What will the Built Environment look like 20 years from now?

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Future Thinking - Not everyone gets it right

- EVERYTHING THAT CAN BE INVENTED HAS
(Head of US Patent Office - 1889)

    Nearly 200,000 patents filed in 2007

- HEAVIER THAN AIR FLYING MACHINES ARE NOT POSSIBLE
(Lord Kelvin - 1895)

    The Wright Brothers flew in 1903

- THERE IS A WORLD MARKET FOR 15 COMPUTERS
(IBM Chairman - 1945)

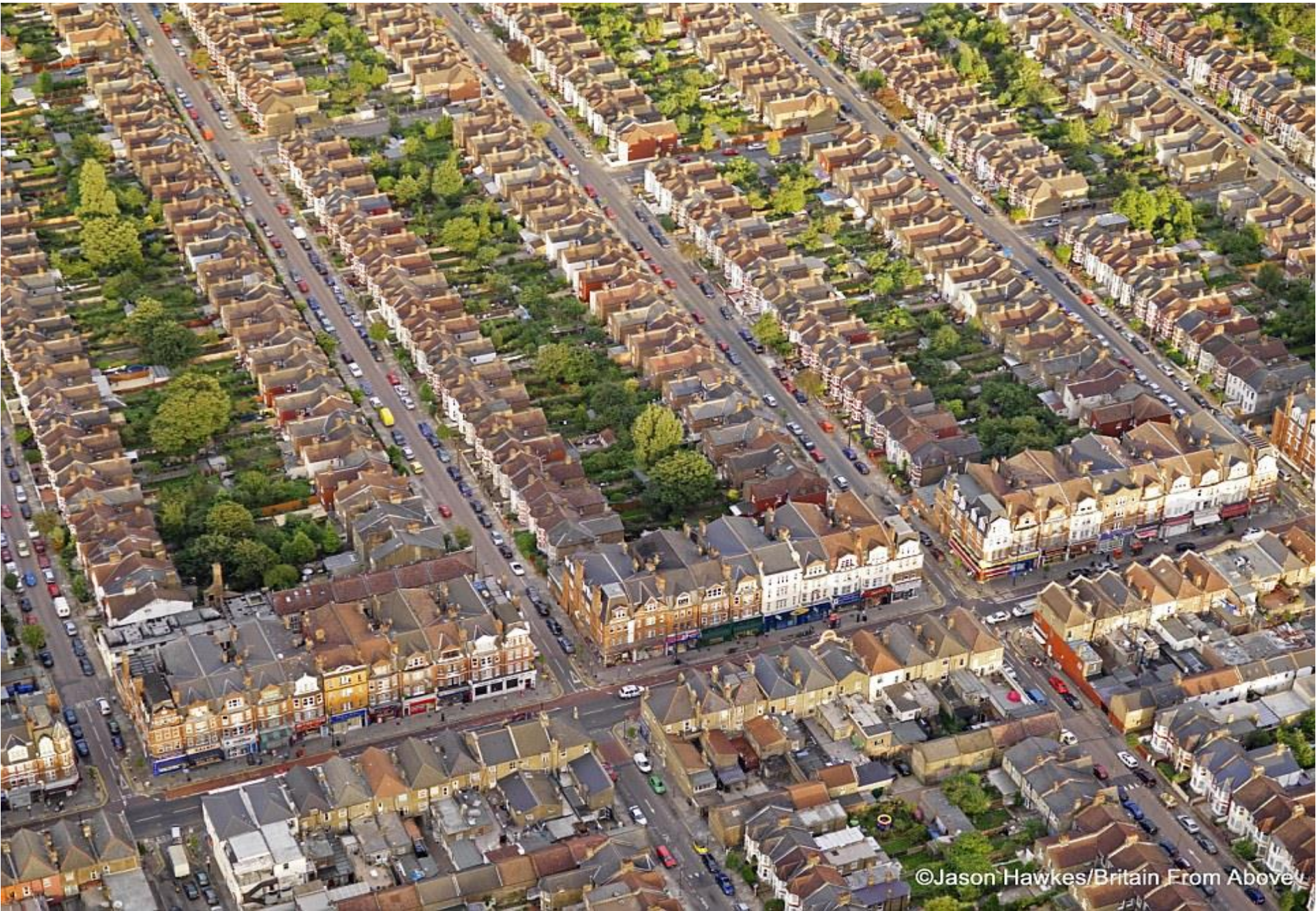   *Zillions of computers are now linked by the Internet*

- SPACE FLIGHT IS HOKUM
(Astronomer Royal - 1956)

    Yuri Gagarin was the first man in space in 1961

- Microsoft missed the Internet
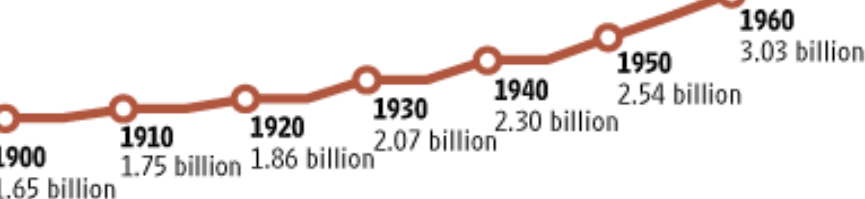- Everyone missed the credit crunch

The Global Resource Squeeze

As the world grows more populous, it is also growing more prosperous. Rising living standards in the developing world have boosted demand for resources, lifting prices. CRB Spot Index of prices for 22 commodities, including oil, steel and hogs:

