GIIA & MMC Roundtable

Exploring the global risks landscape for investors in infrastructure

25 September 2019, London

Speakers

Martin Bennett,
Managing Director, Marsh
Martin.Bennett@mmc.com

MARSH

Blair Chalmers,
Director, Marsh & McLennan Insights
Blair.Chalmers@mmc.com

MARSH & McLENNAN INSIGHTS

Guillaume Thibault,
Partner, Oliver Wyman Forum
Guillaume.Thibault @oliverwyman.com

OLIVER WYMAN FORUM

Neil Duchesne,
Senior Partner, Marsh
Neil.Duchesne@marsh.com

MARSH

Andy Perry,
Principal, Oliver Wyman
Andrew.Perry@oliverwyman.com

OLIVER WYMAN

Sarika Goel,
Principal, Mercer
Sarika.Goel@mercer.com

MERCER

Nicholas Tonkes,
Partner, Oliver Wyman
Nicholas.Tonkes@oliverwyman.com

OLIVER WYMAN


MARSH & McLENNAN COMPANIES
WORLD ECONOMIC FORUM
GLOBAL RISKS REPORT 2019
Considerations for Infrastructure

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Insight Report

The Global Risks Report 2019
14th Edition

In partnership with Marsh & McLennan Companies and Zurich Insurance Group

THE QUEST FOR CONTROL

THE QUEST FOR CONTROL

IN RECENT YEARS, ENV., TECH., AND GEOPOLITICAL THREATS HAVE COME TO SUPPLANT ECONOMIC RISKS AS ISSUES OF GREATEST CONCERN

Evolving Global Risk Landscape (2009–2019)

Economic | Environmental | Geopolitical | Societal | Technological

Top 5 Global Risks in terms of likelihood

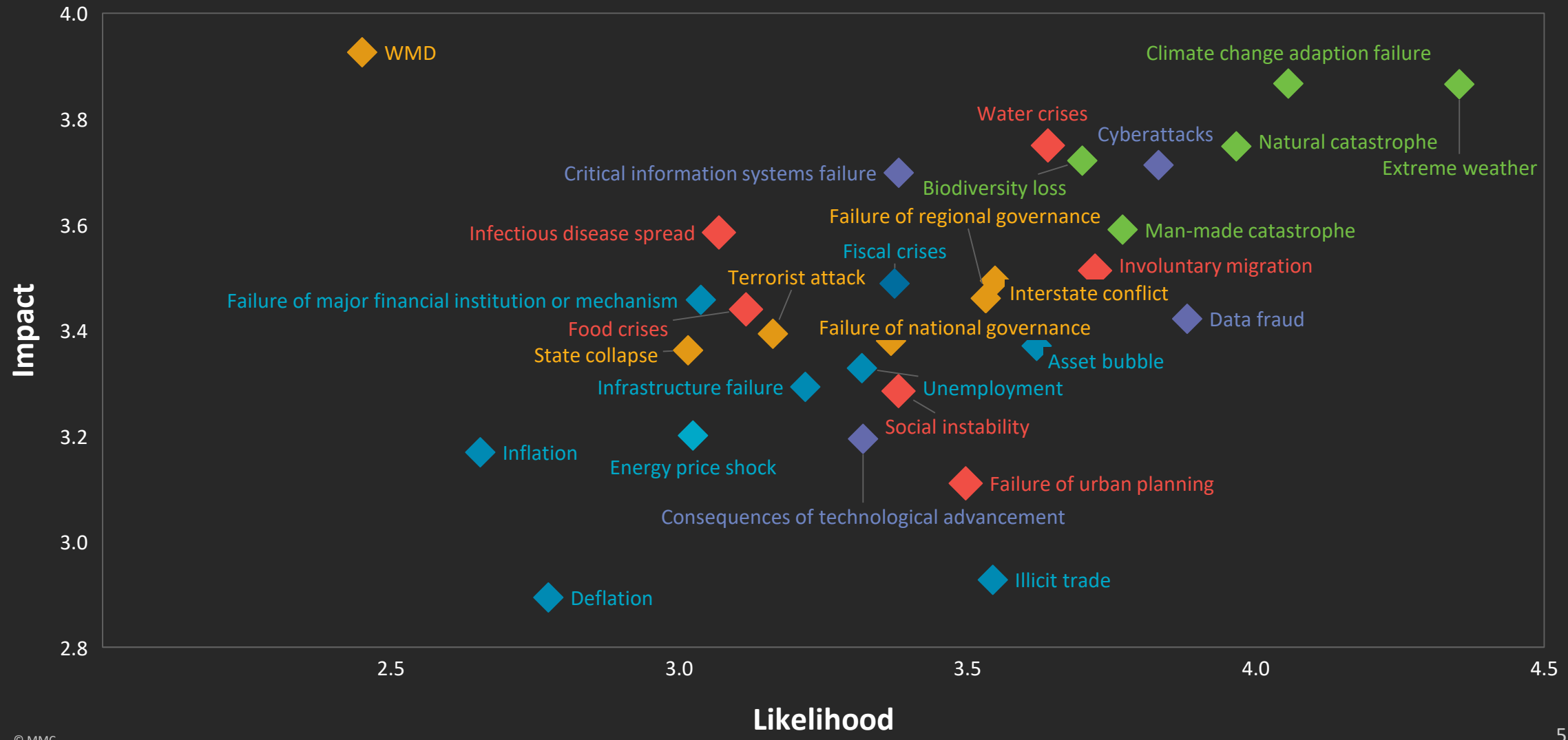
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Asset price collapse	Asset price collapse	Storms and cyclones	Income disparity	Income disparity	Income disparity	Interstate conflict	Involuntary migration	Extreme weather	Extreme weather	Extreme weather
2	Slowing Chinese economy	Slowing Chinese economy	Flooding	Fiscal imbalances	Fiscal imbalances	Extreme weather	Extreme weather	Extreme weather	Involuntary migration	Natural catastrophes	Climate change mitigation and adaption failure
3	Chronic disease	Chronic disease	Corruption	Greenhouse gas emissions	Greenhouse gas emissions	Unemployment/ under-employment	National governance failures	Weak climate change response	Natural catastrophe	Cyberattacks	Natural catastrophes
4	Global governance gaps	Fiscal cries	Biodiversity loss	Cyber attacks	Water supply crises	Climate change	State collapse	Interstate conflict	Terrorist attack	Data fraud	Data fraud
5	Retrenchment from globalisation	Global governance gaps	Climate change	Water supply crises	Aging population	Cyberattacks	High unemployment	Natural catastrophes	Data fraud	Climate change adaption failure	Cyberattacks

Top 5 Global Risks in terms of impact

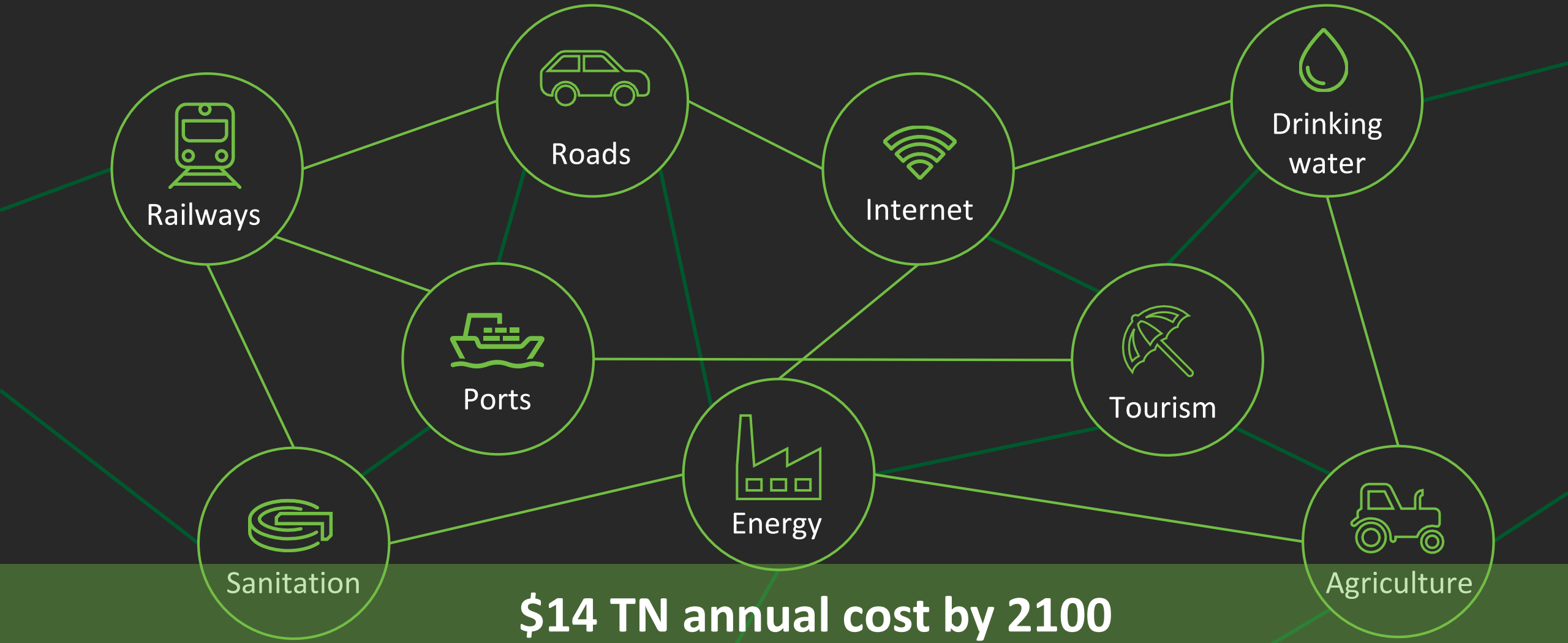
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Asset price collapse	Asset price collapse	Fiscal crises	Systematic financial failure	Systematic financial failure	Fiscal crises	Water crises	Weak climate change response	WMDs	WMDs	WMDs
2	Retrenchment from globalisation	Retrenchment from globalisation	Climate change	Water supply crises	Water supply crises	Climate change	Infectious diseases	WMDs	Extreme weather	Extreme weather	Climate change mitigation and adaption failure
3	Oil and gas price spike	Oil price spike	Geopolitical conflict	Food crises	Fiscal imbalances	Water crises	WMDs	Water crises	Natural catastrophes	Natural catastrophes	Extreme weather
4	Chronic disease	Chronic disease	Asset price collapse	Fiscal imbalances	WMDs	Unemployment/ under-employment	Interstate conflict	Involuntary migration	Water crises	Climate change adaption failure	Water crises
5	Fiscal crises	Fiscal crises	Extreme energy price volatility	Volatility in energy and agri-cultural prices	Weak climate change response	Critical ICT systems breakdown	Weak climate change response	Energy price shock	Weak climate change response	Water crises	Natural catastrophes

Source: World Economic Forum, *Global Risks Report 2019*

EXECUTIVE OPINION SURVEY RISKS ON A 10-YEAR OUTLOOK



ECONOMIC IMPACTS OF RISING SEA LEVELS

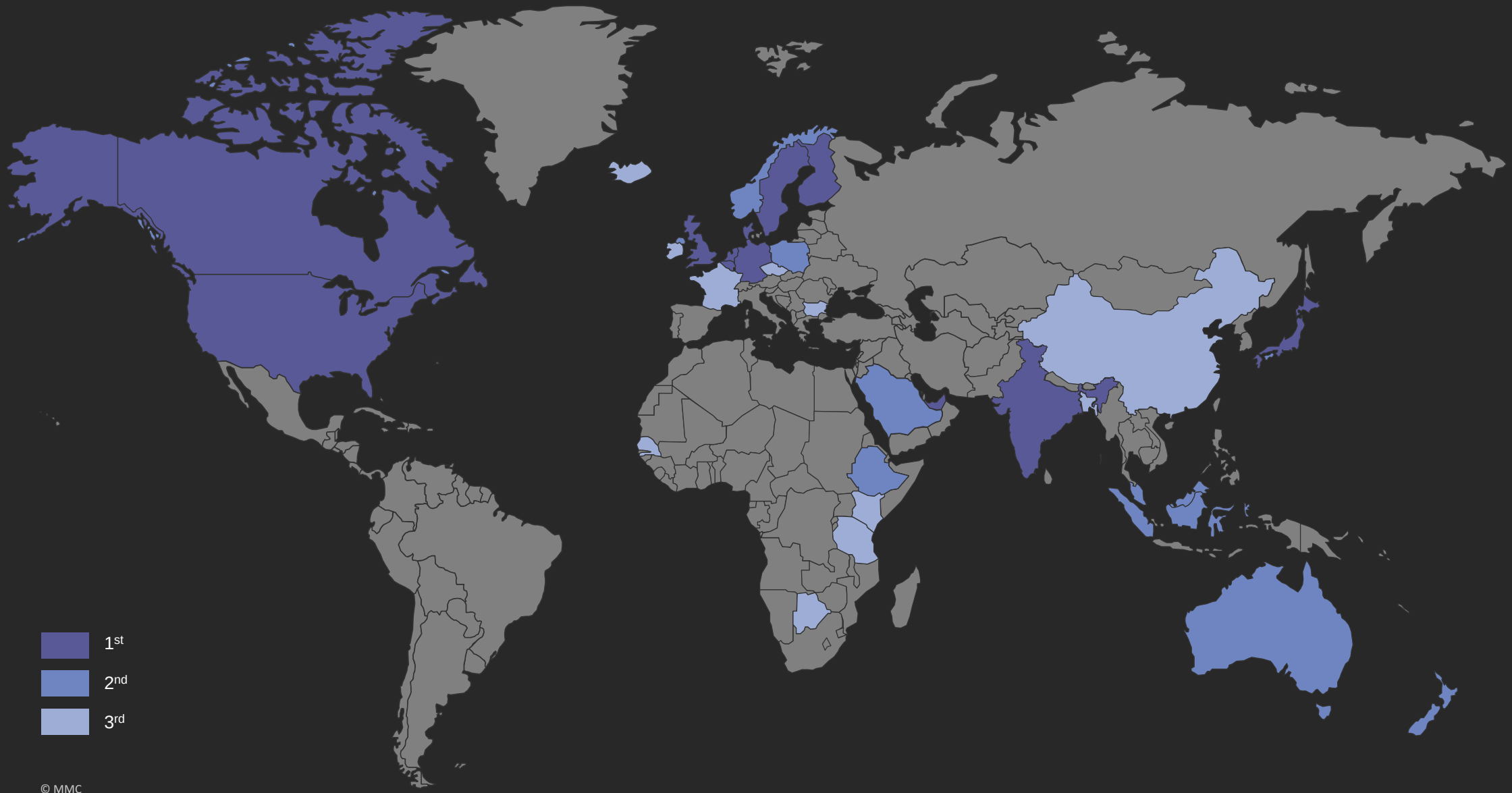


$14 TN annual cost by 2100

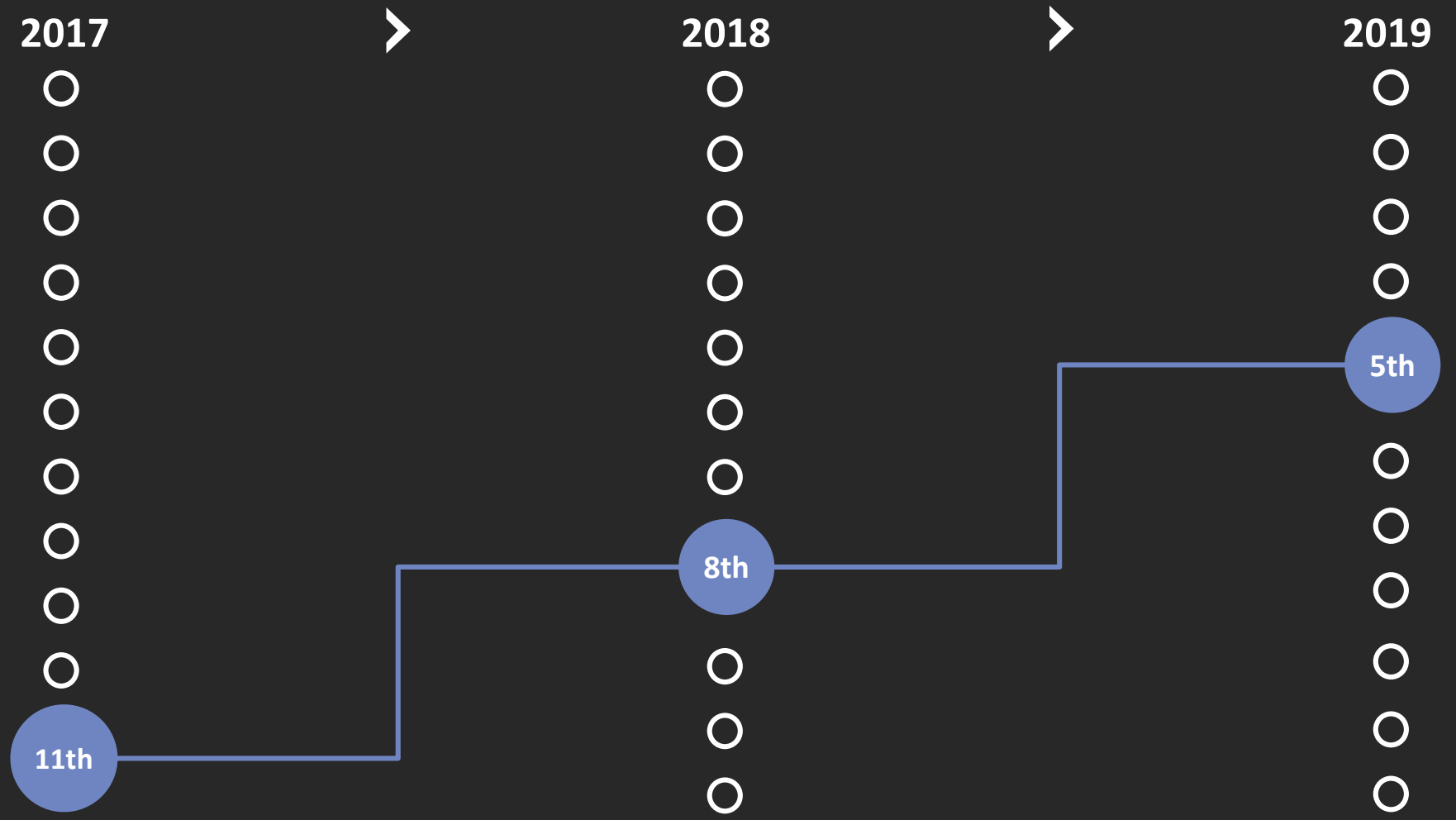
CITIES AT GREATEST RISK

● Cities with >10 million people, at risk of 0.5m sea-level rise by 2100

CYBER RISKS ARE A KEY CONCERN FOR BUSINESS LEADERS GLOBALLY



AND THE PRECEIVED RISK LEVEL IS RISING STEADILY



$310 BN

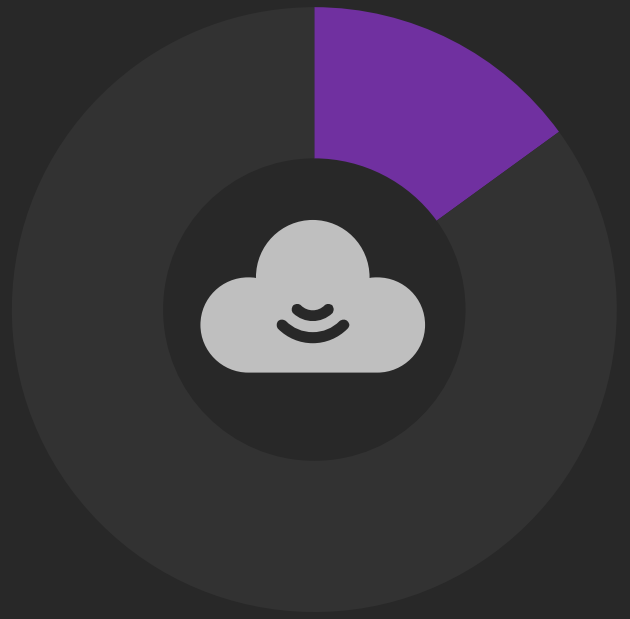
Economic losses from
natural disasters

$1.5 – $4 TN

Economic losses from
cyber attacks

55%

Estimated insured losses from natural disasters



15%

Estimated insured losses from cyber attacks


MARSH & McLENNAN
COMPANIES

MARSH JLT SPECIALTY

Political Risk in Developed Markets
An Evolving Challenge

Wednesday 25 September 2019

Neil Duchesne
Senior Partner, Credit Specialties

London, UK

MARSH

Overview

- Political Risk: A Global Introduction.
- Global Infrastructure Trends: Region and Sector.
- Infrastructure Gap.
- Current Geo-Political Conditions.
- Theme 1: Radical Politics – Radical Effects? UK Focus.
- Theme 2: Chinese Belt and Road Initiative (BRI).
- Theme 3: Trade War in the US.
- Claims and Review.

2019
Major Global Political Events

Ukraine: Volodymyr Zelnskyi secures presidency, while his Servant of the People party wins parliamentary majority.

China: Second Belt and Road Forum attracts 5,000 delegates.
US$64 billion worth of deals reportedly signed.

USA: Redacted version of Mueller report suggests systematic Russian interference in 2016 election, but insufficient evidence of co-ordination with Trump campaign.

United Kingdom: Boris Johnson becomes PM, Brexit deadline set at 31 October 2019.

India: Constitutional amendments remove autonomy for Jammu and Kashmir.

Hong Kong: Protests and civil unrest in response to proposed extradition legislation.

Venezuela: Maduro remains in control of government, despite recognition of Juan Guaidó as interim president by the US and Canada.

Sri Lanka: Easter Sunday bombings on churches and luxury hotels kill 259 people.

Brazil: Jair Bolsonaro inaugurated as president on 1 January 2019.

Sudan & Algeria: Protests lead to removal of Omar al-Bashir and resignation of Abdelaziz Bouteflika.

Ethiopia: Continued economic and political liberalisation, but attempted coup in Amhara suggests declining military cohesion.

Number and Value of Pipeline Infrastructure Projects

The power sector has the most projects in the pipeline.

All Infrastructure Projects Pipeline, by Region

Region	Volume	Value (US$ million)
North East Asia	1,843	3,631,119
South and South East Asia	3,252	3,168,102
Western Europe	1,694	1,661,318
Middle East and North Africa	1,181	1,544,312
North America	1,763	1,454,384
Eastern Europe	1,157	1,130,235
Latin America	1,539	906,916
Sub-Saharan Africa	1,136	852,930
Australasia	582	468,787
Grand Total	**14,147**	**14,818,103**

Rail projects dominate, worth US$5.4 trillion followed by power at US$4.7 trillion.

