BOND UNIVERSITY

CCCR
Centre for Comparative Construction Research
Faculty of Society & Design

MAJOR SHIFTS IN THE BUILT ENVIRONMENT FUTURE WORLD OF WORK

Capabilities Required of BE Professionals

Dr Jasper Mbachu

Keynote

7th New Zealand Built Environment Research Symposium (NZBERS)

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FOOD 4 THOUGHT

The Future belongs to those who prepare for it today

[Malcolm X (1925-1965]

To be prepared for the future, you have to understand it

[PriceWaterhouseCoopers (n.d]

ABSTRACT

This study aimed to explore the major shifts in the built environment future world of work, and the capabilities professionals need to develop in order to strategically reposition themselves to exploit the major shifts as opportunities to survive and thrive. It was hypothesized that transformations – rather than reformations – are needed; and that built environment professionals must develop and sustain agile and responsive capabilities to leverage the eminent changes as tailwinds to rise up to the challenges.

A four-step pragmatic exploratory research and analytical approach was adopted which comprised industry consultations, systematic reviews of literature, thematic analysis of facts and result validations by experienced industry practitioners.

The presentation highlights the major shifts in the built environment future world of work, and the capabilities professionals need to develop in order to strategically reposition themselves to exploit the major shifts as opportunities to reach new heights.

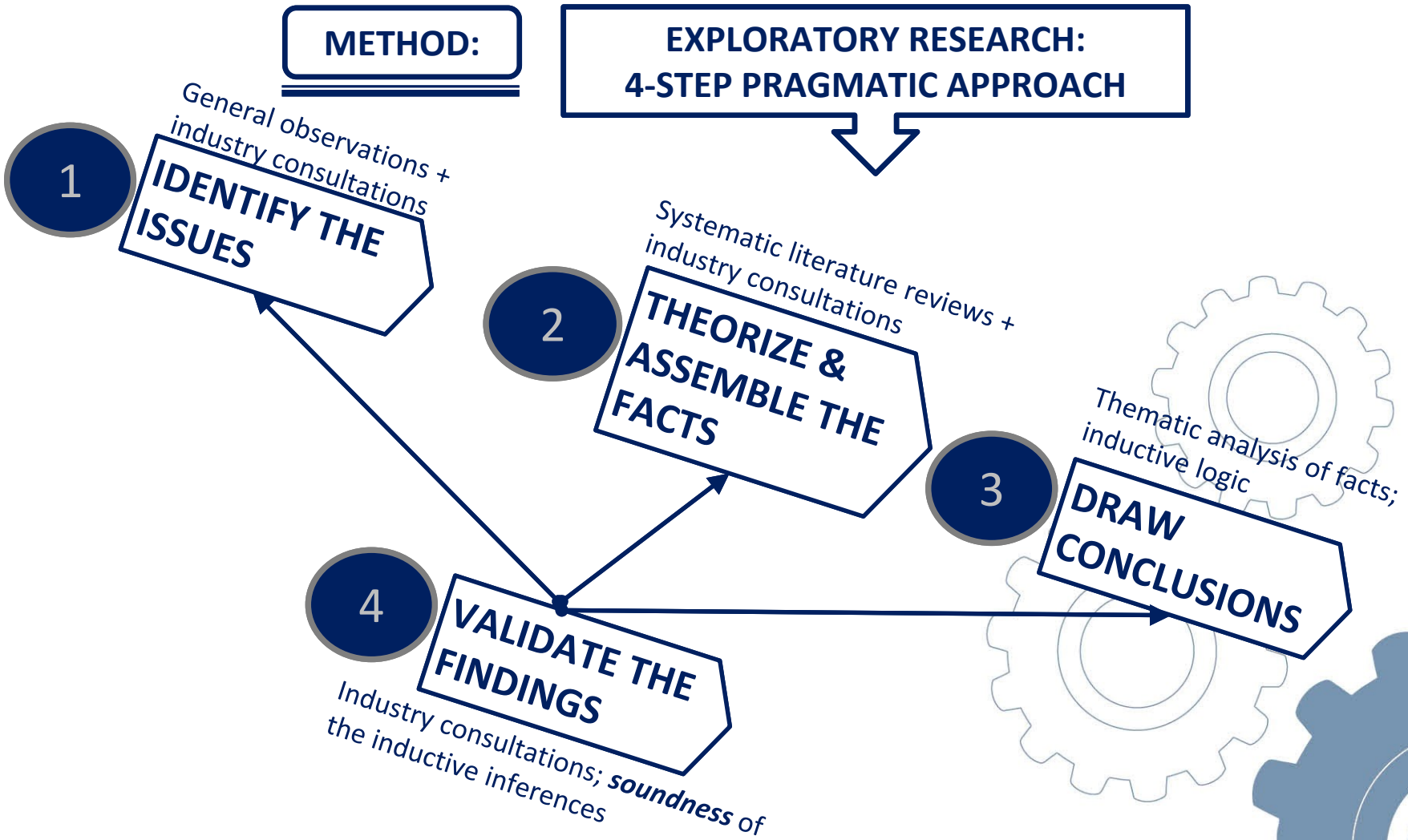
ISSUES

1 MAJOR DISRUPTIVE SHIFTS IN THE BUILT ENVIRONMENT (BE) FUTURE WORLD OF WORK

2 KEY DRIVERS

3 SIGNIFICANT IMPACTS

4 CAPABILITIES REQUIRED OF BE PROFESSIONALS


METHOD:
EXPLORATORY RESEARCH:
4-STEP PRAGMATIC APPROACH
1
IDENTIFY THE ISSUES
General observations + industry consultations
2
THEORIZE & ASSEMBLE THE FACTS
Systematic literature reviews + industry consultations
3
DRAW CONCLUSIONS
Thematic analysis of facts; inductive logic
4
VALIDATE THE FINDINGS
Industry consultations; soundness of the inductive inferences

