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Feasibility analysis and development of on-road charging solutions for future electric vehicles

# Identifying first deployment feasibility: separating unrealistic from real options

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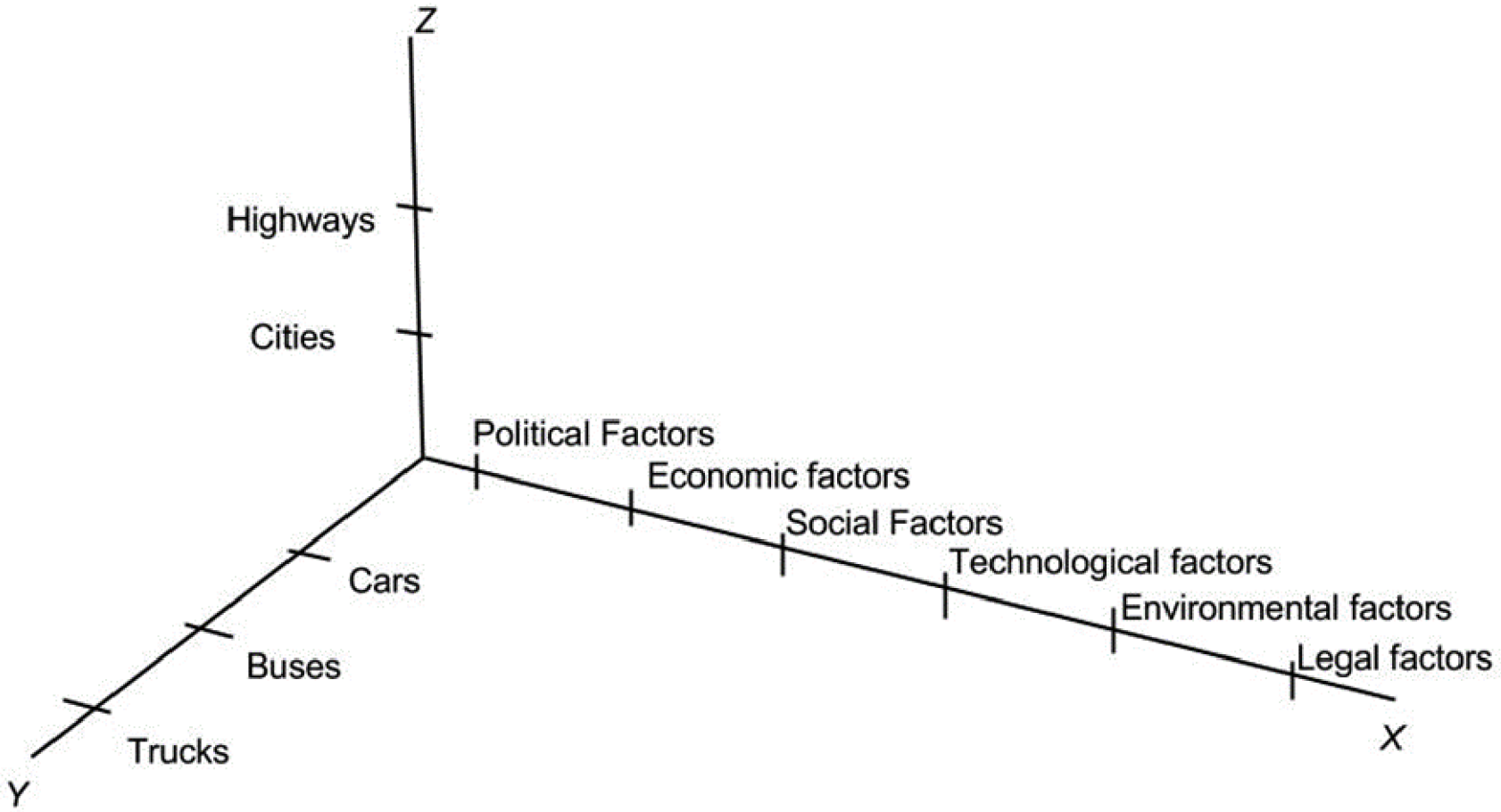
# WP52: Feasibility study on societal perspectives towards on road charging

1. Goal: investigate ERS feasibility on a system scale with CURRENT knowledge (i.e. pre-SP2/3/4 results)
2. As guiding input to other SPs
3. Months 1 – 18, with 2 deliverables
   - Feasibility study (D521)
   - Background document (D522)
4. Motto: ‘separate the wishful thinking from the potentially possible’
5. However: very large amount of unknowns and even unknown unknowns

6. Method: Large matrixed PESTEL analysis (1 axis), with location (cities / highways) and vehicle type

# Feasibility analysis framework



# FABRIC PESTEL items considered

| Political | Economic | Societal | Technological | Environ-mental | Legal |
|---|---|---|---|---|---|
| Stakeholders acceptance | Cost | User acceptance | Charging efficiency | GHG reduction | Fuel provision |
| Tax actions | TCO | Reduction of range anxiety | Power transfer control | Carbon footprint | Safety |
| Benefits for stakeholder groups | RoI | Usability in terms of comfort | Booking and billing systems | Safety | Accessibility |
| Macro-economic benefit | Time | Regional limitations | Integration into existing infrastructure | Electro-magnetic field exposure | |
| Freedom for specific solutions | Quality of service (QoS) | | Privacy and system security | | |
| | Service Performance | | Vehicle as energy storage | | |
| | | | Standards | | |
| | | | Maturity of technology | | |

