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SHIFT TO ELECTRIC VEHICLES:
LONG-TERM EFFECTS

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2 Foreword

1. By the end of 2016 Electric Vehicles (BEV+PHEV) provided:
   - 0.2% of world cars fleet
   - 0.04% of world electricity consumption
   - 0.005% of world primary energy consumption

   Currently for world energy sector EVs are comparable to zero

2. World energy sector is very inert
   The last example of a rapid change in the world energy consumption structure is the spread of renewable energy sources, namely solar and wind energy. Since 2005 with high oil prices technological progress in the RES has been reached – their economic characteristics significantly improved. Many countries practice government support for RES. Since 2010 the annual investments in solar and wind energy has constantly exceeded $200 bln

   As a result in 2005-2015 the share of solar and wind energy
   - increased from 0.6% to 4.5% in the structure of the world electricity generation
   - Increased from 0.15% to 0.9% in the structure of world primary energy consumption

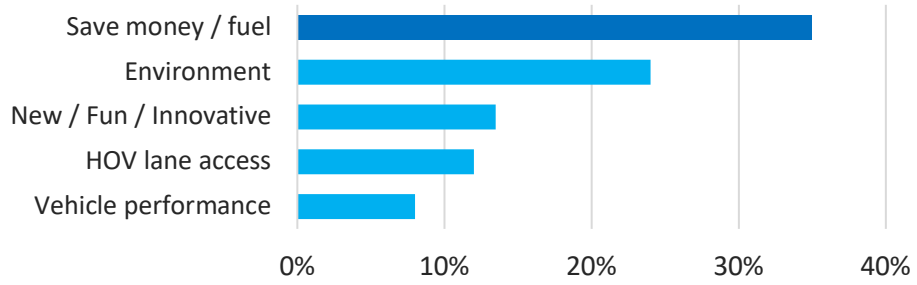
3. EVs spread process will be slow and may have wide range of trajectories

Source: IEA

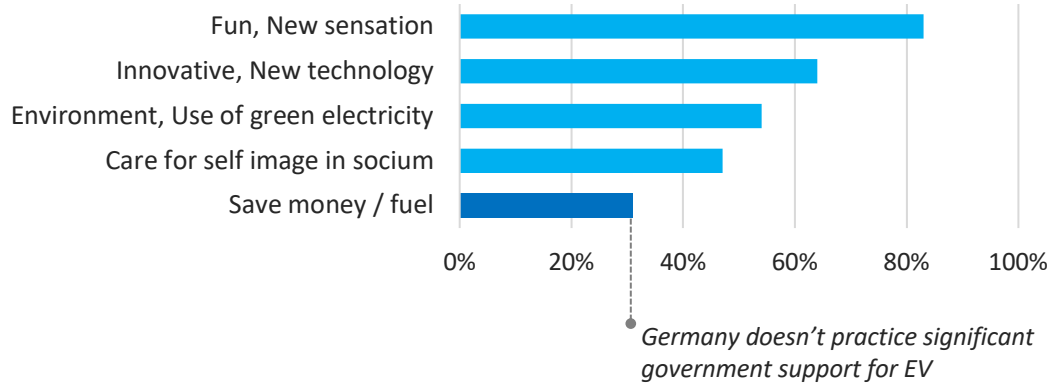
3 Why do people buy EVs?

Sociological studies show that economic factors have a decisive influence on the consumer's choice to buy EV or to refuse of such purchase

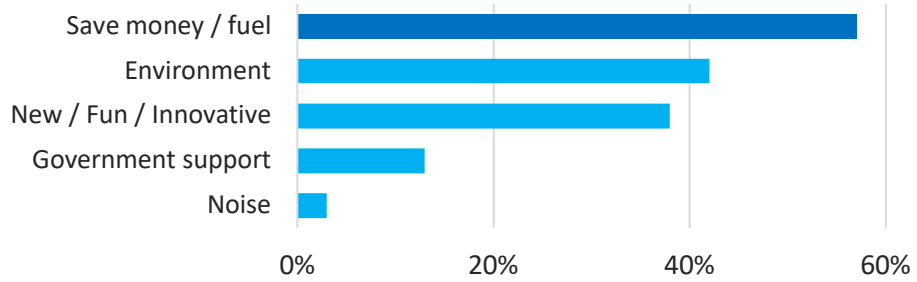
Main reason for buying EV – US, California