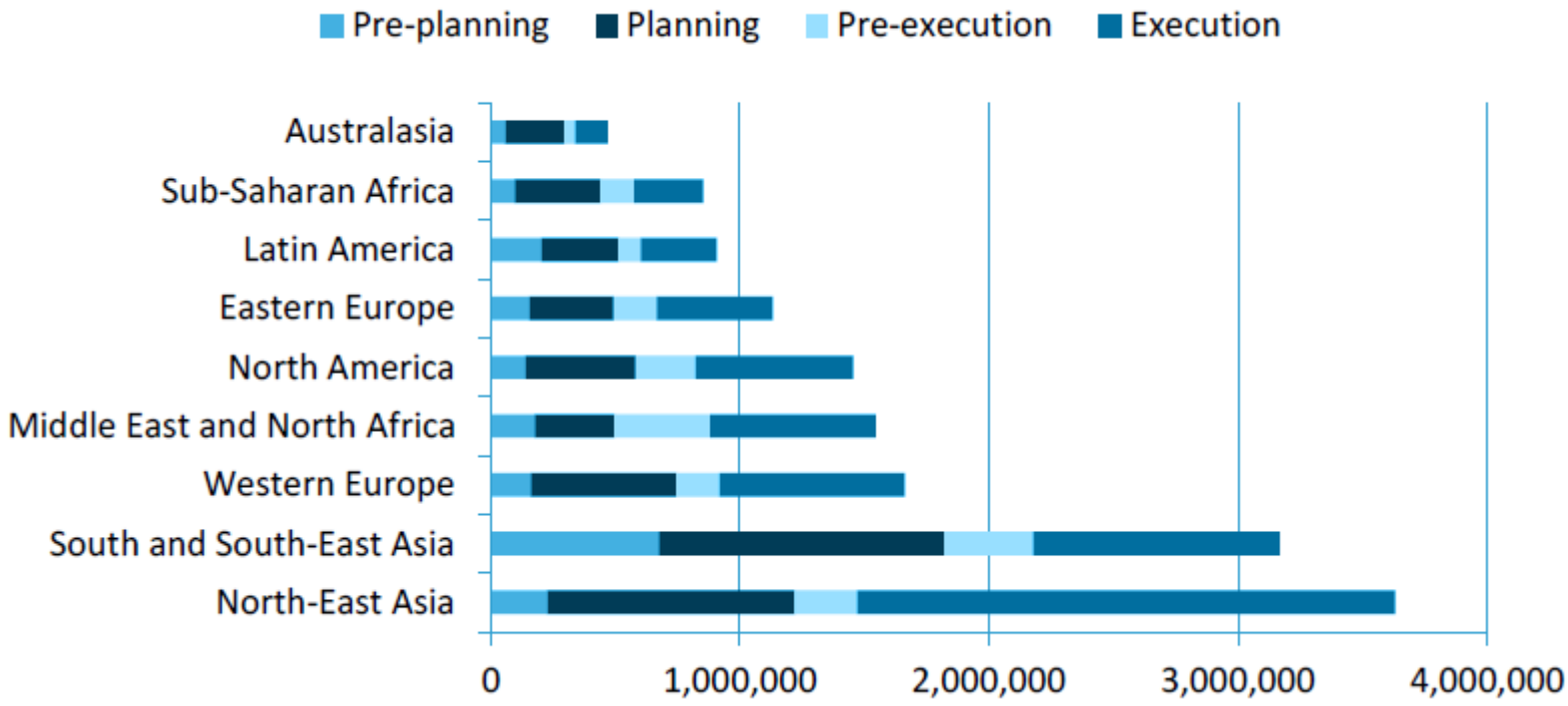
Global Project Pipeline by Sector

Region	Volume	Value (US$ million)
Railway	1,945	5,437,394
Power	5,681	4,730,370
Road	4,004	2,614,139
Airport	650	819,498
Marine and inland water	903	756,197
Water and sewage	964	460,505
Grand Total	**14,147**	**14,818,103**

Source: GlobalData Global Infrastructure Outlook to 2023 Report

Stage of Pipeline Projects

All Infrastructure Projects Pipeline, By Stage (US$ million)

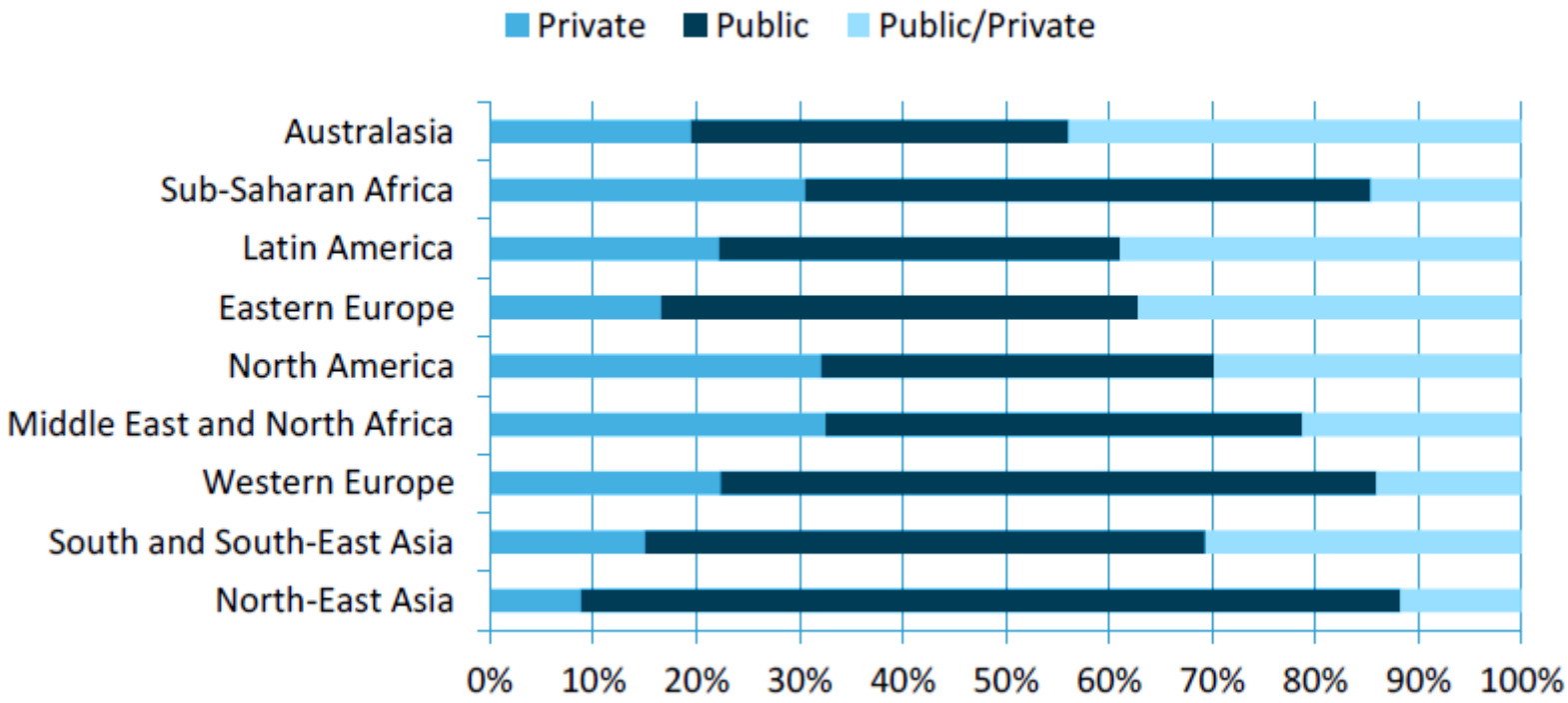


- The majority of projects in the pipeline (12,288) are set to be completed between 2019-2023.
- 1,747 projects are expected to finish between 2024 and 2030.

Source: GlobalData Global Infrastructure Outlook to 2023 Report

Funding of Pipeline Projects

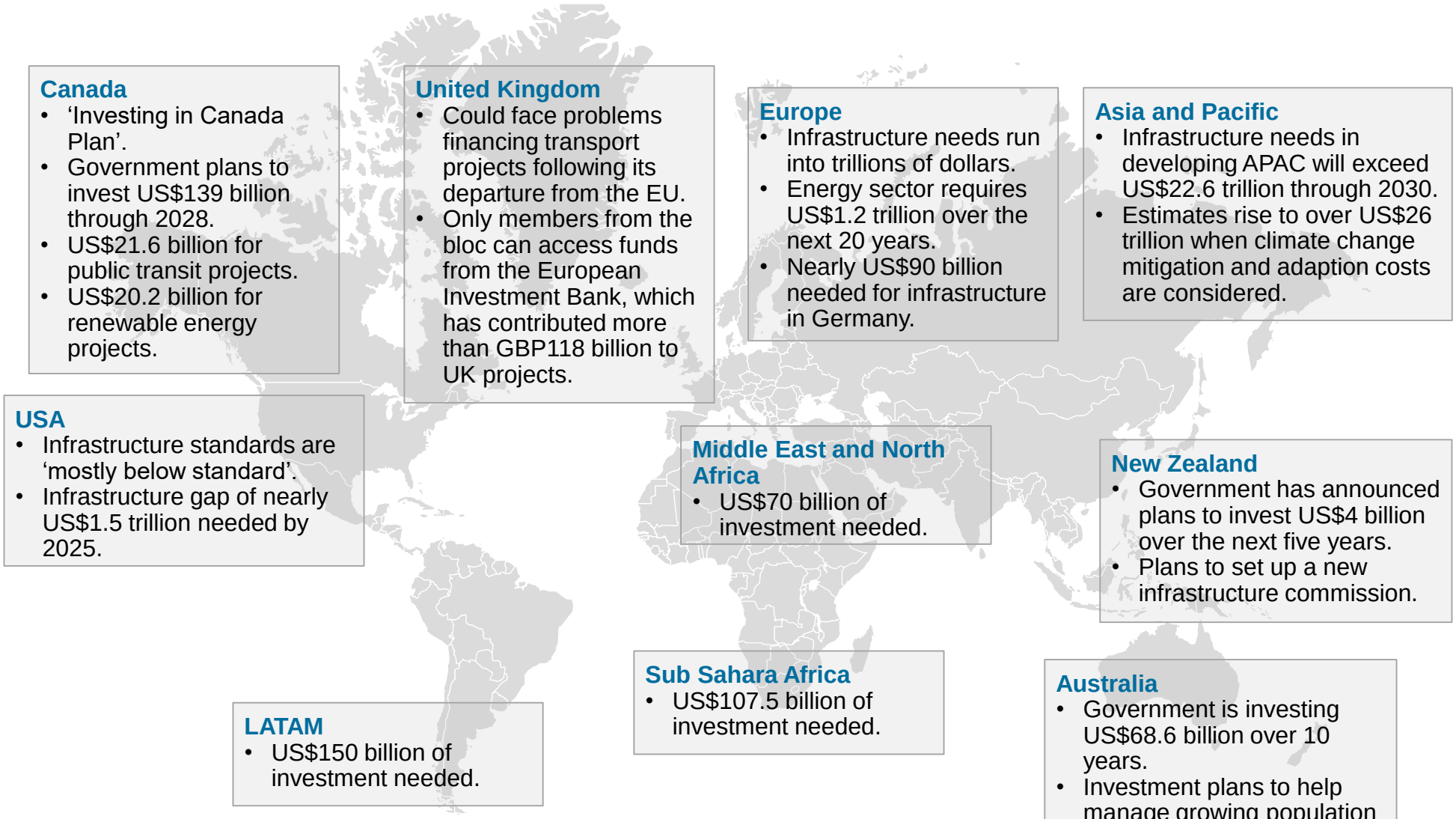
All Infrastructure Projects Pipeline, By Funding (US$ million)



- Public sector will directly finance 56.5% of the total value of projects.
- 24.4% will be jointly financed by public and private sectors.
- 19.09% will be directly financed by the private sector.

Source: GlobalData Global Infrastructure Outlook to 2023 Report

Key Issues in Global Infrastructure



Canada
- 'Investing in Canada Plan'.
- Government plans to invest US$139 billion through 2028.
- US$21.6 billion for public transit projects.
- US$20.2 billion for renewable energy projects.

United Kingdom
- Could face problems financing transport projects following its departure from the EU.
- Only members from the bloc can access funds from the European Investment Bank, which has contributed more than GBP118 billion to UK projects.

Europe
- Infrastructure needs run into trillions of dollars.
- Energy sector requires US$1.2 trillion over the next 20 years.
- Nearly US$90 billion needed for infrastructure in Germany.

Asia and Pacific
- Infrastructure needs in developing APAC will exceed US$22.6 trillion through 2030.
- Estimates rise to over US$26 trillion when climate change mitigation and adaption costs are considered.

USA
- Infrastructure standards are 'mostly below standard'.
- Infrastructure gap of nearly US$1.5 trillion needed by 2025.

Middle East and North Africa
- US$70 billion of investment needed.

New Zealand
- Government has announced plans to invest US$4 billion over the next five years.
- Plans to set up a new infrastructure commission.

Sub Sahara Africa
- US$107.5 billion of investment needed.

LATAM
- US$150 billion of investment needed.

Australia
- Government is investing US$68.6 billion over 10 years.
- Investment plans to help manage growing population and meet national freight challenge.

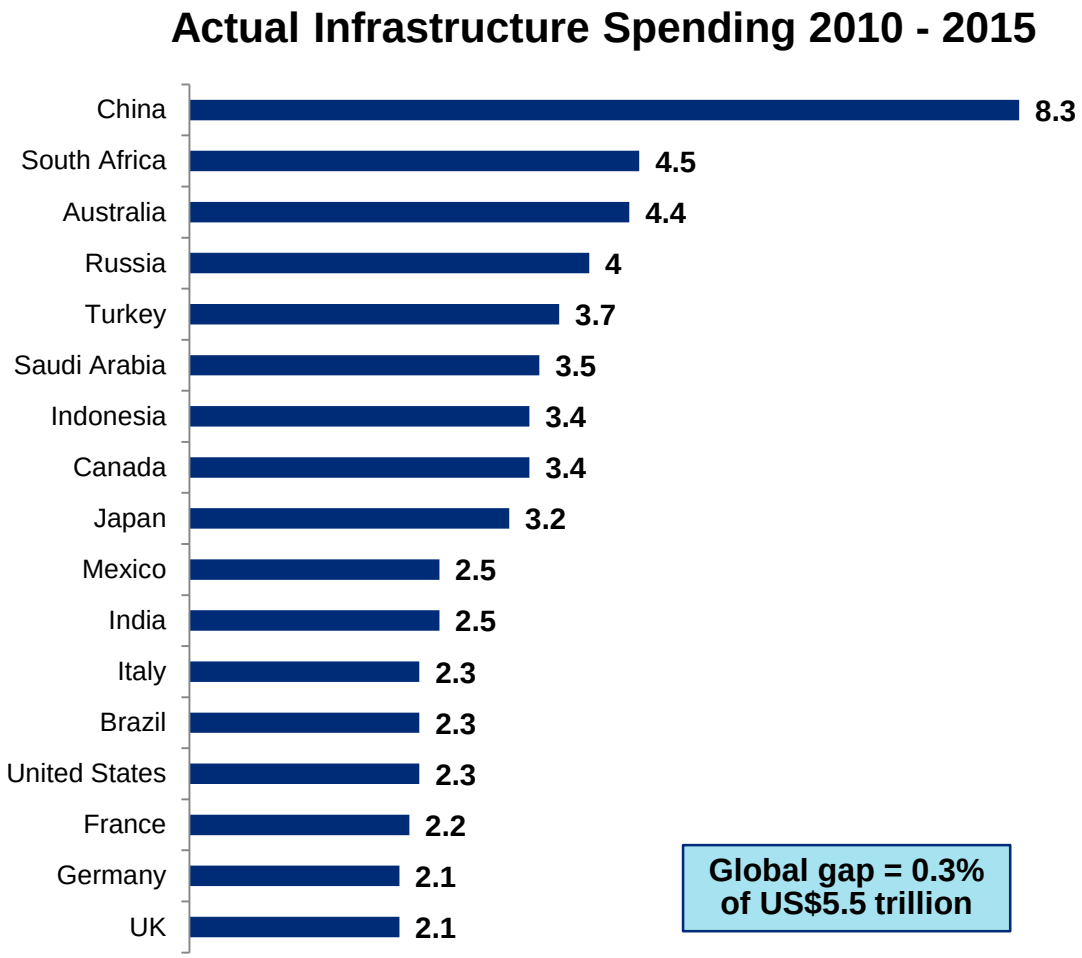
Source: GlobalData Global Infrastructure Outlook to 2023 report

Infrastructure Gap

- Quality of infrastructure is imperative for economic growth.
- According to World Economic Forum, worldwide investment in infrastructure is expected to be **US$79 trillion by 2040.**
- Actual global investment need is closer to **US$97 trillion.**
- To close the gap, average investment would need to increase by **23% per year.**
- For example in Asia:
  - US$26 trillion in infrastructure investments are needed over the 2016-2030 period.
  - This is to maintain 3-7% growth, eliminate poverty, and respond to climate change.

Source: GlobalData Global Infrastructure Outlook to 2023 report
Asian Development Bank

Infrastructure Gap Varies Widely Among Geographies
Economic Infrastructure, % of GDP



Country	Gap Between Spending and Estimated Infrastructure Needs, 2017-35
China	-2.5
South Africa	0.6
Australia	-1.0
Russia	-0.3
Turkey	0.3
Saudi Arabia	-0.2
Indonesia	1.2
Canada	-0.2
Japan	-1.0
Mexico	1.3
India	0.7
Italy	0.2
Brazil	1.1
United States	0.5
France	-0.1
Germany	0.5
UK	0.5

The global gap for 2017-35 as a share of GDP is calculated by adding negative values, converting to dollar term, then dividing by cumulative world GDP.

Source: McKinsey Global Institute analysis

Current Conditions

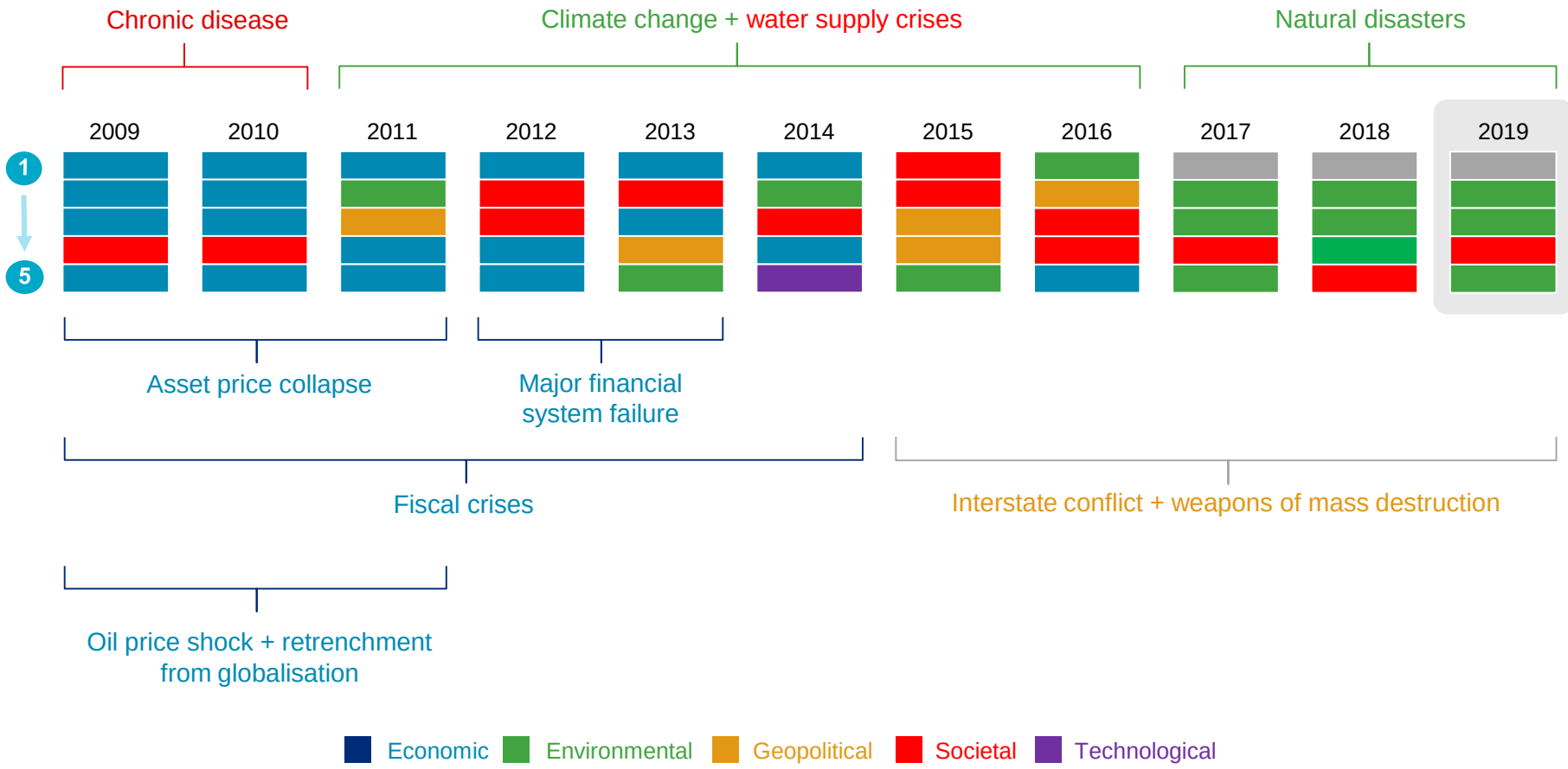
- Era of change and increasing geo-political and economic uncertainty even in previously considered ‘safe’ areas.
- Infrastructure and investment projects could be affected.
- Investors’ main concerns:
  - Government action affecting their decision to invest and develop infrastructure projects.
  - Confidence that long term projects will not complete in accordance to their original specification.
  - Companies and projects they are supporting will fail and ultimately default on their obligations.

Current Conditions

1. Rise of radical, populist parties threatening fundamental regulatory and ownership change.
2. Chinese Belt and Road Initiative competing for deal and debt.
3. Escalating trade war leading to weaponisation of tariffs and escalation.
4. Expropriation, license cancellation, forced divesture, political violence, currency controls and business interruption.
5. Contract renegotiation for long term power projects.

In Recent Years, Environmental, Technological, and Geopolitical Threats Have Come To Supplant Economic Risks As Issues Of Major Concern

Top 5 Global Risks in terms of impact
2009–2019

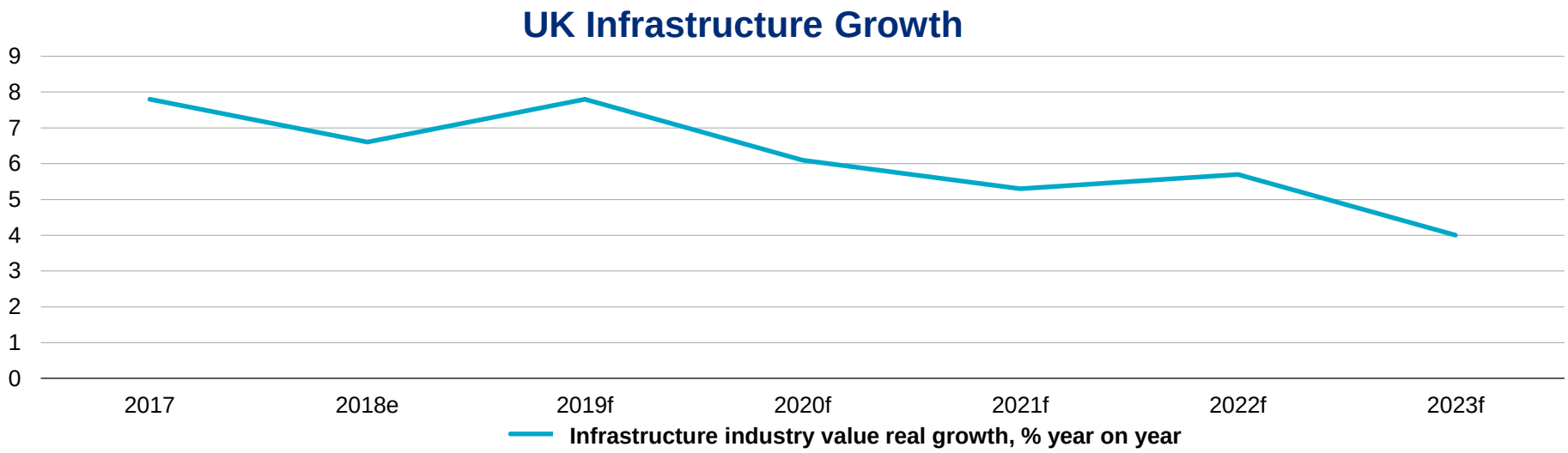


Note: Over the ten years, the report has adjusted the list of global risks and moved risks between categories. The depiction here assigns a consistent category for risks.
Source: World Economic Forum, *Global Risks Report 2019*

1: United Kingdom

Rise of Radical, Populist Parties Threatening Fundamental Regulatory and Ownership Change

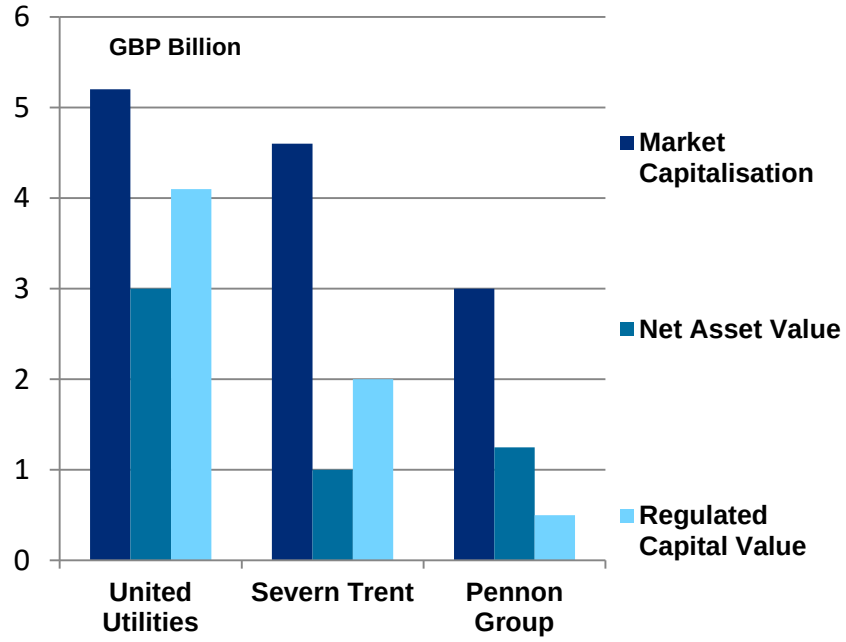
- Boris Johnson at odds with the majority of MPs, having lost a working parliamentary majority and suffering four defeats in his first four votes.
- Brexit-related uncertainty is likely to continue to weigh on the UK's infrastructure sector in 2020. A further extension to Article 50 will further limit private investment in commercial infrastructure projects.
- Brexit will also continue to be a focus of political debate, delaying planning and funding decisions on major infrastructure projects. At the same time, the government is reviewing the HS2 rail-link (GBP55.7 billion estimate), with a decision on its future by the end of 2019.



Source: Fitch Solutions

"We have to rewrite the rules of our economy…change is coming"
John McDonnell, Shadow Chancellor of the Exchequer

English water companies' book values are well below their market cap:



Source: FT research; annual report and accounts for the year ended March 2018

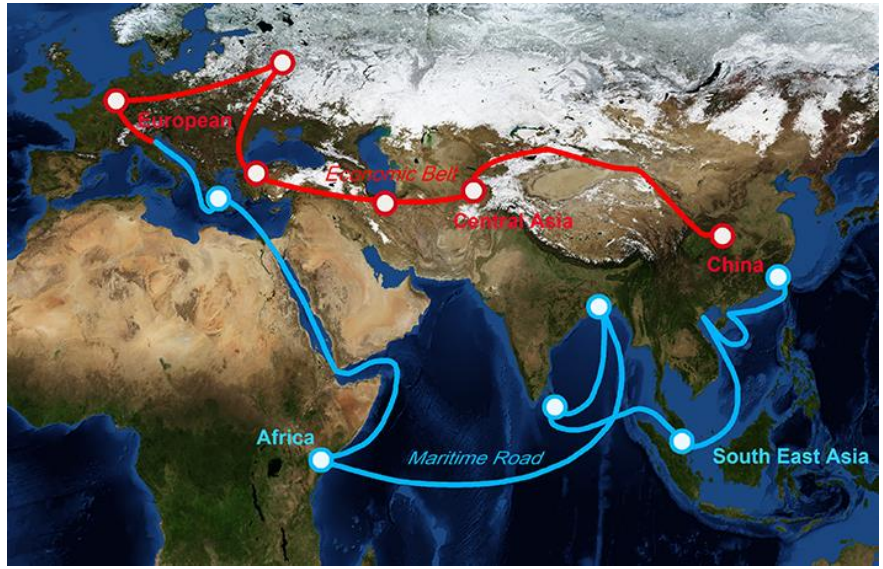
Populist, polarised politics is pushing into the mainstream and could have serious ramifications for investors and shareholders in infrastructure from government interference and nationalisation.

