# Reinventing the Automobile: Personal Urban Mobility for the 21st Century

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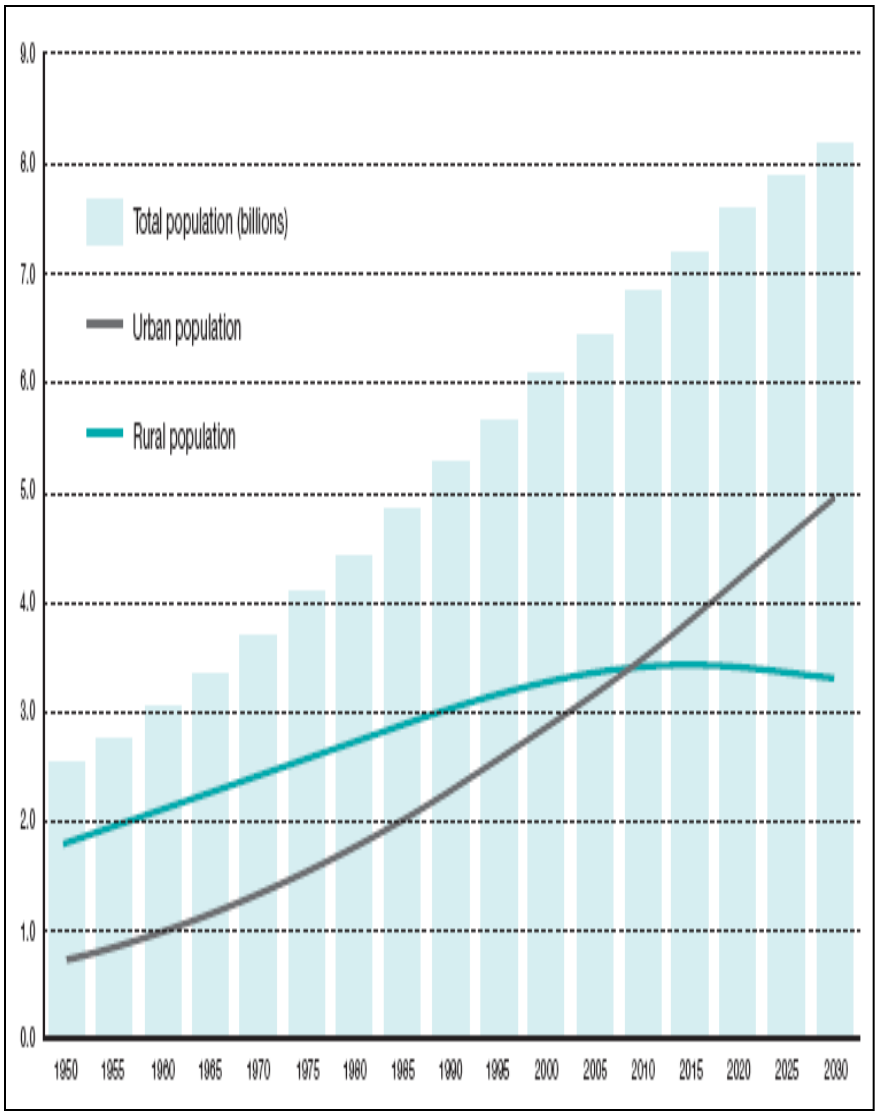
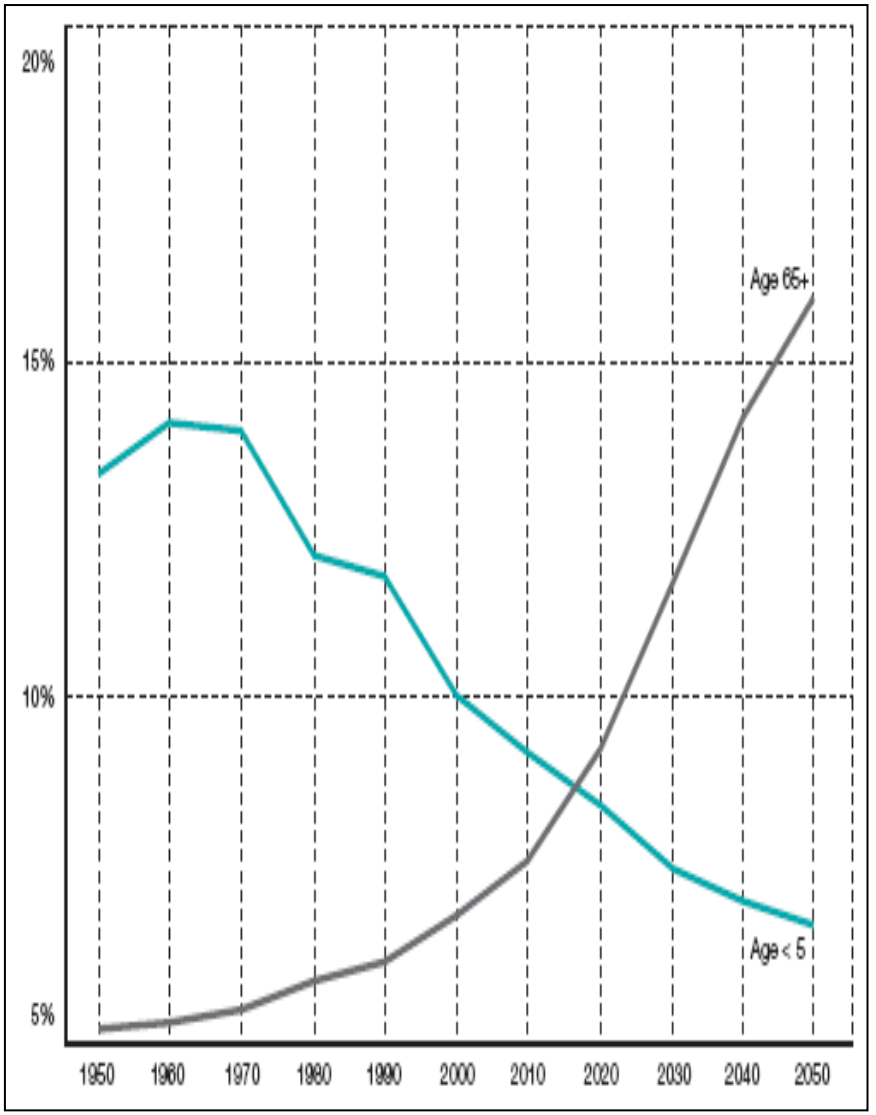
# Challenges to a Sustainable Auto Industry