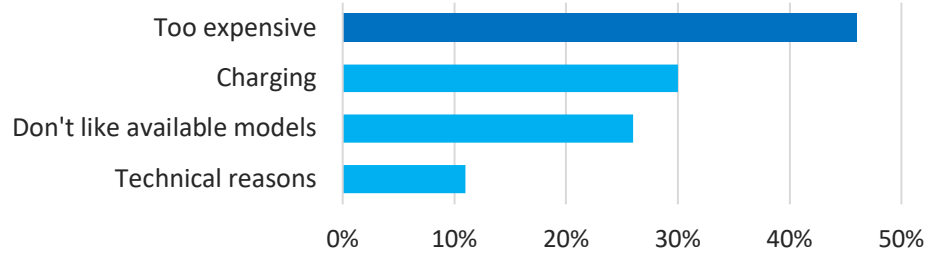
Reason for buying EV – Germany



Reason for buying EV – UK

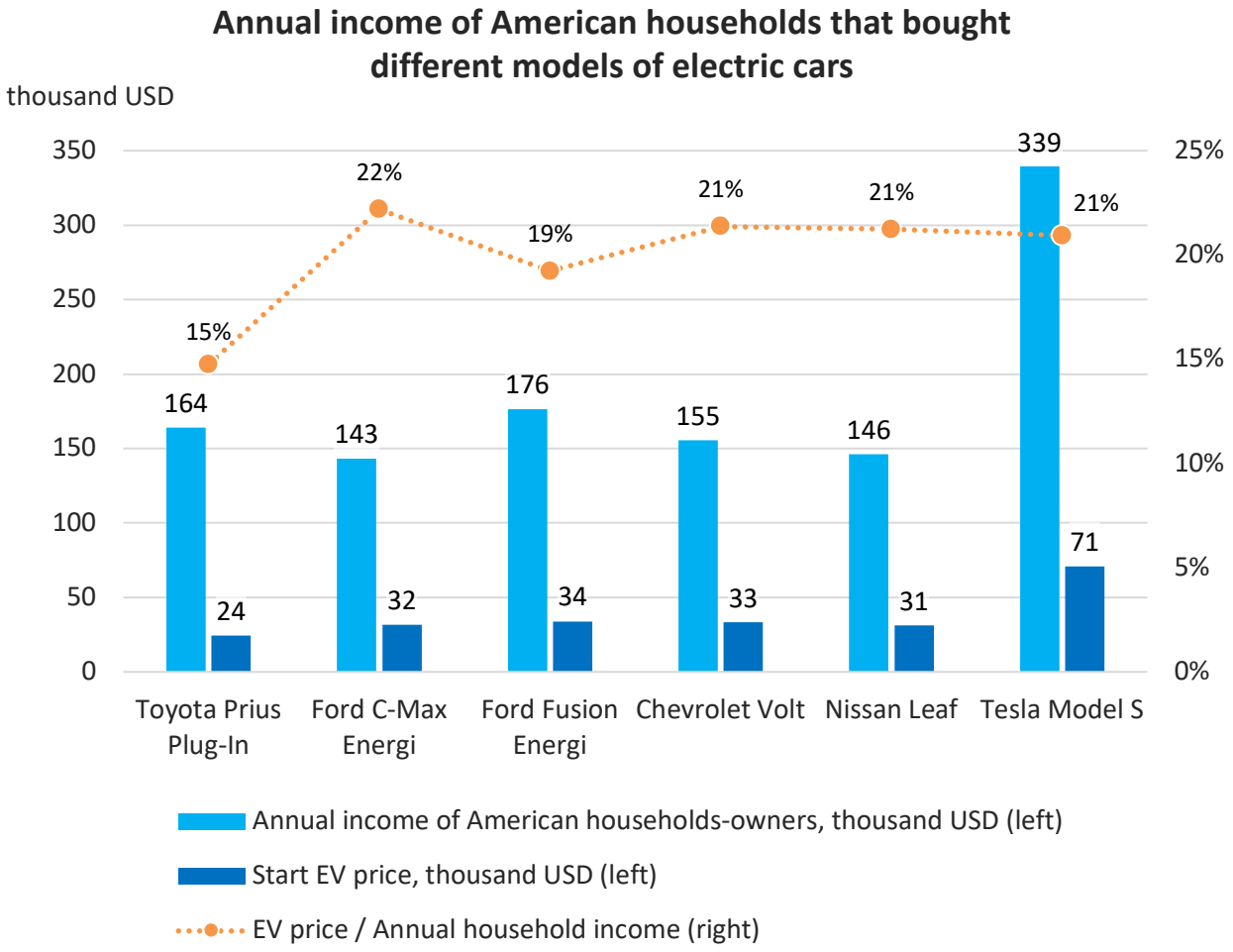


Reason for not buying EV – Germany



Источники данных: EVObsession 2015, M. Vogt. German Emobility User survey 2015

Who buys EVs?

