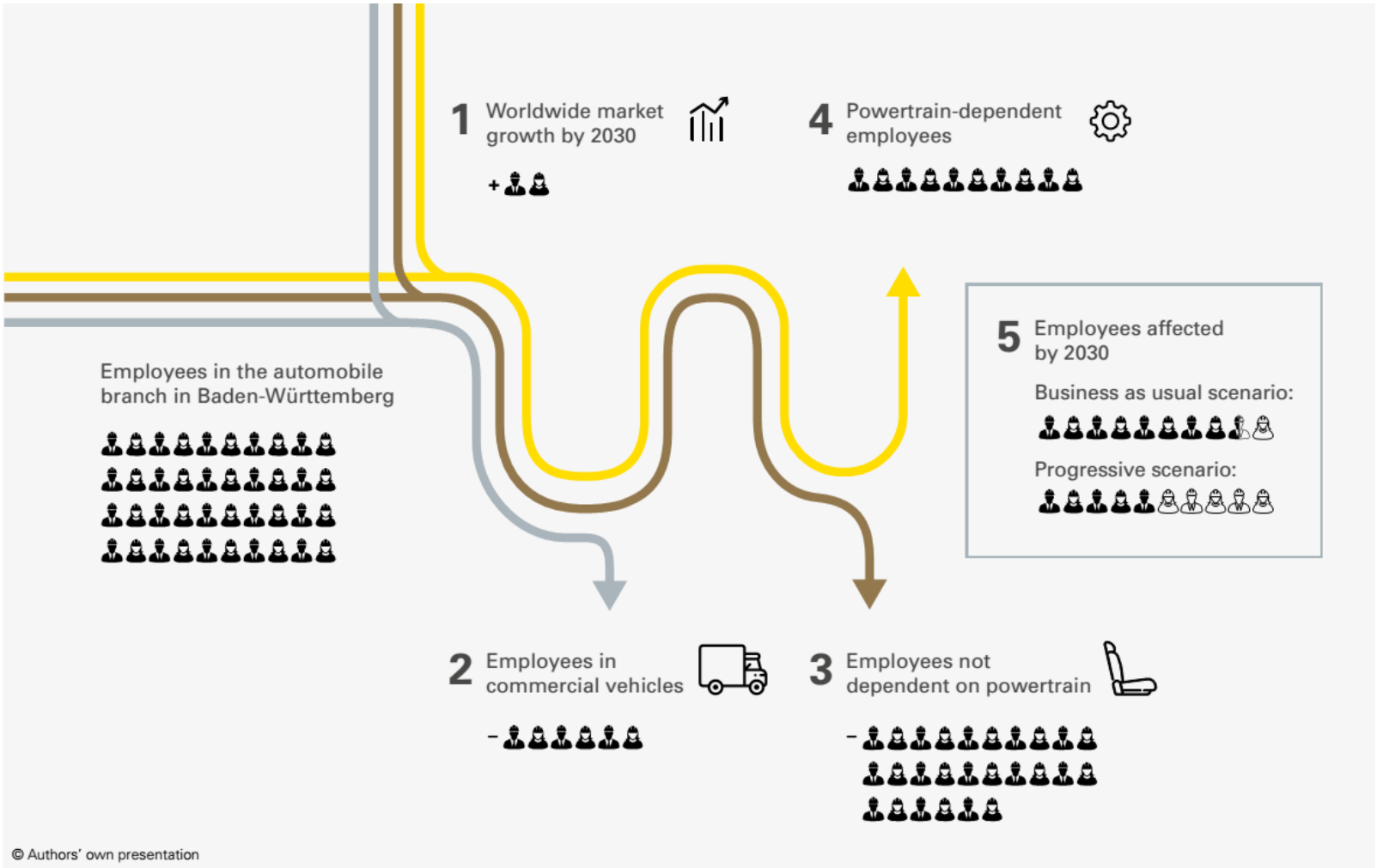
Gesamt-**Netto**-Personal-bedarfe in **2016** für die **Herstellung** von	Analys. Anteil der Beschäftigung in der jeweils betr. WSK	Beschäftigte bei 250.000 Stück/a	Beschäftigte bei 1.000.000 Stück/a
ICE Benzin (4 Zylinder, 100 kW)	60%	**~ 1.140**	**~ 3.990**
ICE Diesel (4 Zylinder, 100 kW)	60%	**~ 1.150**	**~ 4.030**
ICE-Peripherie Benzin (4 Zylinder, 100 kW)	25%	**~ 630**	**~ 2.100**
ICE-Peripherie Diesel (4 Zylinder, 100 kW)	25%	**~ 1.030**	**~ 3.380**
Automatikgetriebe (Doppelkupplung, 6 Gänge)	75%	**~ 940**	**~ 3.360**
Hybridgetriebe (Doppelkupplung, 6 Gänge) ein-schließlich Elektrischer Maschine (synchron, 75 kW)	75%	**~ 1.230**	**~ 4.420**
Elektrische Maschine (synchron, 100 kW) einschl. Getriebe, ohne Magnete (nicht in betrachteter WSK)	85%	**~ 530**	**~ 1.840**
Traktionsbatterie (60 kWh) ohne Zellen (nicht in betrachteter WSK)	70%	**~ 350**	**~ 1.320**
Leistungselektronik	55%	**~ 120**	**~ 420**
Fahrzeugeinbau bei ICE		**~ 270**	**~ 900**
Fahrzeugeinbau bei PHEV		**~ 430**	**~ 1.450**
Fahrzeugeinbau bei BEV		**~ 210**	**~ 680**