- Energy
- Environment
- Safety
- Affordability

# Megatrends: Urbanization and Aging




Source: UN Population Division

# Challenges to a Sustainable Auto Industry

- Energy
- Environment
- Safety
- **Accessibility**
- Congestion
- Parking

**Urban Mobility**

# Megacities – Regional Transportation Policies

| | Delhi | Mumbai | Beijing | Shanghai | Moscow | Seoul | New York | London | Tokyo |
|---|---|---|---|---|---|---|---|---|---|
| Bus Rapid Transit Lanes | ✓ | ⊘ | ✓ | 2011 | ⊘ | 2011 | ✓ | ✓ | ⊘ |
| Metro/Subway | ✓ | 2011 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Congestion Charging | Planned | Planned | 2012 | 2012 | Future | ✓ | Planned | ✓ | Future |
| Parking Cuts | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ✓ | ✓ | ✓ | ⊘ |
| Road use Charging/Ban | ⊘ | Yes | 1 Week Day Ban | 1 week Day Ban | ⊘ | 1 Week Day Ban* | ⊘ | ⊘ | Future |
| EV/Hybrid Incentives | ✓ | ⊘ | ✓ | ✓ | ⊘ | ✓ | ✓ | ✓ | ✓ |
| Bicycle Lanes | ⊘ | ⊘ | ✓ | ✓ | ⊘ | ✓ | ✓ | ✓ | ✓ |
| Energy and Environmental Standards | Euro 4 | Euro 4 | Euro 4 | Euro 4 | Euro 3 Euro 4 by 2012 | Euro 4 | CAFE 27.8mpg by 2011<br>34.7 mpg by 2016 | Euro 4 Euro 5 by 2011 | 25% reduction by 2015 |

⊘ Not planned ✓ Existing currently * Voluntary no road usage incentive

Source: Frost and Sullivan

# What type of "car" does the city need?

| City Objectives | No Pollution (air, noise) | Renewable energy sources | Safety for all road users | Faster, more predictable travel times | Reduced parking space requirements | Accessibility for All | Beautiful Urban Design |
|---|---|---|---|---|---|---|---|