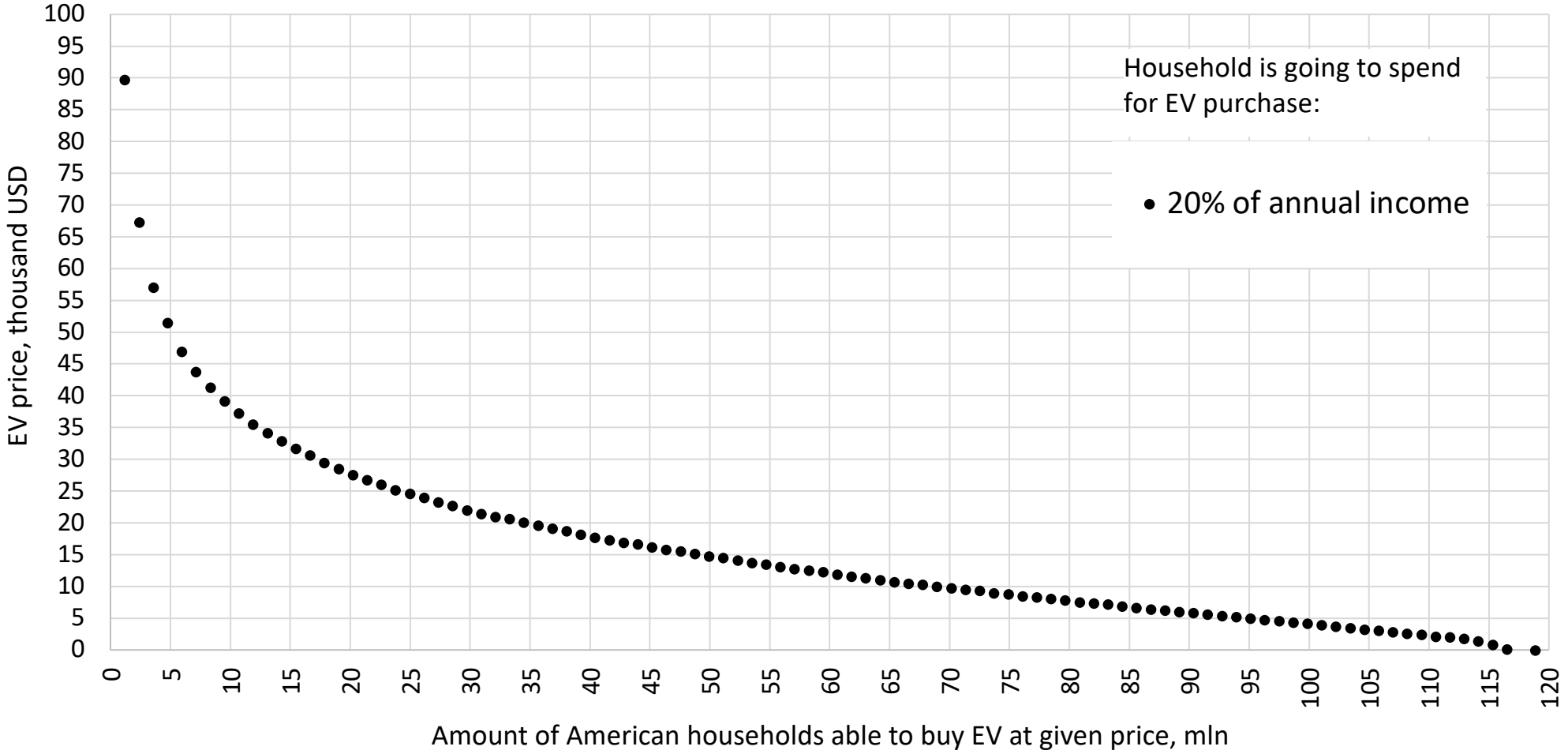


1. Price of electric car purchased was about 20% of annual income of households-buyers. And this is valid as for relatively cheap models (by the standarts of EVs) with price of 30-35 thousand USD, and for more expensive Tesla Model S.