Abbildung 4: Personalbedarfe für die Komponentenherstellung bei analysiertem Antei der Beschäftigung in der jeweils betrachteten WSK sowie für den Fahr-zeugeinbau im Jahr 2016 (netto)



Employment structure in Baden-Württemberg's automobile cluster

Labor impact of fade-out of ICE related components

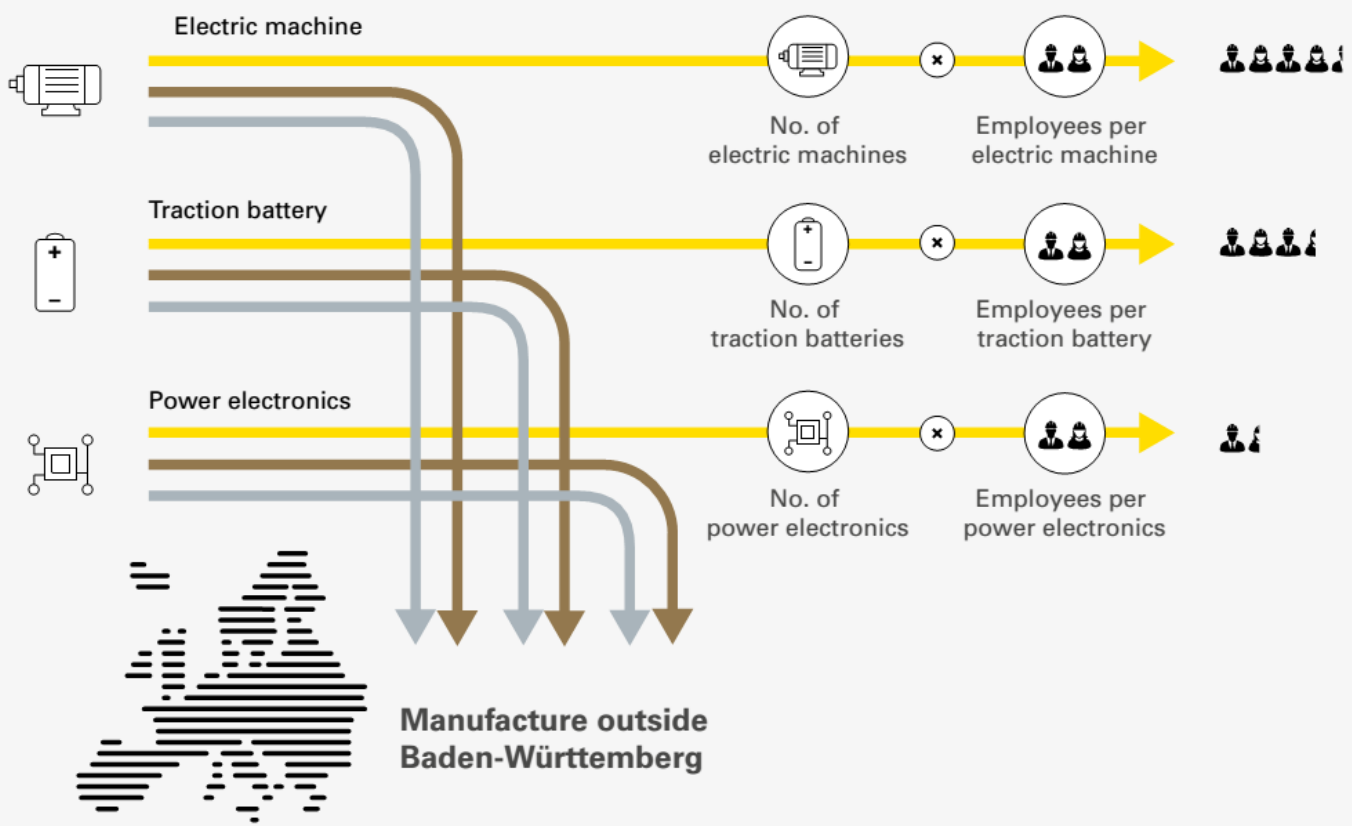


Procedure used to identify the number of employees affected by electric mobility in 2030

Overall effect fade out ICE componentes until 2030:

- **BAU scenario**
  + 1.200 employees
- **Progressive scenario**
  - 45.000 employees

Labor impact of face-in of new components



Procedure used to identify the number of employees potentially affected by new components in 2030

Overall effect of new components until 2030

Assumption that 8% of all new components will be manufactured in Baden-Württemberg

- **BAU scenario**
  + 8.000 employees
- **progressives scenario**
  + 15.000 employees

Effects for the entire sector

	Workforce in 2016	Overall effects in 2030 (Business as usual)		Overall effects in 2030 (Progressive)	
Total for automobile cluster as a whole (including vehicle trade)	468,500	8,900	1.9 %	–30.800	–6.6 %
Impacts on employment of electric mobility in vehicle trade					

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No threat to the industry as a whole with a successful transformation:

The transformation will only be successful if:

- the **innovation leadeership** is maintained
- A share of **8% of all new components** will indeed be built in the region of Baden-Württemberg

Most concerned employees

However, each value-added segment is affected quite differently.

Two groups of employees are particularly affected :

I. Huge challenges for R&D:

- Employee levels will stay more or less the same but ...
- 10-15 % of the 70,000 R&D employees have to be retrained for new assignments/technologies!

Betroffene Beschäftigte

II. Powertrain related manufacturing plants will be hit hard!

		Powertrain workforce in 2016	Powertrain workforce in 2030 (Business as usual)		Powertrain workforce in 2030 (Progressive)	
Fade-out of powertrain-dependent manufacture		**69,600**	**–7,100**	**–10.2 %**	**–32,300**	**–46.4 %**
