BlueSolutions by Bolloré

WORLD MATERIALS FORUM

JUNE
2017

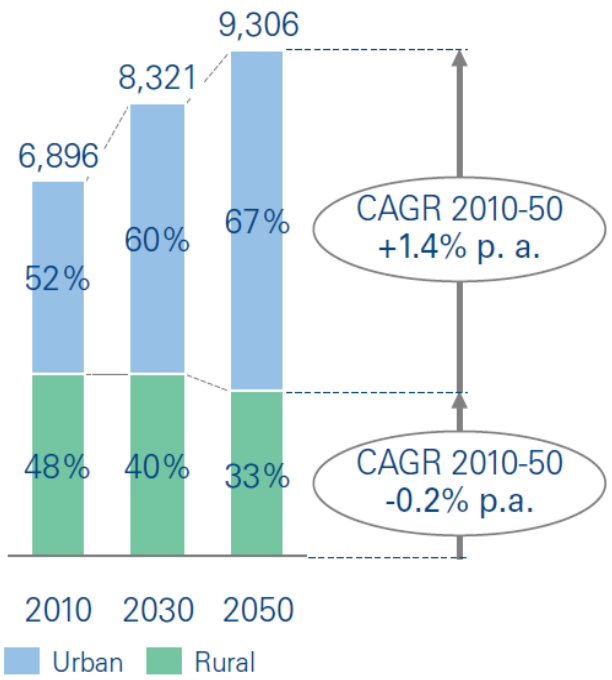
1 – Trends for Urban Mobility

2 – EV and battery issues

The future of earth will be urban

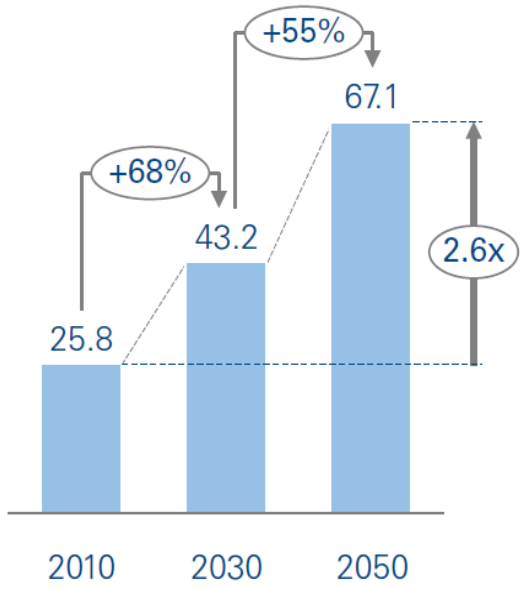
The world is becoming increasingly urban

Urban and rural population, 2010-2050 [m people; %]



Urban mobility demand explodes

Urban mobility demand, 2010-2050 [trillions pkm p.a.; %]