2. Tesla model 3 is not the cheapest model of electric car. Average American household that will buy Tesla model 3 is likely to have annual income 170-180 thousand USD

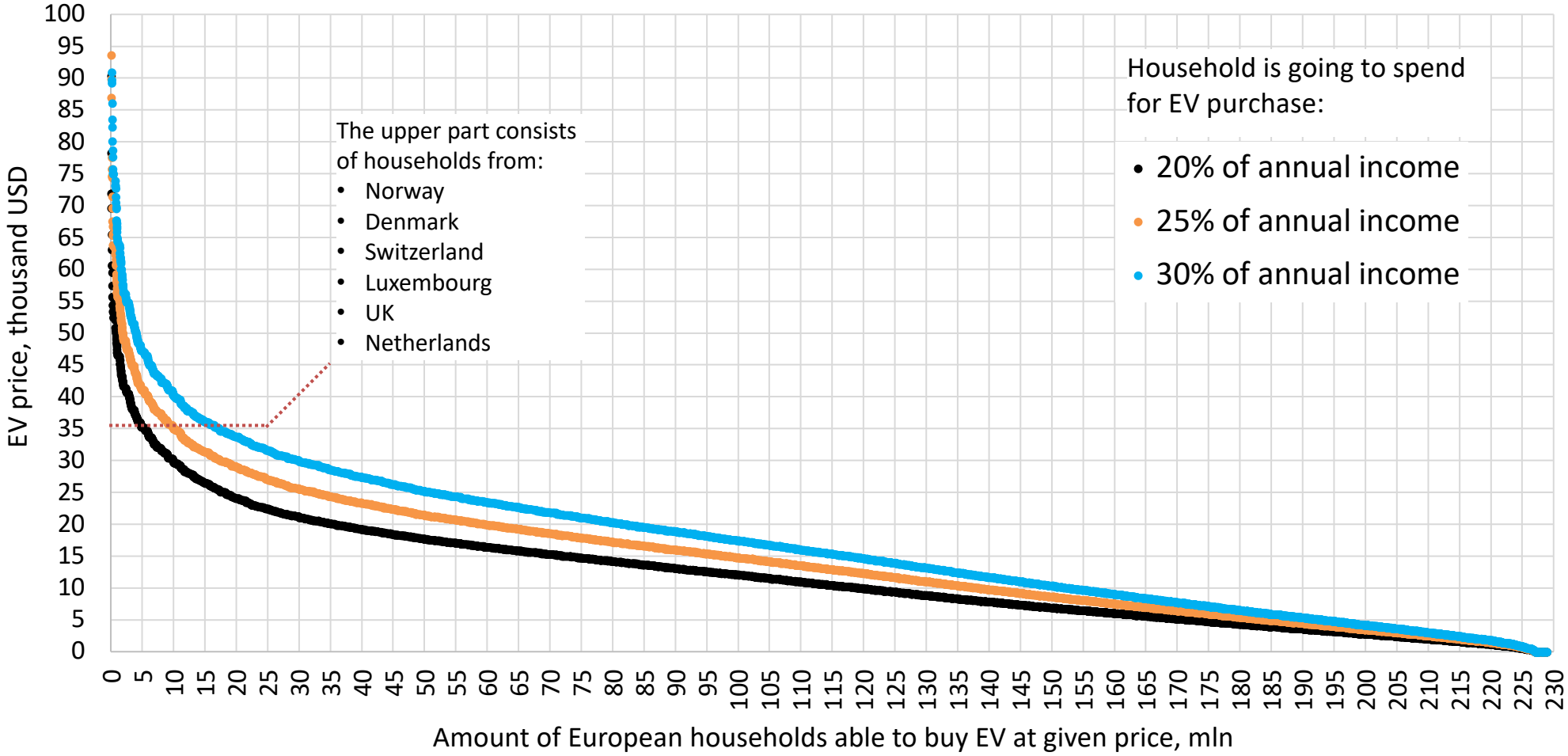
Source: Electric Power Research Institute.
Plug-In Electric Vehicle Multi-State Market and Charging Survey 2016

Amount of American households able to buy electric car depending on its price



Source: IEF RAS estimations based on DQYDJ United States Household Income Brackets and Percentiles in 2017

Amount of European households able to buy electric car depending on its price



Source: IEF RAS estimations based on Eurostat Distribution of income statistics

Potential demand for EVs in the United States and Europe

Currently, the IEA scenario, corresponding to the fulfillment of the goals declared in the Paris Agreement, suggests the increase of EV fleet to 120 million by 2030 (about 10% of the total world cars fleet)