Productivity and low-cost-country strategy			–11,600		–6,800	
Development without fade-in			**–18,700**	**–26.9 %**	**–39,100**	**–56.2 %**
Fade-in potentials in manufacturing			5,000		7,900	
Overall balance of impacts		**69,600**	**–13,700**	**–19.7 %**	**–31,200**	**–44.8 %**

Impacts of electric mobility on employment in powertrain-dependent production plants

Baden-Württemberg as a cluster of industrial innovations

Baden-Württemberg's economic strength lies in its highly developed industrial innovation cluster, which is based on the close coupling of production knowledge and top performance in R&D.
The state's industrial innovation cluster is based on the development of a new technology for the production of innovative products. The transformation to electro mobility offers opportunities and challenges for this industrial innovation cluster.

Opportunities:

- The reinvention of the passenger car requires precisely this innovation network!

Challenges:

- There are new requirements for R&D excellence (AI, e-mobility, digitization, etc.)
- In order to maintain the innovation cluster, production plants for all e-components in Baden-Württemberg are required.

An important success factor for the transformation of the industrial innovation cluster of the industry lies in the transformation of the manufacturing plants!

Structural study on BW^{e} mobile 2019
Conclusions

If it is possible to prepare the specific industrial innovation cluster for the new tasks, the transformation to electromobility will strengthen the economic region of Baden-Württemberg.

This requires joint efforts on the part of industry, politics and employees. The following is required:

- A qualification offensive also in the field of R&D.
- Maintaining and expanding the link between R&D and manufacturing plants.
- The expansion of added value of all e-components in the region.
- Concrete transformation plans for the powertrain plants in Baden-Württemberg.
- Labor market policy support for the structural change.

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Employment security in the e-mobility transformation process

I. A good corporate strategy is an important prerequisite for maintaining employment in the e-mobility transformation process!