CRB Commodity Index

Source: Commodity Research Board

Global population

- **1900** 1.65 billion
- **1910** 1.75 billion
- **1920** 1.86 billion
- **1930** 2.07 billion
- **1940** 2.30 billion
- **1950** 2.54 billion
- **1960** 3.03 billion
- **1970** 3.70 billion
- **1980** 4.45 billion
- **1990** 5.29 billion
- **2000** 6.12 billion
- **2010** 6.91 billion
- **2020** 7.67 billion
- **2030** 8.32 billion
- **2040** 8.82 billion
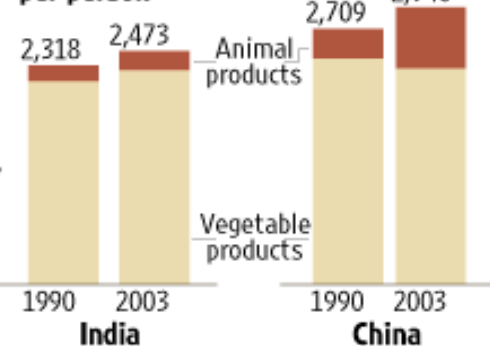- **2050** 9.19 billion

10 billion

Source: United Nations (population)

Richer Diets

In many developing nations, more people are adopting high-protein diets richer in meats, taxing supplies of water and arable land.
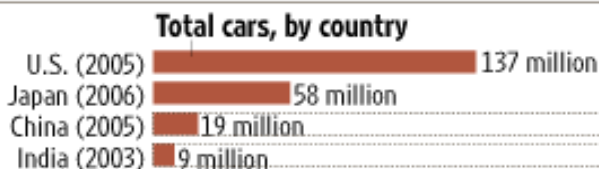
Source: United Nations

Daily calorie consumption per person

Animal products

Vegetable products

India
- 1990: 2,318
- 2003: 2,473

China
- 1990: 2,709
- 2003: 2,940

Auto Planet

Car ownership rates in China and India are rising, which could add significant new pressure on oil supplies.

Total cars, by country

- U.S. (2005): 137 million
- Japan (2006): 58 million
- China (2005): 19 million
- India (2003): 9 million

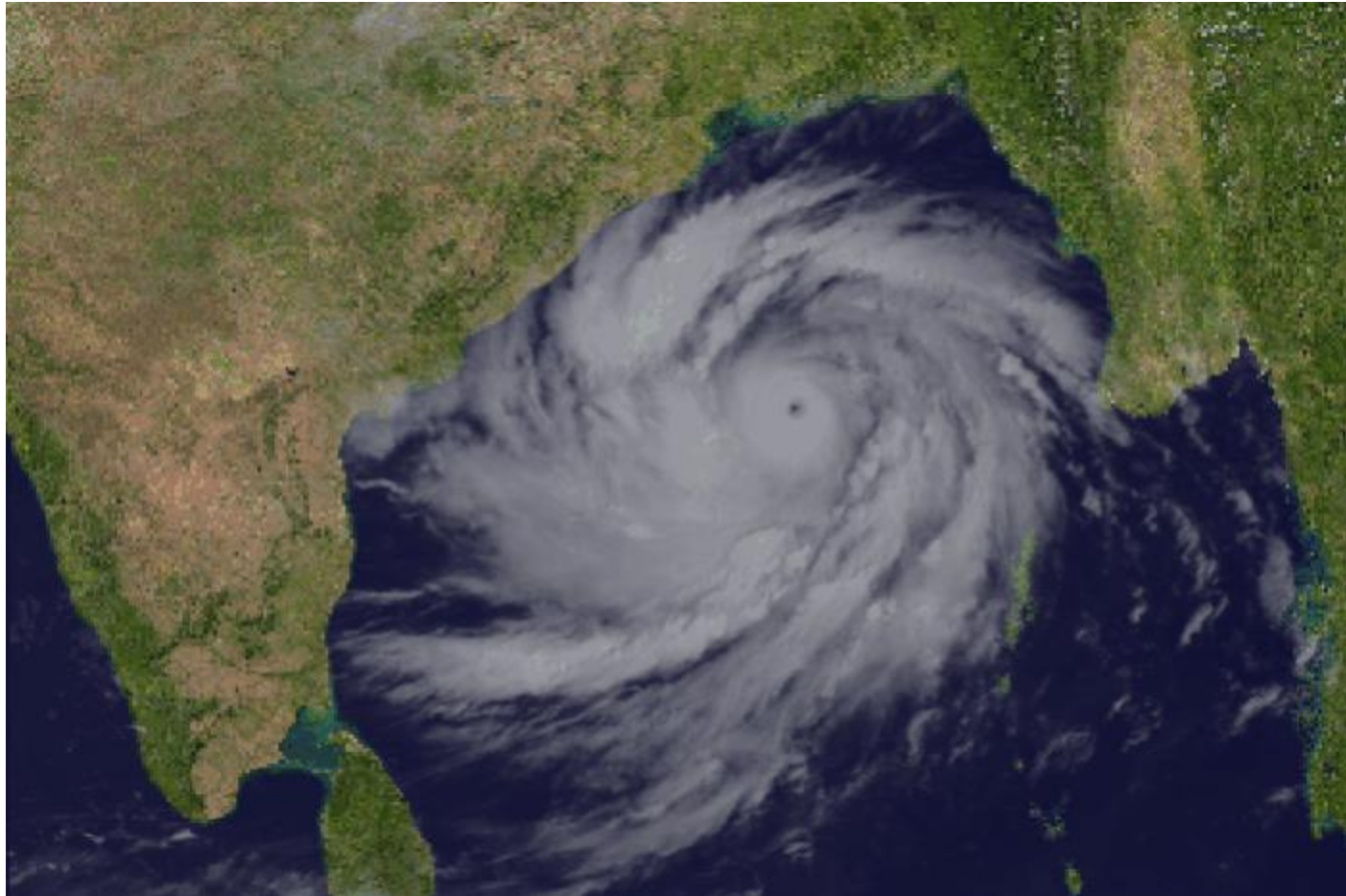**Number of cars if per-capita ownership rates rose to U.S. levels**

- 590 million
- 497 million

Sources: International Road Federation; Japan Automobile Manufacturers Association; Japan Statistics Bureau.