If we assume that approximately half of the fleet will locate in the US and Europe (as it is now), then EV fleet here should reach 60 million

If each household purchases only one electric car, then in order to implement such a scenario, average price of electric vehicles purchased must be reduced to $24,000 (25-30% below today's typical levels, which vary in the range of 31-35 thousand USD)

If each household buys 2 electric cars, then the price of $30,000 will be acceptable (10-15% below current typical levels)

But these estimates are valid only if all households choose the electric vehicle, not ICE one

Scenarios of EVs spread

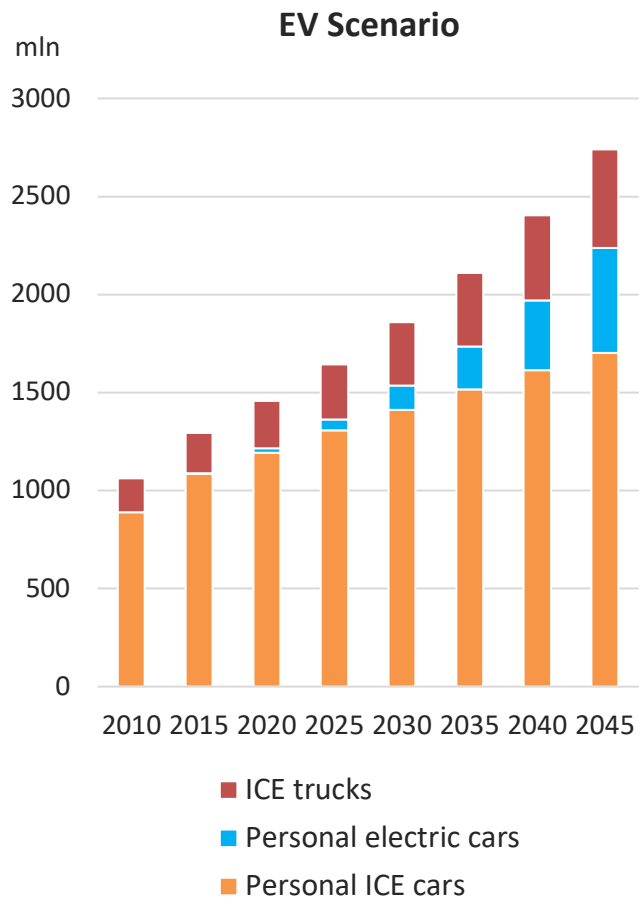
	2010	2015	2020	2025	2030	2035	2040	2045
Common parameters								
World population, mln	6958	7383	7795	8186	8551	8893	9210	9504
World GDP growth rate (average for 5 years)	3.7%	3.4%	3.4%	3.3%	3.1%	2.9%	2.9%	2.8%
Energy intensity of World GDP (2010 = 100)	100	91	84	76	69	63	57	52
EV Scenario								
World cars fleet, mln	888	1087	1215	1362	1534	1735	1969	2238
Personal ICE cars fleet, mln	888	1086	1194	1306	1413	1515	1615	1701
Personal electric cars fleet, mln		1	21	56	121	220	354	537
World ICE trucks fleet, mln	173	208	242	281	325	376	435	502
EV Trucks Scenario								
World cars fleet, mln	888	1087	1215	1362	1534	1735	1969	2238
Personal ICE cars fleet, mln	888	1086	1194	1306	1413	1515	1615	1701
Personal electric cars fleet, mln	0	1	21	56	121	220	354	537
World ICE trucks fleet, mln	173	208	242	275	306	335	361	377
World electric trucks fleet, mln				6	19	41	74	125
EV Trucks + TaaS Scenario								
World cars fleet, mln	888	1087	1215	1356	1472	1561	1618	1680
Personal ICE cars fleet, mln	888	1086	1194	1298	1330	1283	1147	957
Personal electric cars fleet, mln		1	21	56	121	220	354	537
TaaS electric cars fleet, mln				2	21	58	117	185
World ICE trucks fleet, mln	173	208	242	275	306	335	361	377
World electric trucks fleet, mln				6	19	41	74	125