Case Study: Nationalisation of utilities by Jeremy Corbyn and The Labour Party:

- Payouts to shareholders could be pegged to book value, defined as assets minus liabilities on a company balance sheet.
- Compensation could be based on regulated capital value, a measure of a utility's assets on which watchdogs permit it to earn a rate of return.
- Linking payouts to either valuation measure would lead to compensation at well below current share prices.

2: Chinese Belt and Road Initiative (BRI): Competing for Projects? Driving Spiralling Debt? Leveraging 'Debt-trap Diplomacy'?

- BRI spans at least 68 countries with an announced investment as high as US$8 trillion for a vast network of transportation, energy, and telecommunications infrastructure linking Europe, Africa, and Asia.
- European nations such as Ukraine, Montenegro, and Belarus are taking on Chinese infrastructure-related debt and increasing their debt to GDP ratio, as well as Mongolia, Montenegro, and Pakistan.
- A dozen EU members have already signed memoranda with China on the BRI. Italy would be the first G7 country to join, followed by Greece.



2: Chinese Belt and Road Initiative (BRI): Competing for Projects?
Driving Spiralling Debt? Leveraging ‘Debt-trap Diplomacy’?

Case Study: Italy

- Keen to be the first G7 country to join BRI.
- Sovereign debt sustainability and ‘debt overhang’ effects wider infrastructure investment and feasibility of continuation of current and future projects.

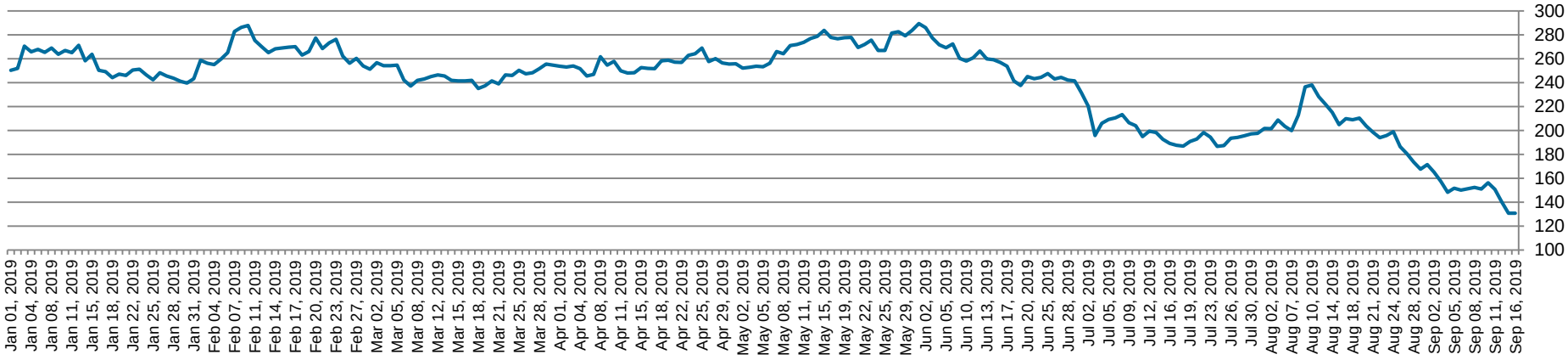
Looking at 37 poor countries monitored by the International Monetary Fund:

- Loans from traditional bilateral lenders, including America and Japan, have declined from 7% of the debtors’ GDP to 2% over the past decade.
- Loans from China, by contrast, have soared from virtually nothing to 4%

Case Study: Italy

- Short-term investment climate has improved with formation of Five Star-Democratic Party coalition.
- Likelihood of a run-in with EU over budget has reduced.
- Bond yield spreads with German equivalents have narrowed…
- …But coalition unlikely to survive in 2020, with a snap election probable. A league-led government would not be received well by bond markets.
- Economic uncertainty, and the likelihood of renewed populist government, will weigh on investor confidence in the infrastructure sector.

Difference between Italy 10 Year versus Germany 10 Year Bond Yield Spread, basis points

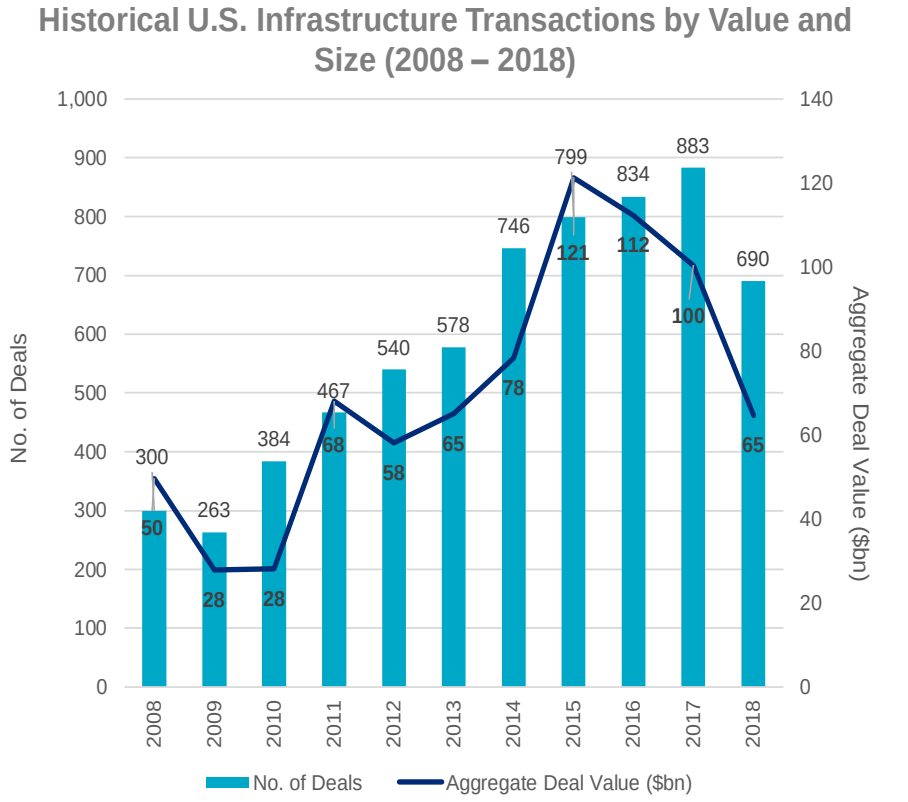


Source: Fitch Solutions

3: United States – Trade Wars

The escalating trade war between the US and China and wider weaponisation of trade and tariffs across the world will lead to spiralling costs for Engineering, Procurement, Construction and investors, and raises the threat of direct export embargos.

- President Donald Trump is unlikely to be able to pass a federal infrastructure plan in 2020, given Democrat control of the House of Representatives.
- Measures at a state and local level will therefore drive infrastructure investment, exposing projects to cancellation and alteration risks driven by local political dynamics.



Source: Preqin

3: United States – Trade Wars

January 2018: Trump announces tariffs of up to 30% on solar panels outside the domestic market.

March 2018: Tariffs imposed on Chinese steel and aluminium.

Q4 2019: Tariffs to be raised from 25% to 30% of existing US$250 billion of Chinese goods and 10% to 15% of remaining US$300 billion from December.

August 2018: Huawei and ZTE banned for government use.

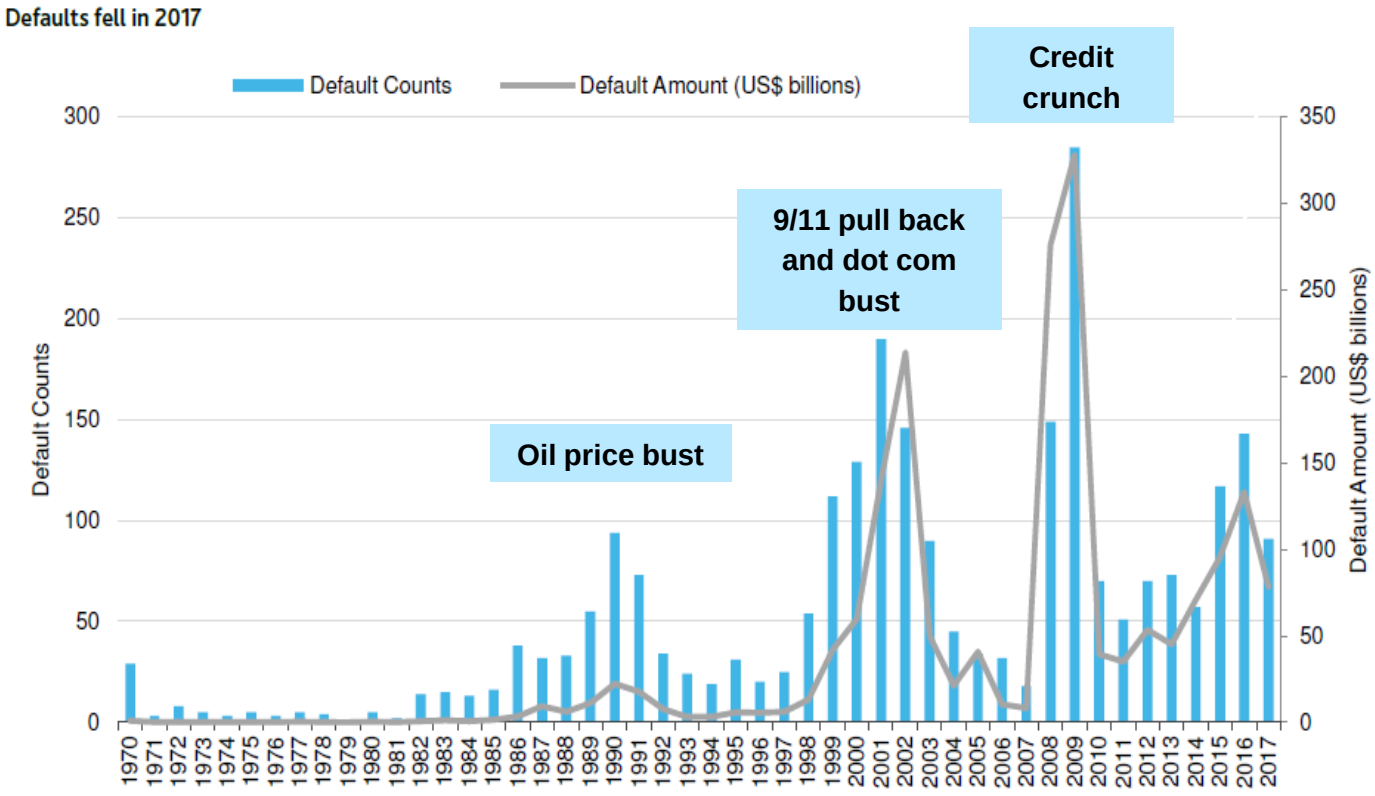
"I hereby order [American companies to] immediately start looking for an alternative to China"

Donald Trump, 23 August 2019

Source: Preqin

Economic Slowdown? Effects on Defaults

- Recession or tightening = corporate defaults.
- Investors most at risk.



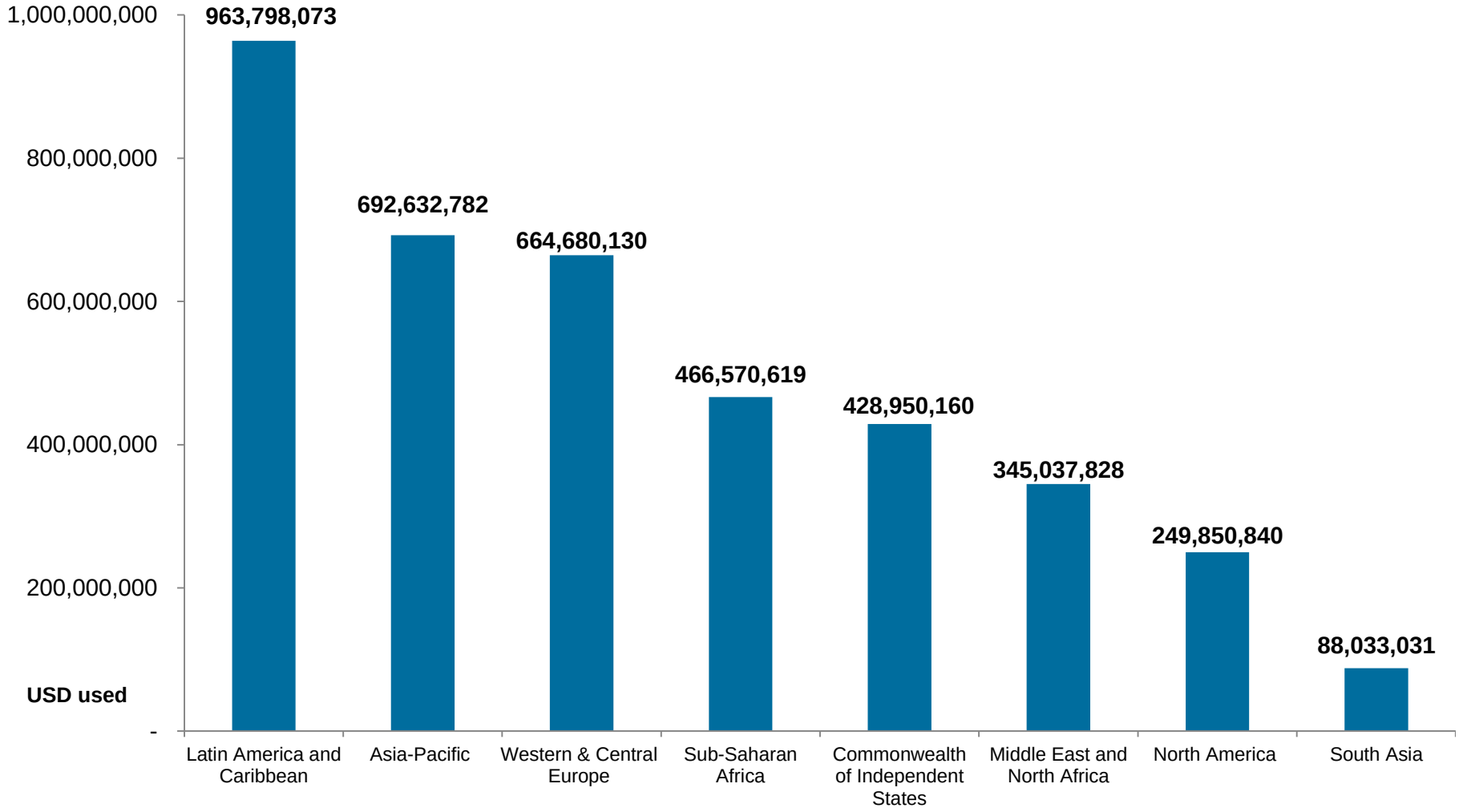
Source: Moody's Investors Service, Data Report, 15 February 2018
Annual Default Study: Corporate Default and Recovery Rates

2016 Default spike driven by stress in the commodity sector

The broader message is clear…Investors are now paying more attention to the reality of messier politics contaminating economics.

Financial Times
4 June 2019

Claims By Geographical Region
Lloyd's Paid Political Risk Claims: 1997-2017



Source: Lloyd's paid political risks claims from Xchanging

Summary of Key Issues

- Economic uncertainty and volatility is rising – both in developed and undeveloped markets.
- US$ funding gap for infrastructure projects needs to be filled.
- Global infrastructure projects impacted and delayed.
- Government legislation is harder to predict.
- China/America trade war is increasing threats to project development globally.
- Adverse impact from China's BRI initiative across both developed and developing markets.
- Radical and potentially punitive government actions to foreign investors.

Risk Mitigation Strategies

- Close monitoring of government activities in jurisdiction of interest.
- Understand your supply chain and identify any risk exposures as far back as possible.
- Extensive legal due diligence on all contractual matters.
- Ensure transparent revenue flow and research your project partners thoroughly.
- Up to date, accurate, and independent information and analysis about the developed geo-political landscape – utilising known experts in that field.
- Seek risk mitigation control from either private or public third parties.

INVESTING IN INFRASTRUCTURE IN A TIME OF CLIMATE CHANGE

Sarika Goel
Principal, Responsible Investment Manager Research
London

25 SEPTEMBER 2019

AN EVOLUTION OF THINKING AND PRACTICE

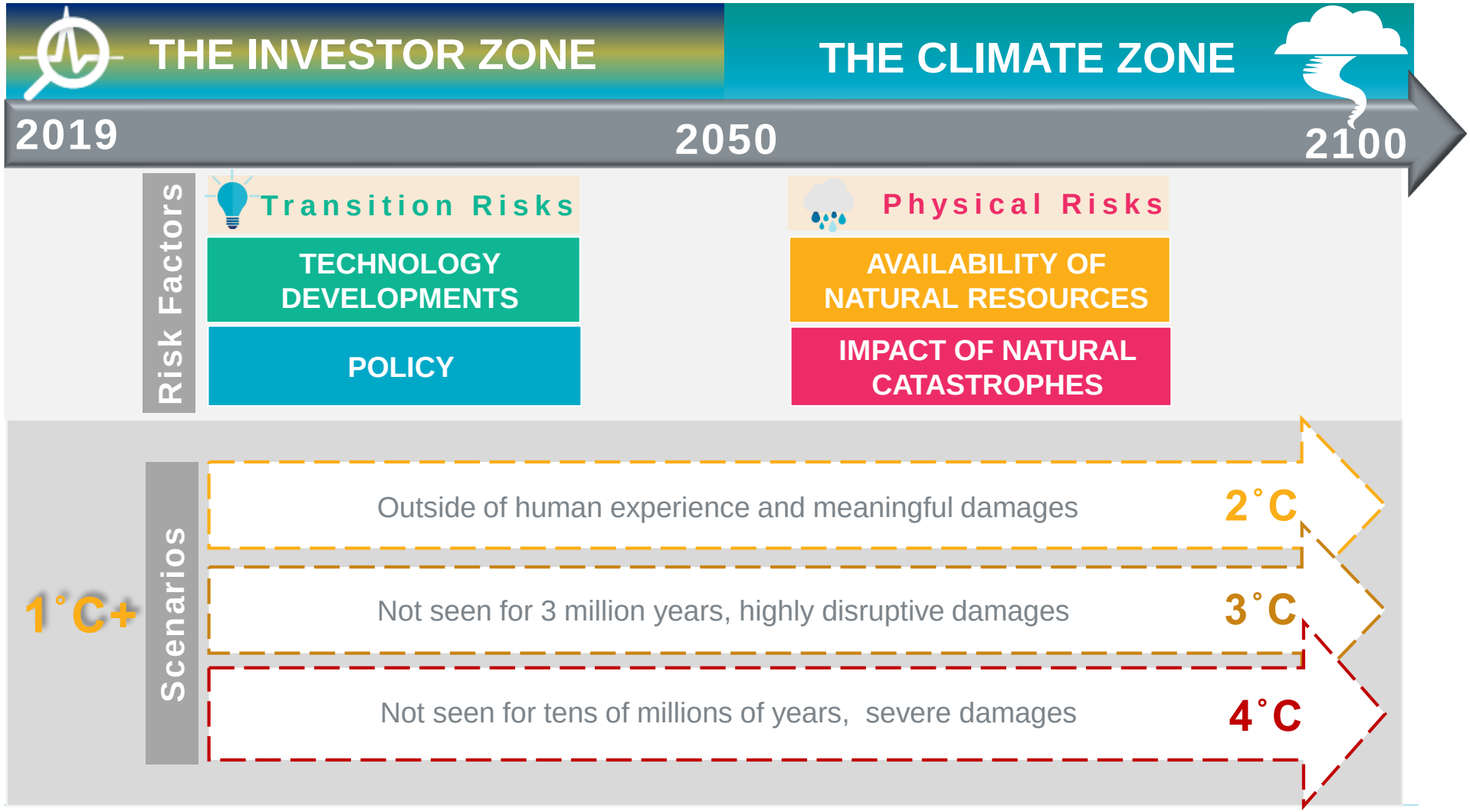
2011

2015

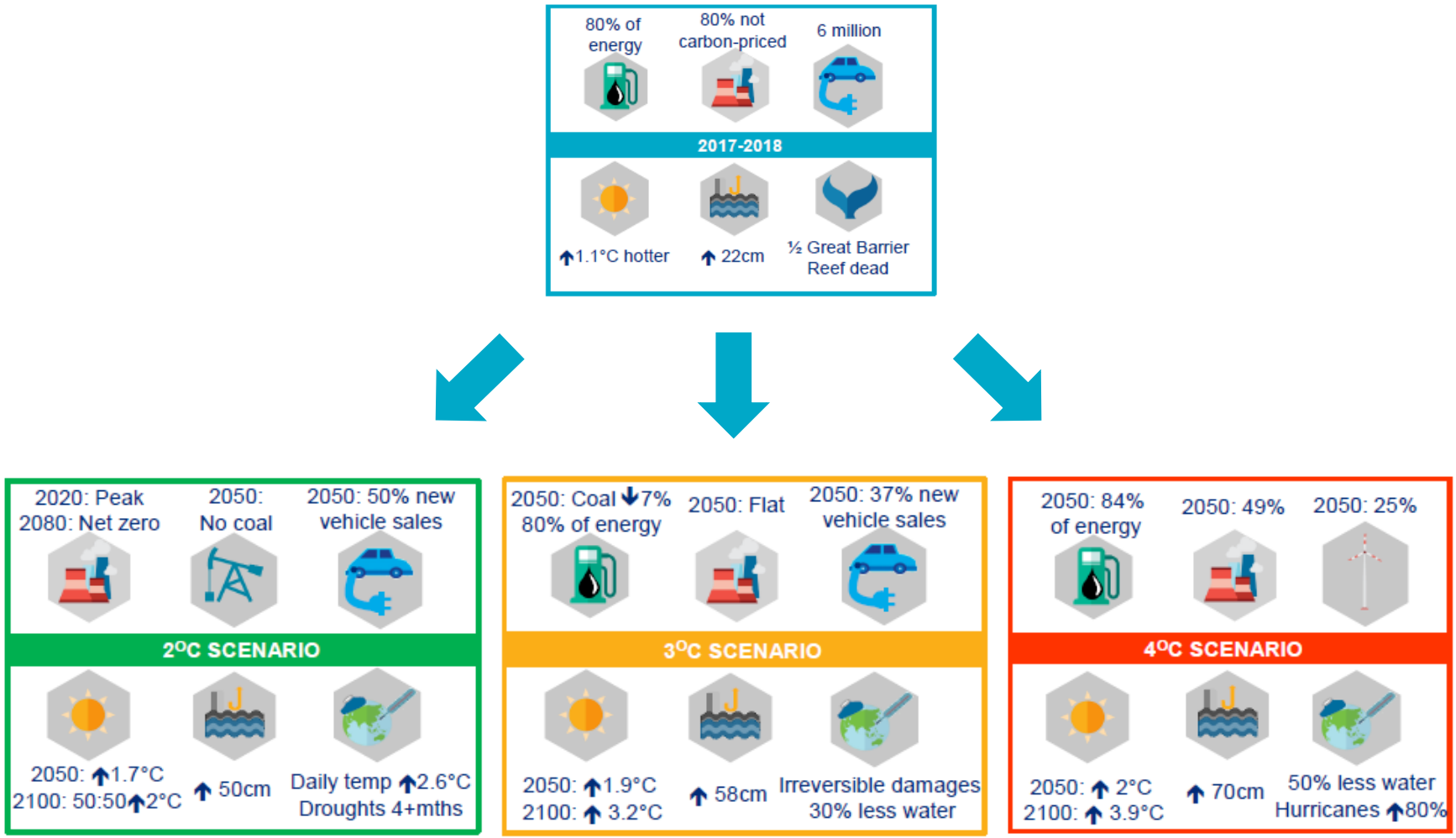
2019

CLIMATE RISK FACTORS AND SCENARIOS

Significant increases in GHG emissions are raising average temperatures and changing the Earth's climate



THREE CLIMATE CHANGE SCENARIOS



KEY FINDINGS

Investing for a 2ºC scenario is both an imperative and an opportunity.

- **An imperative** since for nearly all asset classes, regions and time frames a 2ºC scenario has enhanced projected returns versus 3ºC or 4ºC, and therefore a better investor outcome.
- **An opportunity** as while there are incumbent 'losers' in a 2ºC scenario there are many notable 'winners' in the investment opportunities in a low-carbon transition. There are mostly 'losers' in 3ºC & 4ºC.

ENHANCED PROJECTED RETURNS

- 2ºC scenario is in the best interest of investors

OPPORTUNITIES

- Include exposure to companies delivering solutions

INDUSTRY/ASSET CLASS DIVERGENCE

- Prioritize key sectors and asset classes

STRESS TESTING

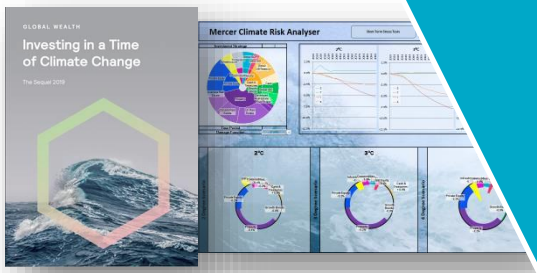
- Stress testing helps prepare for sudden change

KEY FINDINGS
SAMPLE ASSET CLASS IMPACTS

Prioritizing key asset classes

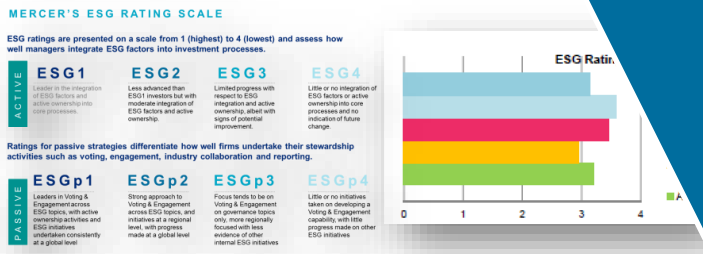
Sample Asset Classes	Returns to 2030 in 2°C Scenario	Returns to 2050 in 2°C Scenario
Developed market equities	0.0% p.a.	-0.2% p.a.
Emerging market equities	0.2% p.a.	-0.1% p.a.
All world equities – sustainable themed	1.6% p.a.	0.9% p.a.
Infrastructure	2.0% p.a.	1.0% p.a.