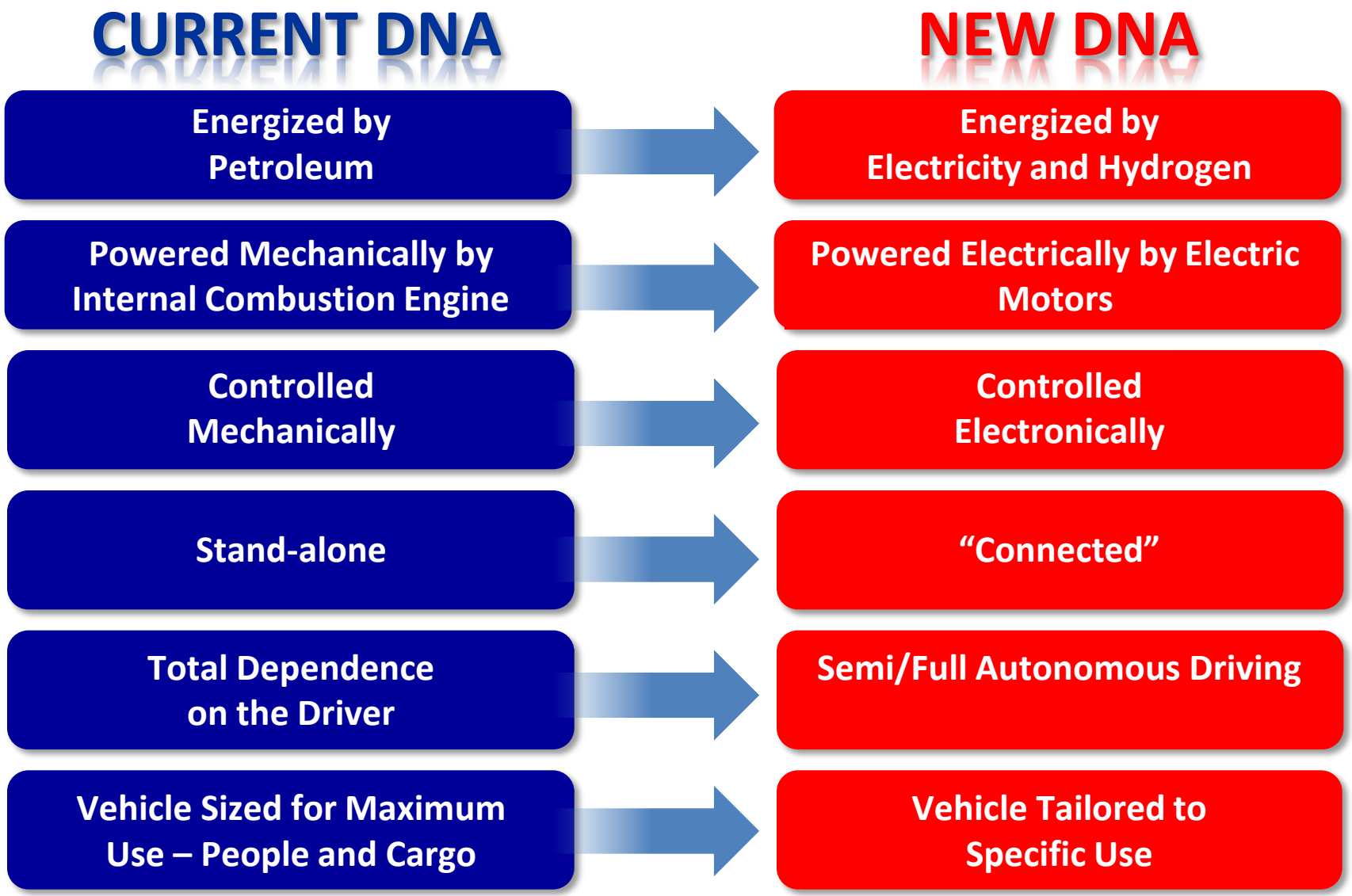
**Electrification, Connectivity *and Appropriate Design***

| | |
|---|---|
| **Future "Car"** | • INFORMATION: Vehicles wirelessly communicate with each other, the road, electronic devices (pedestrians, cyclists,..)<br>• POWER/ENERGY: Battery and/or Hydrogen Fuel Cell, Wheel Motors, 360° electronic cocoon,…<br>• TRANSPORTATION: Compact and/or reconfigurable footprint and shape, based on environmental conditions |
| **Future City** | • INFORMATION: Wireless communications with infrastructure (road, intersections, parking lots, mass transit stations,...)<br>• POWER/ENERGY: Rapid Charging stations, Smart Grids, Inductive Charging, Electric Guideways<br>• TRANSPORTATION: No city center signage, dedicated lanes/zones/highways, Intelligent Intersections |

