# Autonomous vehicles in rural areas

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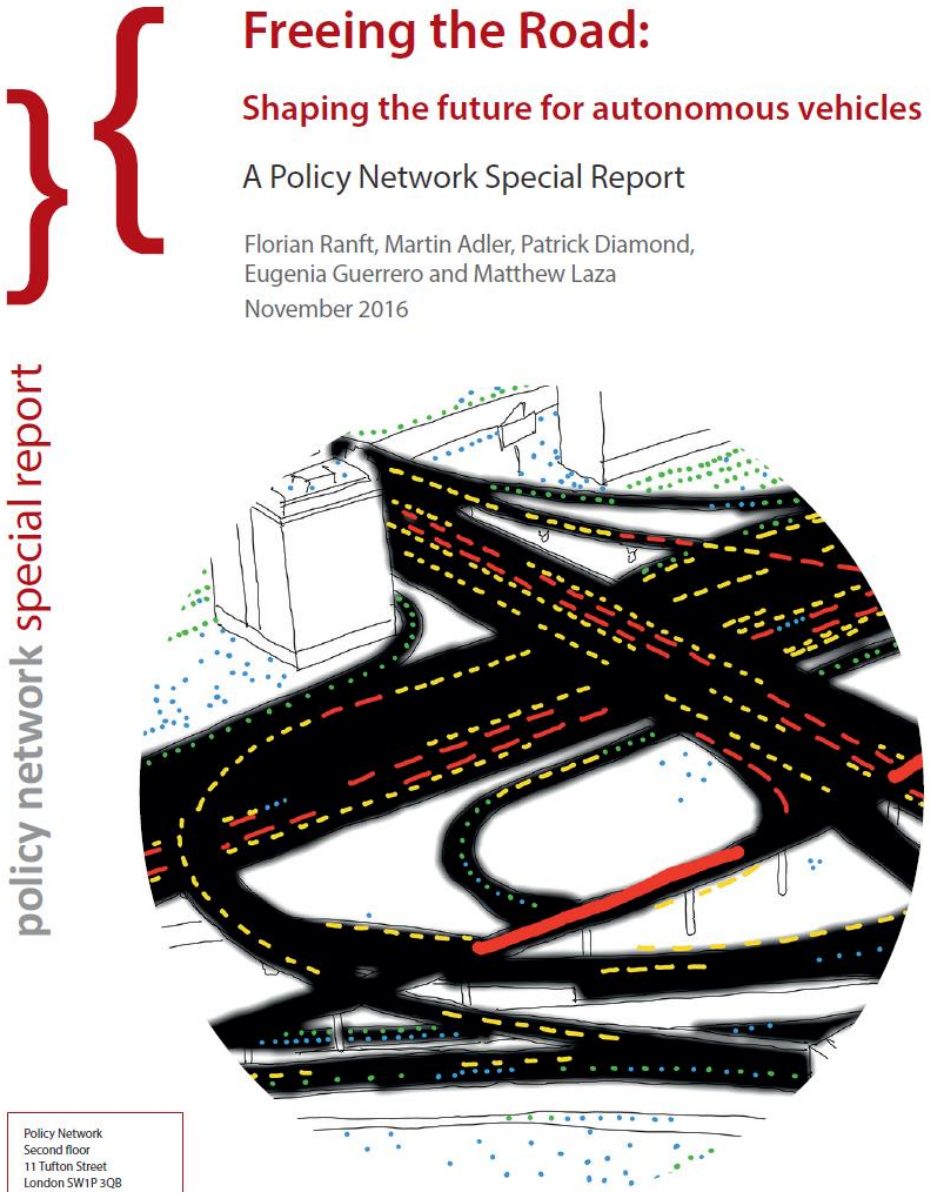
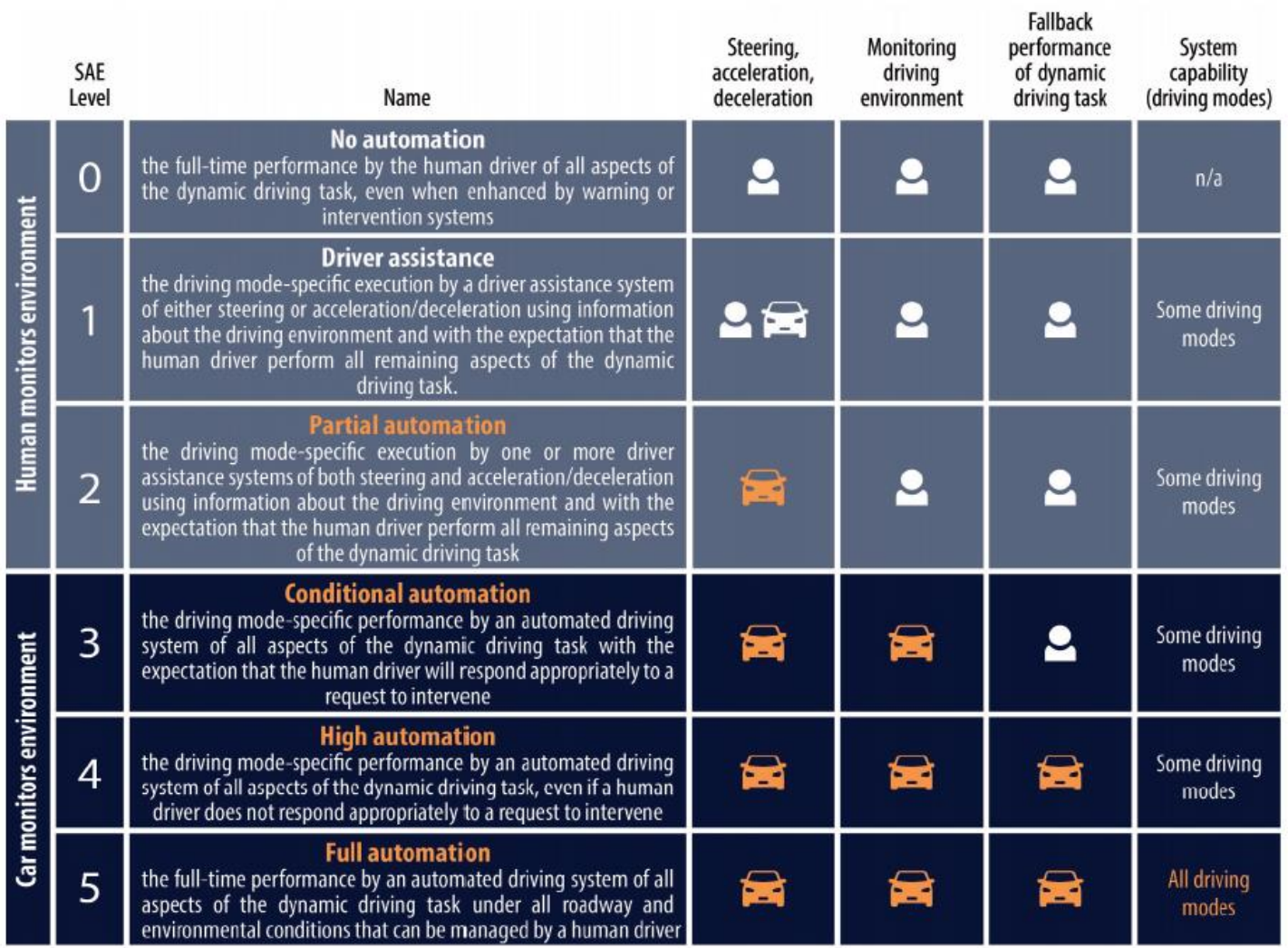