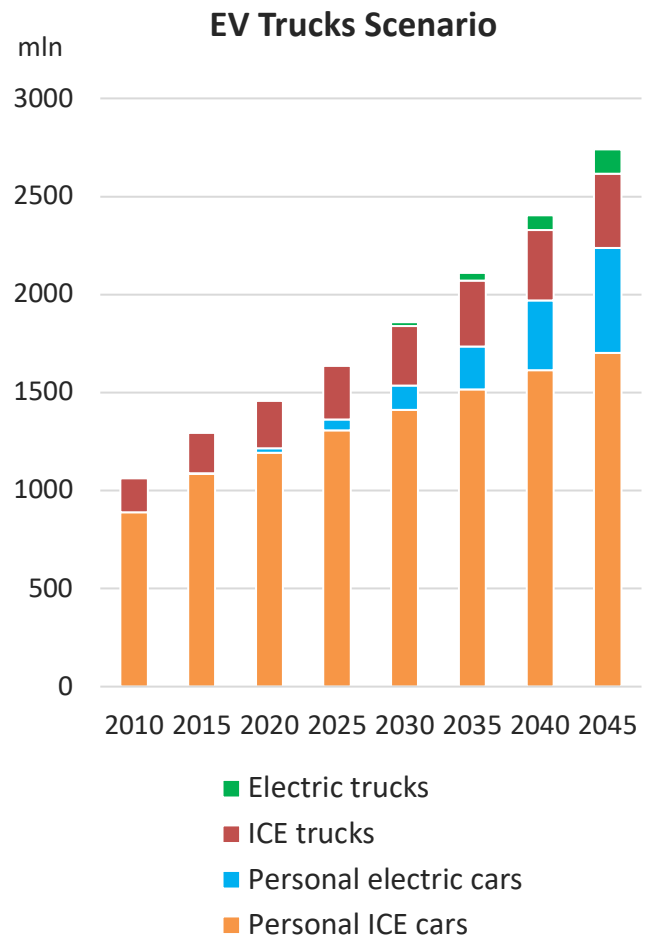
The effect of personal electric cars spread is not very impressive. A multiplier is needed

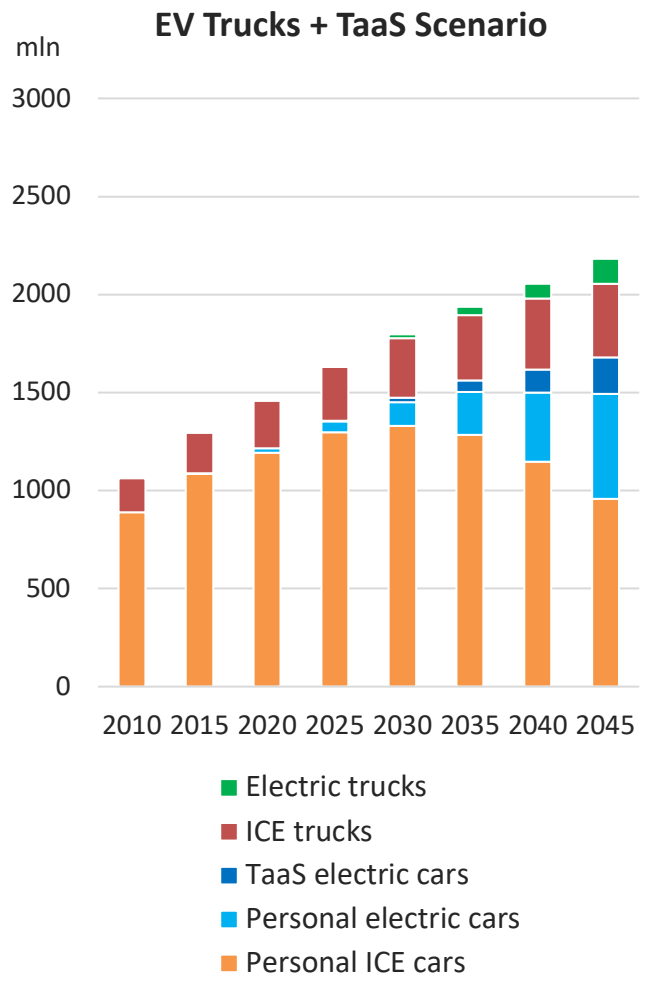
Due to the greater mileage and fuel consumption, the replacement of one truck by an electric analogue gives 5 times more significant effect than the replacement of car

We assume that each TaaS electric car may replace 4 personal ICE cars, but due to a 4-times increase in the average mileage. This is also a way to make electric car cheaper for consumer