1 MAJOR DISRUPTIVE SHIFTS: SCENARIOS FOR THE FUTURE WORLD OF WORK

Pwc's Four Worlds of Work

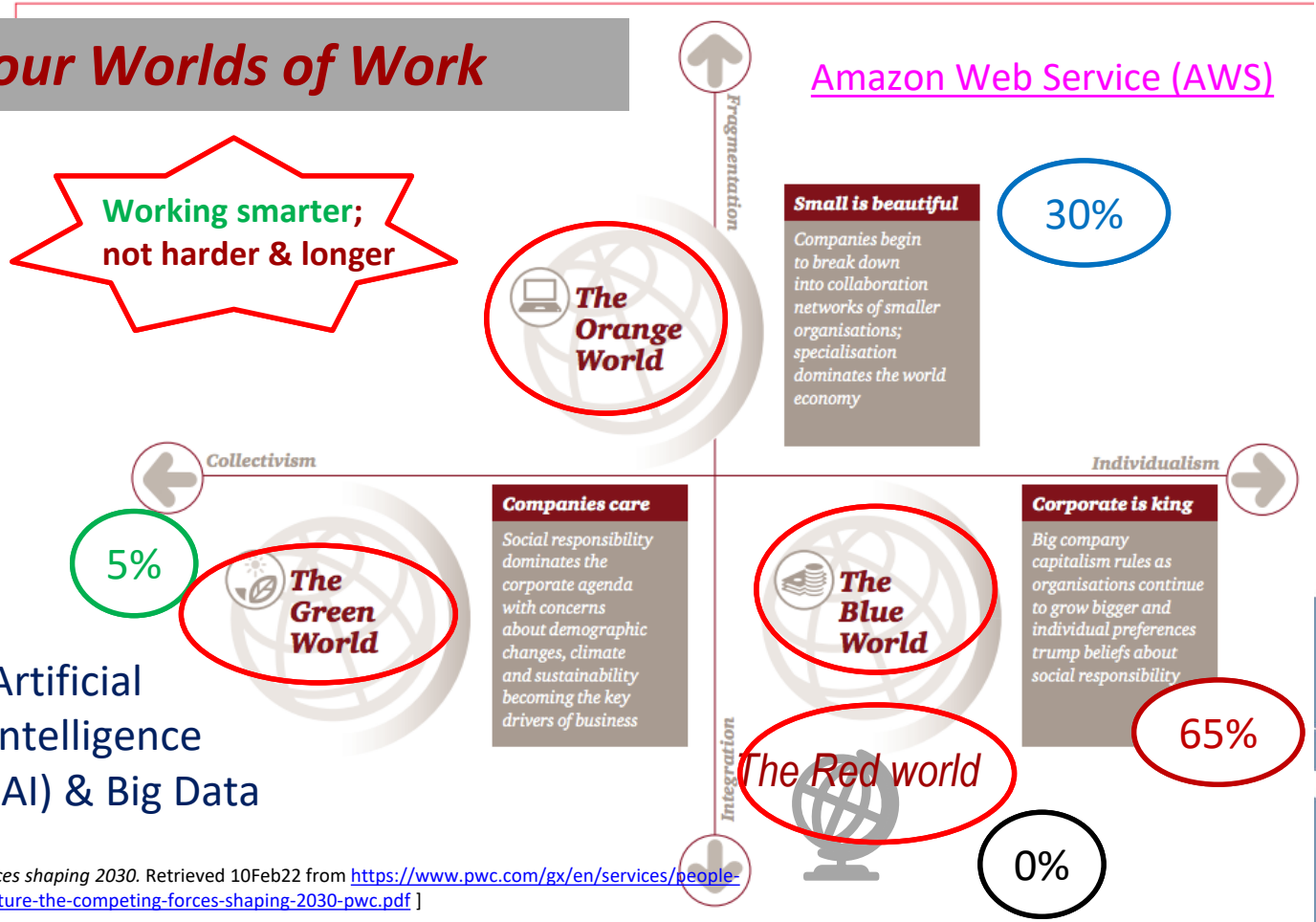
Amazon Web Service (AWS)

The Red world

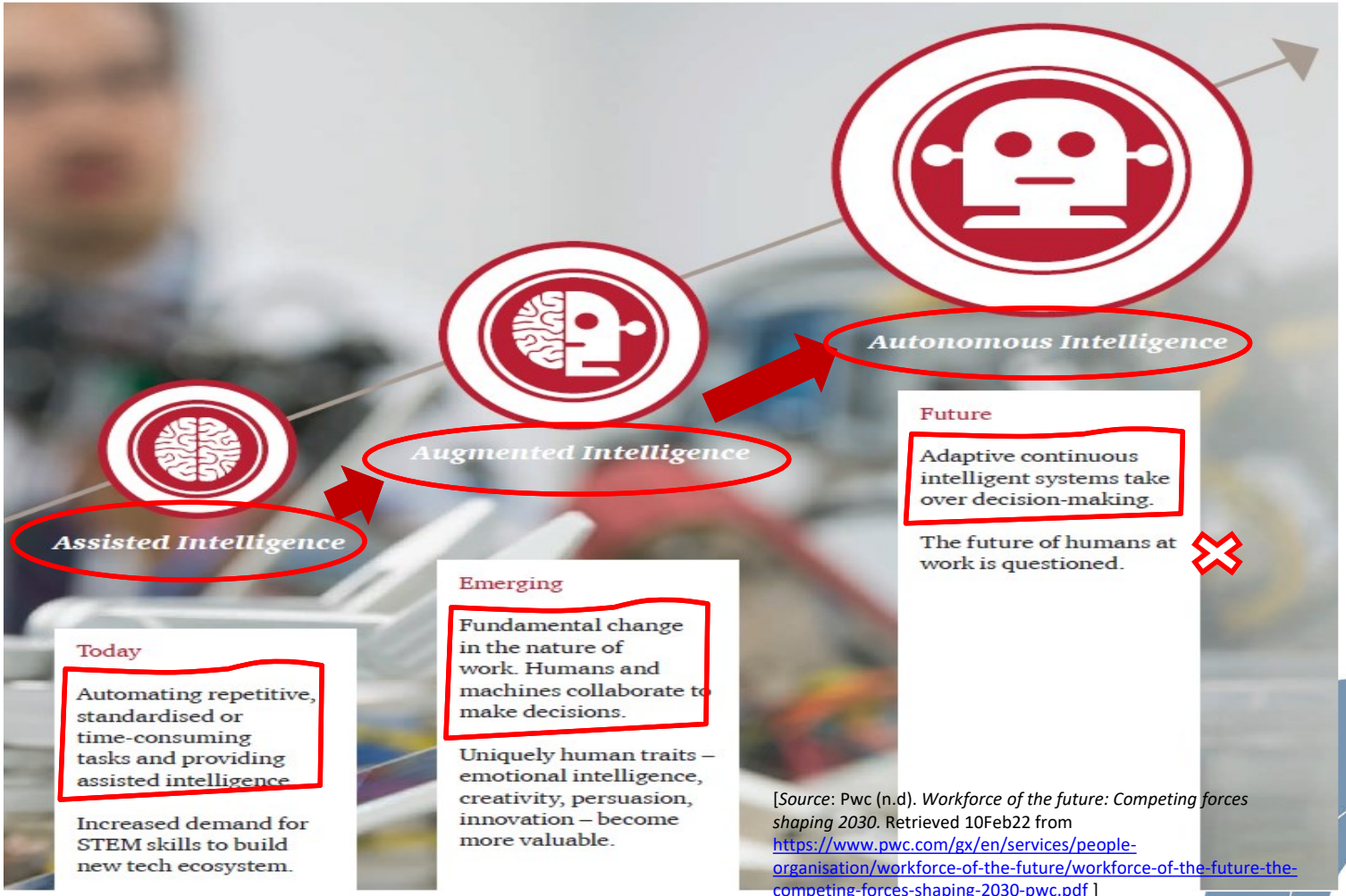
Organisations are stripped-down and nimble
Supplemented by talented workers who gravitate towards each other, aided by technology, sparking bubbles of innovation.
HR is non-existent; entrepreneurial leaders rely on outsourced services & automation for people processes