Cities are confronted with new challenges

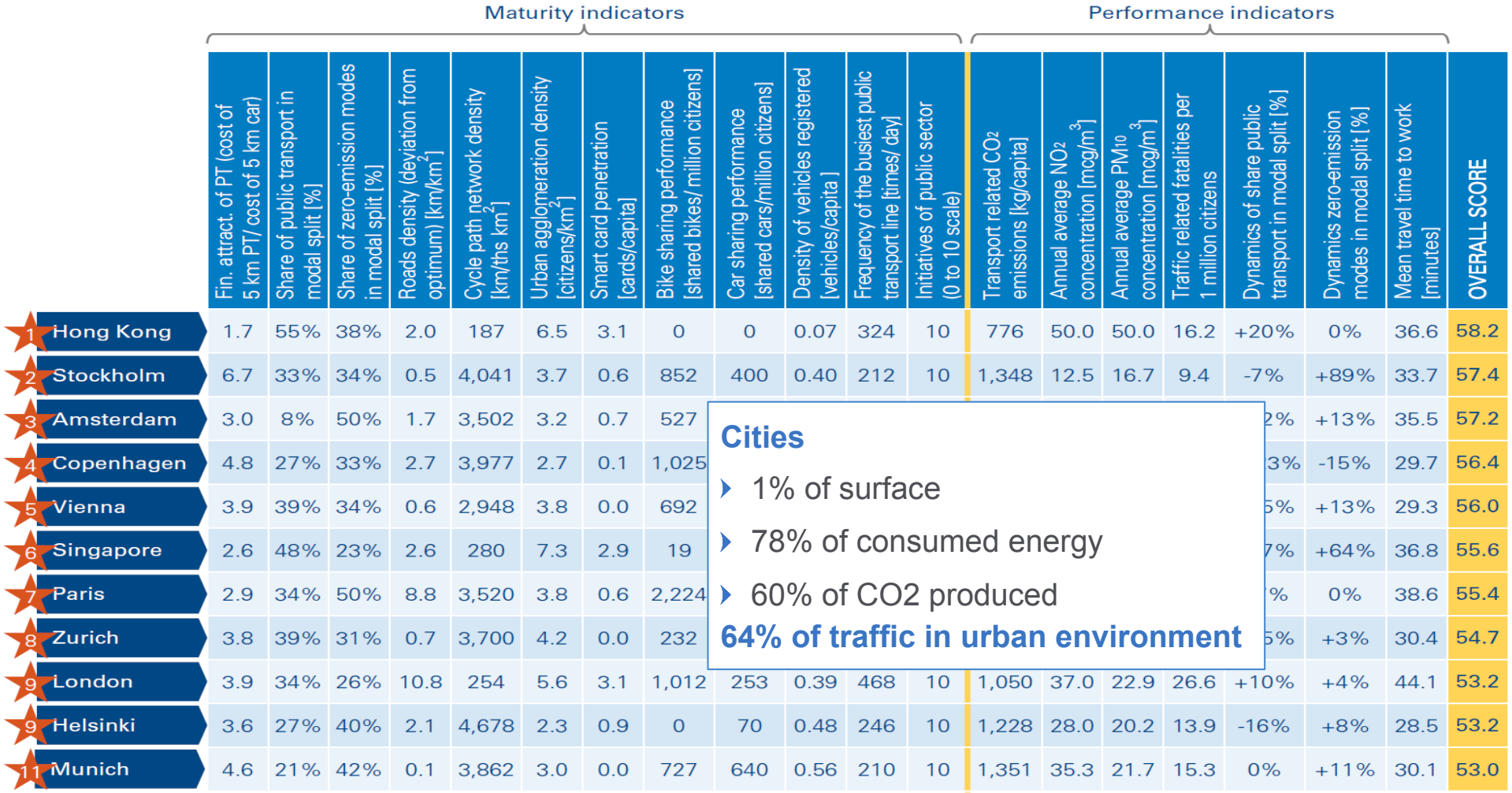
Planet
- Air pollution
- CO_2 emissions
- Noise
- Increasing ecological footprint

People
- Traffic chaos
- Traffic security
- Traffic jam
- Decreasing quality of life and convenience

Profit
- Overloaded infrastructures
- Insufficient public transport capacities
- Increasing motorization
- Limited parking places

Source: UN Population Division, Schäfer/Victor 2000, Cosgrove/Cargett 2007, Arthur D. Little

Figure 8: Top 11 cities with above average mobility score



		Maturity indicators											Performance indicators							
		Fin. attract. of PT (cost of 5 km PT/ cost of 5 km car)	Share of public transport in modal split [%]	Share of zero-emission modes in modal split [%]	Roads density (deviation from optimum) [km/km^2]	Cycle path network density [km/ths km^2]	Urban agglomeration density [citizens/km^2]	Smart card penetration [cards/capita]	Bike sharing performance [shared bikes/ million citizens]	Car sharing performance [shared cars/million citizens]	Density of vehicles registered [vehicles/capita]	Frequency of the busiest public transport line [times/ day]	Initiatives of public sector (0 to 10 scale)	Transport related CO_2 emissions [kg/capita]	Annual average NO_2 concentration [mcg/m^3]	Annual average PM_{10} concentration [mcg/m^3]	Traffic related fatalities per 1 million citizens	Dynamics of share public transport in modal split [%]	Dynamics zero-emission modes in modal split [%]	Mean travel time to work [minutes]	OVERALL SCORE
1	Hong Kong	1.7	55%	38%	2.0	187	6.5	3.1	0	0	0.07	324	10	776	50.0	50.0	16.2	+20%	0%	36.6	58.2
2	Stockholm	6.7	33%	34%	0.5	4,041	3.7	0.6	852	400	0.40	212	10	1,348	12.5	16.7	9.4	-7%	+89%	33.7	57.4
3	Amsterdam	3.0	8%	50%	1.7	3,502	3.2	0.7	527									2%	+13%	35.5	57.2
4	Copenhagen	4.8	27%	33%	2.7	3,977	2.7	0.1	1,025									3%	-15%	29.7	56.4
5	Vienna	3.9	39%	34%	0.6	2,948	3.8	0.0	692									5%	+13%	29.3	56.0
6	Singapore	2.6	48%	23%	2.6	280	7.3	2.9	19									7%	+64%	36.8	55.6
7	Paris	2.9	34%	50%	8.8	3,520	3.8	0.6	2,224									%	0%	38.6	55.4
8	Zurich	3.8	39%	31%	0.7	3,700	4.2	0.0	232									5%	+3%	30.4	54.7
9	London	3.9	34%	26%	10.8	254	5.6	3.1	1,012	253	0.39	468	10	1,050	37.0	22.9	26.6	+10%	+4%	44.1	53.2
9	Helsinki	3.6	27%	40%	2.1	4,678	2.3	0.9	0	70	0.48	246	10	1,228	28.0	20.2	13.9	-16%	+8%	28.5	53.2
11	Munich	4.6	21%	42%	0.1	3,862	3.0	0.0	727	640	0.56	210	10	1,351	35.3	21.7	15.3	0%	+11%	30.1	53.0