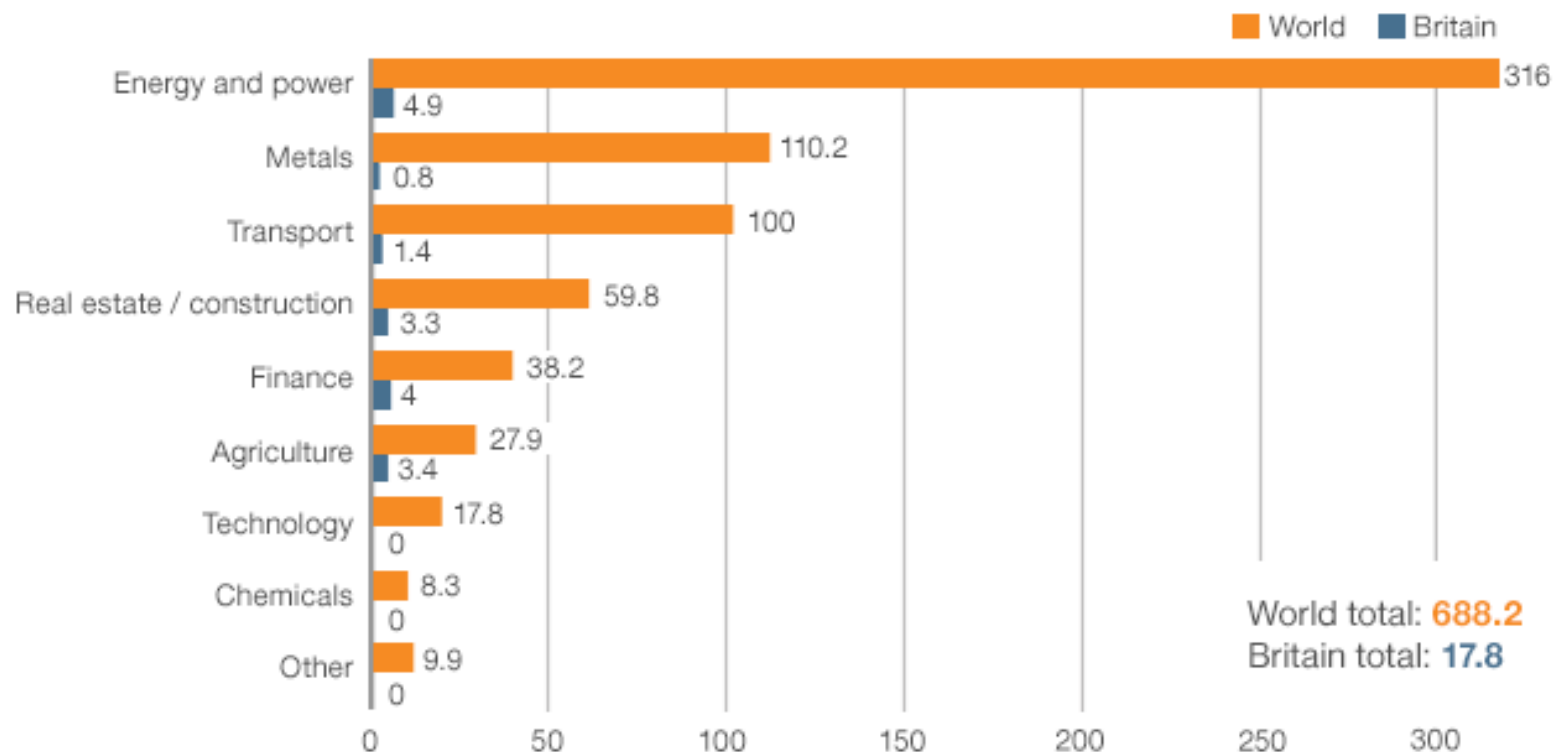The urban and rural population of the world, 1950-2030
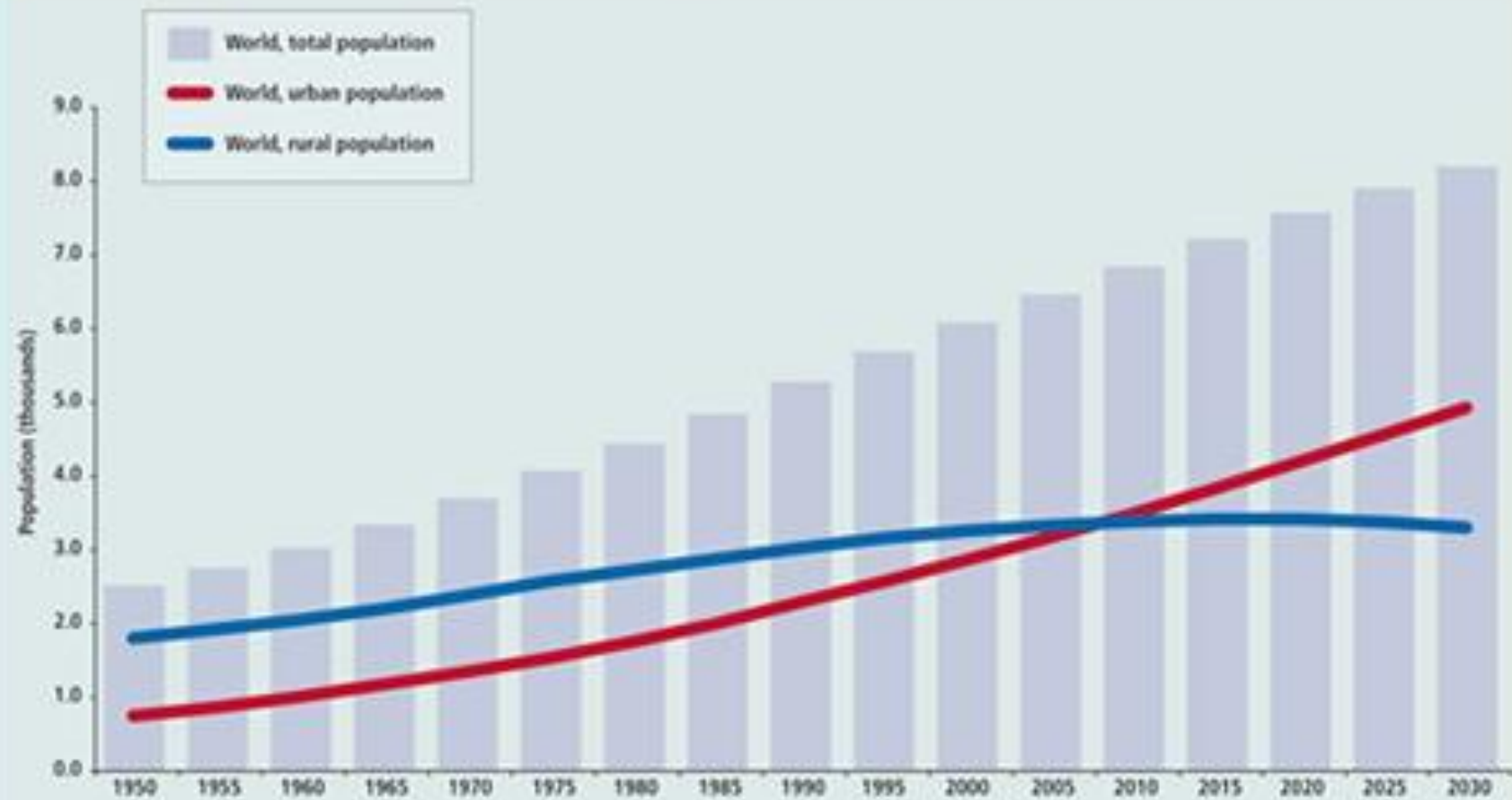
International Day of Older Persons 2012