- Digitalisation
- Automation
- Robotization

Artificial intelligence (AI) & Big Data

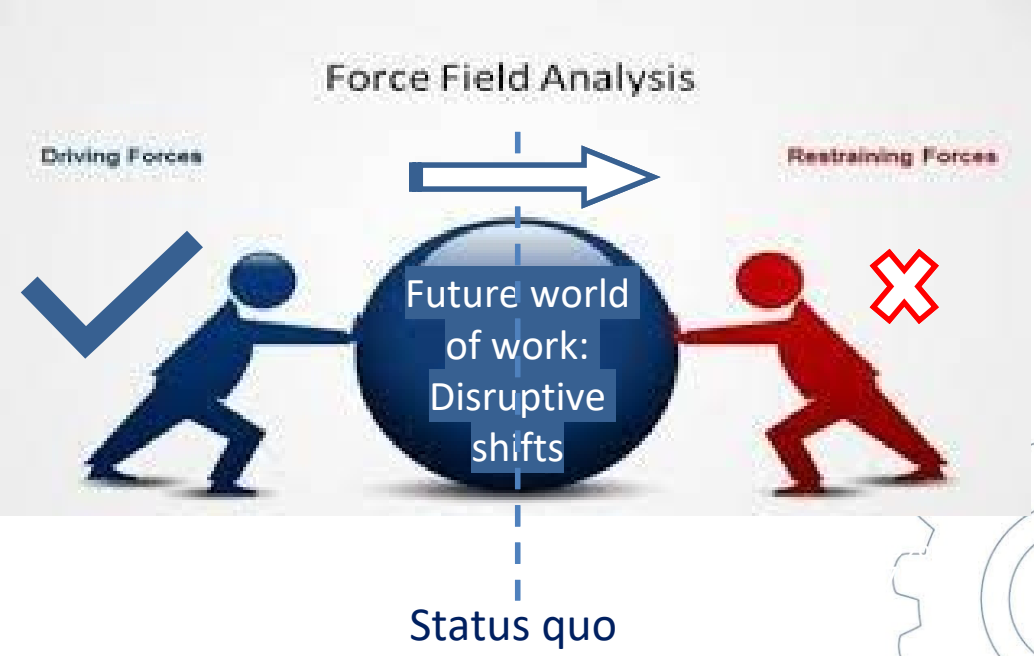


[*Source*: Pwc (n.d). *Workforce of the future: Competing forces shaping 2030.* Retrieved 10Feb22 from https://www.pwc.com/gx/en/services/people-organisation/workforce-of-the-future/workforce-of-the-future-the-competing-forces-shaping-2030-pwc.pdf]



[*Source*: Pwc (n.d). *Workforce of the future: Competing forces shaping 2030.* Retrieved 10Feb22 from https://www.pwc.com/gx/en/services/people-organisation/workforce-of-the-future/workforce-of-the-future-the-competing-forces-shaping-2030-pwc.pdf]