CLIMATE CHANGE RISK ASSESSMENT
A TOTAL PORTFOLIO APPROACH



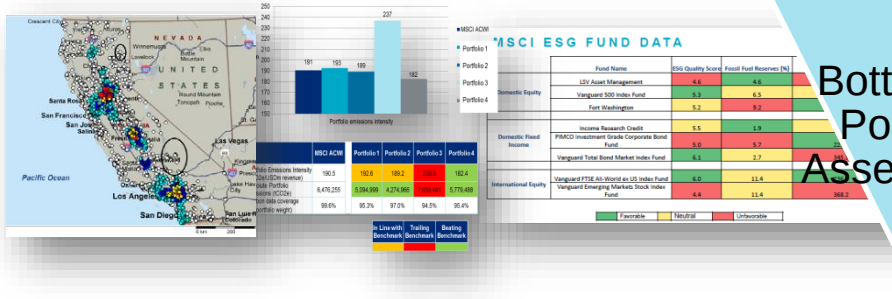
Asset Allocation

- Use top down scenario modeling and stress testing to identify total portfolio risk
- Identify asset class vulnerability to physical / transition risks



Manager Selection and Monitoring

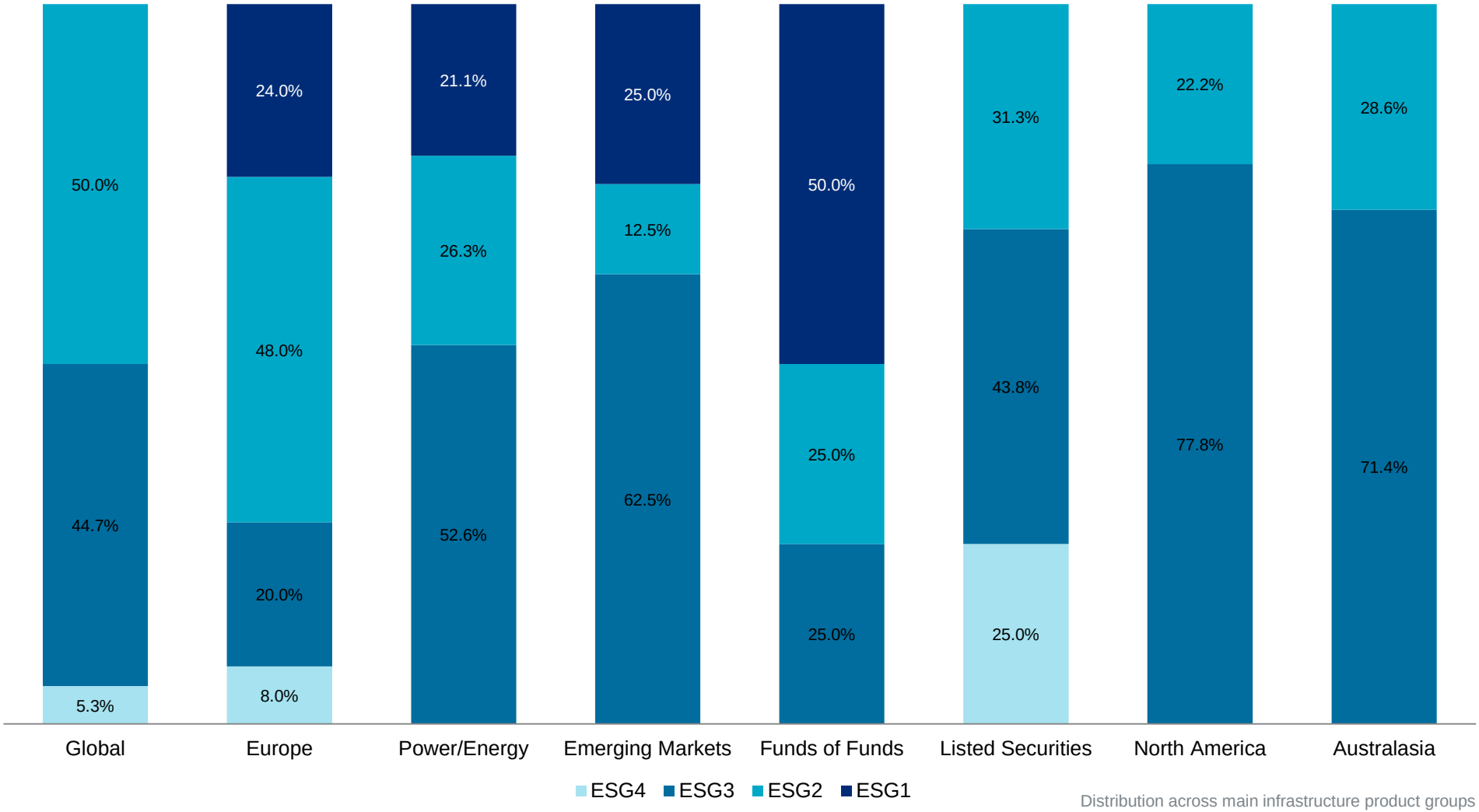
- Assess existing managers' investment processes for integration of climate considerations into idea generation and portfolio construction
- Allocate to sustainable managers



Bottom Up Portfolio Assessment

- Conduct assessment of existing portfolio carbon and ESG characteristics
- Monitor portfolio manager compliance with targets and ESG-related investment policies

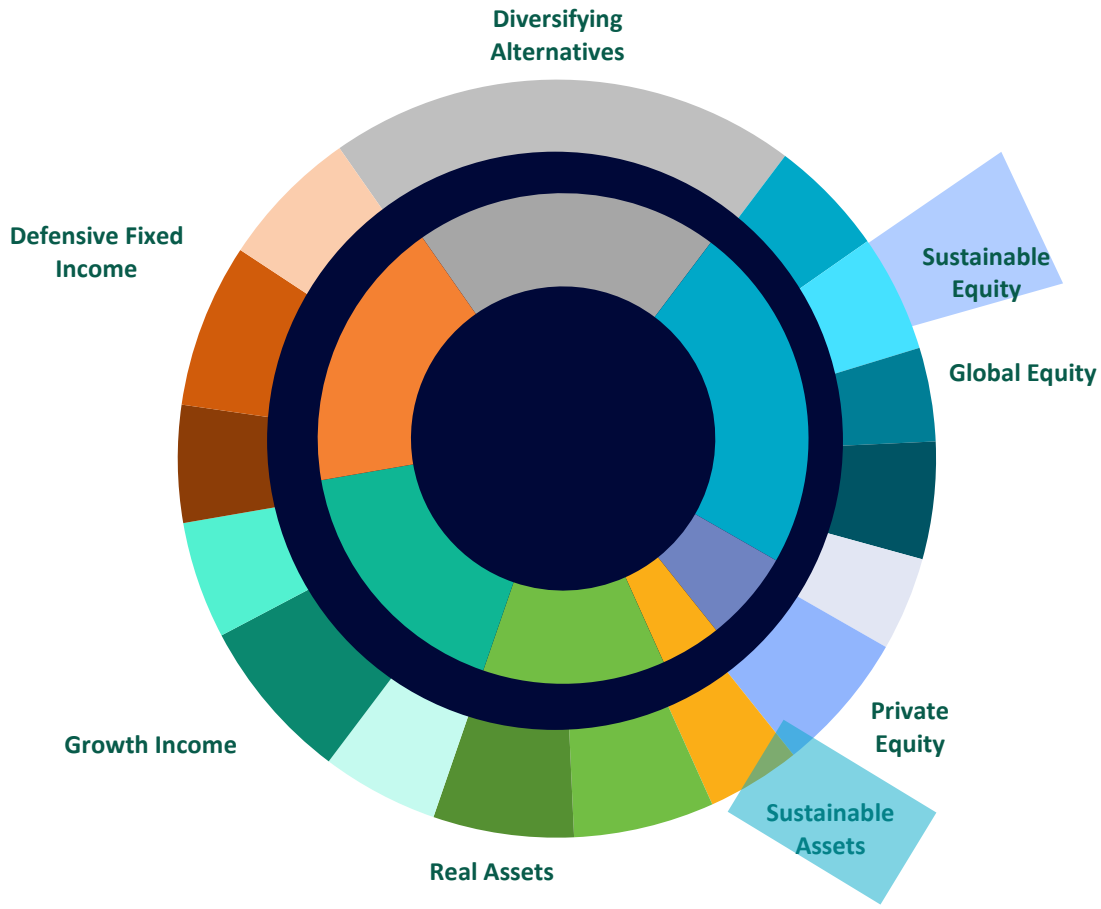
INCORPORATING ESG & CLIMATE RISKS IN INFRASTRUCTURE



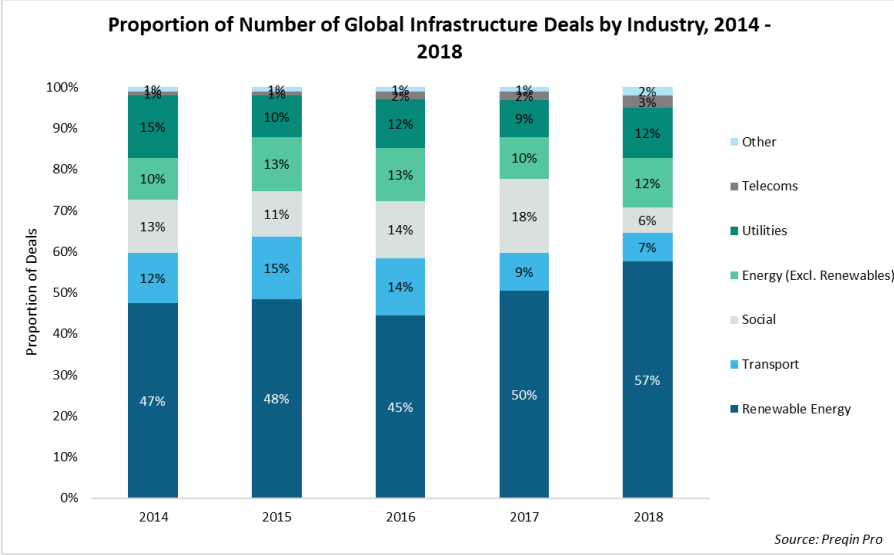
Distribution across main infrastructure product groups

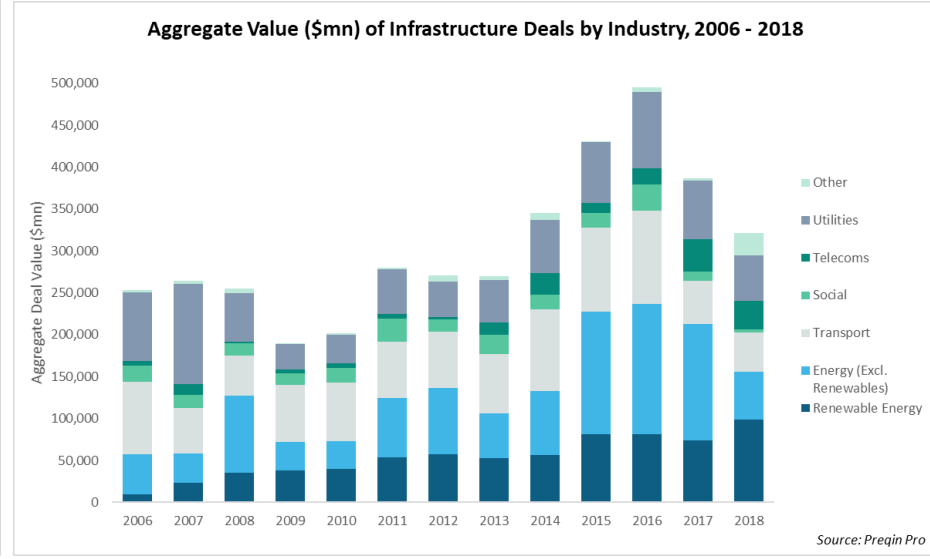
As at March 2019

ALLOCATING TO SUSTAINABLE INFRASTRUCTURE IN REFERENCE PORTFOLIOS



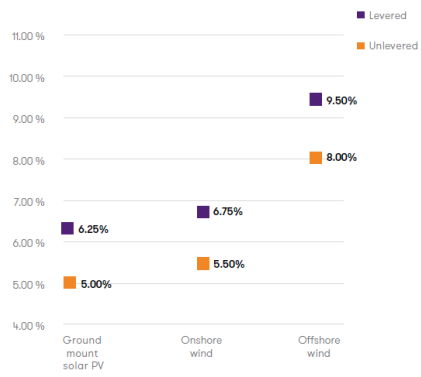
RENEWABLE ENERGY INFRASTRUCTURE DEALS
A LARGE AND GROWING SECTOR…



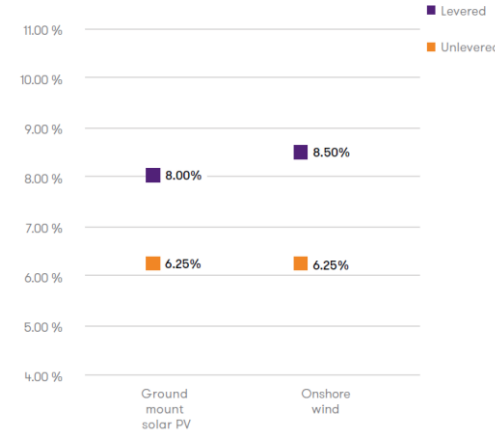


RENEWABLE ENERGY INFRASTRUCTURE DEALS
…BUT LOW RETURN EXPECTATIONS

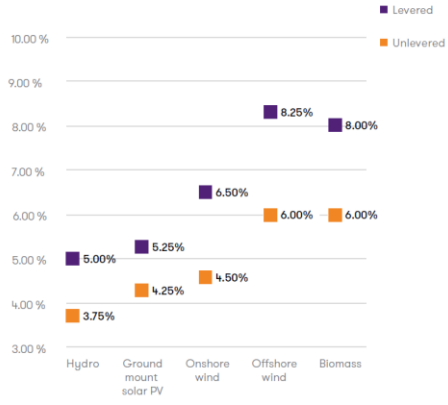
FRANCE



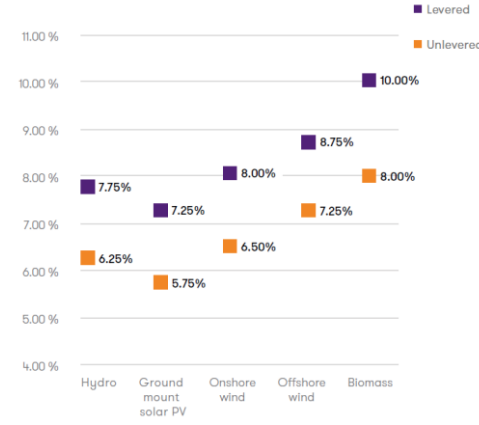
ITALY



GERMANY



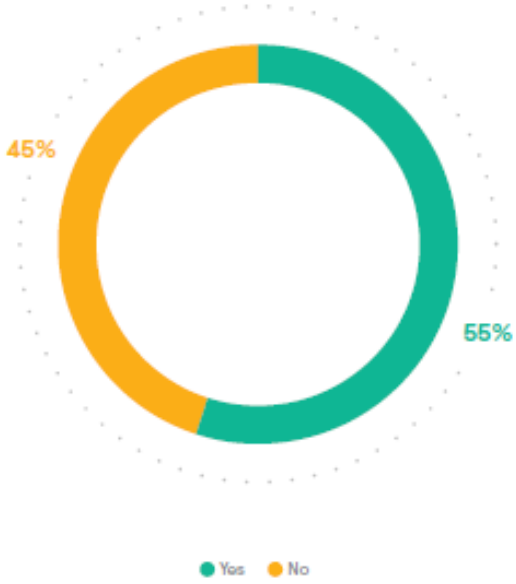
UK



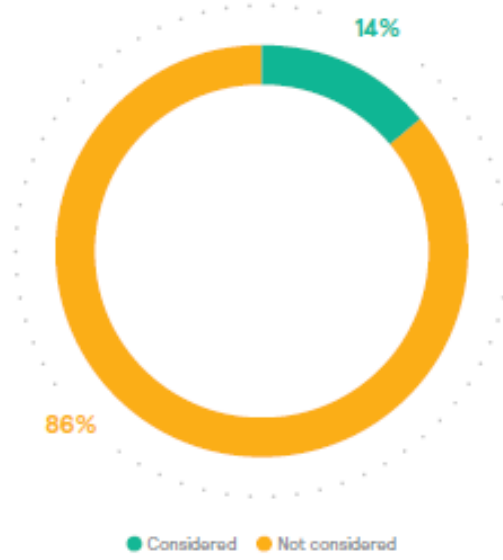
Source: Grant Thornton, Renewable energy discount rate survey results – 2018

EUROPEAN ASSET ALLOCATION SURVEY
EMBEDDING CLIMATE RISKS IN PORTFOLIOS

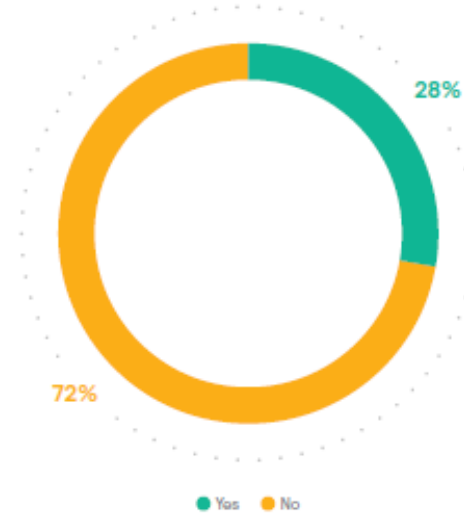
ASSET OWNERS CONSIDERING ESG RISKS



ASSET OWNERS CONSIDERING CLIMATE CHANGE RISKS



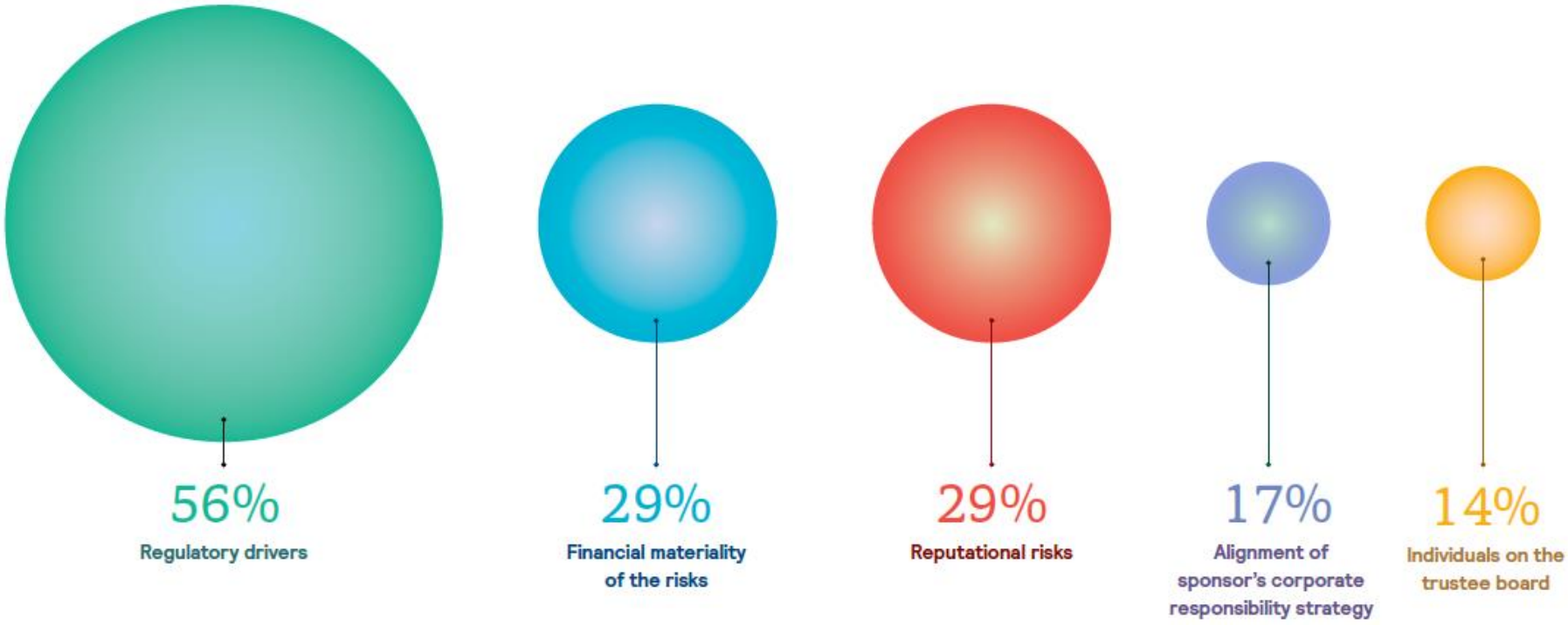
ASSET OWNERS PLANNING TO CONSIDER CLIMATE CHANGE RISKS



Source: Mercer European Asset Allocation Survey, 2018

EUROPEAN ASSET ALLOCATION SURVEY
KEY DRIVERS BEHIND ESG CONSIDERATIONS

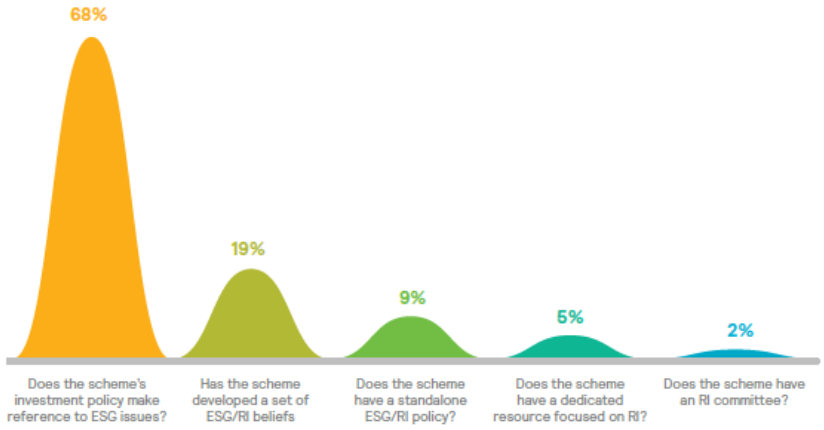
KEY DRIVERS BEHIND CONSIDERATION OF ESG RISKS



Source: Mercer European Asset Allocation Survey, 2018

EUROPEAN ASSET ALLOCATION SURVEY
SLOW STEPS IN THE RIGHT DIRECTION

GOVERNANCE, BELIEFS, POLICIES



ALLOCATION TO ALTERNATIVES

Source: Mercer European Asset Allocation Survey, 2018

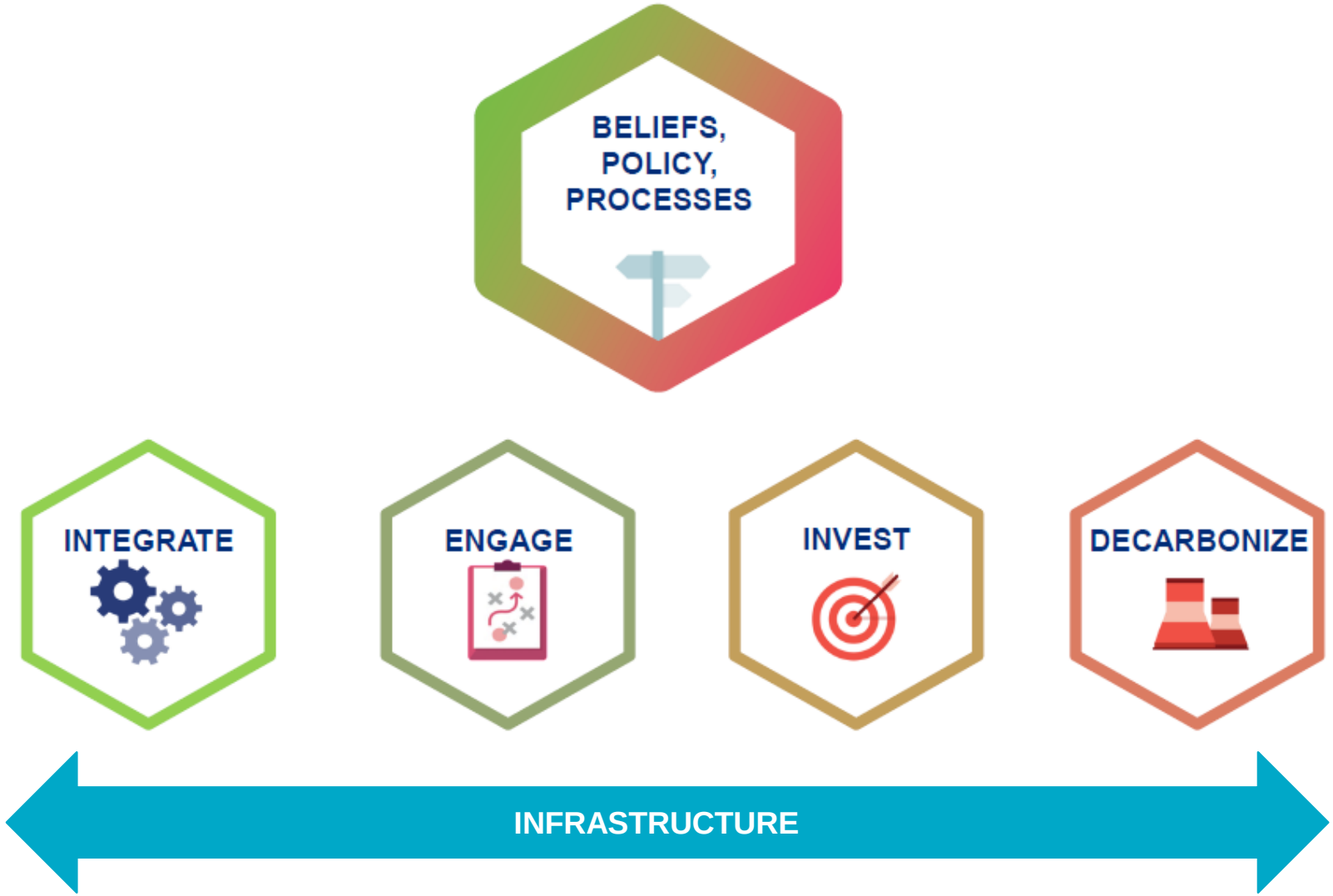
CLIMATE CHANGE FUTURE MAKERS
INFLUENCING A 2°C OUTCOME

Ignore risks and opportunities linked to systemic risks, to the potential detriment of long-term returns

Consider systemic risks in portfolios, taking action across and within asset classes and industry sectors

Build upon the aware future taker position and make a concerted effort to influence systemic, market-wide actions aligned with ideal real world outcomes

INVESTING IN A TIME OF CLIMATE CHANGE



IMPORTANT NOTICES

References to Mercer shall be construed to include Mercer LLC and/or its associated companies.