# Competing technologies comparison

| Aspect | Wireless dynamic charging | Wireless static charging | Plug-in EV |
|---|---|---|---|
| Battery | Smaller battery, lower costs | Bigger, heavy and expensive battery | Bigger, heavy and expensive battery |
| Range | No limitation of driving mileage within regions equipped with power transfer systems | Limited by the range from charging station | Limited by the range from charging station |
| Cost reduction electricity | Potentially with smart scheduling | Potentially with smart metering | Potentially with smart metering |
| Long term usage | Technology buy-in | Technology buy-in | Robust solution |
| Gradual growth potential | Low, large investments required per stretch. | High, provision of parking spots, etc with coils | High |
| Capital intensiveness | High | Medium | Low |
| Need for standardisation | High | Medium | Low |
| Multi-level governance dependency | High | Low | Low |
| Solution for all vehicles | Yes | Yes | No, special for heavy-duty vehicles |

# Advantages / disadvantages of EV charging technologies

| Plug-in | | Conductive | | Inductive | |
|---|---|---|---|---|---|
| Cons | Pros | Cons | Pros | Cons | Pros |
| User discomfort | Mature technology | Visual pollution | Easy installation | Expensive infrastructure | Smaller batteries |
| Long charging duration | | Expensive pantograph systems | Smaller batteries | | Cheaper EVs |
| Large and expensive batteries | | | Extended range | | Extended range |
| Expensive EVs | | | Comfort | | Comfort |
| Vehicle must be parked | | | Increased mobility | | Increased mobility |
| | | | | | No visual pollution |

# 10 deployment scenarios

| Nr | Name |
|---|---|
| 1 | Metropolitan deployment for heavy freight vehicles |
| 2 | Metropolitan deployment for busses |
| 3 | Metropolitan deployment for general light vehicles |
| 4 | Metropolitan deployment for service vehicles / taxi's |
| 5 | International freight corridors |
| 6 | Long-haul national freight corridors |
| 7 | Short-haul freight corridors |
| 8 | National deployment for general light vehicles |
| 9 | International deployment for general light vehicles |
| 10 | International deployment for all vehicles classes |

# Methodology

1. Find all literature on ERS
2. Make comparison with similar systems / technology
   - Railways vs Overhead conductive charging
   - Network externalities of alternative fuels
3. Series of interviews
   - Industry experts with ERS involvement (i.e. Swedish…)
4. Early info from demonstration projects in Europe (conductive)

5. Both heavy and light-weigt vehicles
   - Though more info on heavy available

6. Traffic light logic: green – no problem, yellow – needs attention, red – unlikely to be solved with current knowledge.

# Key points found

1. LCA shows significant positive case for ERS
   - For heavy duty vehicles (busses and trucks)
   - For light vehicles WHEN BATTERY == 0

2. Ownership structures and investment incentives for roads are highly defragmented.
   - If ERS limited to major arteries: easier
   - If multiple levels of governance involved: difficult

3. Uncertainties around EMF: need for positive proof of safety

4. Conductive for heavy vehicles seems match
   - Inductive for light vehicles? Needs eco-system

# Highly likely potential scenarios

| Nr | Name | PESTEL Conclusion |
|---|---|---|
| 2 | Metropolitan deployment for busses | There are examples of such scenarios already, thus feasible if enough incentives given. |
| 5 | International freight corridors | Seems feasible for freight transport. Main concerns are interoperability and legal agreements |
| 6 | Long-haul national freight corridors | Feasible, but high risks due to utilisation |
| 7 | Short-haul freight corridors | Even though several risks and more precise data is needed, this scenario seems feasible. |

# Less likely potential scenarios

| Nr | Name | PESTEL Conclusion |
|---|---|---|
| 1 | Metropolitan deployment for heavy freight vehicles | Possible, but high circular dependencies lead to high risks. Strong policy involvement is key for implementation. The economic feasibility seems to be given. |
| 3 | Metropolitan deployment for general light vehicles | Currently, this scenario is less likely due to high economic risks for stakeholders, and unsure if manufacturers will invest in the necessary infra. No emission benefit if battery remains necessary. |
| 4 | Metropolitan deployment for service vehicles / taxi's | Currently, it is unlikely to be realised. Economic feasibility not given. Highly dependent on metropolitan case |

# Highly unlikely potential scenarios

| Nr | Name | PESTEL Conclusion |
|---|---|---|
| 8 | National deployment for general light vehicles | Balance between investment needed and gains is complex. Large number of public and private ownership constructions. Emission benefit null if battery remains necessary. Other alternatives possible. |
| 9 | International deployment for general light vehicles | See 8). |
| 10 | International deployment for all vehicles classes | Standardisation and coordination actions required are so massive that it is unlikely to happen, especially given the variation in benefits and differences in climate constraints in Europe. |

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# Thank you!

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