GM


Same DNA
for 100 years

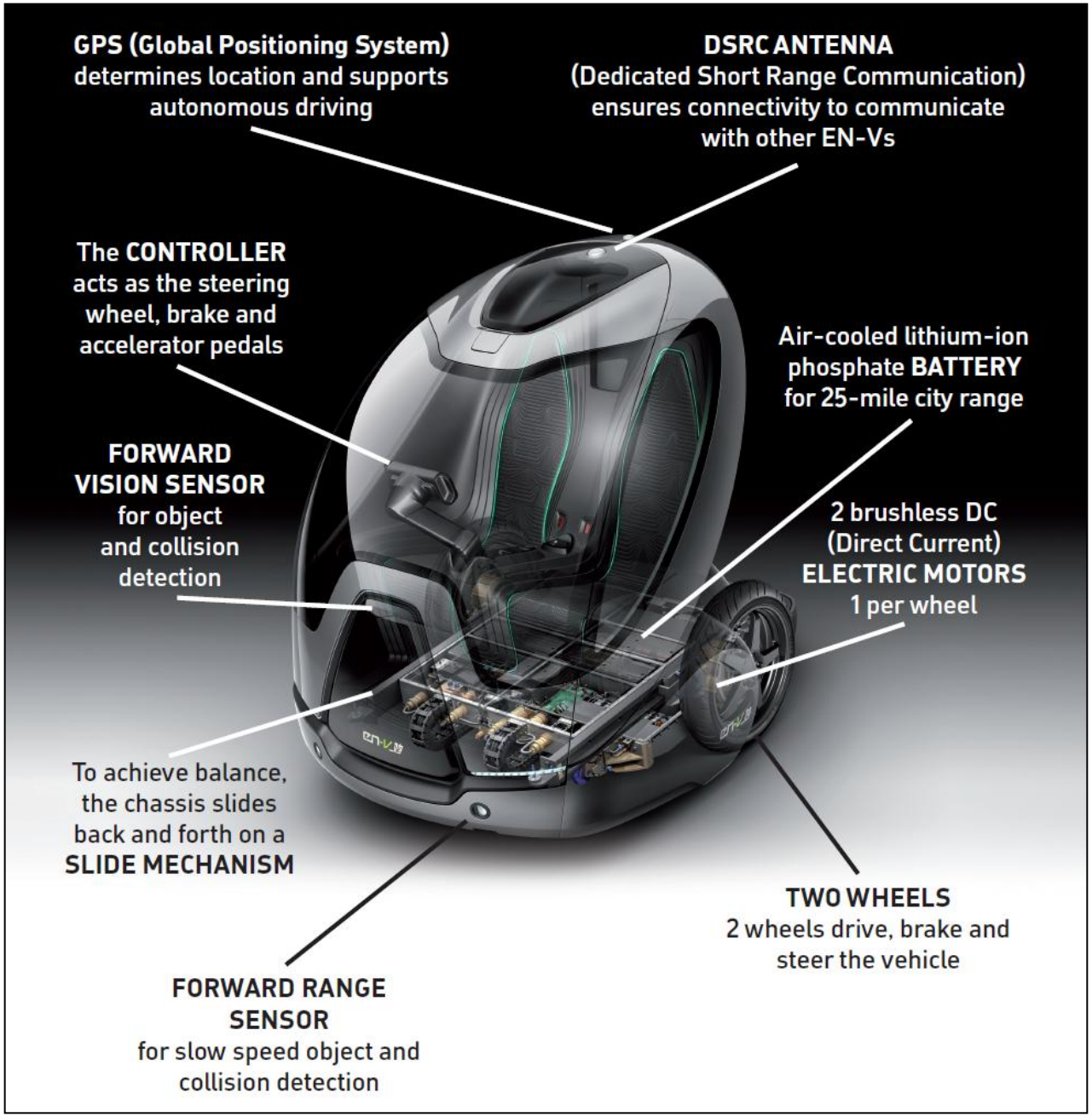
# New Automotive DNA



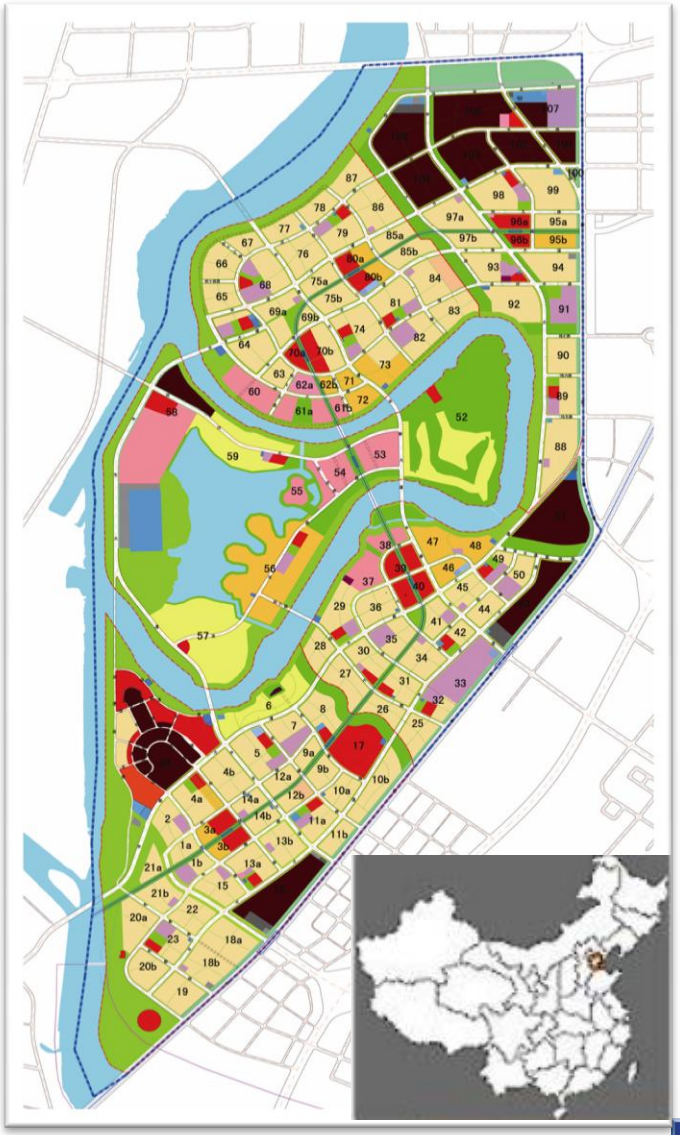
# EN-V (Electric Networked Vehicle): A comparison with a conventional city car

| | Typical city car | Typical EN-V |
|---|---|---|
| Mass (kg) | 1,000 | 500 |
| Occupancy (# seats) | 4 | 2 |
| Footprint ($m^2$) | 5 | 3 |