This contains confidential and proprietary information of Mercer and is intended for the exclusive use of the parties to whom it was provided by Mercer. Its content may not be modified, sold or otherwise provided, in whole or in part, to any other person or entity, without Mercer's prior written permission.

The findings, ratings and/or opinions expressed herein are the intellectual property of Mercer and are subject to change without notice. They are not intended to convey any guarantees as to the future performance of the investment products, asset classes or capital markets discussed. Past performance does not guarantee future results. Mercer's ratings do not constitute individualised investment advice.

Information contained herein has been obtained from a range of third party sources. While the information is believed to be reliable, Mercer has not sought to verify it independently. As such, Mercer makes no representations or warranties as to the accuracy of the information presented and takes no responsibility or liability (including for indirect, consequential or incidental damages), for any error, omission or inaccuracy in the data supplied by any third party.

This does not constitute an offer or a solicitation of an offer to buy or sell securities, commodities and/or any other financial instruments or products or constitute a solicitation on behalf of any of the investment managers, their affiliates, products or strategies that Mercer may evaluate or recommend.

For the most recent approved ratings of an investment strategy, and a fuller explanation of their meanings, contact your Mercer representative.

For Mercer's conflict of interest disclosures, contact your Mercer representative or see www.mercer.com/conflictsofinterestMercer

MAKE TOMORROW, TODAY

OLIVER WYMAN

FOCUS ON FLEXIBILITY – THE FUTURE OF RENEWABLES INVESTING

SUMMARY DECK

SEPTEMBER 2019

MARSH & McLENNAN COMPANIES

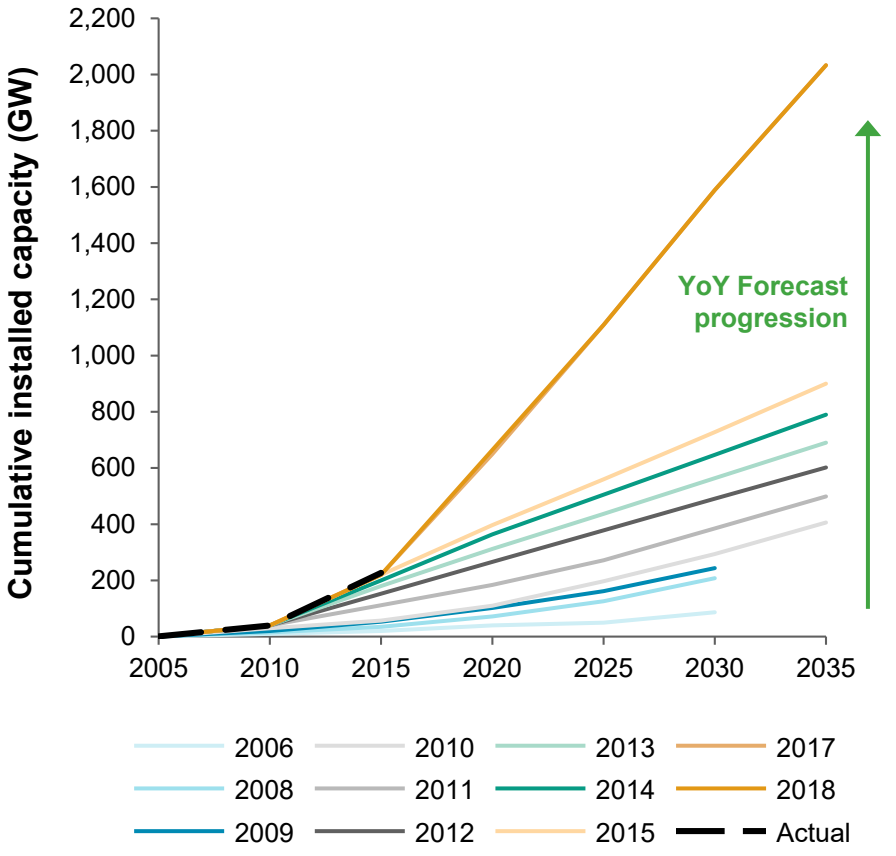
CONFIDENTIALITY

Our clients' industries are extremely competitive, and the maintenance of confidentiality with respect to our clients' plans and data is critical. Oliver Wyman rigorously applies internal confidentiality practices to protect the confidentiality of all client information.

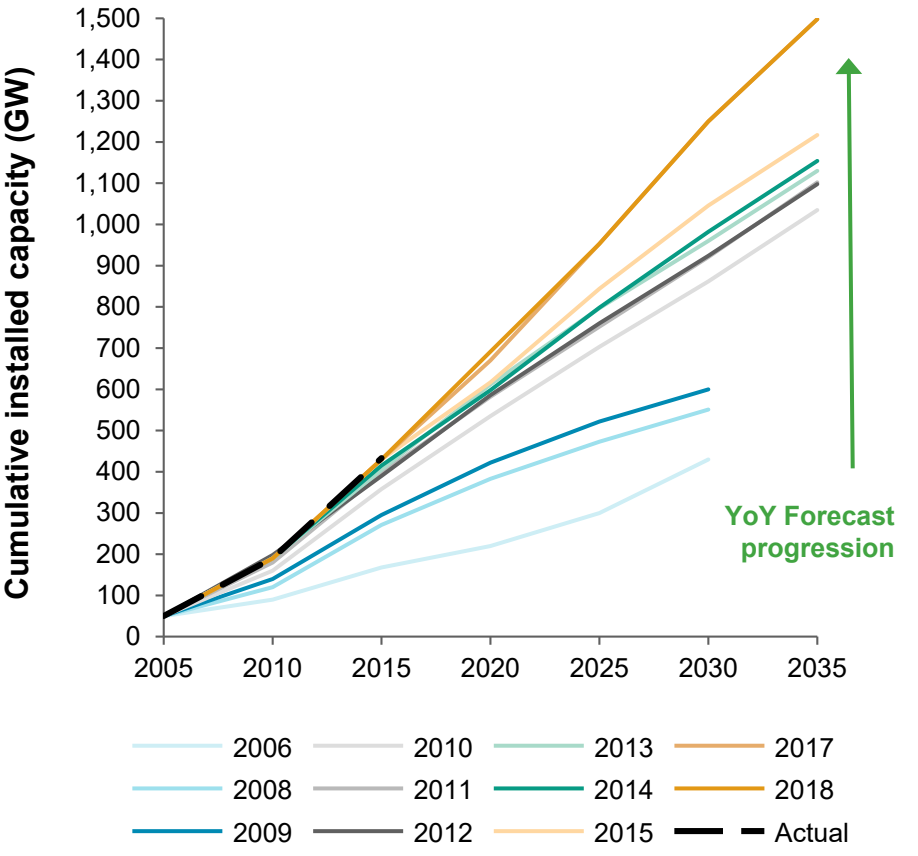
Similarly, our industry is very competitive. We view our approaches and insights as proprietary and therefore look to our clients to protect our interests in our proposals, presentations, methodologies and analytical techniques. Under no circumstances should this material be shared with any third party without the prior written consent of Oliver Wyman.

Global development of renewables has consistently outpaced any attempts to forecast it

Solar PV – IEA Capacity projections between 2006–2018
GW, up to 2030/35



Wind – IEA Capacity projections between 2006–2018
GW, up to 2030/35



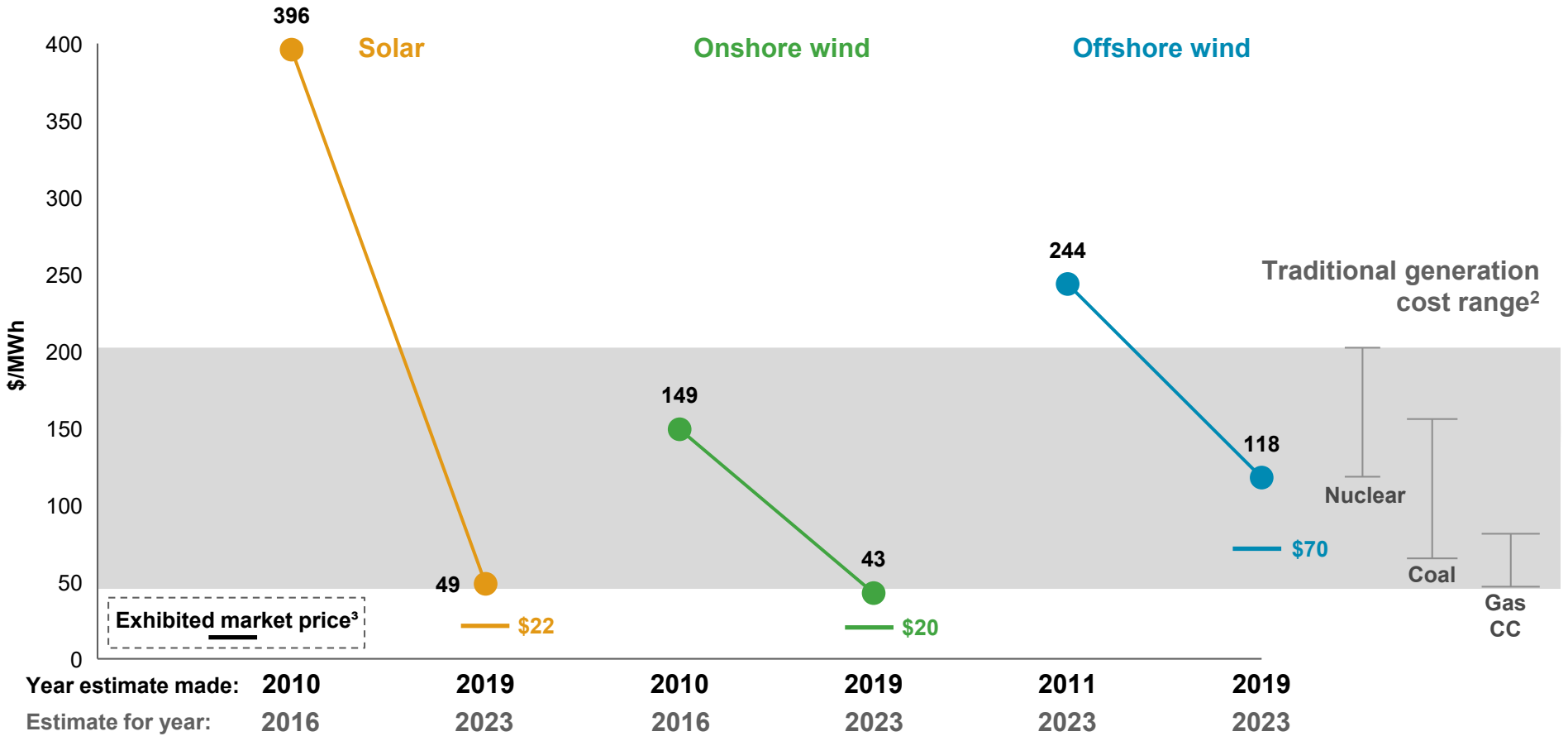
Note: Successive revisions of IEA's renewable capacity projections, where projections were made in 2006 – 2018 (with the exception of 2007 and 2016)

Source: GWEC, IRENA, IEA World Energy Outlook 2006 – 2018, Oliver Wyman analysis

The case for renewable generation has become increasingly strong, as technological advances have dramatically brought down costs

Global LCOE[1] of electricity and exhibited market price

Median cost in $/MWh, 2010 and 2018



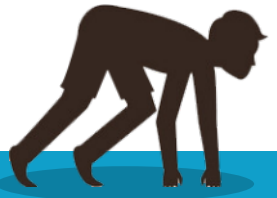
1. Levelized Cost of Electricity: average total cost to build and operate a power-generation asset over its lifetime divided by the total energy output of this asset over its lifetime
2. Based on 2018 USA data
3. US Solar PPA prices 2018, Onshore PPA, Offshore UK CfD strike price

Source: EIA; Levelten; DOE; Oliver Wyman analysis

The industry is moving to a new phase of development where the challenge is to establish a profitable market-based model for RE development

- Focus on LCOE
- Can RE be cost competitive on volume basis with fossil fuel?
- Answer is now yes

1



Phase 1
'Right to compete'

Up to 2020

- Value shift from generation volume to flexibility
- Coordination and integration of RE+flex business models
- VPP at commercial scale

2

Phase 2
'Focus on flexibility'

2020 to 2030/35

- Gas as transition fuel but operating as 20-30% load factor rather than 60-70%+ baseload

3

Phase 3
'Move to net zero'

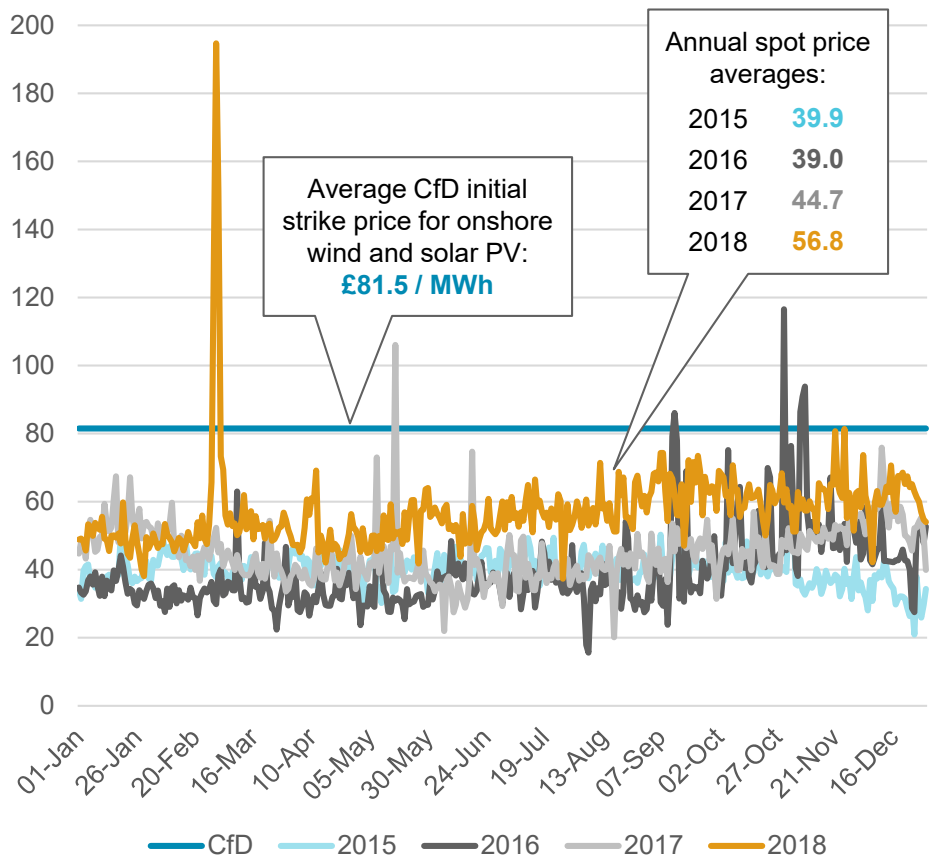
Beyond 2030/35

- Net zero energy system possible through combination of cheap home solar, local EV and home storage, affordable large-scale cheap RE, H2 as globally traded flexibility, CCUS
- Role of gas v uncertain.

The intermittency of renewables means that without subsidy protection, developers have to accept discounted PPAs – losing out on premium returns

Daily average spot price vs CfD strike price[1]

GB spot price, 2015-18, £/MWh



Commentary

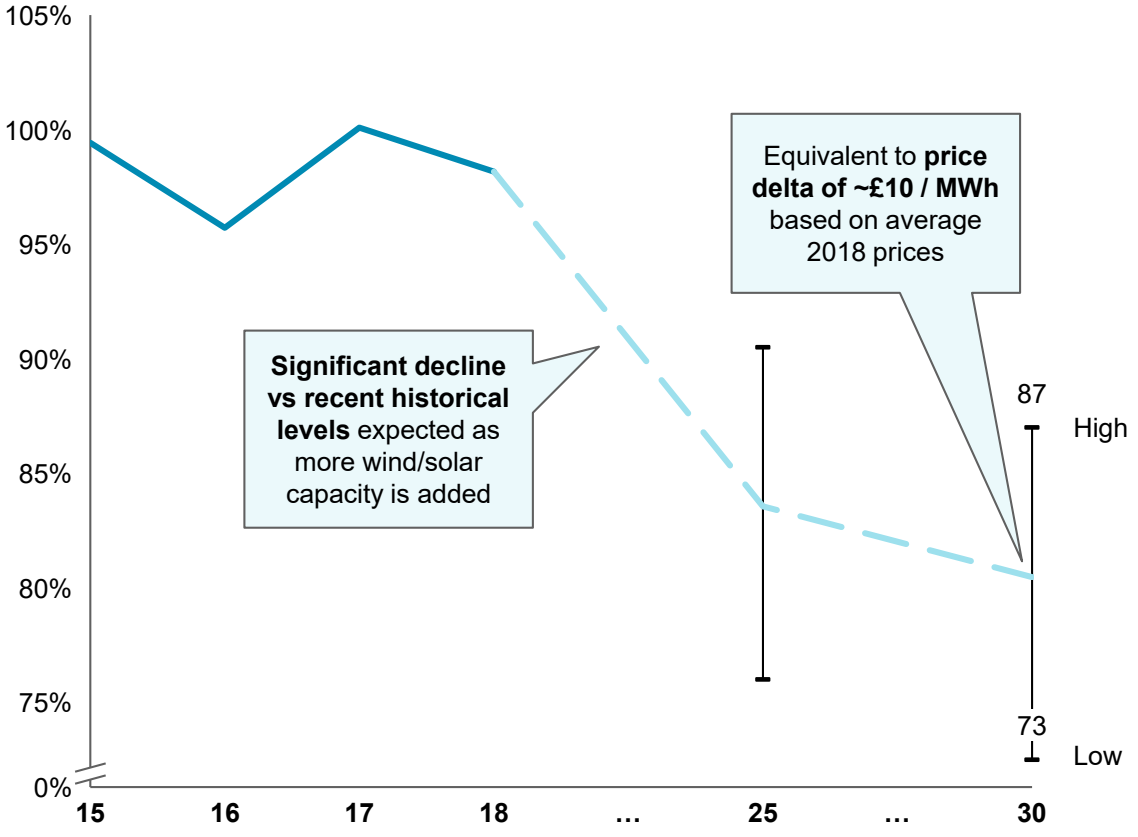
- New onshore wind and solar PV projects are **no longer eligible for UK government support** through CfD or RO schemes
- Existing projects with CfD support benefit from a strike price which is **well above the market spot price**
- Without subsidy support, new project developers must accept **shorter duration** PPAs which include a **discount on the market spot rate** – driven by:
  - **Need for certainty:** discount in exchange for a fixed price
  - **Intermittency:** discount to account for unpredictability of renewable output
- Wind/solar PPAs in 2019 typically **priced between £35-50/MWh** (>10% discount vs 2018 average spot price) while it is difficult to secure contracts for longer than **3 years**
- There is no shortage of shovel-ready projects in the market, but the **lack of PPA customers** offering an attractive structure or price is stalling development
- Planned changes to **embedded benefits** will only make this situation worse

1: Daily average of APX reference spot price vs average initial CfD strike price for live onshore wind/solar PV projects (18 sites, ~700 MW capacity)

Source: Bloomberg/APX; BEIS; Expert interviews; Smartest Energy; Oliver Wyman analysis

This problem is expected to worsen over time as cannibalisation drives down the average price captured by renewable generation

Average price captured by wind as % of baseload price[1]
GB 2015-18 spot price actuals, 2025/30 average of market projections



Commentary

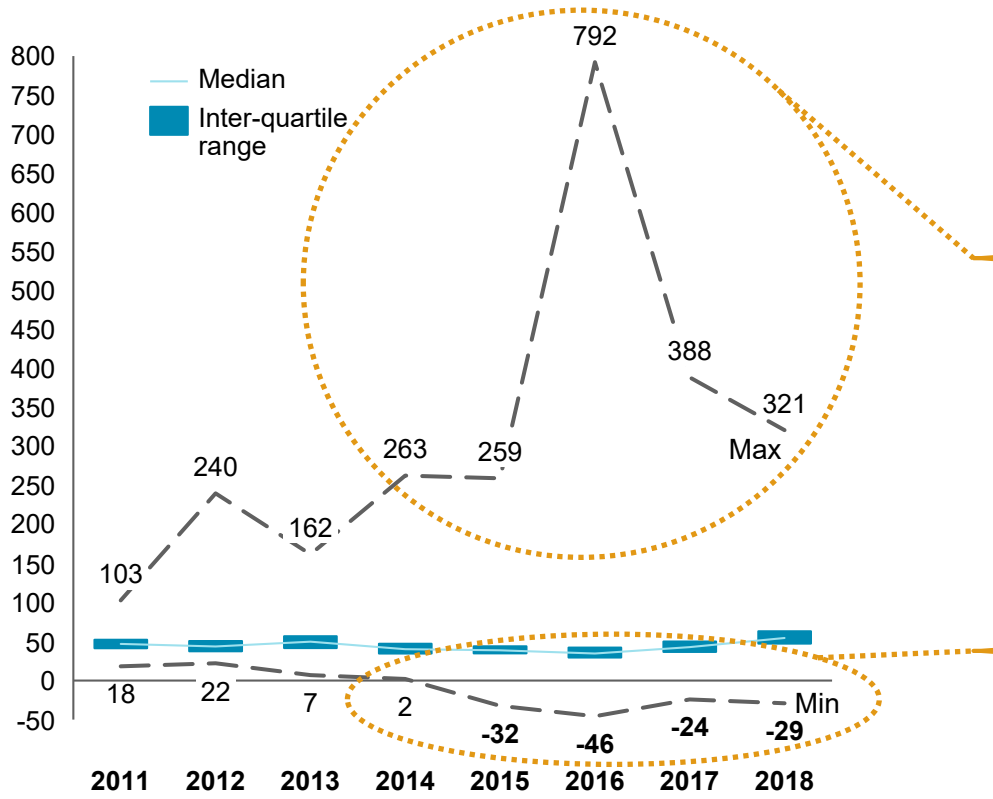
- The **effects of price cannibalisation remain relatively subdued in today's market**, primarily surfacing in periods of low demand
- In recent years, "merchant" renewables projects would have received a **relatively small discount vs average market prices** – e.g. average price for wind in 2018 of £52.34 vs £53.32 for all generation (~1.8% discount)
- However, as the wind/solar share of supply increases, **cannibalisation will drive down the price** captured by merchant projects
- Assessment of market projections suggests that the price captured by wind could approach **80% of average market price by 2030**
- Solar is **expected to perform better** (output correlated with daytime periods of higher demand) but **may still see discount of ~10% by 2030**

1: Average price captured by wind calculated as volume-weighted average spot price for onshore/offshore wind generation; baseload price is volume-weighted average for whole system
Source: Bloomberg/EPEX SPOT, Cornwall Insight, Arup, Oliver Wyman analysis

Future price variations will depend on a number of variables, whichever way things go no-subsidy RE will need to optimise its output to capture value

Distribution of UK wholesale power prices, 2011-19 H1

APX half-hourly reference spot price, £/MWh



Factors that impact price variation

Increasing wind penetration – limits load factors for firm generation (e.g. gas), increasing peak price

Increasing peak demand – e.g. from uncontrolled EV charging of electrified heating