2 MAJOR DISRUPTIVE SHIFTS: KEY DRIVERS



2 MAJOR DISRUPTIVE SHIFTS: DRIVERS

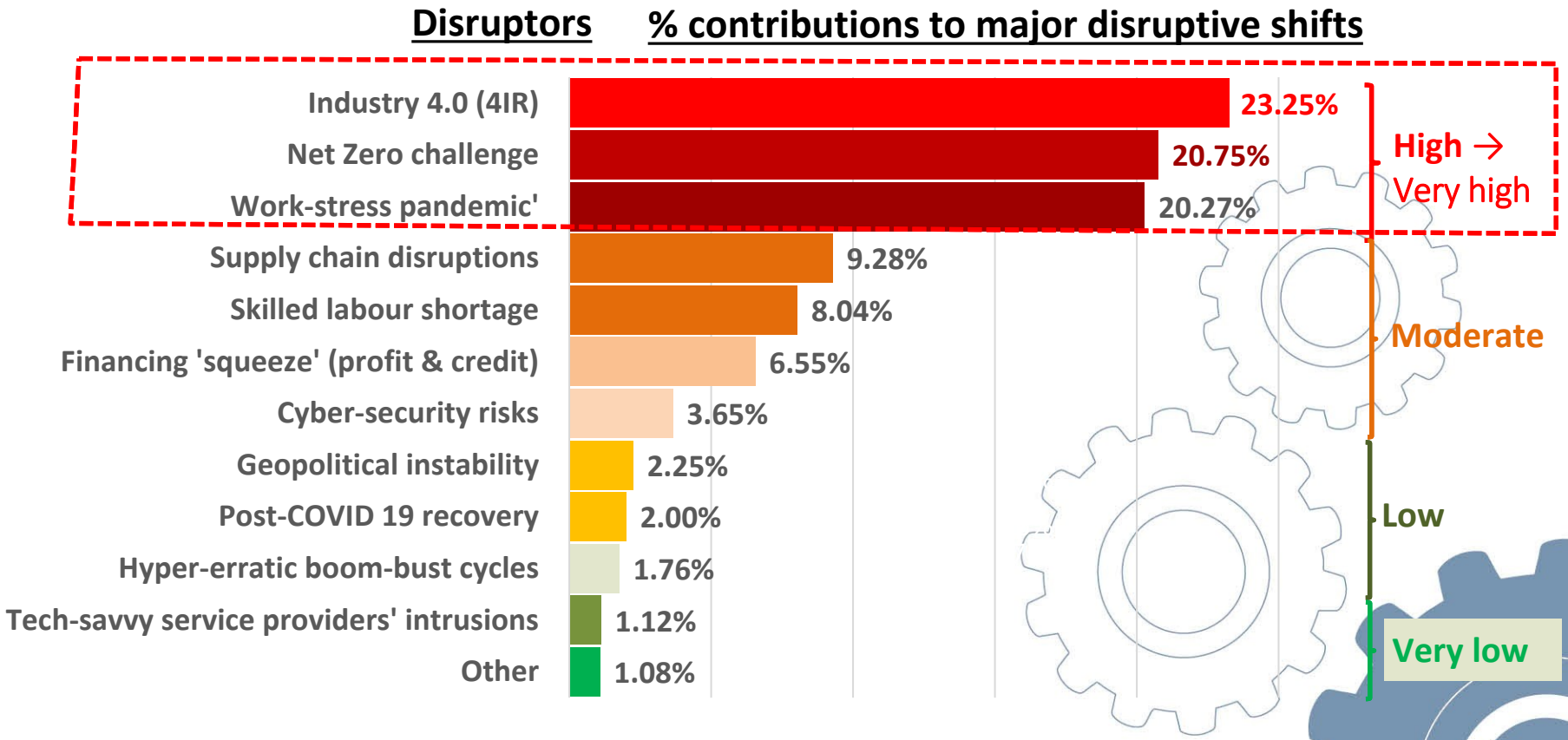
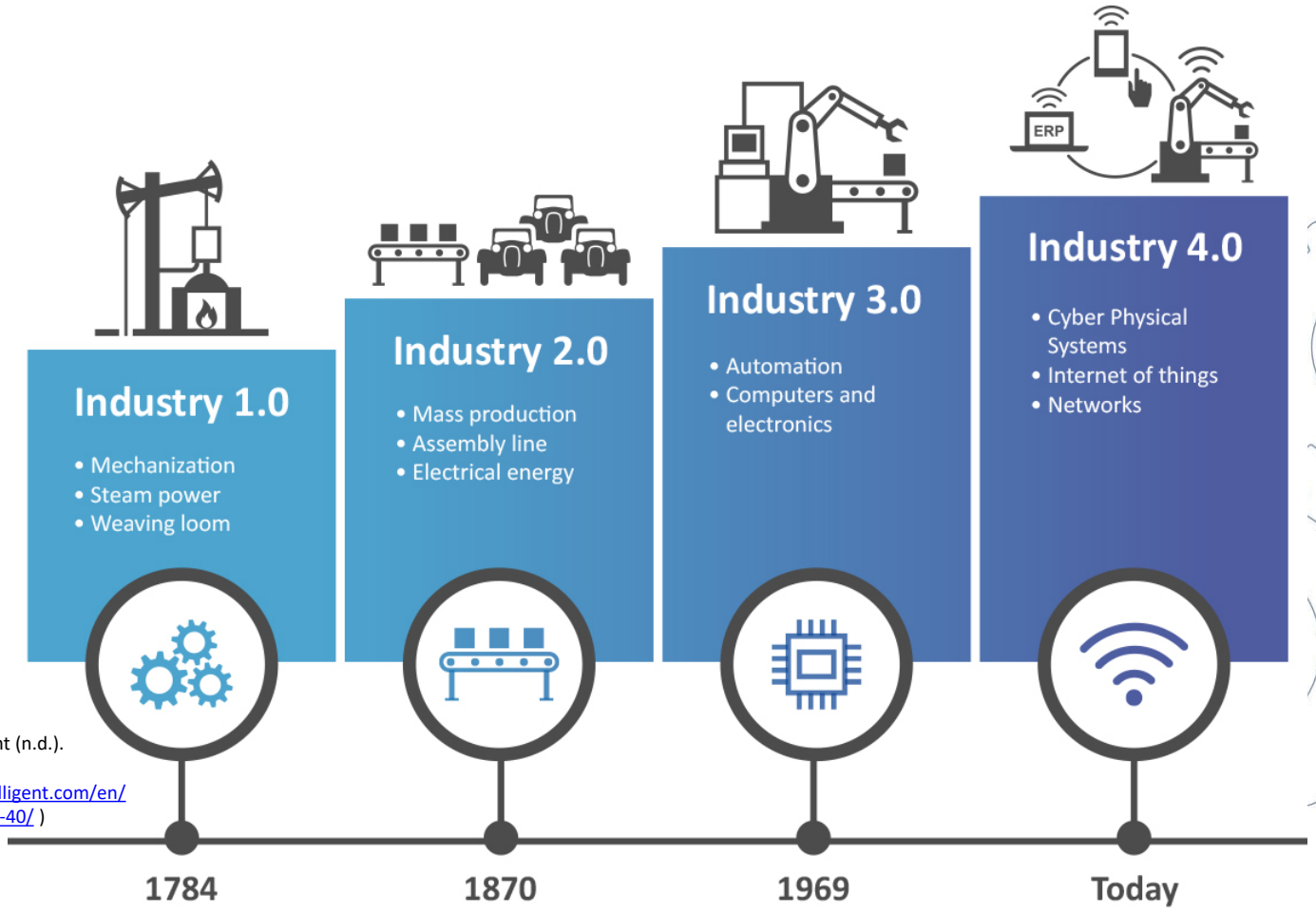