| Maximum speed (km/h) | 150 | 50 |
| Propulsion output (kW) | 100 | 10 |
| Driving range (km) | 500 | 50 |
| Vehicle energy consumption (Wh/km) | 400 | 80 |
| Well-to-wheels $CO_2$ (g /km), US electricity mix | 150 | 50 |

# EN-V: Components & Features



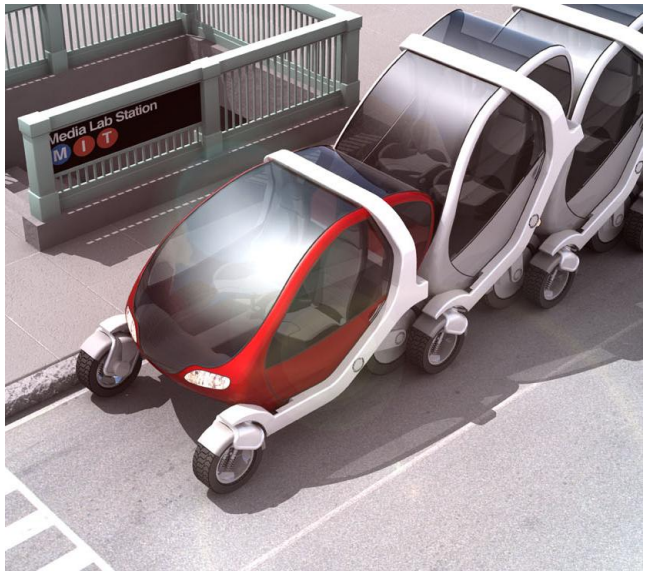
# EN-V Program Next Steps:
# EN-V2.0 pilot in Tianjin Eco-City