II. Not every good corporate strategy is a good location strategy!

- If all internal combustion engine sites are used until the end and then closed down.
- When the new competencies are acquired through international company acquisitions and are not used at the existing locations.

III. Safeguarding employment in Germany always also means sustainable development of the existing (manufacturing) locations!

IV. Therefore, the corporate strategy must be supplemented by intelligent location strategies!

- This will not be possible without the active involvement of the works councils (and committed plant managers).

Example

Automotive supplier:

- 80,000 employees worldwide, approx. 12,000 in Germany
- 20 sites in Germany
- More than 80% of the sites in Germany depend on combustion engines

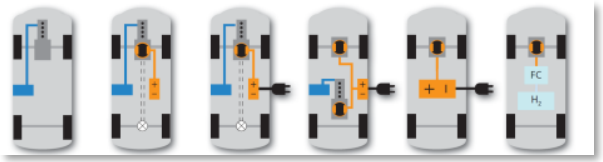
Company strategy:

- Transformation of portfolio through the acquisition of competences in the area of e-mobility
- Acquisition of an e-motor manufacturer with 2,000 employees and of an electronics manufacturer

IG Metall strategy:

- The existing **collective agreement on employment security** states that all sites have to adapted to change
- At the **supervisory board** the demand was tabled to prepare also the German sites for the new era of e-mobility
- The management was instructed to develop **future-oriented concepts** or all **German sites** together with the employee reps (IMU-Institute as advisor)

How to elaborate the future concepts <automotive supplier>



Allocation of powertrain types
(ICE, Hybrid, Electric, Fuel Cell)

Workshops on fostering potential

Interviews Business Unit Experts

Working Group ‘technology‘

Interviews external experts

I. Impact Analysis 2030

Product portfolio	DLR-scenarios

II. Profile of expertise of site

Self-assessment	External assess.

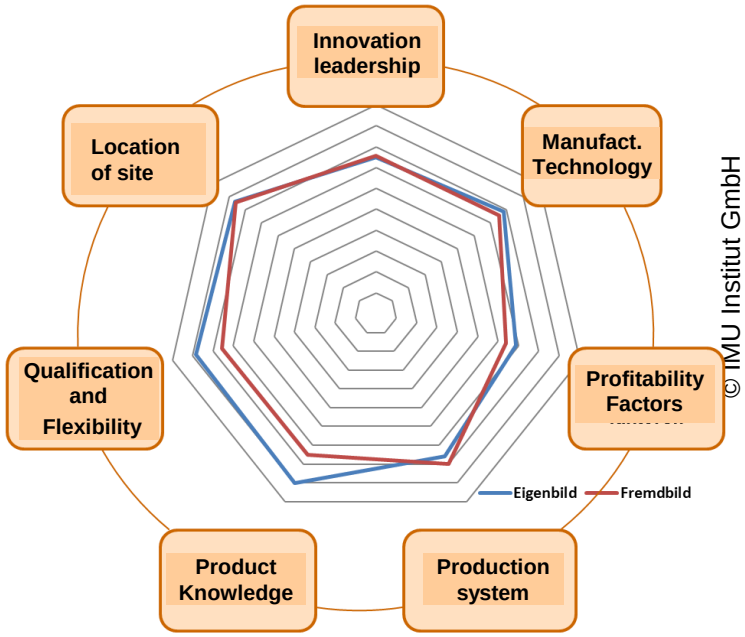
III. Development of future concept for site

Future potential of existing product portfolio	New products and applicability in e-mobility
Future trends manufacturing technology	Requirements on innovation leadership

IV. Derivation of concrete actions

Product volumes by 2030

Volume by Product in Mio. St.	Fcst.2 2017	Szenario "GP" 2030	Differenz 2022 / 2030 "GP"
Air Intake Modules & Components & Actuators	1,29	0,80	-0,67
Air Cleaner Modules & Components	0,57	0,33	-0,26
Cover / Crankcase Ventilation Modules (40%)	0,13	0,04	-0,03
Oil Filters	0,27	0,07	-0,03
Industrial Filtration	0,03	0,03	+0,01
Others (95%) - Transfer STM, ext./int. Customers	0,35	14,75	-2,18
Subtotal sheet metal	2,64	16,03	-3,15
Cover / Crankcase Ventilation Modules (60%)	0,19	0,07	-0,04
Tank Ventilation Modules	0,11	0,01	+0,00
Pump Systems	0,52	0,09	-0,03
Subtotal plastic	0,82	0,17	-0,07



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