Figure 4: Contributors to disruptive shifts in the built environment future world of work

1 MAJOR DISRUPTIVE SHIFT DRIVER 1: INDUSTRY 4.0



[*Source*: B.Telligent (n.d.). *Industry 4.0* (https://www.btelligent.com/en/portfolio/industry-40/)

1 MAJOR DISRUPTIVE SHIFT DRIVER 1: INDUSTRY 4.0

- **Interconnection:** Machines, devices, sensors, and people connect and communicate via the Internet of things (IoT)
- **Cyber-physical assistance:** Cyber-physical systems assist humans in decision-making and problem-solving, including completing difficult or unsafe tasks
- **Decentralised:** Cyber physical systems make decisions on their own and perform low-level tasks autonomously.

[*Source*: I.Scoop (n.d.). *Industry 4.0: Digital Transformations* (https://www.i-scoop.eu/industry-4-0/)

2

MAJOR DISRUPTIVE SHIFT DRIVER 2:

The Net Zero Challenge (??)

Two major trends define the future of work:

- **Continuing environmental degradation - through escalation of natural disasters & associated risks**
- **Global coalition push towards environmental sustainability & social justice - through legislations, regulatory standards and reallocation of resources**

[*International Labour Organization, ILO, 2018*]

[ILO (2018). The future of work in a changing natural environment: Climate change, degradation, and sustainability. *ILO Future of Work Research Paper Series 4.* https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_644145.pdf]

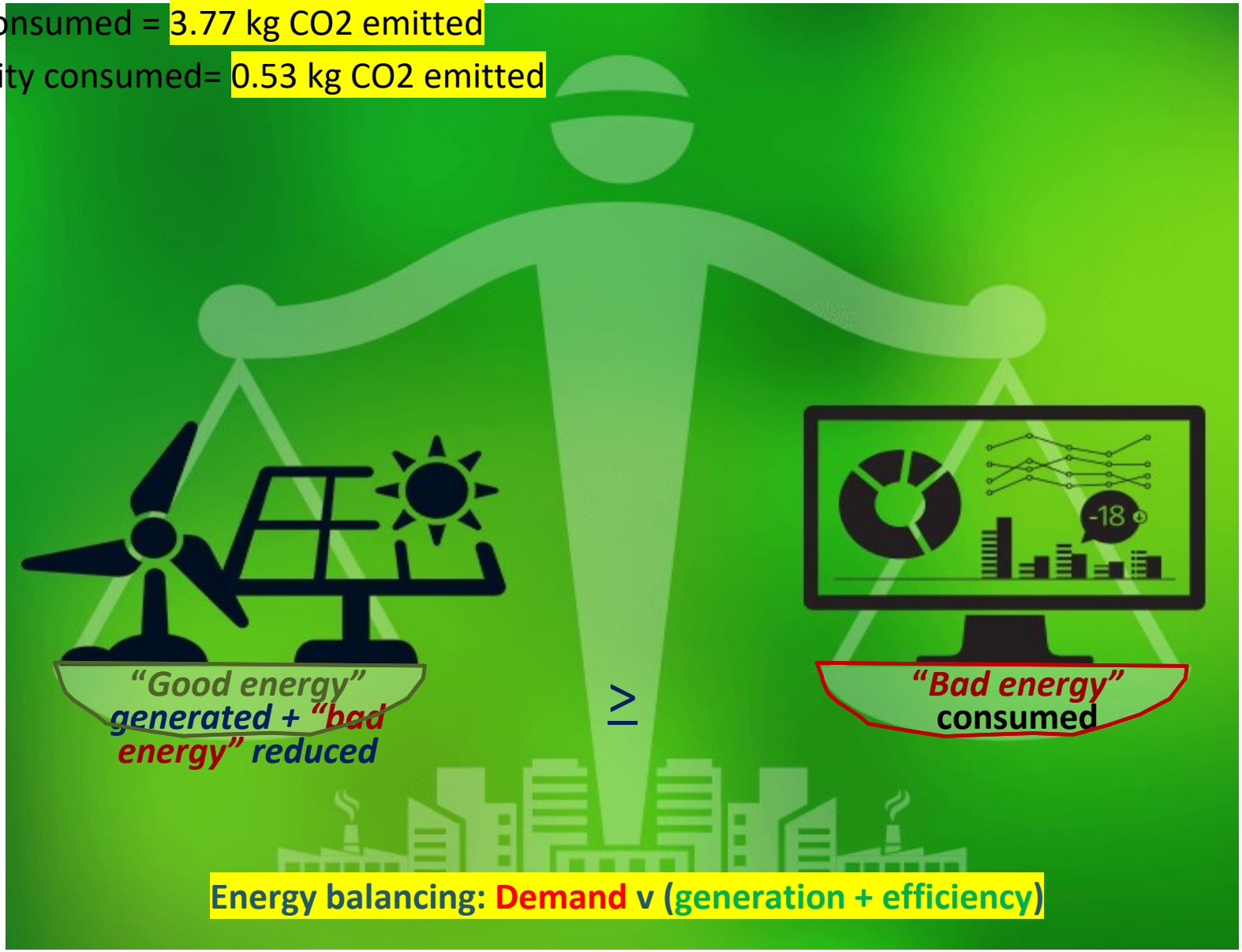
Global commitment to meeting Net Zero target by 2050

World leaders at the November 2021 G20 summit in Rome committed to take meaningful action to keep the world from warming by no more than 1.5C above pre-industrial levels

The Net Zero Challenge (??)