- Social and economic benefits for EU28 until 2050 (part of report)
- Policy environment and constraints (part of report)

# Autonomous vehicle classification



| | SAE Level | Name | Steering, acceleration, deceleration | Monitoring driving environment | Fallback performance of dynamic driving task | System capability (driving modes) |
|---|---|---|---|---|---|---|
| Human monitors environment | 0 | **No automation** the full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems | | | | n/a |
| | 1 | **Driver assistance** the driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task. | | | | Some driving modes |
| | 2 | **Partial automation** the driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task | | | | Some driving modes |
| Car monitors environment | 3 | **Conditional automation** the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene | | | | Some driving modes |
| | 4 | **High automation** the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene | | | | Some driving modes |
| | 5 | **Full automation** the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver | | | | All driving modes |

# Autonomous vehicle introduction

| 2017 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| **AD market introduction:** | | | | | | | |
| **Test phase** | **Take-off phase** | | **Rapid expansion** | **Connectivity** | | **Market saturation** | |

- Take –off phase L3 between 2020 and 2022, supported by industry statements and developments such as TESLA, Uber, Nissan, Google
- S-shaped adaptation curve (Sigmoid curve)
- Replacement rate at current automotive production levels

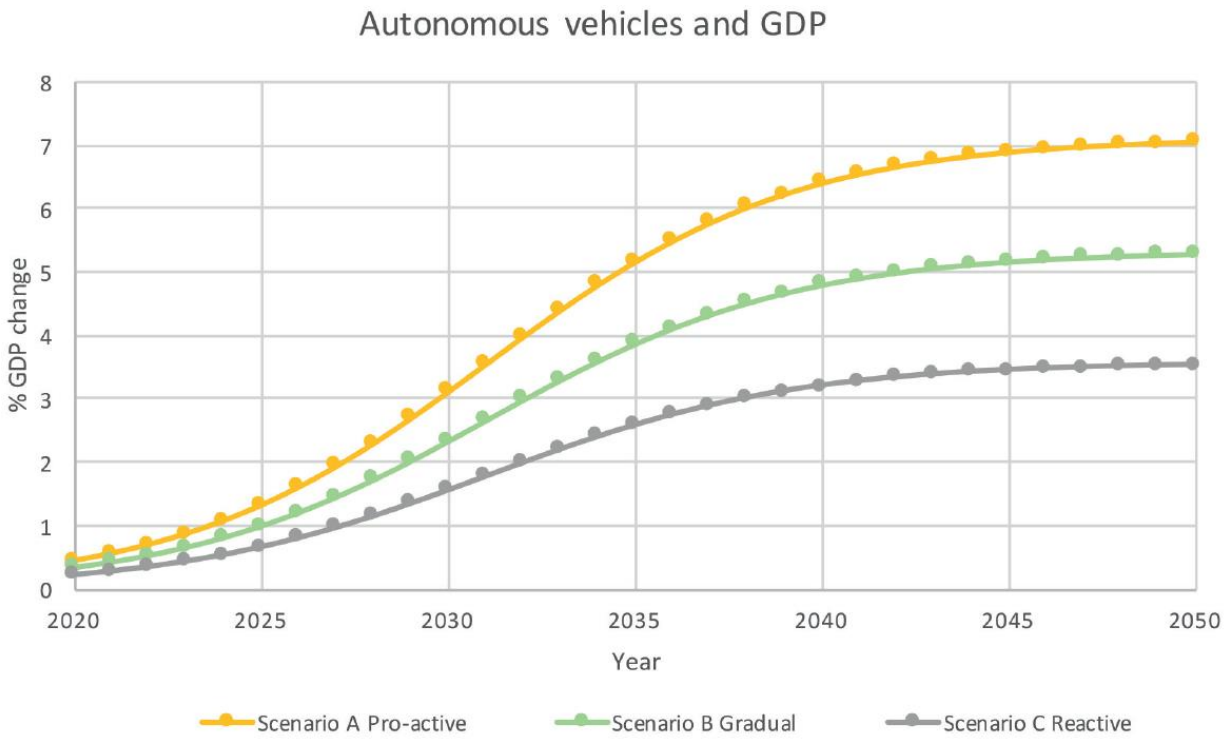
# Social and economic benefits

## Uncertainty and assumptions

**Table 3: Autonomous vehicle supply-side effects on the economy**

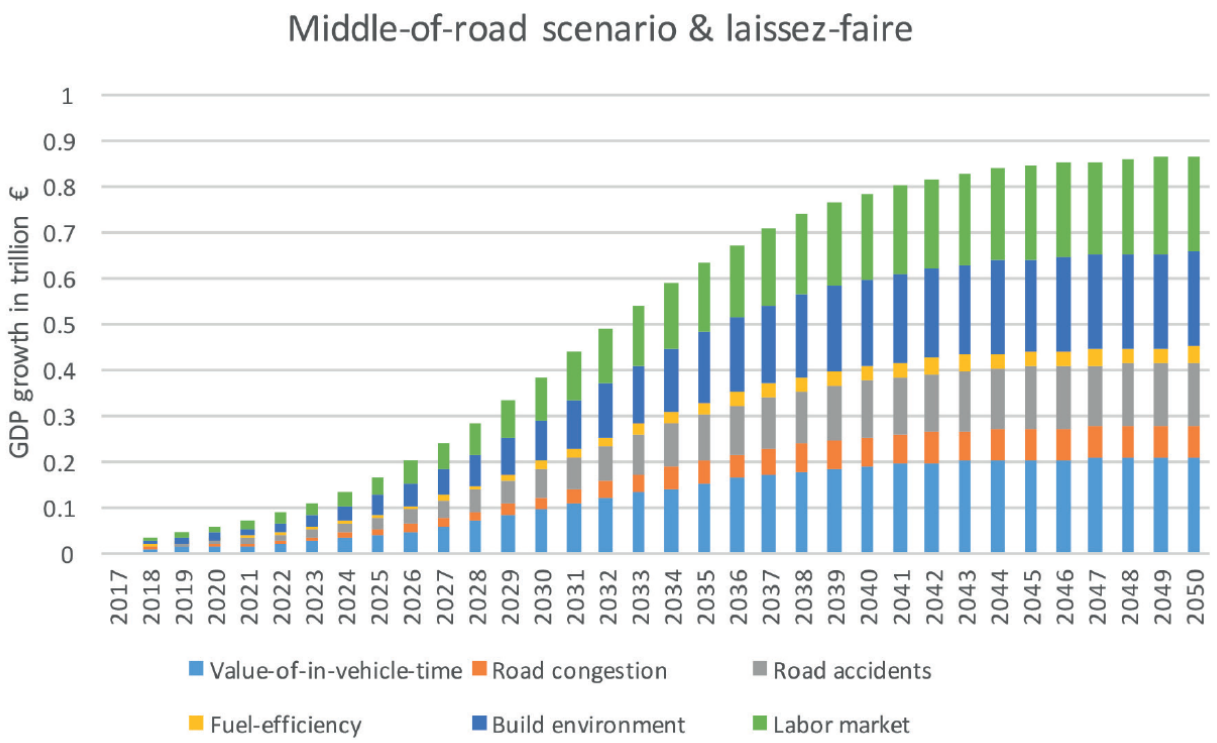
| Effect | Market mechanism | Maximum Productivity impact |
|---|---|---|
| Value of in-vehicle time | Travel cost, labour supply | 2% - 3% |
| Road congestion | Travel cost, commuting distance | 0.5% - 1% |
| Road accidents | Expected travel cost | 2% |
| Fuel-efficiency | Environment, public health, travel cost | 0.5% |
| Road infrastructure | - | - |
| Build environment | Urban structure, city density | 2% - 4% |
| Labour market | Labour supply | 1% - 5% |

# Autonomous vehicle productivity benefits




- Conservative macro-economic model
- Model predicts productivity effects according to the social and economic factors, an uptake rate and three policy scenarios
- Autonomous vehicles can increase productivity by 0.15% annually and cumulatively 5.3% by 2050 Cumulative benefit is 17 trillion
- The model results are in-line and conservative in comparison to the other model for the US (which predicts +8%)

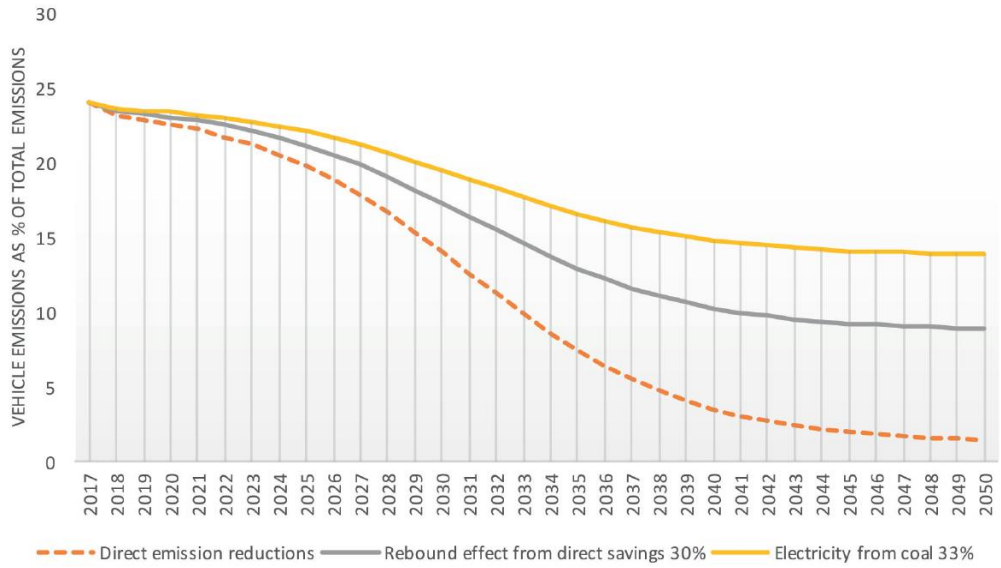
# Autonomous vehicle productivity benefits