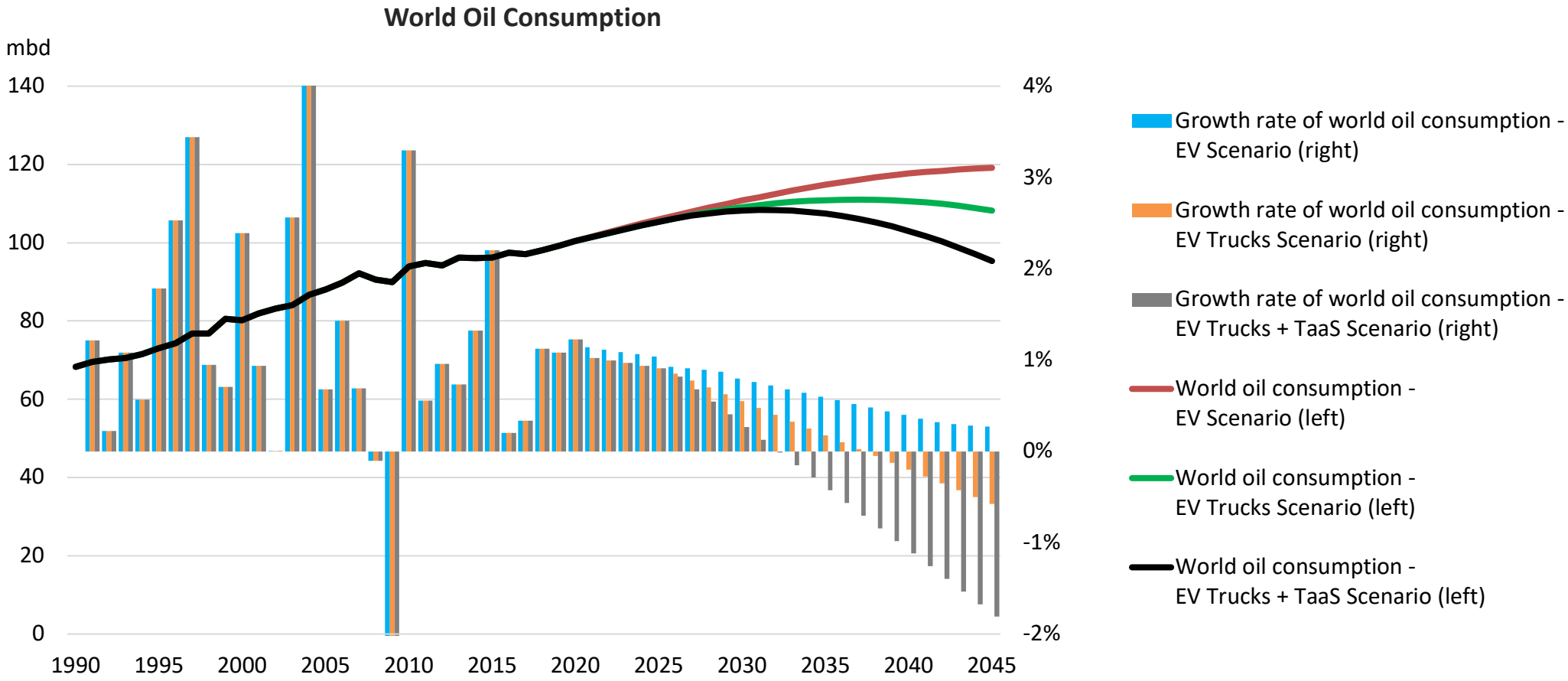
Scenarios of EVs spread: World cars and trucks fleet