Longevity: Shaping the Future

What China invested in 2005-present
Investments and contracts, $bns US

Legend: World (orange) · Britain (blue)

Category	World	Britain
Energy and power	316	4.9
Metals	110.2	0.8
Transport	100	1.4
Real estate / construction	59.8	3.3
Finance	38.2	4
Agriculture	27.9	3.4
Technology	17.8	0
Chemicals	8.3	0
Other	9.9	0

World total: **688.2**
Britain total: **17.8**

Note: 2013 data to June
Source: Heritage Foundation

The world's megacities

Population 2007		Population 2025
1. Tokyo	35.7m → 36.4m	1. Tokyo
2. Mexico City	19.0m	26.4m 2. Mumbai
3. New York-Newark	19.0m	22.5m 3. Delhi
4. Sao Paulo	19.0m	22.0m 4. Dhaka
5. Mumbai	18.8m	21.4m 5. Sao Paulo
6. Delhi	15.9m	21.0m 6. Mexico City
7. Shanghai	15.0m	20.6m 7. New York-Newark
8. Kolkata	14.8m → 20.6m	8. Kolkata
9. Buenos Aires	12.8m	19.4m 9. Shanghai
10. Dhaka	13.5m	19.1m 10. Karachi
11. LA-Long Beach-S' Ana	12.5m	16.8m 11. Kinshasa
12. Karachi	12.1m	15.8m 12. Lagos
13. Rio de Janeiro	11.9m	15.6m 13. Cairo
14. Osaka-Kobe	11.7m	14.8m 14. Manila
15. Cairo	11.3m	14.5m 15. Beijing
16. Beijing	11.1m	13.8m 16. Buenos Aires
17. Manila	11.1m	13.7m 17. LA-Long Beach-S' Ana
18. Moscow	10.5m	13.4m 18. Rio de Janeiro
19. Istanbul	10.1m	12.4m 19. Jakarta
		12.1m 20. Istanbul
		11.8m 21. Guangzhou
		11.4m 22. Osaka-Kobe
		10.5m 23. Moscow
		10.5m 24. Lahore
		10.2m 25. Shenzhen
		10.1m 26. Chennai