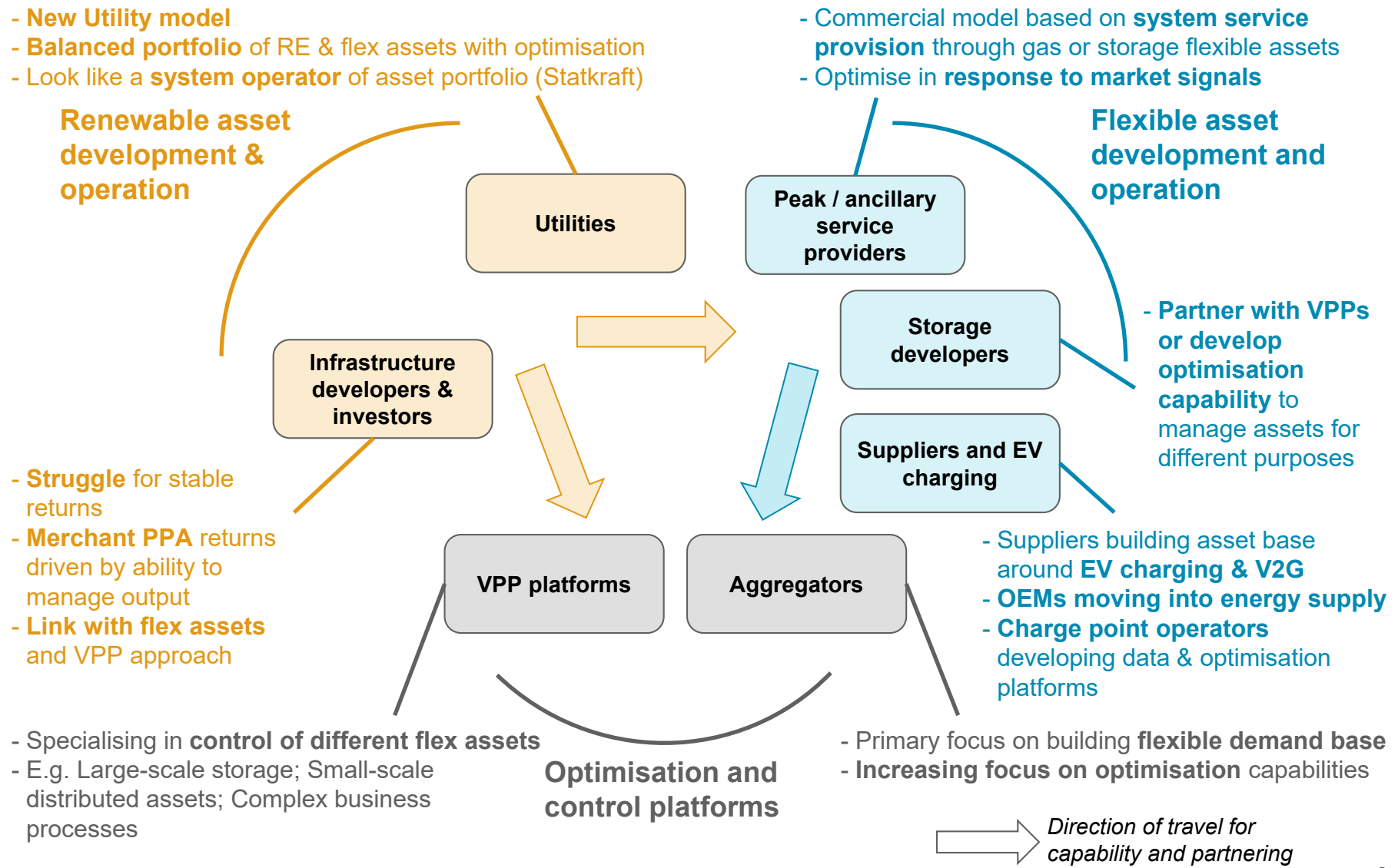
Capacity Market – limits high prices by stimulating competition (new gas/flex) for peak generation

Increasing flexibility – e.g. battery storage, DSR, EV smart charging that can smooth demand & RE gen limiting max & min price

RE subsidies (CfD) – volume based subsidies incentivise wind generation at negative prices

Source: Bloomberg, BEIS, Oliver Wyman analysis

The move to no-subsidy could be the trigger for VPP commercial models to become mature realities: large-scale integration of RE with flex services



Source: Oliver Wyman analysis

Regardless of how the market and regulation evolve, using flexibility to control renewables output will be critical to optimising returns

Options for incorporating flexibility

	Option	e.g.	Implications
Physical development	**Physical co-location of RE with flex** • RE and flex assets jointly developed at same site by same owner/investor • Operate flex to smooth on-site RE but can gain additional value on top of this	**Nevada solar & storage** • 3 projects in development totalling 1,190 MW solar and 590 MW battery storage with 25 year PPAs	• Requires **optimisation capability**, but can potentially be outsourced • Co-location **may not be optimally efficient** – optimal RE location may be different to optimal flex location
	Portfolio approach • Multiple RE and flex assets in different locations operated in unison • Potential to incorporate other forms of flex in portfolio e.g. gas, bioenergy etc.	**Statkraft 'European VPP'** • 19.3 GW of own capacity and 22 GW of 3rd party capacity • Combines wind, solar, biomass, hydro, gas & battery	• **Long-term** hold strategy • **Scale effects** reduces flex requirement • Requires **operational capability** to optimise across portfolio
Contractual alignment	**Joint PPA with profile guarantee** • Contractual agreement for remote flex assets to smooth RE output for off-taker • Could be in form of a guaranteed profile or smoothed output boundaries	**Projects in development** • Relatively new concept in the market but anecdotal evidence of deals in development	• **Multiple assets** can be jointly operated with including storage, DSR and gas • **Separation of optimisation capability** to specialist entity
	VPP participation • Sell RE into 3rd party VPP platform • VPP takes responsibility for optimising output in tandem with separately procured flex capability	**Nascent platforms** • Start-up led technology platforms (e.g. Limejump, Upside, Open Energi) but not yet matured / large-scale	• Requires functioning and **scaled VPP** that can take on large-scale load • Likely to be **beaten down on price** through competition with other RE providers

QUALIFICATIONS, ASSUMPTIONS AND LIMITING CONDITIONS

This report is for the exclusive use of the Oliver Wyman client named herein. This report is not intended for general circulation or publication, nor is it to be reproduced, quoted or distributed for any purpose without the prior written permission of Oliver Wyman. There are no third party beneficiaries with respect to this report, and Oliver Wyman does not accept any liability to any third party.

Information furnished by others, upon which all or portions of this report are based, is believed to be reliable but has not been independently verified, unless otherwise expressly indicated. Public information and industry and statistical data are from sources we deem to be reliable; however, we make no representation as to the accuracy or completeness of such information. The findings contained in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties. Oliver Wyman accepts no responsibility for actual results or future events.

The opinions expressed in this report are valid only for the purpose stated herein and as of the date of this report. No obligation is assumed to revise this report to reflect changes, events or conditions, which occur subsequent to the date hereof.

All decisions in connection with the implementation or use of advice or recommendations contained in this report are the sole responsibility of the client. This report does not represent investment advice nor does it provide an opinion regarding the fairness of any transaction to any and all parties.


OLIVER WYMAN

OLIVER WYMAN

FUTURE MOBILITY TRENDS
THE REVOLUTION OF MOBILITY

2019

MARSH & McLENNAN COMPANIES

MOBILITY

Movement of people between where they live, work and play, as well as movement of goods that help them in all aspects of their lives

Mobility – The most dynamic and transformative market for the Global economy

Mobility is a **fundamental pillar** for the global economy, representing 16% of global GDP

Connectivity

of people, goods and ideas as a critical enabler of short and long term development

#1 area

for cities' economic attractiveness

Catalyst of innovation

as mobility leverage on all critical fields of future R&D (artificial intelligence, big data, energy, …)

$245 BN

in E-mobility R&D by 2022

19%

potential GDP generated by Mobility in 2030 (vs. 16% today)

Growth engine

for entrepreneurs, investors and regional economy

>80%

of respondents prioritized fast and cheap mobility as a key requirement for a City attractiveness

Quality of life

for local population and visitors

Source: International Data (IDC), Siemens "Megacity Challenges", World Bank, Oliver Wyman analysis

Mobility value chains converge around customer use cases, breaking silos between transportation industries

Use cases

People	Leisure	• Shopping • Social gatherings • Sight seeing • Sports • Cross-border travel
	Work	• Office work • Mobile work • Labor work
	Care	• Prayer • Education • Healthcare • Errands
Freight	Com-mercial	• Perishable goods • Non-perishable goods • Input materials
	Industrial	• Raw materials • Components • Oversize/heavy loads • Trade
	Personal	• Food • Packages • Laundry
Util-ities	Disposal	• Waste • Sewage
	Non-disposal	• Water • Gas • Petrol • Electricity
Ser-vices	Private	• Port maintenance • Airport maintenance
	Public	• Emergency response • Safety & security • Public maintenance

Solutions

Planning	• Mobility planning • Door-to-door & multimodal solutions • Personalized plans • Privacy & data security
Order	• Order placement • Commissioning • Payment/contract • Pricing
Transit	• Waiting time (frequency) • Guidance • Proactive notifications & real-time information • Passenger and logistic hub services (retail, F&B, entertainment, etc)
Journey	• Pick-up/inbound sort • Line-haul • Real-time travel information • Outbound sort • Services onboard
Arrival/ delivery	• Consumption-based & transparent invoice • Rate, comment, share • Loyalty rewards • Listening & caring • Good delivery

Assets & infrastructure

Vehicle	Sea	• Sub-sea • Surface
	Ground	• Walking • Underground • Rideable • Collective vehicles • Robots, AGV
	Air	• VTOL • Fixed-wing • Hybrid
	Space	• Spacecrafts • Balloons
Routes	Routes & corridors	• Dedicated corridors • Multi-purpose routes
	Signaling	• Onboard Signaling • Integrated in routes & corridors • Dedicated assets
Stations	Hubs	• People • Freight • Utilities • Services
	Stations	• Vehicle parking & storage • Sharing zones • MRO facilities
	Facilities	• Energy distribution • Retail, food & beverage
Backbone	Energy	• Supply & distribution
	Data	• Telecom network
	Control	• Command & control facilities

Systems

Onboard	• Sensors & interfaces • Navigation • Actuators
Fleet operations	• MRO & aftersales services • Mission management • Asset & energy management
Traffic & infra-structure management	• Mobility master planning • Geo-mapping • Traffic command & control • Real-time traffic management • Digital asset management
Digital platforms	• Customer application • Smart city services • Infrastructure management
Data & communi-cation	• Data transmission • Connectivity • Cybersecurity
Financing	• Business models • Financing • Public-private partnerships
Governance	• Legal • Certification • Police, customs
Innovation & talents	• Research & development • Academy • Industrial ecosystem

The 4th Revolution of Mobility has begun: **the Digital mobility era**

XVIII century & earlier

Active mobility

- *Supply scarcity*
- *Waterways as most important traffic routes*
- *Horses and carriages*

1830–1914

Industrialized mobility

- *Rail become central to economic development*
- *Development of local public transport solutions*
- *Bicycle as a horse substitute*
- *Steam ships displace sailing*

1914–2008

Mass mobility

- *Automotive transportation becomes the backbone of mobility*
- *Democratization of air travel*
- *First space explorations*
- *Infrastructure development*
- *Urban mass transit systems*

2008–…

Digital mobility

- *Autonomy-connectivity-electrification*
- *Mobility as a service*
- *Modal redistribution (car ownership decrease)*
- *Intermodality*
- *High-speed / active mobility*
- *City competition*

Behind the digital revolution lies a **multitude of trends and disruptions** that massively change the Mobility landscape

USE CASES

Demand explosion

Globalization

Growth of global trade and e-commerce will drive mobility of goods

+40%

Increase in global exports tons between 2017 and 2030

Source: World Trade Organization

Urbanization

70% of world population being urban will be mobility most powerful growth driver

20%

increase in demand for urban mobility (in people-km) between 2017 and 2030

Source: Arthur D. Little

Rise of new middle classes

Emerging middle-classes in Asia, Africa and South America will increase people mobility needs

+70%

Increase in number of international tourists arrivals between 2017 and 2030

Source: World Travel and Tourism Council

Flexible needs

Flexible working modes

Development of work-at-home policies reduces needs for work mobility

40%

of employers worldwide offer work-at-home options in 2018

Source: American Community Survey

Digital personal services

Digital services bring entertainment and retail at home

23%

less shopping malls construction in 2017 vs 2016 in Europe

Source: Cushman and Wakefield

Near shoring

Development of robotics & rising costs in China drives US and EU companies to near shore their production

51%

of US and EU companies have started nearshoring their production

SOLUTIONS

Experiential revolution

Well-being

Personal well-being becomes the primary mobility purchase driver

+47%

of generation Y willing to relocate to be closer to work

Source: Deloitte Global Automotive Study

Environmental awareness

Young generation prefer environmental-friendly mobility solutions

+23%

of people in the UK asked in 2018 want their next car to be hybrid

Source: UK department for statistics

Shared & usage economy

The long-lasting love affair between people and cars is now declining

169%

CAGR 2012-2017 of investments in ride sharing apps

Source: JP Morgan

Integrated experience

Clients are looking for Mobility as a Service (MaaS) solutions

waze, whim, Uber

No hassles

New payment apps will enable hassle-free and seamless ticketing experiences

Pay, Alipay

Efficiency

As time is more valued, mobility-time will be used for working, traveling or entertaining

10%

increase in travel retail between 2017-2023

Source: Allied Market

Personalization

Digital platforms will leverage operators' data to offer personalized experiences

Qixxit

Route planning is based on travel history and modal preferences

ASSETS & INFRASTRUCTURE

Vehicle proliferation

Electrification

By 2030, all vehicles (air, sea, ground) will go electric

20%

of market share expected for EV in 2030

Source: World Economic Forum

Autonomy

Autonomous vehicle market size will reach 20% of annual vehicles sales

x40

Growth of autonomous vehicle market between 2015 and 2030

Source: Oliver Wyman analysis

Connectivity

Connectivity will be enabled by communication network (5G), Cloud, mapping and V2X

23 000

Connected aircrafts by 2025

Source: Ericsson Mobility report

Miniaturization

Light high-tech rideable will transform the "first and last mile"

Flexibility

Acceleration of on-demand transportation and hyper modularity will solve the first/last mile and mass transit connection

70%

of millennials use multiple travel options several times per week

Source: American Public Transportation Association

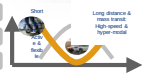
High-speed

There is an important customer value at stake in high-speed mobility

1000 km/h – Hyperloop

Modal redistribution

Tomorrow, usage will shift from private cars to the extremes



Smart routes & infrastructure

Asset usage reinvention

Vehicle innovation will dramatically improve space utilization

40%

Expected parking supply reduction by 2040

Source: Siemens

Air & underground routes

E-VTOL will require dedicated infrastructures, to be financed by city authorities and private sectors

Smart traffic & Signaling

Digital technologies are influencing future urban master plans

$2.8 BN

Invested by NASA & Google over 2017-2021 to develop a US airspace management system

Multimodal concepts & hubs

Transport modes will be integrated to offer seamless journey

Energy distribution

Infrastructure will become both producer & distributer of energy

Data & control

At the digital age, data & control infrastructures become critical enablers for future mobility systems

-20%

Decrease of infrastructure costs due to centralized digital interlocking systems

Source: Thales

New city shapes

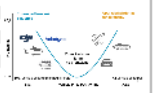
Mobility innovation will strongly impact city shapes of the future (both brown and green field)

SYSTEMS

New business models

Vehicle value polarization

OEM will face a trade-off between volume and value



Remote aftermarket services

MRO profitability will decline over time

-10%

Estimated decrease of vehicle maintenance costs by 2030

Source: Oliver Wyman analysis

Enhanced fleet management

Car sharing is gaining ground after successive waves of innovation

Infrastructure financing

Collaboration modalities and cost recovery strategies will be paramount for profitable infrastructures

7%

CAGR between 1995 and 2015 in investments and spend on infrastructure, accelerating since 2010

Source: OCDE

Data monetization

Customer data and its monetization will drive additional revenues

$400bn

Usage-based Insurance value at stake for society

Source: World Economic Forum

Cities services

The smart city global market experiences a 10% annual growth rate, smart mobility being a key pillar

2.1 $Tn

Smart city global market in 2025, with the APAC region capturing 64% of the value

Source: IHS Insights, Frost & Sullivan

Coalition

Creating an ecosystem leveraging each players' capabilities will be key to offer seamless travel

33

key urban mobility players gathered to launch a multi-modal and door-to-door solution in Helsinki

Ecosystemic governance

City competition

Mobility will become a megacity competition

New mobility ecosystem

Mobility of the future will involve stakeholders from very diverse background

$25Bn

Amount invested in new mobility players

DiDi, Lyft, Grab

Mobility regulation & governance

Strong public incentives are required to promote adoption of new technologies

10

EU capitals have already taken measures banning diesel in a near future (2025 or 2030)

Geo-intelligence & mobility planning

Digitalization is revolutionizing urban planning and management

3

Technologies will shape mobility planning : 3D digital models, operational intelligence and digital twins

Smart traffic management

Singapore is one the first city to have deployed an integrated traffic management system

8%

Average speed increase on arterial roads in Singapore between 2005-2014 with the Intelligent Transport system

Source: SmartMobility2030, LTA

Digital asset management

Future mobility systems will require a dedicated data architecture

1.4M

recalls in the US due to Vehicle IoT problems or weaknesses in 2015

Cybersecurity

Given their vital role in supply chains, mobility companies are subject to a set of specific cyber risks

25%

of the vehicles sold will have a cybersecurity software managed by private companies

Source: IHS Markit

Huge **social, economic and environmental impacts** are at stake

Social benefits

- **1,300,000 lives** to be saved every year
- **30%** of urban space to be recovered and used for quality of life purposes

Business benefits

- **US$3.8TN** of cumulative impacts over the next 10 Y through digital platforms
- **+50%** customer choice enabled by seamless supply chain

Economic benefits

- **Up to 40%** lower commuting time & supply chain time-to-market
- **30 to 70%** transportation cost decrease

Environmental benefits

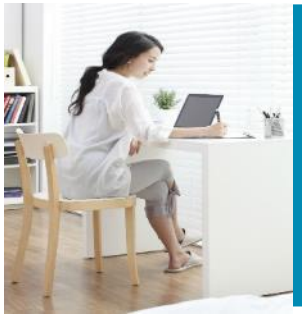
- **54%** of global oil demand and **25%** of emissions generated by current transportation systems, to be potentially saved

Sources: Oliver Wyman, McKinsey, BCG

A demand explosion with dramatic shifts in customer expectations

Consumption patterns are fragmented and volatile as digital mobility substitute provide with a freedom of choice …

Mobility substitutes, emerged in latest 10 years



Flexible working modes

- **Increasing flexibility** in working locations and hours, for talents attraction & retention or manage practicalities
- More frequent commuting & mobile work
- Growth of **freelance & flexible work** engagements
- Generalization of telecoms & connectivity services

Digital personal services

- Digital services **available at home** (home cinema, e-commerce)
- **VR/AR technologies** or holograms to create immersive meeting/ entertainment experiences
- Smart devices add intensity to daily life and **increases time-consciousness**

Near shoring

- **Robotics & salary increases** reduce emerging countries cost advantage leading a majority of companies to nearshore or onshore
- **3D printing** emerge as an optimal manufacturing mode in a growing number of industries
- **Predictive maintenance** reduces need for inspections
- **Moving stores/shops** decrease distances
- **Recycling** favouring local industries

By 2030, mobility needs will be multiplied by 2.3, while mobility market growth will outperform GDP by 30%

Drivers of mobility demand explosion
2017–2030 outlook

Globalization

40% increase in global exports volume

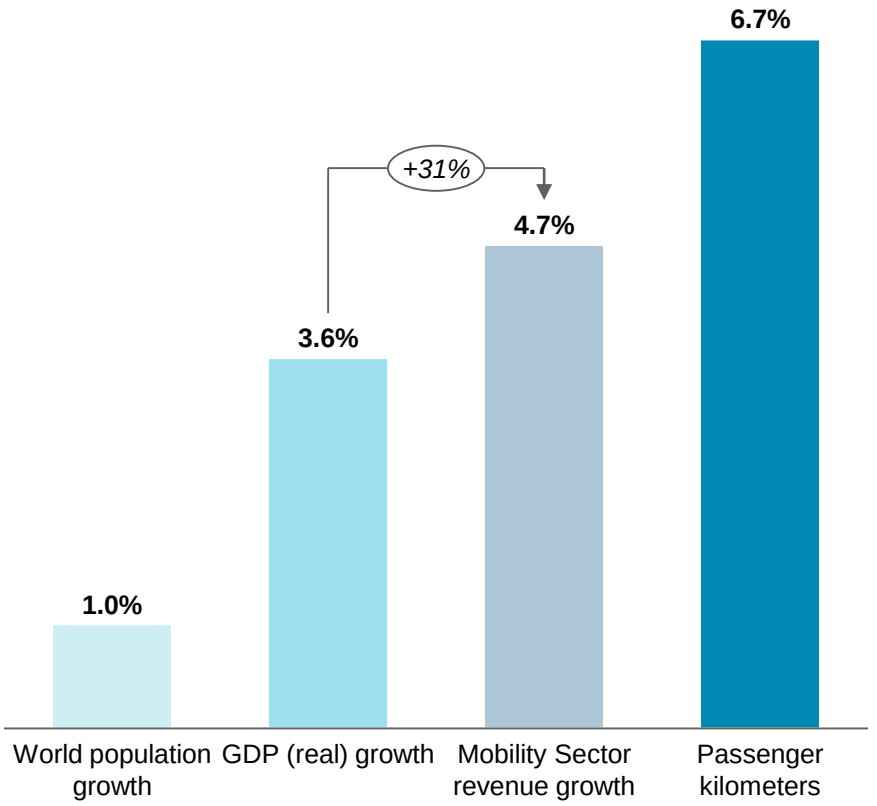
Urbanization

X2.3 in mobility demand (pax-km)

New middle classes

70% increase in number of international tourist arrivals

Forecasted growth in the mobility sector
2017–2030, CAGR[1]



Note: 1. Compound Annual Growth Rate; 2. Business as usual scenario.
Source: Arthur D. Little, ICAO, IMF, OECD, UN, WTO, WTTC, Oliver Wyman analysis

Automobile has been central to human mobility systems for over a hundred years

Automobile is the "industry of industries" (P. Drucker)

$3,5 TN in annual revenues, equivalent to World's n°4 rank among nations

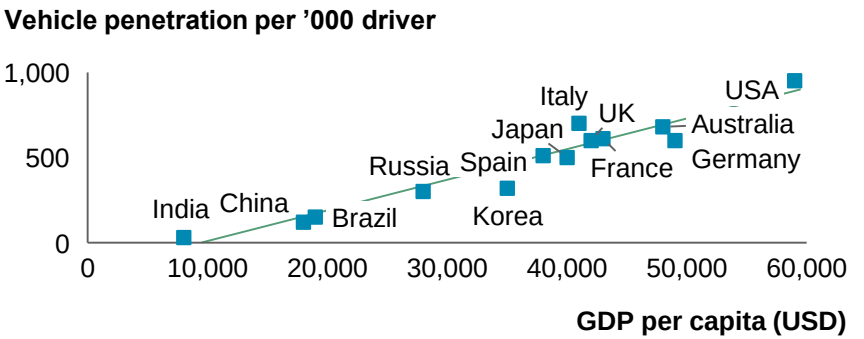
50 MM employed across the value chain

1,1 BN global vehicle population, which is as many cars on Earth today as there were when automobile was invented

Since 1920

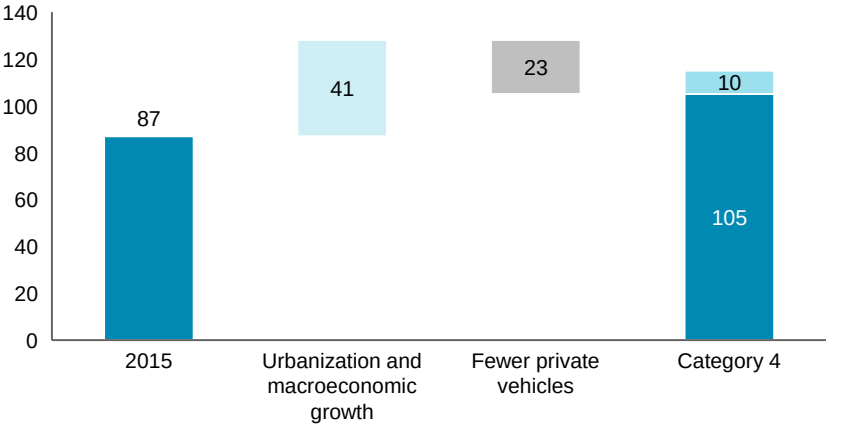
a long-lasting love affair between ***people and cars***

Vehicle penetration is well correlated with GDP/Capita (2015)[1]



Global vehicle sales growth

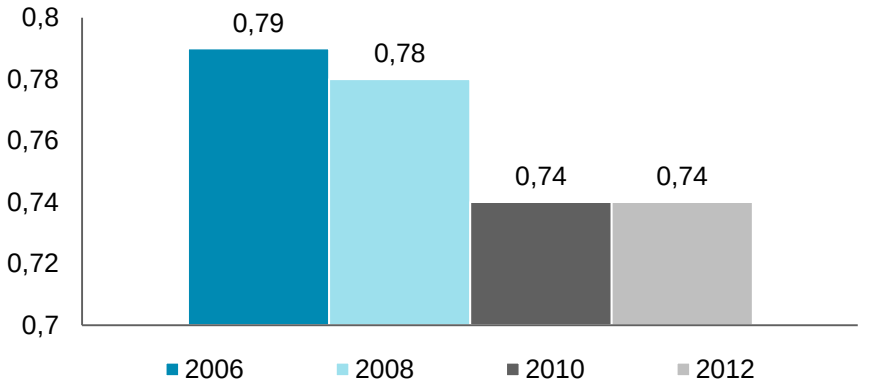
Current and future annual vehicle sales, MM, Global



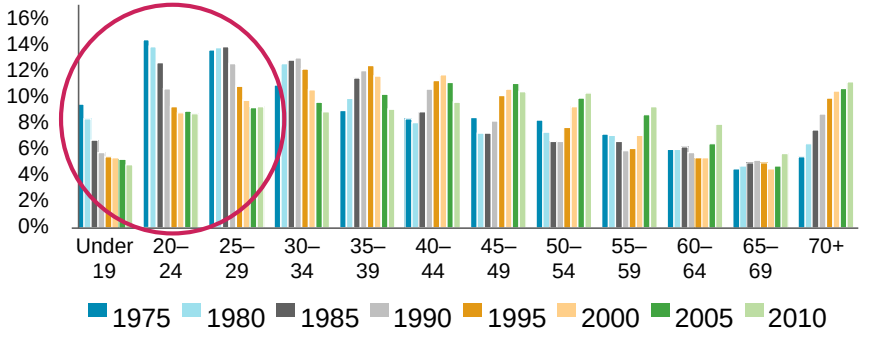
1. LMC, Bloomberg. BofA Merril Lynch Global Research

Mobile devices have supplanted cars as a portal to social interactions, communication, entertainment, & even as a space of privacy

Decline in vehicle ownership rates
Vehicles per person, USA



Decrease in licensed drivers
Licensed drivers by age in US, % of total drivers (1975–2010)



Future Automobile

Last 127 years
Automobile

Auto–manufacturer to service provider

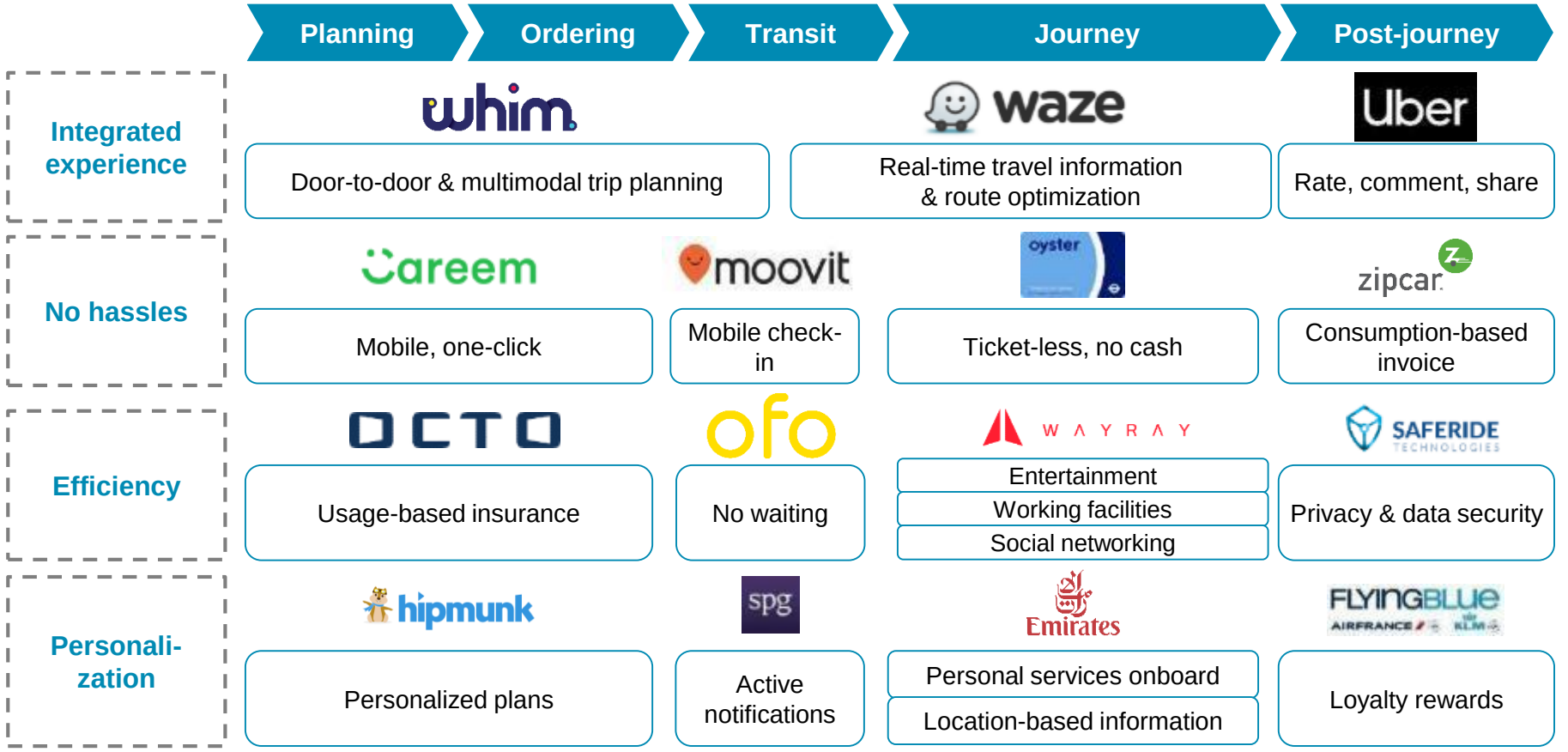
"The age at wich you get your first smartphone is more important than the age at wich you get your driver's license."

