THE POTENTIAL OF LIGHT ELECTRIC VEHICLES FOR INDIVIDUAL MOBILITY

Carolina Sachs, M.Sc.
18.10.2016
How does micro mobility look like?
Micro mobiles / light vehicles can adopt many different forms

Twike
E-Bike
E-Scooter
Mobility Scooter
Segway
Tweezy
…
What is micro mobility?
Micro mobility describes mobility aids and vehicles for a specific space-delimited area of use

**Micro mobility:**
- Non-motorized or motorized vehicles
- **Solutions** for a **concrete mobility need**
- Designed for a **specific** and **delimited area**
- Smaller than passenger cars
- Designed for **short distances**
- **Complement** for other mobility systems
- Serve **core mobility needs**
Are all micro mobiles light vehicles? Definitions may overlap, categorization does not.

| E-bike                                      | • Bicycle with integrated electric motor  
|                                            | • Pedelec (pedal electric cycle): pedal-assisted riding  
|                                            | • No license mandatory                     |
| L-category vehicles                        | L1: mopeds with a maximum speed <= 45 km/h   
|                                            | ……                                           |
|                                            | L6 & L7: Vehicles with a weight <= 400 kg    |
| Microcar (SubA)                            | • No exact definition                      
|                                            | • Various countries have different interpretation  
|                                            | • significant factor is the size of the engine  
|                                            | USA: engine < 1000cc  
|                                            | UK: engine < 700cc                           |

Source: Automotive Indepth
## Motorized light vehicles as part of micro mobility

### The L-vehicle category

<table>
<thead>
<tr>
<th>Category</th>
<th>Features</th>
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</table>
| L1e      | • Mopeds, i.e. two-wheel vehicles  
          | • Maximum speed: 45km/h  
          | • Maximum power: 4 kW (EM) |
| L2e      | • Mopeds, i.e. three-wheel vehicles  
          | • Maximum speed: 45km/h  
          | • Maximum power: 4 kW (EM) |
| L3e      | • Motorcycles, i.e. two-wheel vehicles without sidecar  
          | • Maximum speed: 45km/h |
| L4e      | • Motorcycles, i.e. two-wheel vehicles with a sidecar  
          | • Maximum speed: 45km/h |
| L5e      | • Motor tricycles, i.e. vehicles with three symmetrically arranged wheels  
          | • Maximum speed: 45km/h |
| L6e      | • Light quadricycles with maximum weight: 350 kg (unladen)  
          | • Maximum speed: 45km/h  
          | • Maximum power: 4 kW (EM) |
| L7e      | • Quadricycles with maximum weight: 400 kg (unladen)  
          | • Maximum power: 15 kW (EM) |


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Delimitation between SubA and A Segment from a marketing perspective

**Micro mobility**
- Vehicles for short distances
- Smaller than passenger cars
- Also non-motorized
- Delimited area of use
- Satisfy a concrete mobility need

**A-Segment**
- Motorized
- Individual mobility
- Several seats
- Luggage transport
- Safety
- Weather protection
Delimitation of SubA segment from a EU-legal perspective

Legally speaking, SubA vehicles do not represent a specific vehicle category. Depending on certain technical characteristics, e.g. weight and motor power, they have to be categorized as an L- or an M-type vehicle.
Which factors influence the evolution of LEVs?

- Charging Infrastructure
- Urbanization
- Public Policy regarding E-Mobility and Light Vehicles

(Price-) Development of Fossil Fuels

Mobility Trends

- set needs for changes
- stimulate establishment
- trigger innovation
- widespread emergence
- influences

New Product Applications
Which factors influence the evolution of LEVs?

Mobility trends

World wide ambition to reduce CO₂ emission

• “Zero Emission –life style”: car loses importance as a status symbol ⁴ (Europe)
• Demotorization in metropolises & trend towards smaller vehicles ⁵
• New forms of mobility: car sharing, electric drive
• Customer: increased environmental awareness ⁶
Which factors influence the evolution of LEVs?

Urbanization

- Difficult parking situation
- Increase in noise and fine dust pollution

Source: https://icn.sap.com
Which factors influence the evolution of LEVs?

Price development of fossil fuels

“Innovation reduces the cost of low-carbon technologies and energy efficiency, but – for oil and gas – the gains are offset by the move to more complex fields” (IEA’s world energy outlook 2015)
Which factors influence the evolution of LEVs?

Charging infrastructure

The widespread of light electric vehicles requires an appropriate charging infrastructure. Alternatively, battery swapping and range-extension systems can compensate/substitute the need for a wide charging infrastructure.

Which factors influence the evolution of LEVs?

New product applications

Can electric mobility give place to fully new product applications?

YES! Think, for example, of all the options for the population who do not own a driver’s license.
Which factors influence the evolution of LEVs?
Public policy regarding e-mobility and light vehicles

Legislation can, in different forms, directly or indirectly, influence consumer behavior towards the expansion of the light electric vehicle markets.

**Type-approval policy can be a huge game changer!**

Source: https://www.google.es/search?q=driver%27s+license+europe
Light vehicles

E-bike (EB) sales versus E-scooter (ES) sales

China is the leading producing and consuming market for electric bicycles holding 90% of share of global sales.

Source: EWBR 2016

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## Light four-wheeled vehicles
### Quadrycicles and SubA vehicles

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<td>955*</td>
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</table>

### Vehicles with a weight ≤ 400 kg can be classified as L6e (≤350 kg) and L7e (>350 and ≤ 400 kg)

Sales figures of Renault Twizy Europe

The Renault Twizy is a 2-seater full electric quadricycle, available in a 45 km/h version and an 80 km/h version. In 2014 a 1-seater cargo version was introduced.


*Said Sohinder Gill, Director- of Corporate Affairs of the Society of Manufacturers of Electric Vehicles (SMEV).*
GEM in-Wheel (1/2)

The project

- Fast Track to Innovation Program of the European Commission
- Industrialization of GEM motors' in-wheel technology
- Project supports the EU strategy towards a sustainable and environmentally friendly society

Motor development, project coordination, motor production, relation to customers, dissemination and public relations

Manufacturing technology, stator winding, pilot line production

Electronics production

Motor (fleet-)testing, customer feedback

Production management, product commercialization
GEM in-Wheel (2/2)
The project

- **GEM in-wheel motor: one solution, many applications**
  - Power range 4 – 7.5 kW, system efficiency >92%
  - Power extension through **modularization** up to 30 kW in planning → Meet performance requirements of all vehicles EG-Class L + Microcars

- **Multiple Challenges** due to market-related
  - Vehicle definition
  - Registration criteria
  - Development patterns

Foto: GEM motors d.o.o.
Conclusions and other things to think about…

- Light electric vehicles offer an enormous space for innovation in vehicle design!
- Not everything that DOES NOT shine is NOT gold!
- Pay attention to policy and regulations as they really can be a huge game changer!
- Think in systems, not individual solutions!

PICTURE TO BE ADDED!
CLOSING PICTURE TO BE ADDED
Sources