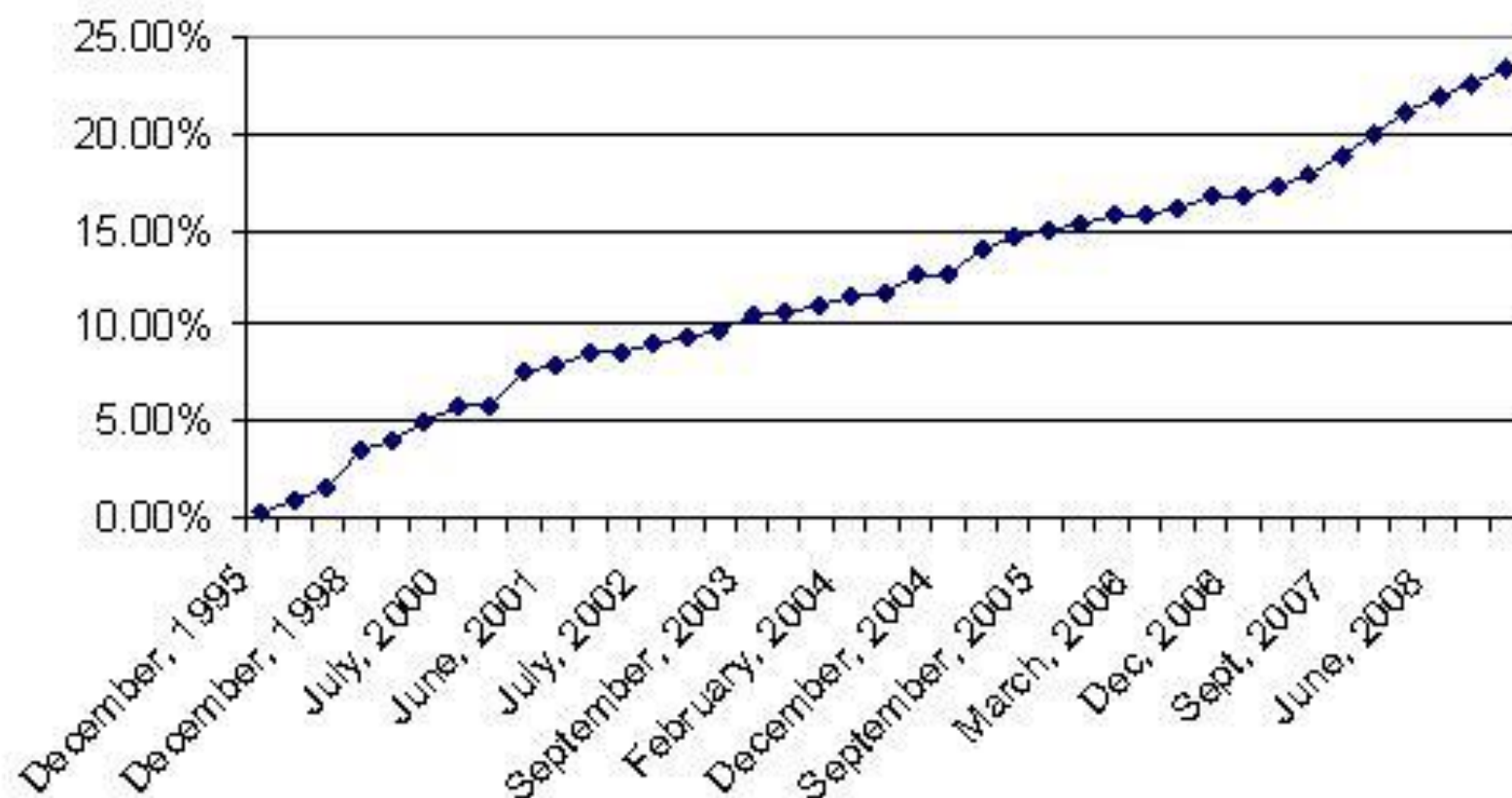SOURCE: UN-HABITAT 2008   NOTE: S' ANA = SANTA ANA

Photo: Luiz Arthur Leirao (Tuca) Vieira

Life in a totally connected world

% of world population using the internet since 1995

Magnus Johansson / AFP

A key part of life

Percentage of respondents willing to give up a lifestyle habit for a year instead of the internet
2012