– Jason Dorsey, Gen Z and Millennial expert

Source. 1. BNEF/McKinsey. 2. WHO, Swiss Re, Kleiner Perkins, Google, Shoup 2005, Kenworthy & Laube, Casualty Actuarial Society, US Department of Transportation

What mobility services will customers expect?

Emerging requirements along the travel chain

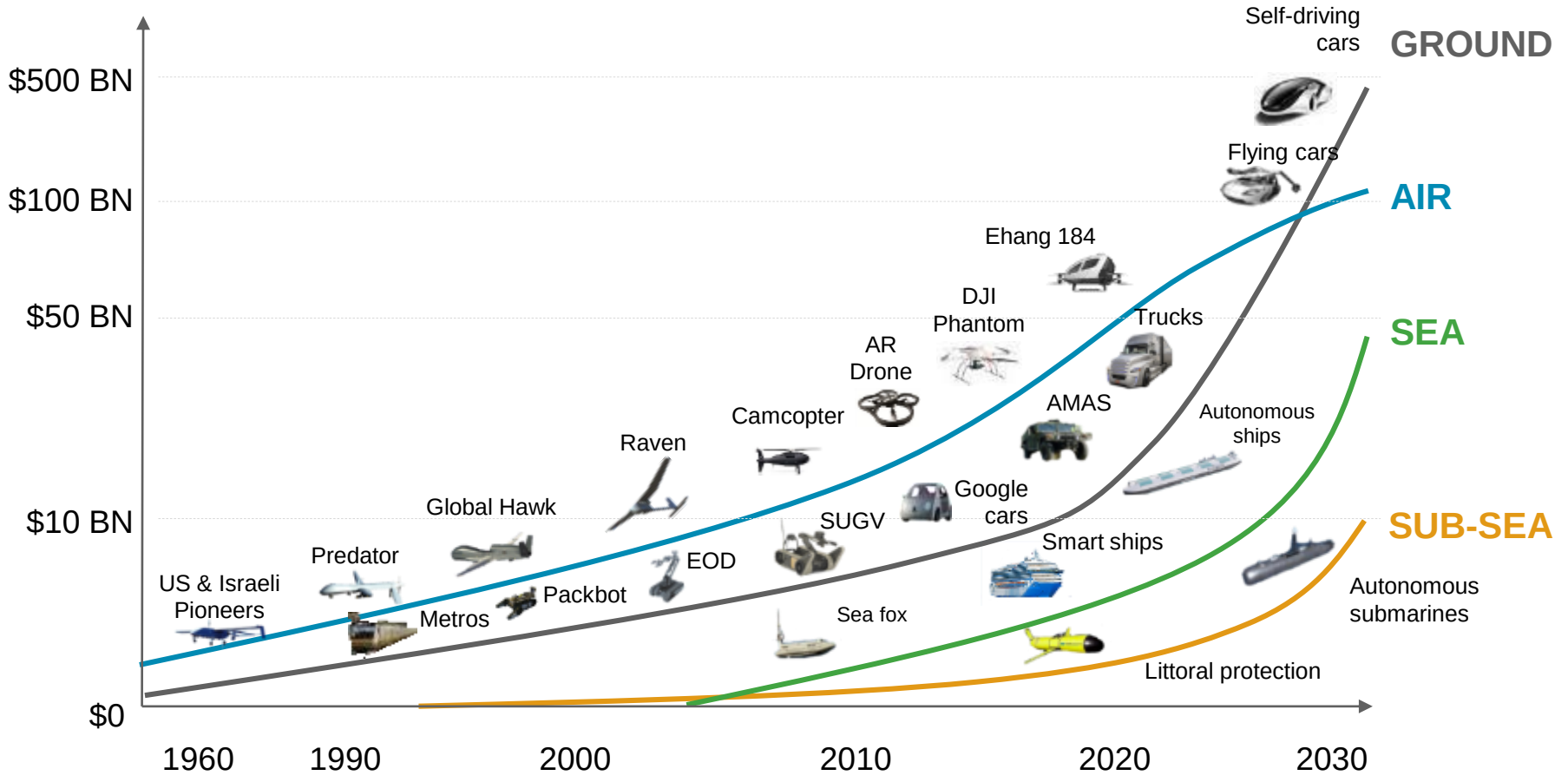


Source: Oliver Wyman analysis

More changes will happen in Mobility in the next 10 years than the latest 100

More changes in mobility should be expected in the next 10 years than in the last 100 years

Autonomous vehicle market size
Logarithmic scale



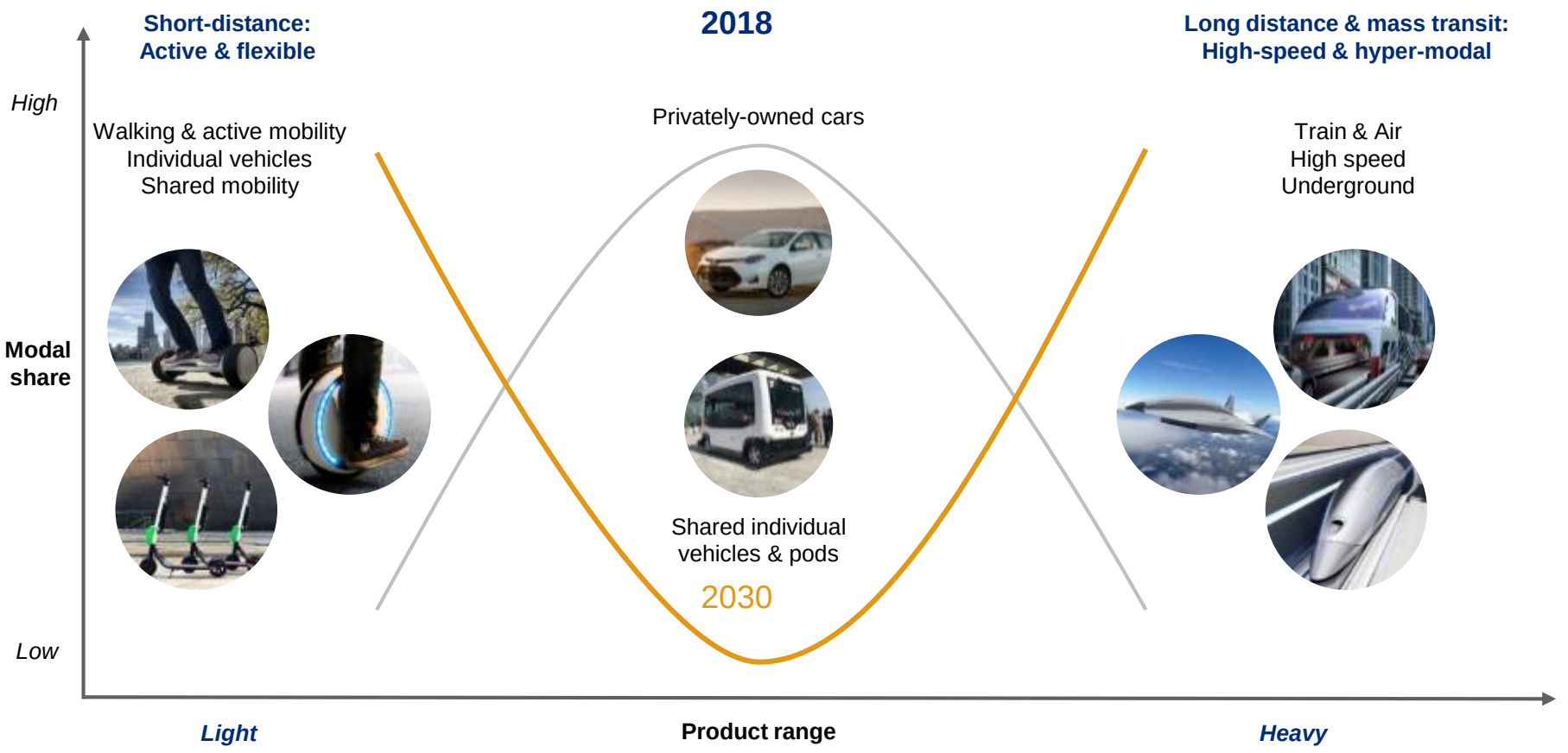
Proliferation of new vehicles concepts will provide customers with an outstanding freedom of choice

2040+ | 2025+ | Operational

GROUND				AIR & SPACE			SEA
Micro e-mobility	Autonomous cars	Exoskeleton	Hyperloop	E-VTOL	Professional drones	Electric passenger jet	Autonomous vessels
							
Individual vehicles	Autonomous shuttles	Travellator	Autonomous Rail Transit	Supersonic planes	Autonomous aircrafts	Future space shuttles	Autonomous underwater vehicles
							
E-Bicycles	Autonomous trucks	Road pods	Freight pipeline	Personal air vehicles	Stratobus	High-speed helicopter	Private submarines
							
Delivery robots	Multi elevators	Personal Rapid Transit	Straddling train	Airships	Suborbital jets	Modular aircrafts	High-speed ships
							
Autonomous train	Spiral escalator	Cargo pods	Maglev train	Flying cars	High-altitude surveillance	Interplanetary transport	Wind-solar ships
							

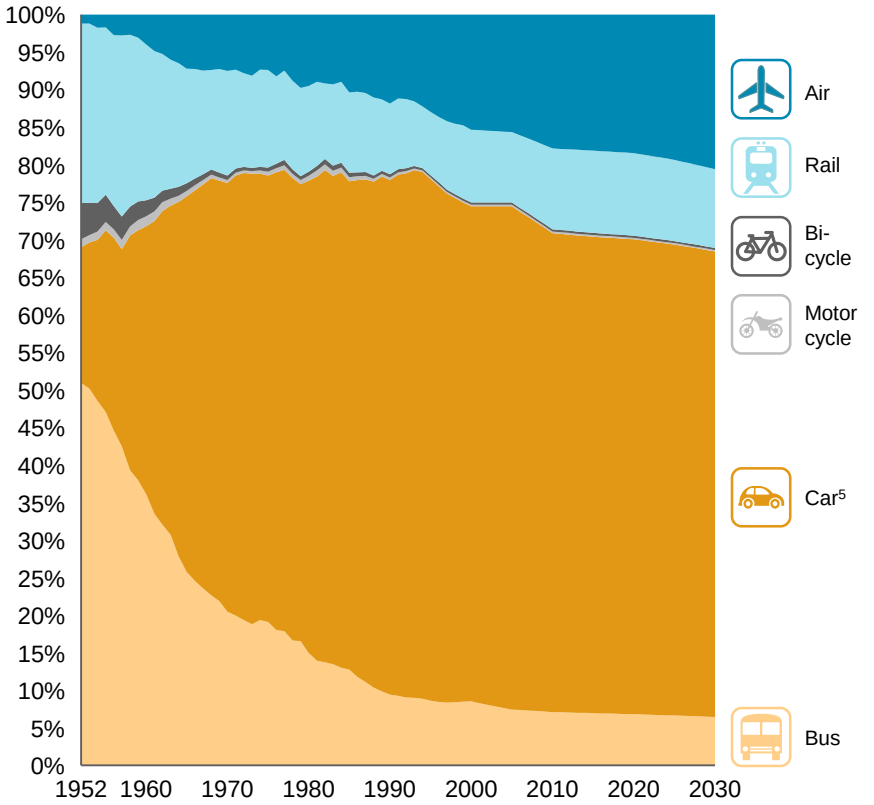
Tomorrow, **usage will shift** from private cars to the extremes

Evolution of urban mobility usage
2018-30 evolution

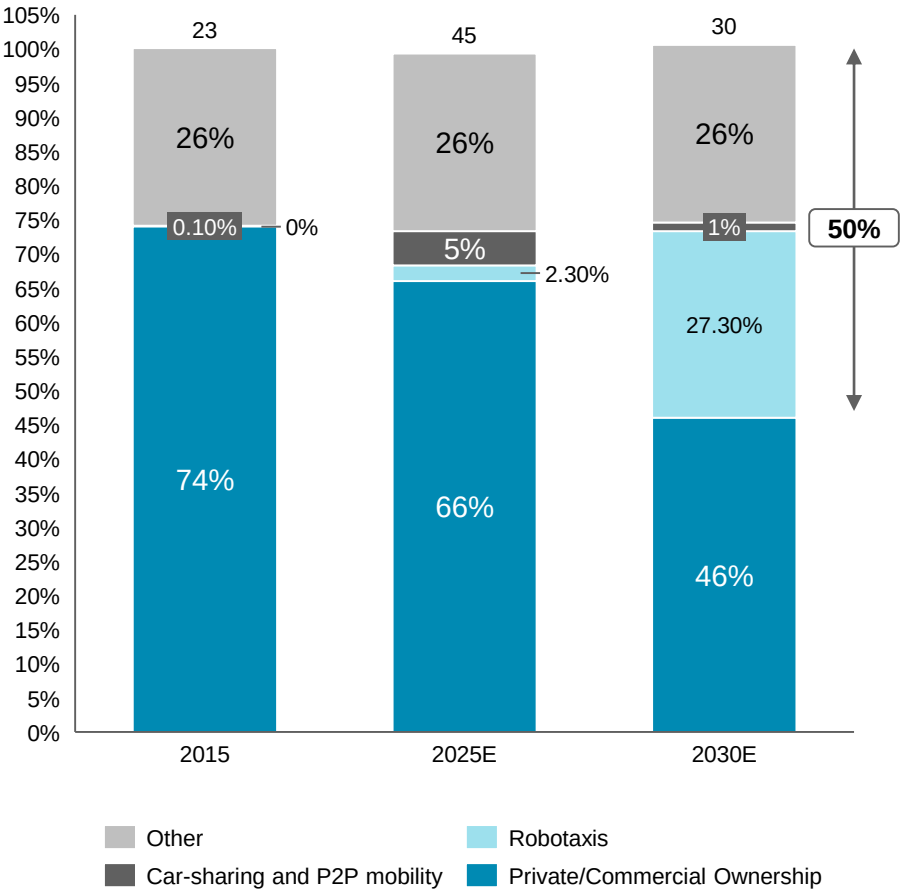


50% of future ground mobility will be with shared vehicles

Global modal split evolution
1952-2030, % share of each mode[1]



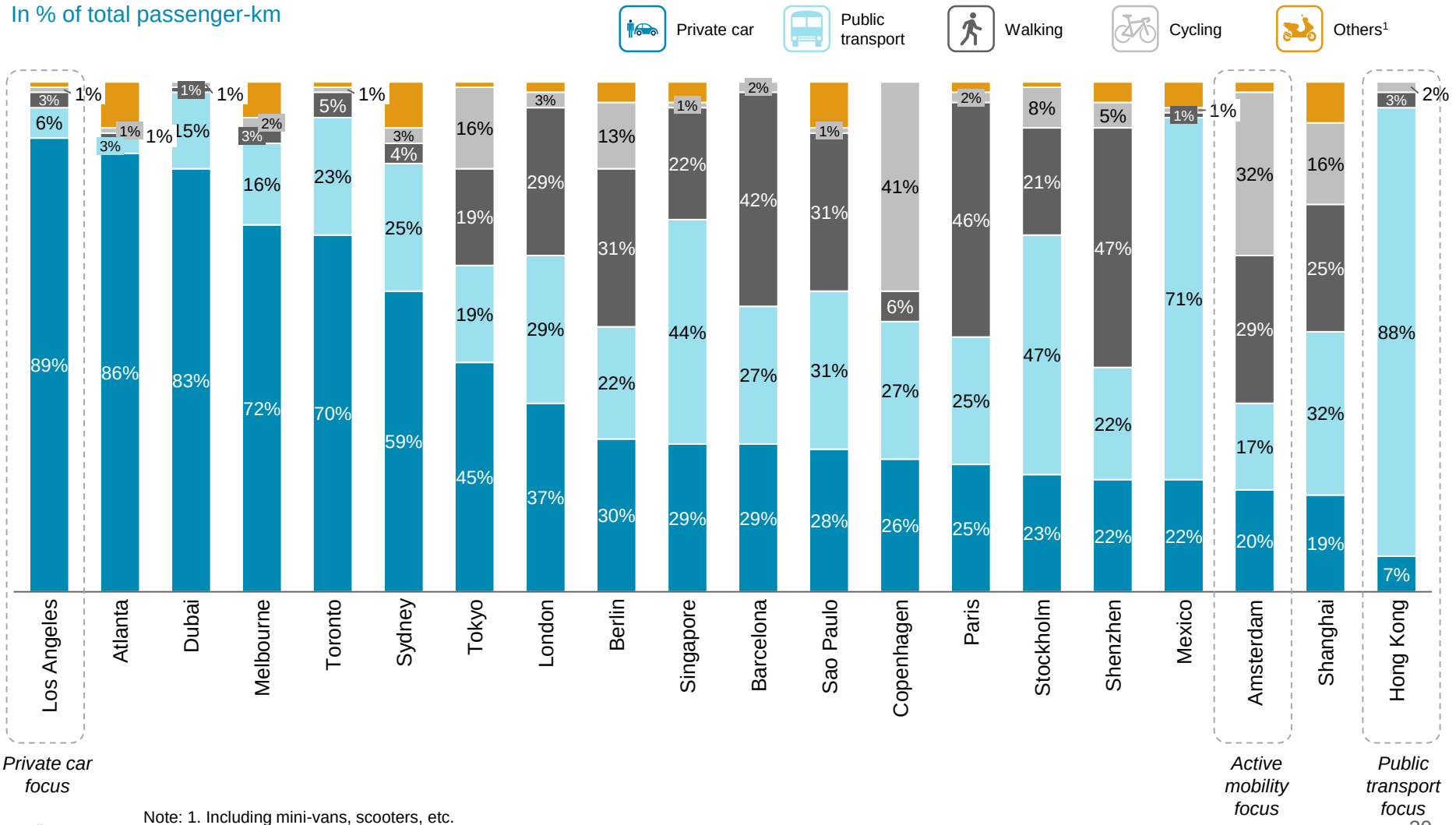
Zoom on ground mobility
Worldwide kilometers driven by mode of transport



Note: 1. Passenger transport only; 2. Passenger Kilometer (PKM) is a measure of movement of passengers by a mode of transport: it is the number of passengers multiplied by the total distance covered in km; 3. Internal Combustion Engine; 4. Autonomous Vehicles, including Autonomous Shuttles; 5. Includes both ICE and Autonomous Vehicles. Source: Oliver Wyman analysis

New mobility usages will dramatically impact the way Cities of the future shall be shaped

Urban modal split in selected mega cities
In % of total passenger-km



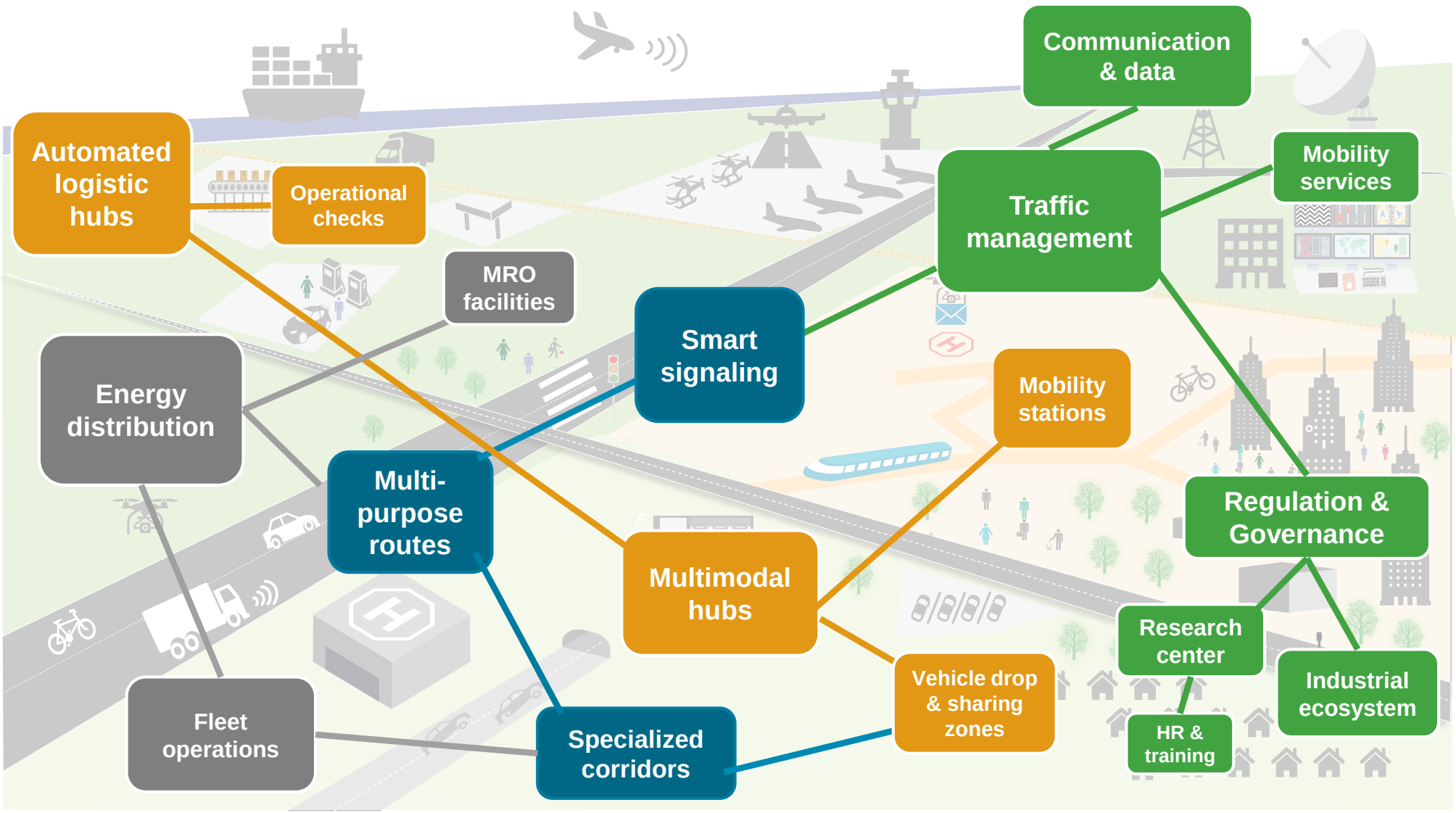
Note: 1. Including mini-vans, scooters, etc.
Source: OECD, Oxford Economics, IATA WATS, ICCT, Oliver Wyman analysis