Cities

- 1% of surface
- 78% of consumed energy
- 60% of CO2 produced

64% of traffic in urban environment

Source: Arthur D. Little Urban Mobility Index 2.0

Key elements and good practices

Transport responsible for

- 7.7 GT CO2 emissions
- 1.3 million deaths

Car penetration per capita decrease :

- Western Europe: 0.45
- Copenhagen: 0.24
- Singapore: 0.18

Public Transportation Share :

- Hong Kong: 64 %
- Singapore: 48 %
- Vienna: 39 %

Shared Mobility platforms :

- Smile in Vienna
- Path2go in San Francisco
- Muliticity Citroen), Moovel Daimler

Bike and car sharing :

- Amsterdam: 1219 shared cars/ M
- Paris: 2224 shared bikes / M

COP21 Target for 2040:

- 20 g CO2 / km from Well to Wheel

Strong development of Low Emission Zones (Tokyo, London since 2008)

- LEZ → Ultra LEZ
- LEC → Zero Emission City

Netherlands: in 2025 only electric buses

- in 2035 new cars only electric

Paris, Singapore in 2025 all buses will be electric

World of the Shared Economy

- Average use of car : 1 hour / day
- Shared Autonomous cars = 7 traditional cars
- Pooled Shared Autonomous cars = 17 traditional cars
- Urban cars will need to be: autonomous, green, shared and connected
- Fewer cars on urban roads
  - *Less Pollution*
    Production = 1/5 of global emissions
  - *Decrease in total operating cost / km*
- Decline in Auto sales but shorter car lifespan

Growth of collaborative economy in the urban mobility ecosystem is disrupting traditional business models of transportation companies

Traditionnal mobility infrastructure:

- Personal vehicle
- Taxi, car-rental
- Public Transportation
- Bus, Rail, Metro
- Parking infrastructure

New service offers

- Convenience: Real-time booking, planning and payment
- Usage-based pricing model, sense of community
- Sustainability: Energy efficiency, climate sensibility
- Easy access to multiple options

From delivering transport to delivering Solutions

Autolib' scheme: The world largest carsharing self service

Electrical

- No noise
- No smell
- No CO2 emission

One way ride

- No need to go back to the departure station

Stations

- Intermodality with public transportation
- No parking fees

Assistance 24/7

- By phone or via the button inside the car

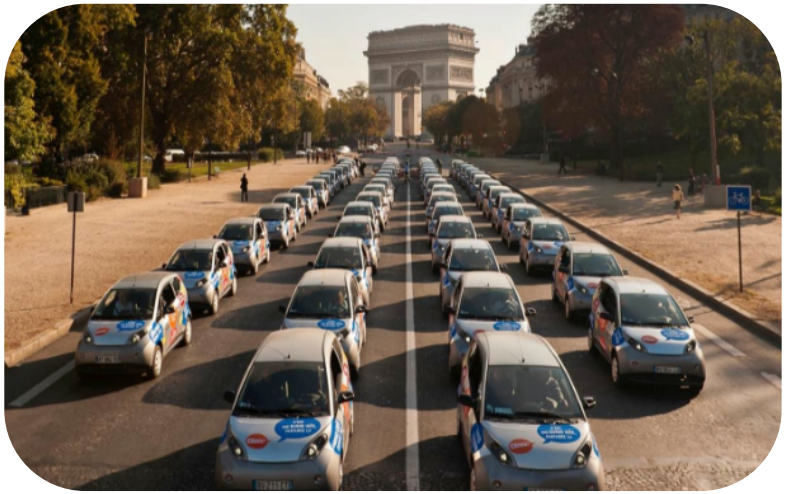
Complete solution

- Access via your computer, mobile or on-board computer

Autolib': The 1st EV carsharing in the world

- 45 towns
- 250 Bluecar vehicles
- 1,300 charging points
- 5,650 subscribers
- 4,600 rentals
- 41,900 km