○ United States ○ China ○ Germany ○ Brazil

Source: Boston Consulting Group

Data over the Internet

Regional Growth
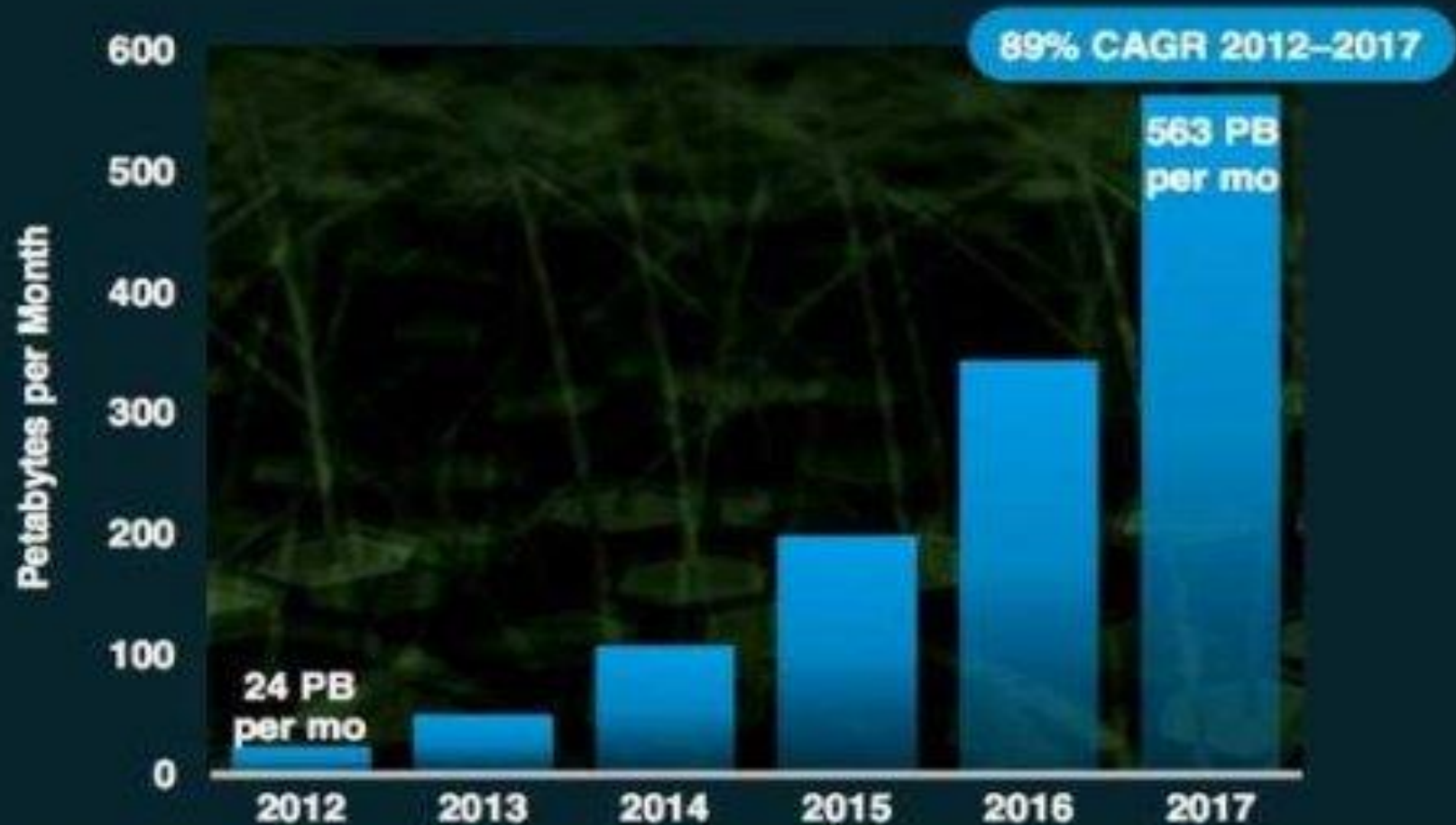
What are the biggest impacts on the construction industry likely to be?

- Changes in infrastructure: more warehousing, less high street retail – high street more of an experience
- Head up displays (HUDs) on construction sites
- Building equivalent to 'power by the hour': pop-up offices, retail etc.
- Time zone, GMT, confers advantage in global marketplace
- Asset and process improvement via 'Big Data' learning; predictive; user feedback; real time decision making
- Polarisation of skills, both on site and in pre-manufacture
- Reducing space needs – 'just in time'
- Sharing data = quick decision making
- Proactive automation
- Construction a parochial business => relatively immune to changes?
- Disintermediation changes role of 'middlemen'
- Traceability of all products impacts supply chains
- Augmented intelligence changes skills availability by enabling more people to reach a given standard
- Opportunity of hyper-connectivity to crowd-source; create 'super brain'; ratings, reviews, Big Data, management information, project performance statistics to inform planning

Life in a resource constrained world

Which are the main resources which are likely to be constrained? Which of these are currently fundamental to the construction industry? What alternatives are there/could there be?

Resources	Alternatives
A. Fresh water	A. Efficient use – air cooling, desalination
B. Oil (transportable energy)	B. Integrated infrastructure, renewables, biofuels, waste, fracking, distributed power sources to reduce demand
C. Food	C. Decrease waste, improve efficiency in growing, eat fewer calories
D. Energy: high carbon / low carbon	D. See (b)
E. Land and associated ecosystems	E. Growth of cities, develop green and blue infrastructure, transport infrastructure; understand the value of ecosystem services
F. Skills (quality)	F. Immigration vs. training, value skills,
G. Metals	G. Reuse and recycle; use alternatives – bio fibres, bamboo, ….
H. Carbon budgets (no more concrete?)	What are the alternatives to copper?
I. Labour (quantity)	Asteroid mining?
J. Minerals	
K. Finance	

What does the construction industry need to do to adapt to the constraints or to using alternative resources?