# Personal Mobility & Public Transport Integration

Now

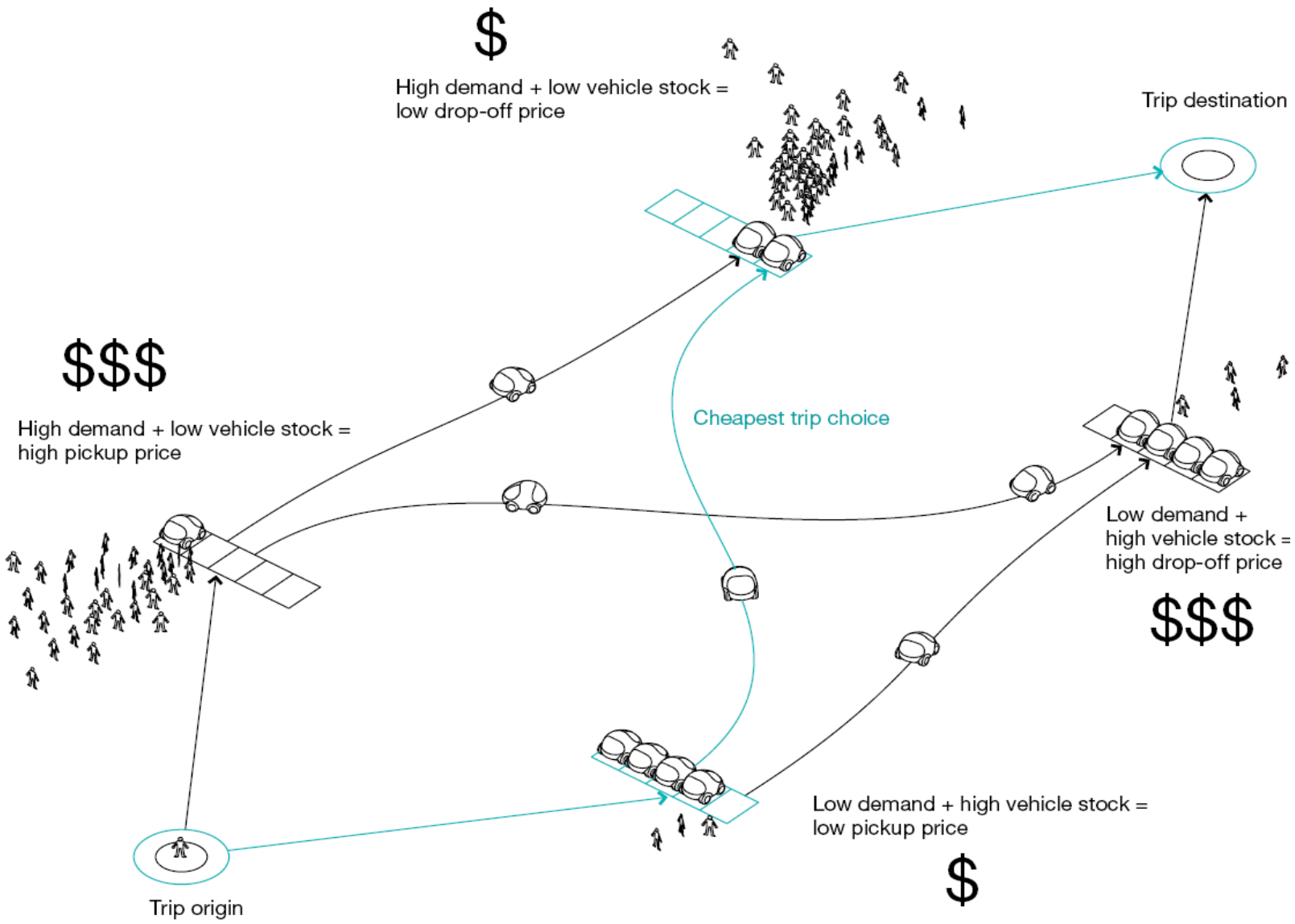
Future?