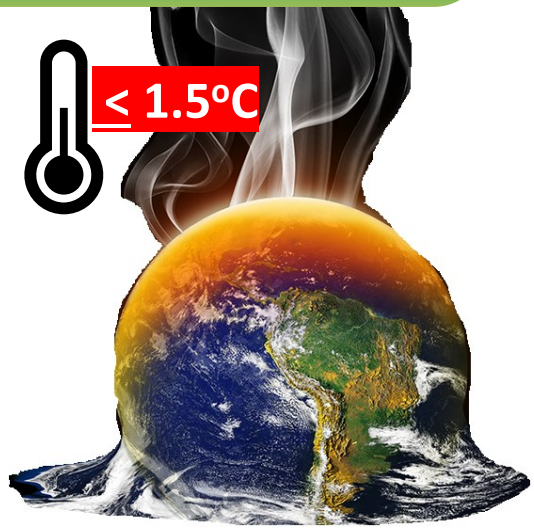
1 litre diesel consumed = 3.77 kg CO2 emitted

1 kWh electricity consumed= 0.53 kg CO2 emitted



[Image *source*: CircuitMeter (2017). The Net Zero Challenge. Retrieved 10Feb22 from https://www.circuitmeter.com/industry-articles/net-zero-challenge/]

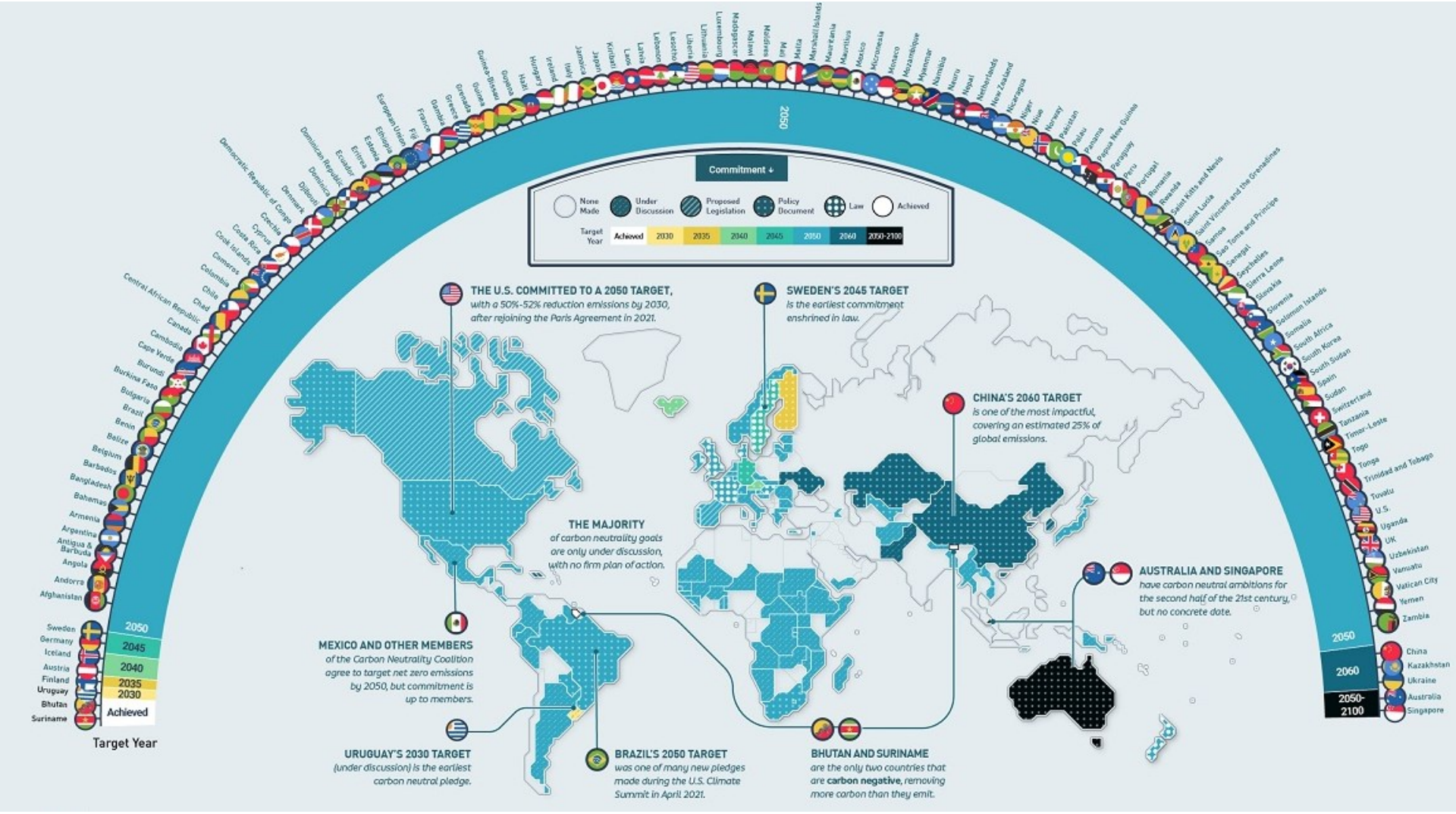
The Net Zero Challenge (??)



Keep the world from warming by no more than 1.5°C above pre-industrial levels

[Image *source*: World Economic Forum (2019). *The Net Zero Challenge Report*. Retrieved 10Feb22 from https://www.weforum.org/agenda/2019/12/countries-companies-net-zero-carbon-emissions/]

The Net Zero Challenge (??)