- Better life-cycle thinking: Working within a circular economy – cradle-to-cradle resource use
- Design for deconstruction and re-use: how do we prove the condition of components we reuse?
- Future proofing (e.g. Olympic park foundations and energy centre) vs. avoiding over-engineering
- Temporary / flexible buildings, design for change of use
- Change in building methods, quality
- Efficiency in design
- Cross-industry integrated design and innovation
- Revised standards, to allow materials to be re-used
- We need a 'totex' approach to delivery – to overcome the separation of capex and opex when assessing costs
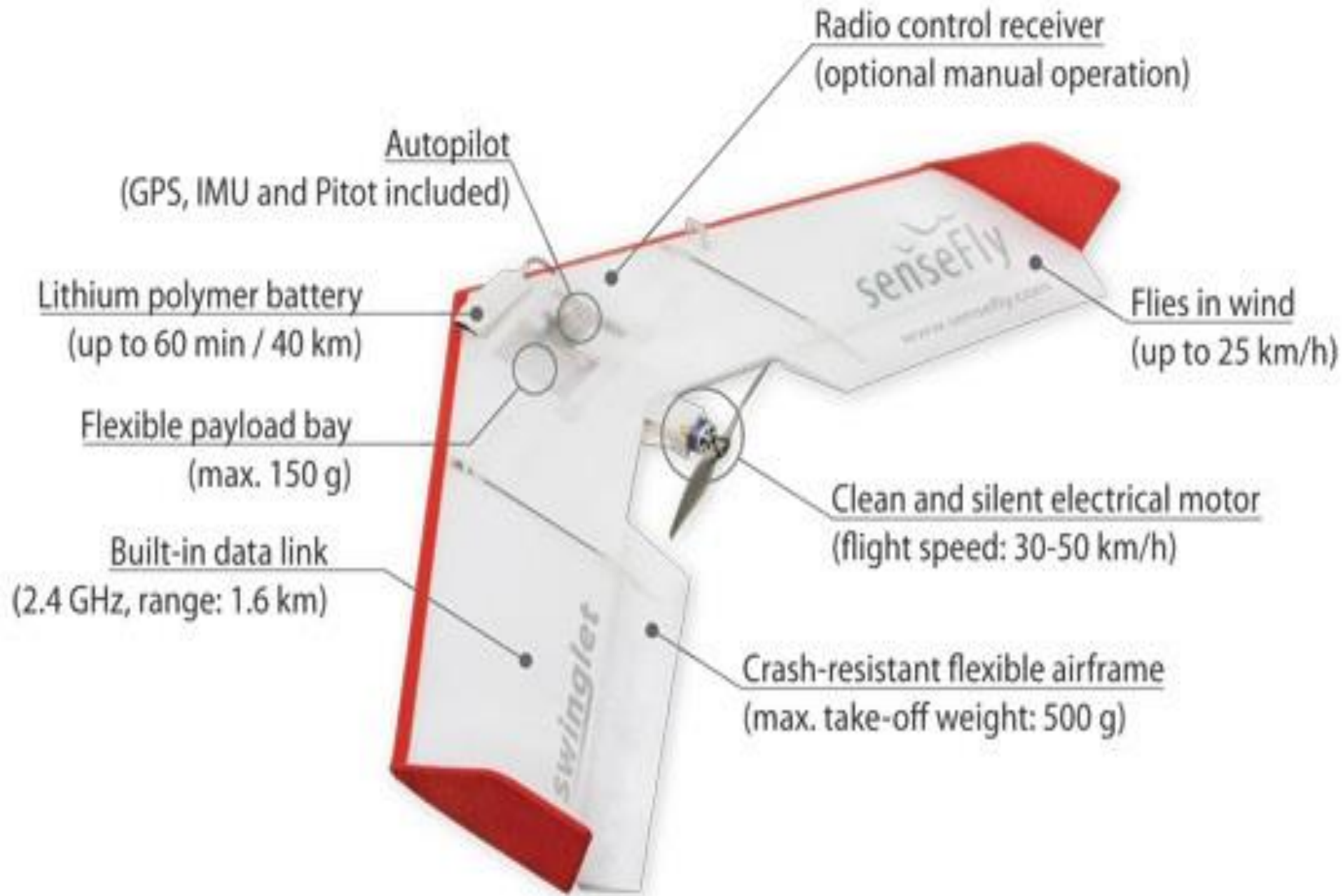
Materials and technologies?

ADVANCED PRISM
DISPLAY

Radio control receiver
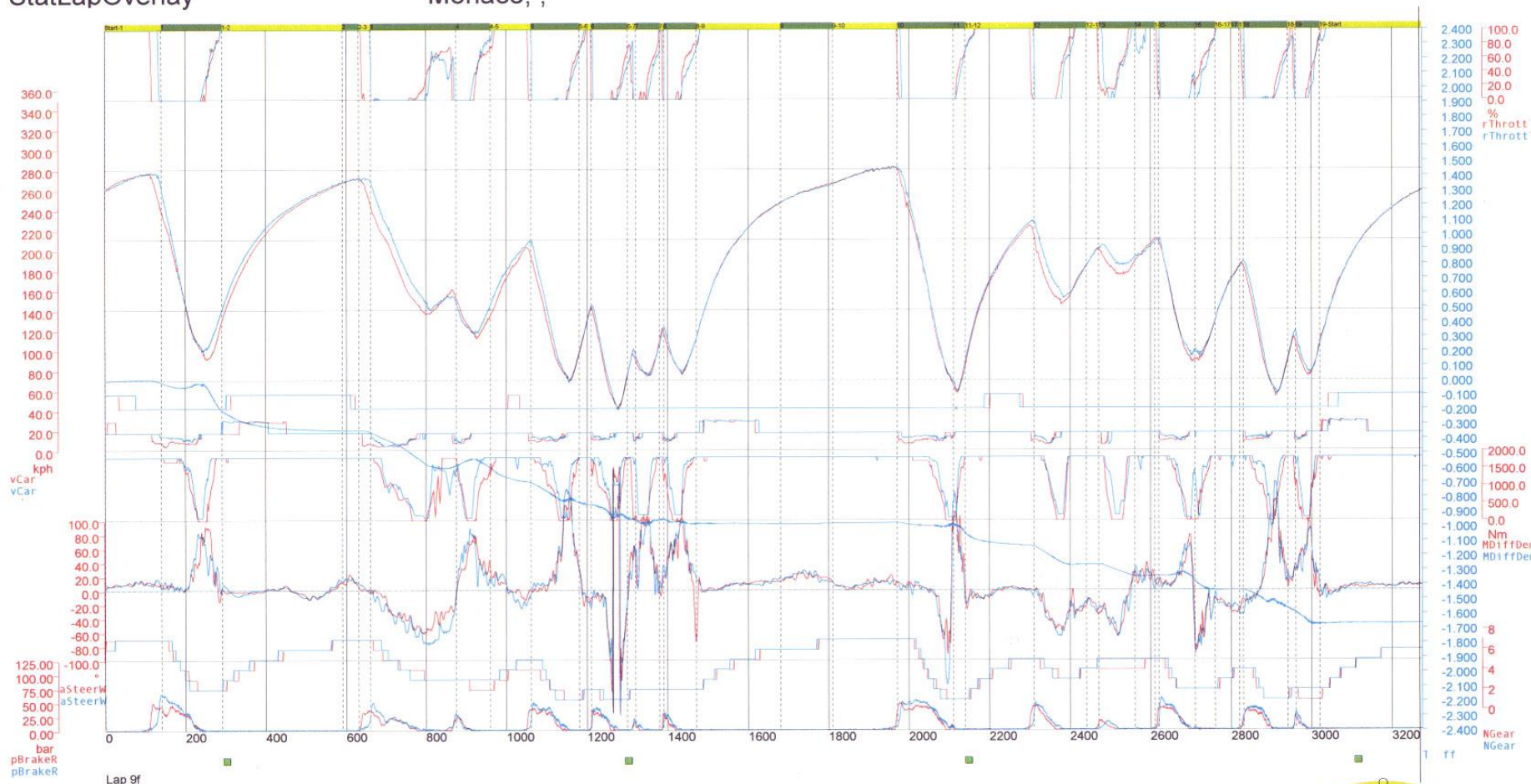(optional manual operation)