- Benefits can be split into its components
- The largest benefits are in-vehicle time, city density and labor markets
- Benefits are not homogenous across space, rural areas likely benefit less from the listed effects

# Are all autonomous vehicles green?

- Not all autonomous vehicles are electric
- Combination of AV and electric drive has synergies – connectivity, efficiency, on-board activities, vehicle-to-grid
- Grid-source of energy important for climate
- Energy savings are partially transferred



# Automotive industry

- Market grows in size and relevant products
- New players
- Mergers & Acquisitions increase
- EU companies are not technology leaders

| | Vehicle manufacturers | Turnover in % | Parts/accessories manufacturers | Turnover in % |
|---|---|---|---|---|
| Germany | 262 | 51.8 | 1,264 | 34.1 |
| France | 171 | 11.9 | 764 | 9.1 |
| United Kingdom | 731 | 9.7 | 1,242 | 5.8 |
| Spain | 113 | 6.2 | 806 | 7.1 |
| Italy | 144 | 5.8 | 1,405 | 8.5 |
| Sweden | 174 | 4.2 | 629 | 2.2 |
| Czech Republic | 101 | 2.6 | 825 | 8.3 |
| Slovakia | 54 | 2 | 188 | 3.6 |
| Poland | 113 | 1.9 | 920 | 6.8 |
| Hungary | 47 | 1.9 | 333 | 4.3 |
| Netherlands | 152 | 0.1 | 167 | 0.1 |
| EU-28 | 2,256 | 100 | 10,300 | 100 |

Source: Euorstat (2015).[17]

# Rural areas & AV

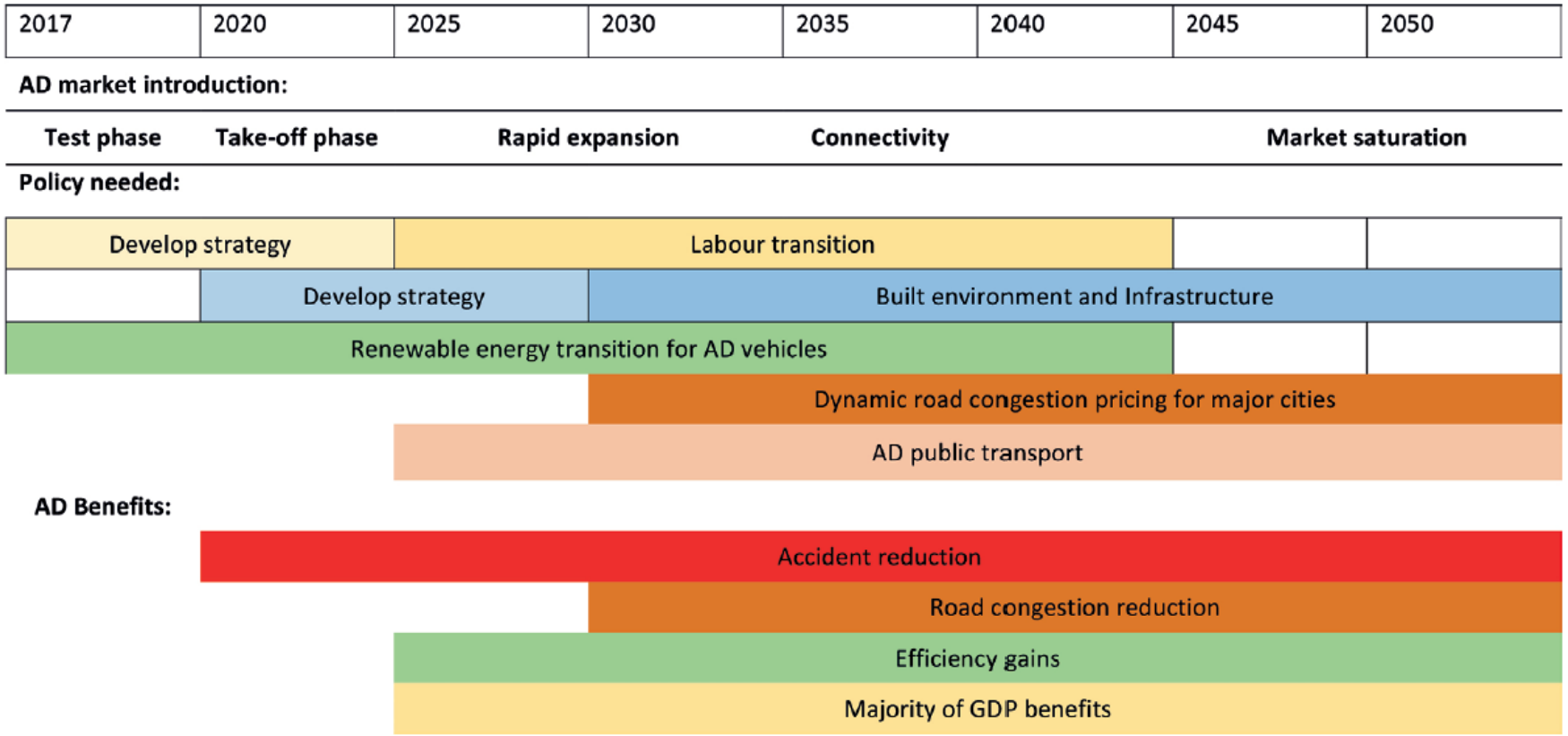
- Fewer AV benefits apply to rural areas
- Increase in mobility for physically impaired and other non-drivers such as the elderly, teens -> labor market matching implications
- AV in direct competition to public transport, opportunity for public finance
- Decrease in transport cost increases concentration (Economic Geography)
- Growth in sub-urban space predicted for Melbourne (KPMG, 2015)