Source: MIT

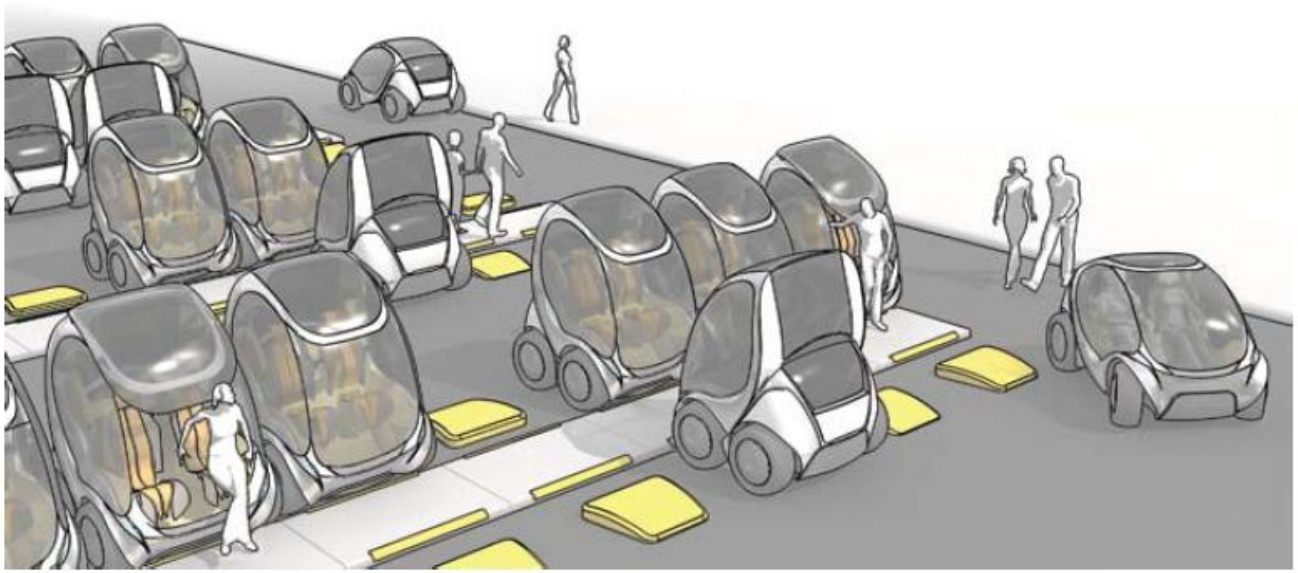

Source: Rinspeed

# Dynamic Pricing for Mobility-on-Demand

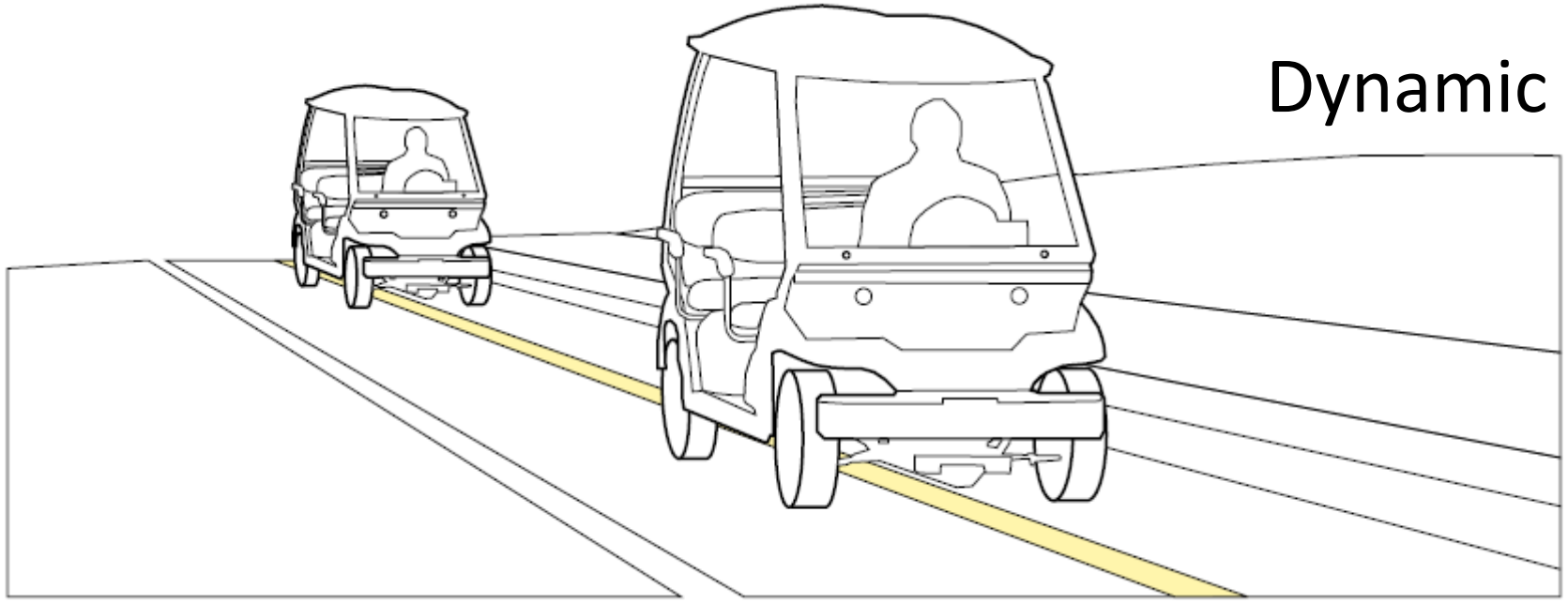



Source: "Reinventing the Automobile: Personal Urban Mobility for the 21st Century"