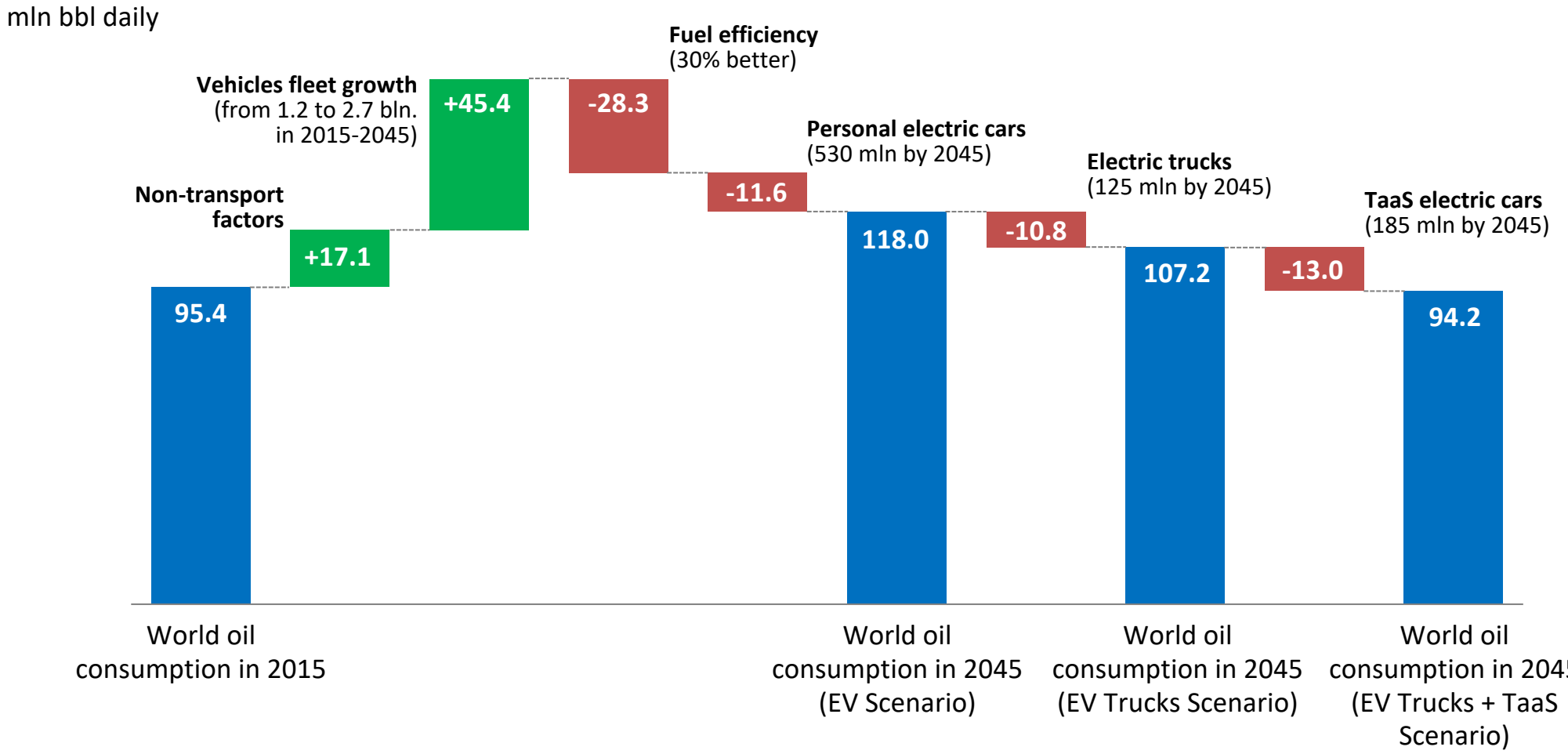


Scenarios of EVs spread: World oil consumption



Source: IEA, IEF RAS estimations

Factors of change in world oil consumption in 2015-2045



Source: IEF RAS estimations

Taxation of electricity consumption

Today the oil industry provides a significant share of revenues to the budgets of many countries, and the share of taxes in the gasoline price can exceed 50%. If in the long term EVs replace ICE cars, how will countries replace the falling oil taxes to fill the budget?

An obvious option is special tax (excise) for electricity since electricity becomes a motor fuel. But this will generate a significant negative impact not only on the economic efficiency of electric cars, but also on the overall macroeconomic indicators of all countries as electricity is consumed everywhere.

For example, in the US taxes related to oil consumption amount to about $110 bln:

- oil production, transportation and refining sectors provide $32 bln
- motor fuel retail taxes provide $77 bln

At the same time, the output of the electric power industry is about $300 bln. Assuming that the country completely shifts to electric cars and applies electricity retail tax to get $110 bln for budget, the price of electricity should increase by 35%. Such a scenario will lead to an increase in prices in the economy by 5.3% and a decrease in GDP by 4.1%.

Thank you for your attention

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Key conclusions

- Electric vehicles spread is likely to be slow and from today's zero point may have wide range of trajectories
- In order to fulfill the goals declared in the Paris Agreement, the price of electric car for consumer should be $24,000 (35% below today's level)
- In the most optimistic scenarios for electric vehicles, they will reduce global oil demand by 35 mbd in next 30 years. In this case world oil consumption by 2045 will be comparable to current level of about 95 mbd
- Electric vehicles spread will provide a lot of different impacts on the world economy, including negative. We should discuss it