Autopilot
(GPS, IMU and Pitot included)

Lithium polymer battery
(up to 60 min / 40 km)

Flies in wind
(up to 25 km/h)

Flexible payload bay
(max. 150 g)

Built-in data link
(2.4 GHz, range: 1.6 km)

Clean and silent electrical motor
(flight speed: 30-50 km/h)

Crash-resistant flexible airframe
(max. take-off weight: 500 g)

senseFly

swinglet

StatLapOverlay   Monaco, ,

Lap 9f

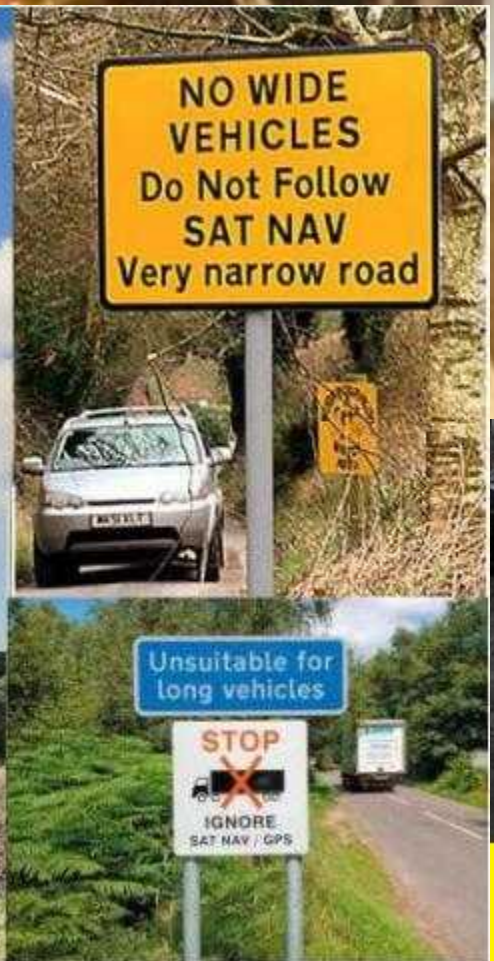| vCar | =259.3 | =258.5 | kph | MDiffDemand | =1800.0 | =1800.0 | Nm |
NGear	=6	=6		MKERSDemand	=0	=0	Nm
rThrottlePedal	=100.0	=100.0	%	BNRearWingStateControlMode	=Active	=Active	
aSteerWheel	=8.5	=7.4	°	TDiff		=-1.670	
pBrakeR	=1.23	=1.07	bar				

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Whilst much modified, **concrete, masonry, steel, timber, glass and asphalt** have been the main materials used in construction for centuries. There are current attempts to develop variants such as low carbon cements and ever-ingenious coatings and admixtures, but are any new materials likely to emerge to challenge the big six above? What are the main types of innovation in materials that are likely to occur over the next 30-40 years?

Desired Material/Product Properties
*   Materials that actively improve the environment eg air quality
*   Materials that adapt eg to temperature/humidity – or have multiple uses eg wood
*   Easy reuse/recycling – but need to be able to check conditions of components for reuse
*   Products that sequester carbon – using more 'grown' products than mined products eg hemp (food, pharma, cloth, buildings)
*   Materials that condition temperature and humidity within buildings
*   Multi-function materials eg glass: lets light in, prevents heat escape, modifies light quality, generates electricity
*   Tighter restrictions on processes/product manufacture
*   Increased durability eg for road surfaces
*   If more timber is available, should this be utilised as a renewable resource? Eg low-rise construction?

Walk-on ferry only (Sat - Nav error)

Long vehicles prohibited Do not follow SAT NAV

NO WIDE VEHICLES Do Not Follow SAT NAV Very narrow road

NO THROUGH ROAD GPS INCORRECT GO BACK

Unsuitable for long vehicles

STOP IGNORE SAT NAV / GPS

£200m damage caused by satnavs!

- Singularity – rapid acceleration of technology caused by smart computers designing even smarter computers
- Likely to happen between 2015 – 2040.
- Assisted by developments in molecular-sized components resulting from nanotech and biotech
- Computers 'start to take over'

Ian Pearson, BT
Futurologist, 2004