# Inductive Charging Infrastructure



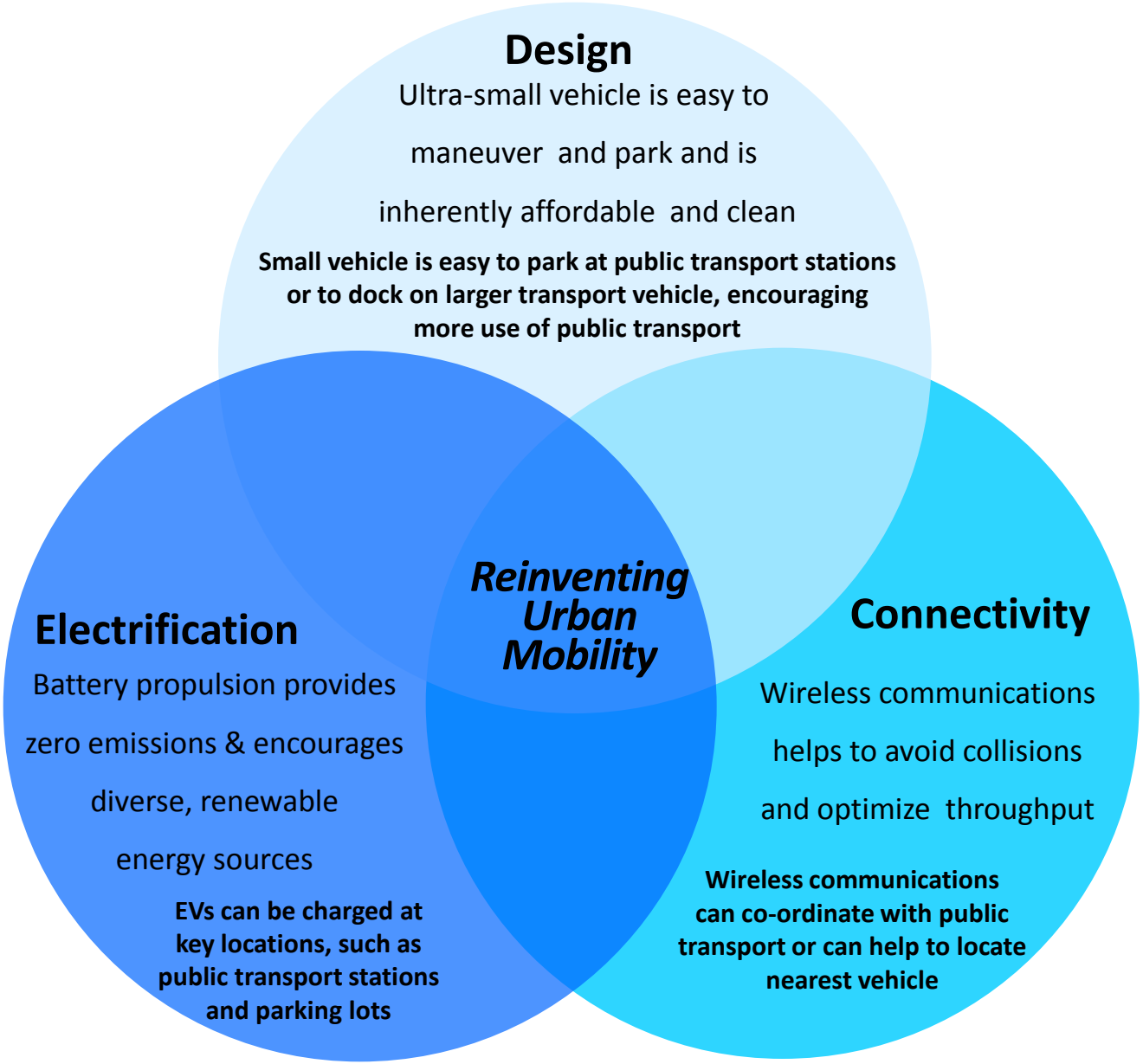
Static



Dynamic

Source: “Reinventing the Automobile: Personal Urban Mobility for the 21st Century”

# Reinventing Urban Mobility



# Summary

- Automobile usage in cities is common because it has some valued advantages over walking/cycling and over public transport
- For urban use, today's automobile is over-engineered AND under-used
- By reinventing the automobile and the ownership model, it is possible to preserve its benefits while significantly reducing the side-effects in urban use
- Autonomy can enhance the mobility experience and enable personal mobility for all the population
- These same enablers (electrification, connectivity and vehicle design) can also create new opportunities for seamlessly integrating personal and public transport
- Autonomy can enhance the consumer experience and improve the business model for mobility-on-demand systems