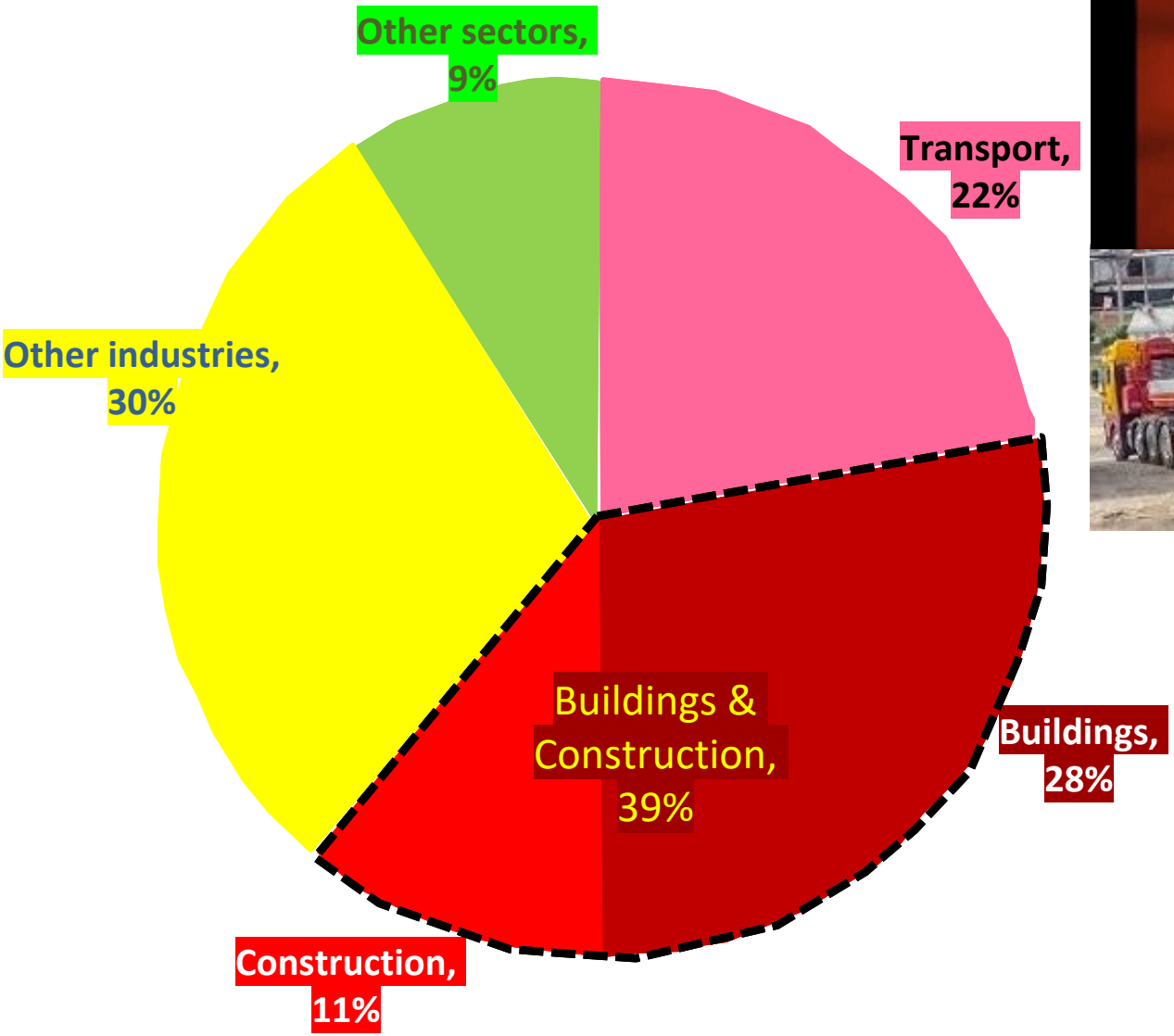


[Image source: Visual Capitalist (2021). *Race to Net Zero: Carbon Neutral Goals by Country*. Retrieved 10Feb22 https://www.visualcapitalist.com/race-to-net-zero-carbon-neutral-goals-by-country/]

The Net Zero Challenge (??)

$275 trillion of cumulative global spending on physical assets needed over the next three decades will be procured utilizing circular economy

[Mckinsey (2021). *The net-zero transition: What it would cost, what it could bring*. https://mckinsey.com]



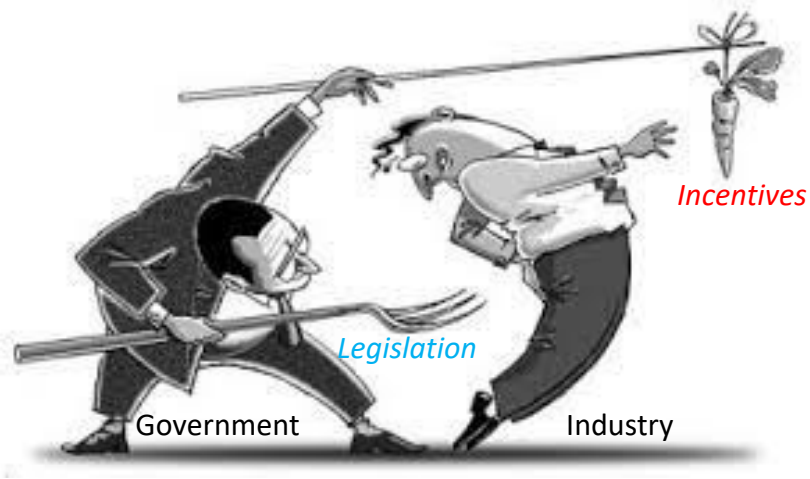
Global share of energy-related CO2 emissions by sector

[*Source*: Global Alliance of Buildings & Construction (2017; Global Status Report)]

2 MAJOR DISRUPTIVE SHIFT DRIVER 2: THE NET ZERO CHALLENGE

Two major trends define the future of work:

- Continuing environmental degradation - through escalation of natural disasters & associated risks
- Global coalition push towards environmental sustainability & social justice - through legislations, policies/regulatory standards and reallocation of resources



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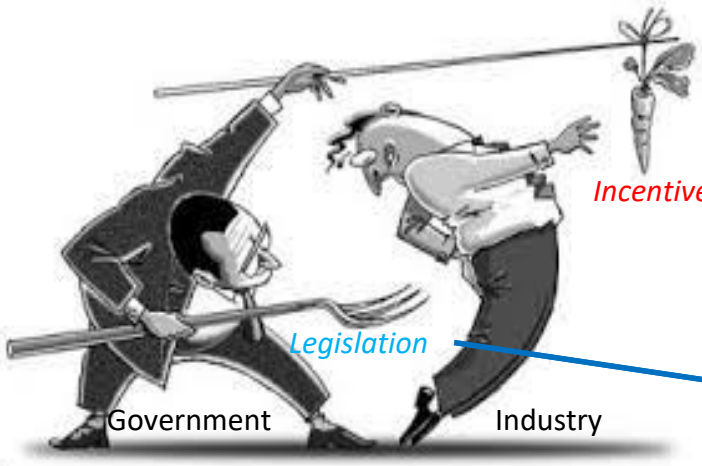
MAJOR DISRUPTIVE SHIFT DRIVER 2: THE NET ZERO CHALLENGE