# Uncertain aspects AV

- AV travel demand from non-drivers and elderly: max. +14% (Harper et al., 2016)
- Shift in car travel demand through price reductions
- Shared economy? Only 15% vehicle fleet (OECD, 2016)?
- Negative externalities (congestion, pollution) and taxation
- Coexistence various technology steps might result in inefficiencies, introduction homogenous technology zones in cities

# Policy debate

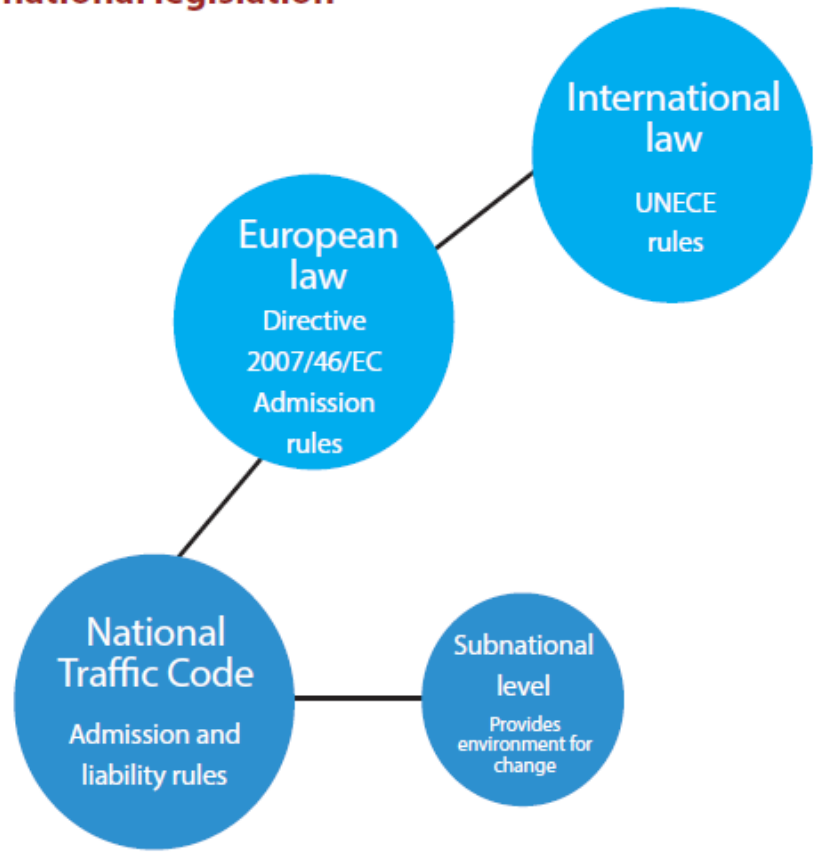
**Figure 1: Timeline of AV adoption**



# Policy debate

- 1968 Vienna Convention
- GEAR 2030, EU working group to insure coordination
- The Amsterdam Declaration, infrastructure for connected AV by 2019
- Cybersecurity and privacy laws are important
- Public could benefit from open discourse on AV and related issues

**Figure 3: National and international legislation**




Source: based on Fraunhofer IAO (2015) Hochautomatisiertes Fahren auf Autobahnen, p 112.