December 2011



The world's first and largest EV carsharing service

- An in-depth real-life test, challenging the technology in tough conditions
- A **commercial success** reflecting the public's interest for carsharing
- A success driving interest from other large cities
- Autolib' rides with **green electricity**

- 100 towns
- 4,000 Bluecar vehicles
- 6,300 charging points
- 340,000 subscribers (since dec 2011)
- 21 million rentals
- 200 million km

June 2017

Urban Mobility requires EV:

- Issues on Batteries and Lithium availability

Challenges for batteries for EV

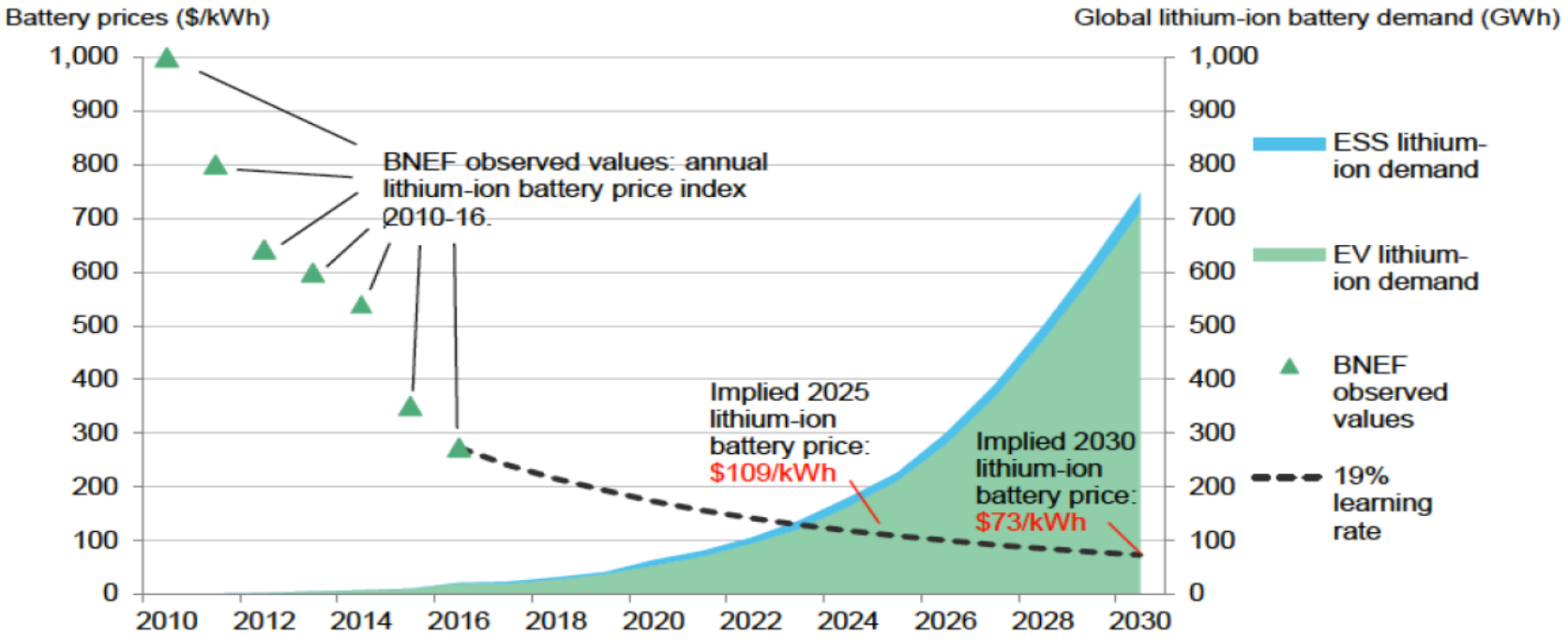
Safety

- Autonomy kWh/kg
- Power kW/kg
- Cycling
- Duration life

- Number of km
- Safety for response
- Number of km
- Years under any external conditions

- Cost $/kWh
- Charging time

Battery pack = cells + BMS + wiring + housing + thermal management



Source: Bloomberg New Energy Finance, 2016

EV cars with lithium batteries: What about Lithium ?

- **Production:** from 17 000 T in 2005 to 32 500 T in 2015
- **Estimated Reserves:** 17 MT to 25 MT
  with Bolivia + Chile + Argentina with more than 15 MT
  33 rd Element on earth
- **3 kg for an EV**
  1 T for an 10 MWh energy storage
- **The good news :** energy / kg is increasing which means more kilometers per kilo of Lithium
- **Recycling**