A wide range of **new mobility infrastructure** concepts are emerging

2040+ | 2025+ | Operational

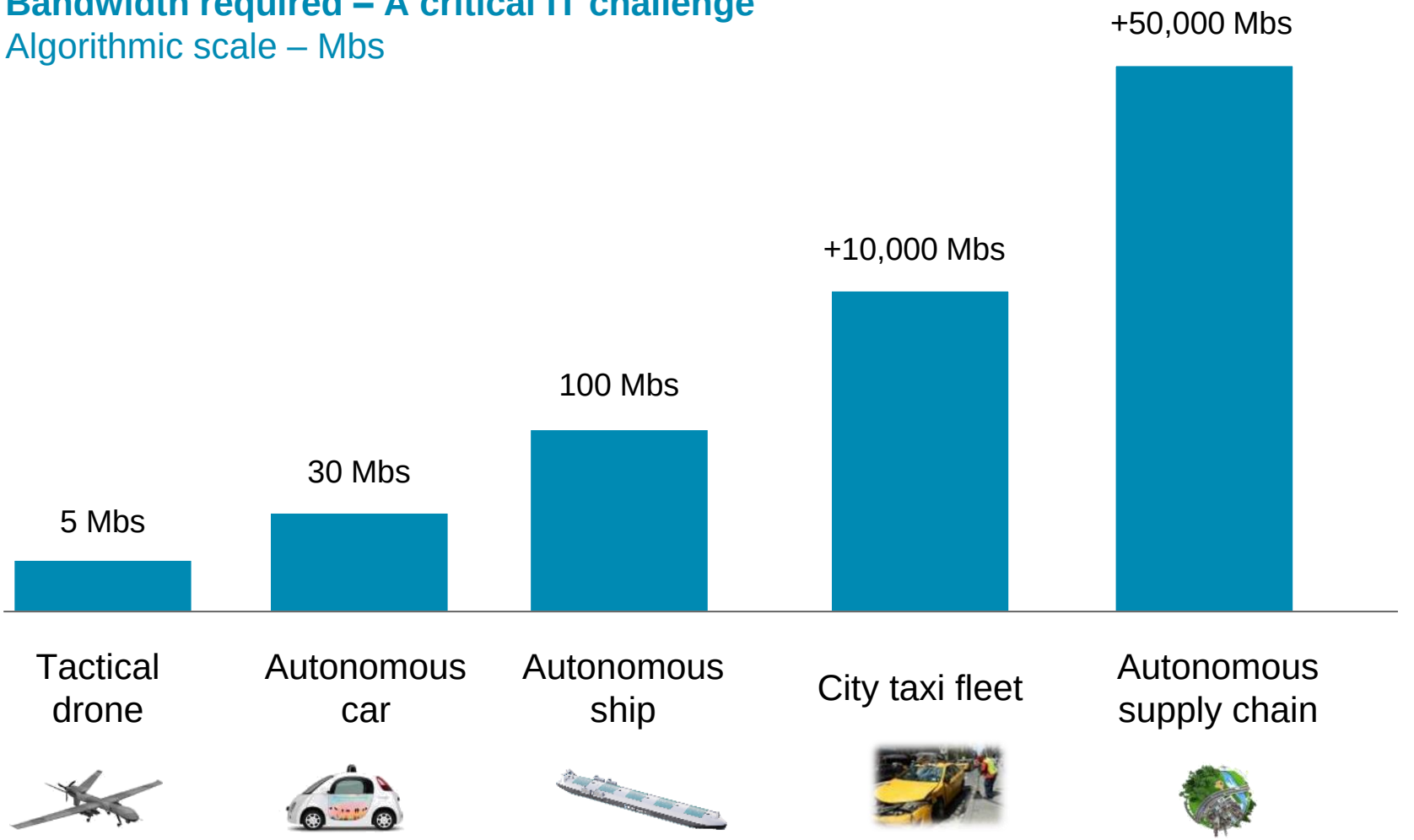
ASSET USAGE REINVENTION		NEW CORRIDORS	NEW CITY SHAPES	MULTIMODAL MOBILITY HUBS	ENERGY DISTRIBUTION	SMART ROUTING & SIGNALLING	DATA & CONTROL
Parking spaces reconversion	UAS highways	Drone delivery system	Vehicle-free zones	Multi-modal hubs	Wireless car charging	Integrated traffic mgmt	High-connectivity network
Multi-purpose routes	Walking areas	Underground networks	Vertical cities	Multi-modal logistics	Charging pavement	Smart pavement	Satellite infrastructures
Active mobility lanes	On-demand public transport	Soft Transportation	Self-sufficient communities	ULS[1]	Powering infrastructure	Cloud-based signaling	City control cockpit
Shared mobility stations	Free floating micro mobility	Verti-ports & verti-stops	Smaller streets	Services optimization	E-charging stations	Modular lane environment	Secured data centers
Girsocopic transport	New parking concepts	Low altitude air corridors	Urban farming, manuf. & logistics	Mass-transit connection	Smart grid	Street censors	Data storage

Cities of the future will develop **smart mobility platforms**, where all mobility components will be interconnected



Dedicated communication infrastructures will be needed to absorb required data exchanges

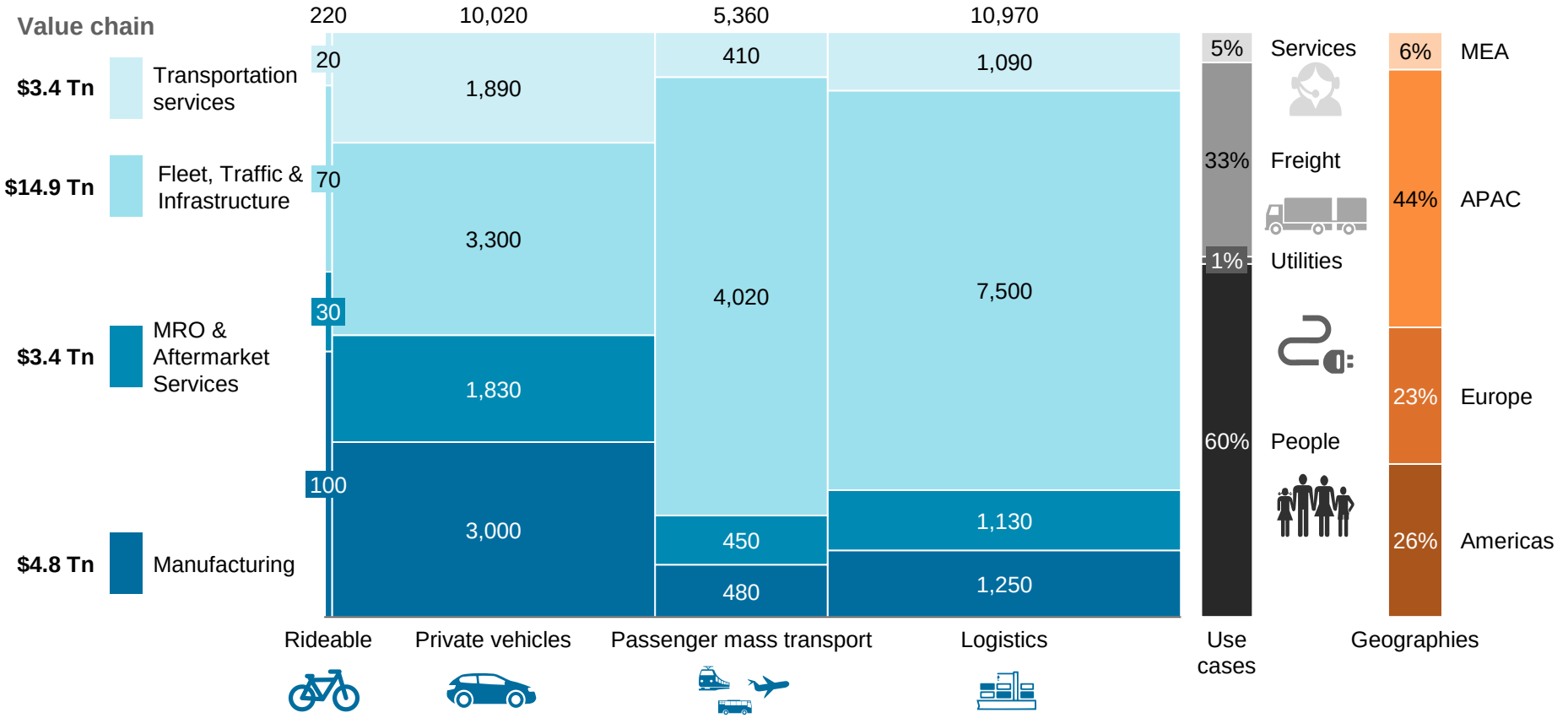
Bandwidth required – A critical IT challenge
Algorithmic scale – Mbs



By 2030, an important number of Top 500 mobility players could disappear

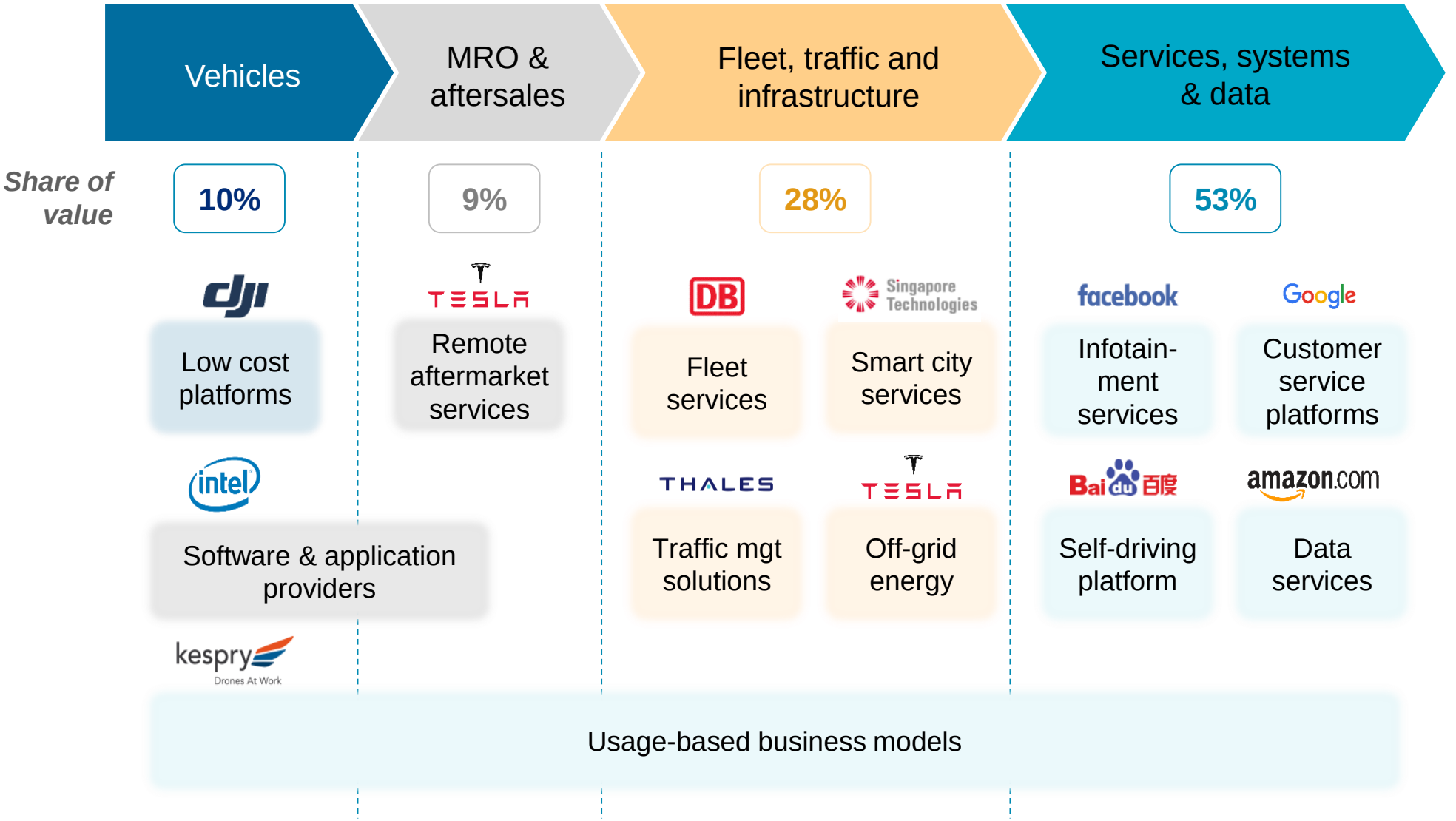
By 2030, **vehicles will only represent 20%** of the overall mobility market revenues

Global mobility market size[1]
2030E, in $ BN



1. Excluding military market ; 2. HSBC estimates global GDP growth between 2017 and 2030 to be ~40%, bringing global GDP to $111 Tn
Sources: HSBC, Oliver Wyman analyses ; Note: totals may not add up due to rounding

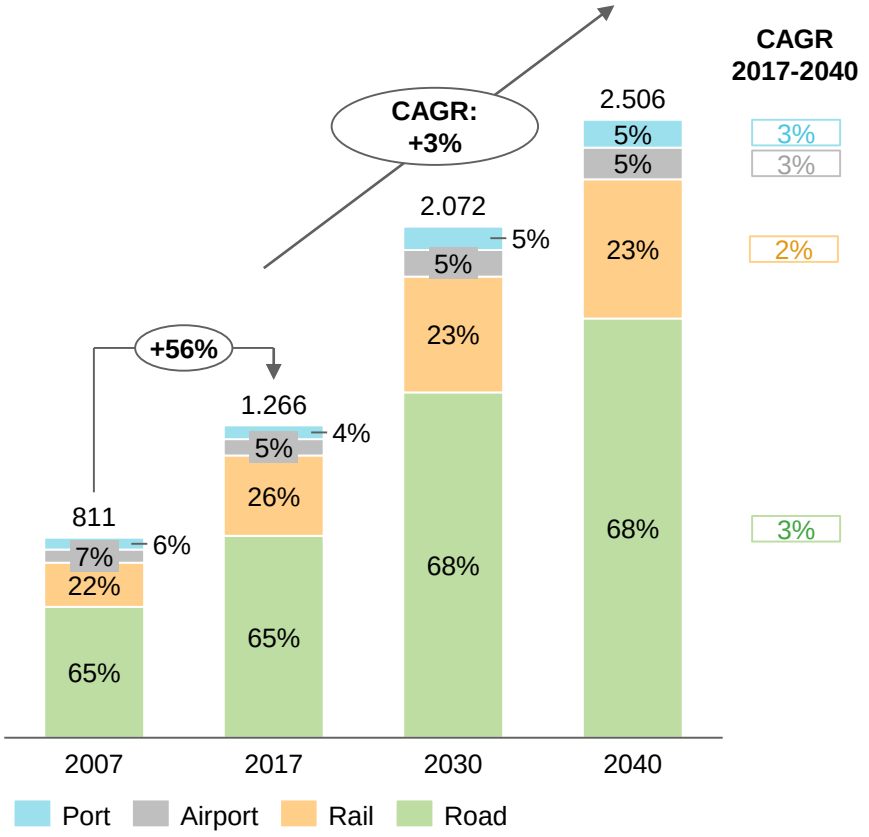
Disruptive **business models** will be required as 53% of market value will be about mobility meta-platforms



As 50% of future mobility **infrastructures** are to be developed by 2030, new financing schemes will be required

Global mobility infrastructure spending need[1]

$BN, 2015 prices and exchange rates



New infrastructure financing schemes will be based on 2 factors

1 Investment structure

Public VS PPP VS Private

2 Cost recovery strategy

Passenger fees VS Dynamic usage-based fees VS Service licenses and fees VS Mobility data monetizing

Note: 1. Mobility system consists of Transportation investments

Source: Oxford Economics - Global Infrastructure outlook 2017, IDC, May 2015, Global Market Insights: ITS Market Size Report 2016, Oliver Wyman Analysis

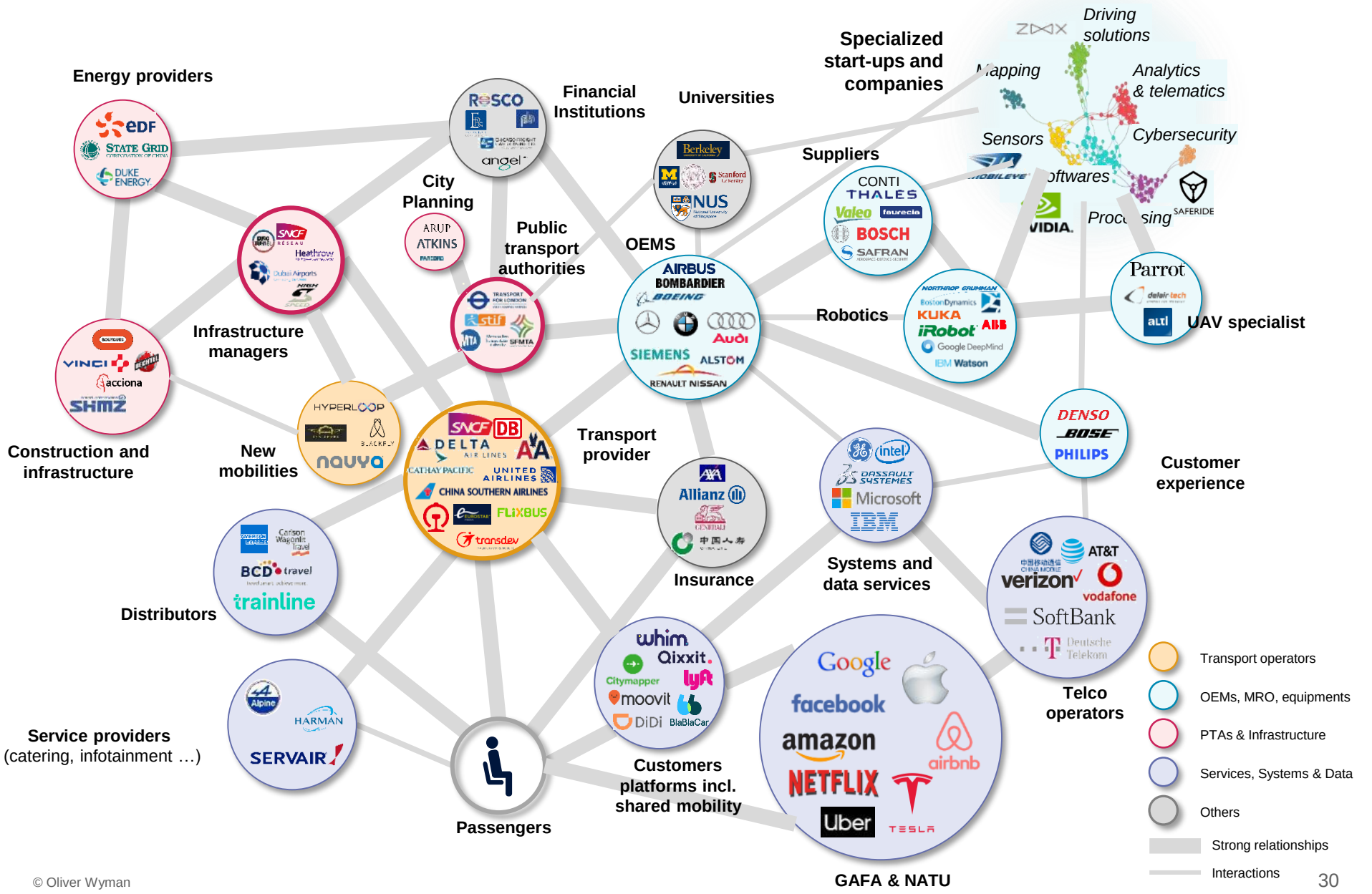
It is expected that a large amount of value will progressively shift from suppliers to consumers and **a few digital leaders**

Observed consolidation of digital applications to one market leader

2000 - 2005	2005 - 2010	2010 - 2018	Now
Search engines	**Social networking**	**On-demand video**	**On-demand mobility**
			
Google	facebook	NETFLIX	?


Disruptive governance & agile
approaches are required to survive

Coalition-building will be a pre-requisite for success

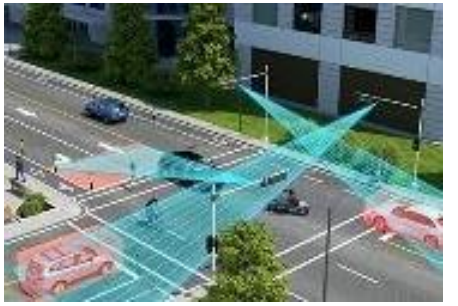


More flexible and open-sourced governance approaches will be needed

Comprehensive and ambitious vision for Mobility

Digital & flexible mobility master planning

Dynamic private sector activation & financing



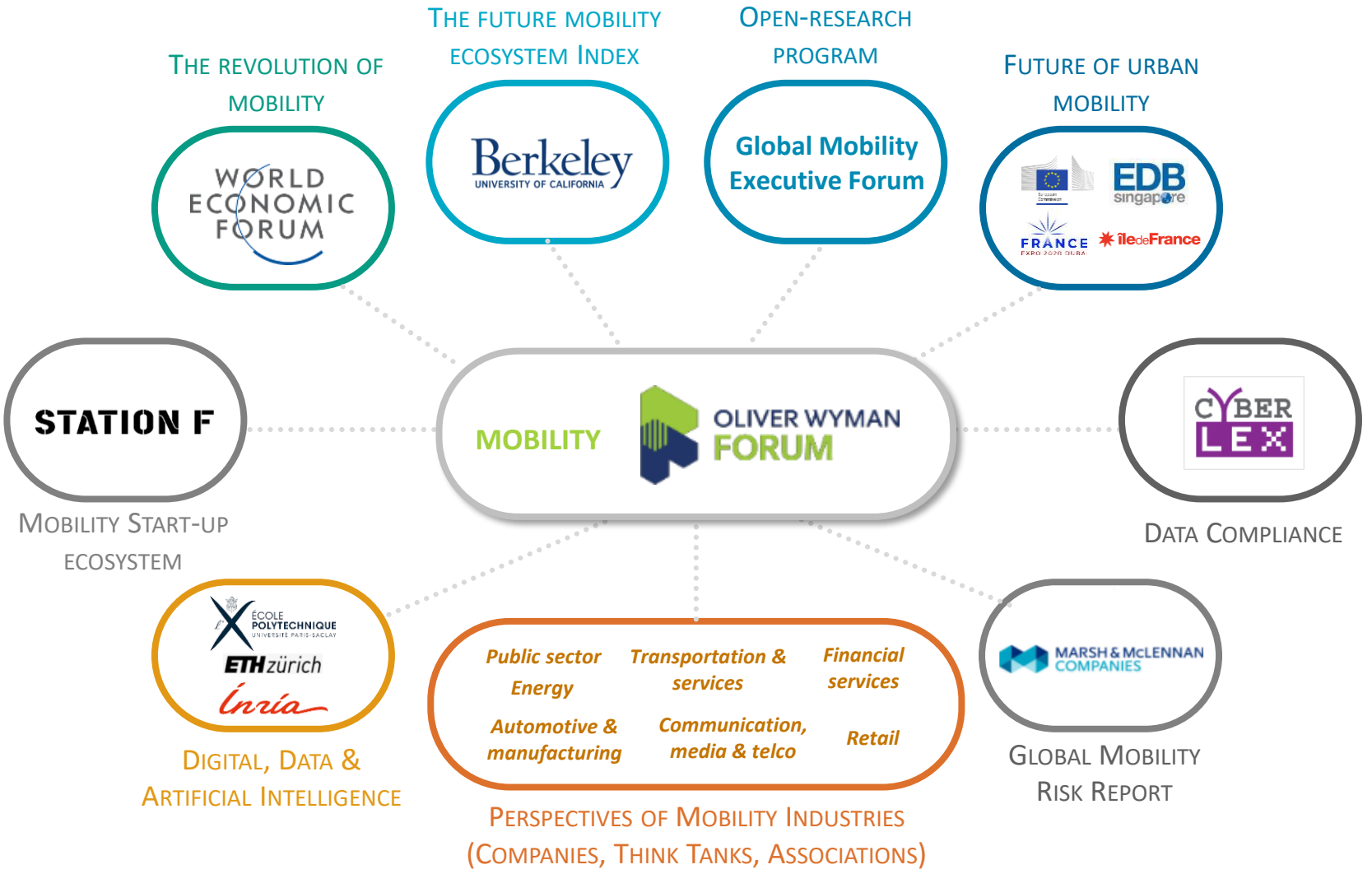
Agile & participative governance

Audacious regulatory schemes

Investments into research & research

Oliver Wyman Mobility Forum

We are developing a global network of partnerships in order to promote Mobility innovation



QUALIFICATIONS, ASSUMPTIONS AND LIMITING CONDITIONS

This report is for the exclusive use of the Oliver Wyman client named herein. This report is not intended for general circulation or publication, nor is it to be reproduced, quoted or distributed for any purpose without the prior written permission of Oliver Wyman. There are no third party beneficiaries with respect to this report, and Oliver Wyman does not accept any liability to any third party.

Information furnished by others, upon which all or portions of this report are based, is believed to be reliable but has not been independently verified, unless otherwise expressly indicated. Public information and industry and statistical data are from sources we deem to be reliable; however, we make no representation as to the accuracy or completeness of such information. The findings contained in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties. Oliver Wyman accepts no responsibility for actual results or future events.

The opinions expressed in this report are valid only for the purpose stated herein and as of the date of this report. No obligation is assumed to revise this report to reflect changes, events or conditions, which occur subsequent to the date hereof.

All decisions in connection with the implementation or use of advice or recommendations contained in this report are the sole responsibility of the client. This report does not represent investment advice nor does it provide an opinion regarding the fairness of any transaction to any and all parties.