GOVERNMENT 'CARROT' & 'FORK' APPROACH: UK EXAMPLE

Push towards environmental sustainability & social justice – through:
Legislations, policy/regulatory standards and reallocation of resources



Industrial Strategy Challenge Fund: GBP72 million allocated for digital transformation of the construction industry through partnership with UK Transforming Construction Alliance (TCA) comprising:

- Manufacturing Technology Centre (MTC),
- Building Research Establishment (BRE), and
- Cambridge University's Centre for Digital Built Britain (CDBB)

[Source: The UK Research & Innovation (UKRI, 2019]

Net Zero Strategy: Build Back Greener: Decarbonisation policies and regulations for the construction industry aimed at keeping the government on track to achieving the UK carbon budgets - 2030 Nationally Determined Contribution, and net zero by 2050

Built environment companies' roadmaps to net zero: Lendlease example

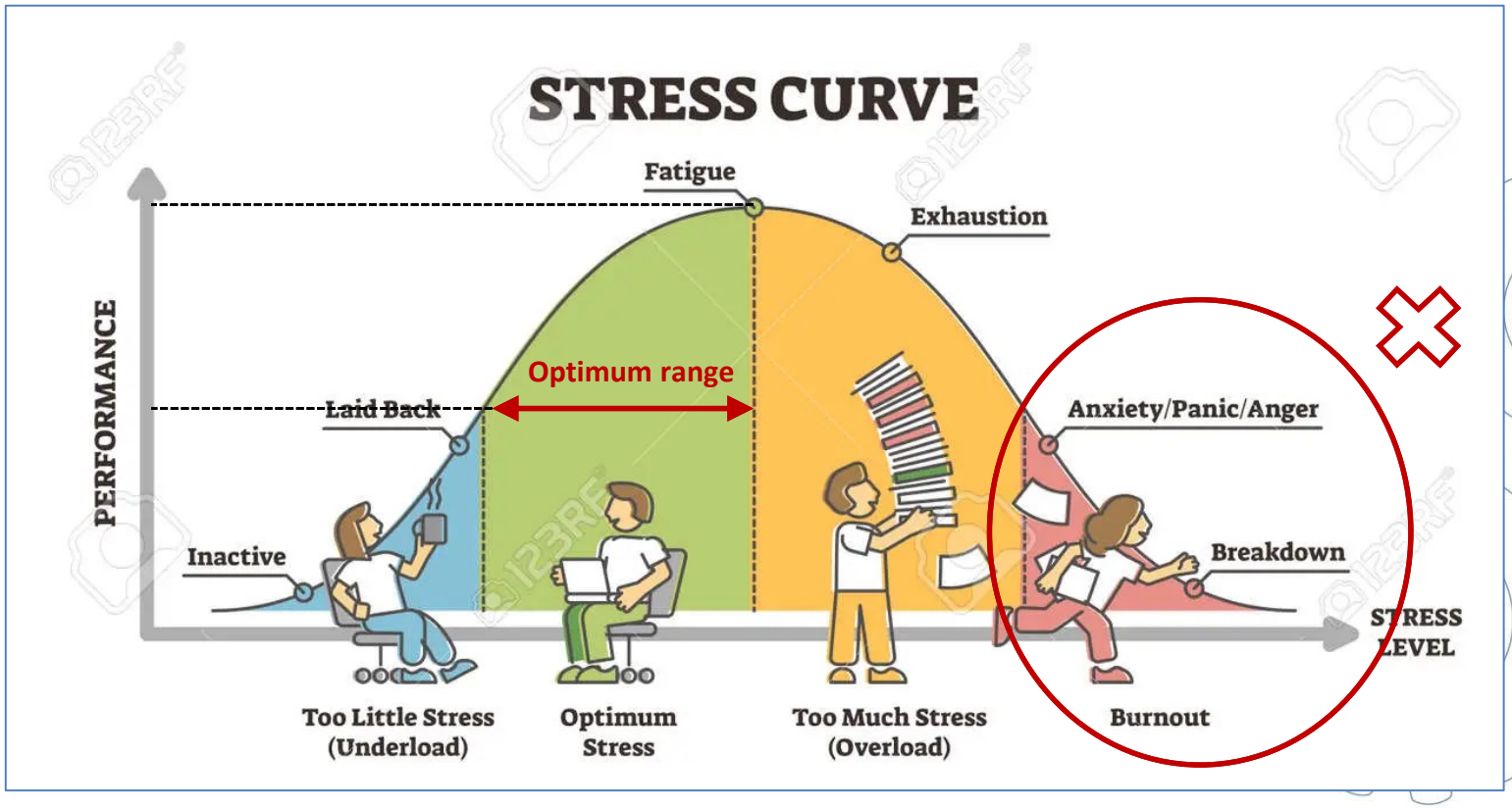
https://www.lendlease.com/better-places/roadmap-to-absolute-zero-carbon/-/media/fa3122e752024a22b1e61bc08bf8972a.ashx

Climate positive development programs

3 MAJOR DISRUPTIVE SHIFT DRIVER 3: '*WORK STRESS PANDEMIC*'

- High risk nature of construction work
- Adversarial and highly litigious environment
- Overly regulated with high regulatory burden
- Unsafe with high incidence of accidents
- Unhealthy and highly inconducive
- High uncertainties

3 MAJOR DISRUPTIVE SHIFT DRIVER 3: '*WORK STRESS PANDEMIC*'



[Image *source*: Dreamtime (n.d). *Stress Curve*. Retrieved 10Feb22 from https://www.dreamstime.com/stress-curve-educational-diagram-performance-level-graph-outline-concept-labeled-work-productivity-efficiency-optimum-image206529299]

3 MAJOR DISRUPTIVE SHIFT DRI

Working smarter;
not harder & longer

Digital technologies

Stress management,
Work-life balance

Four-day week: trial finds lower stress and increased productivity

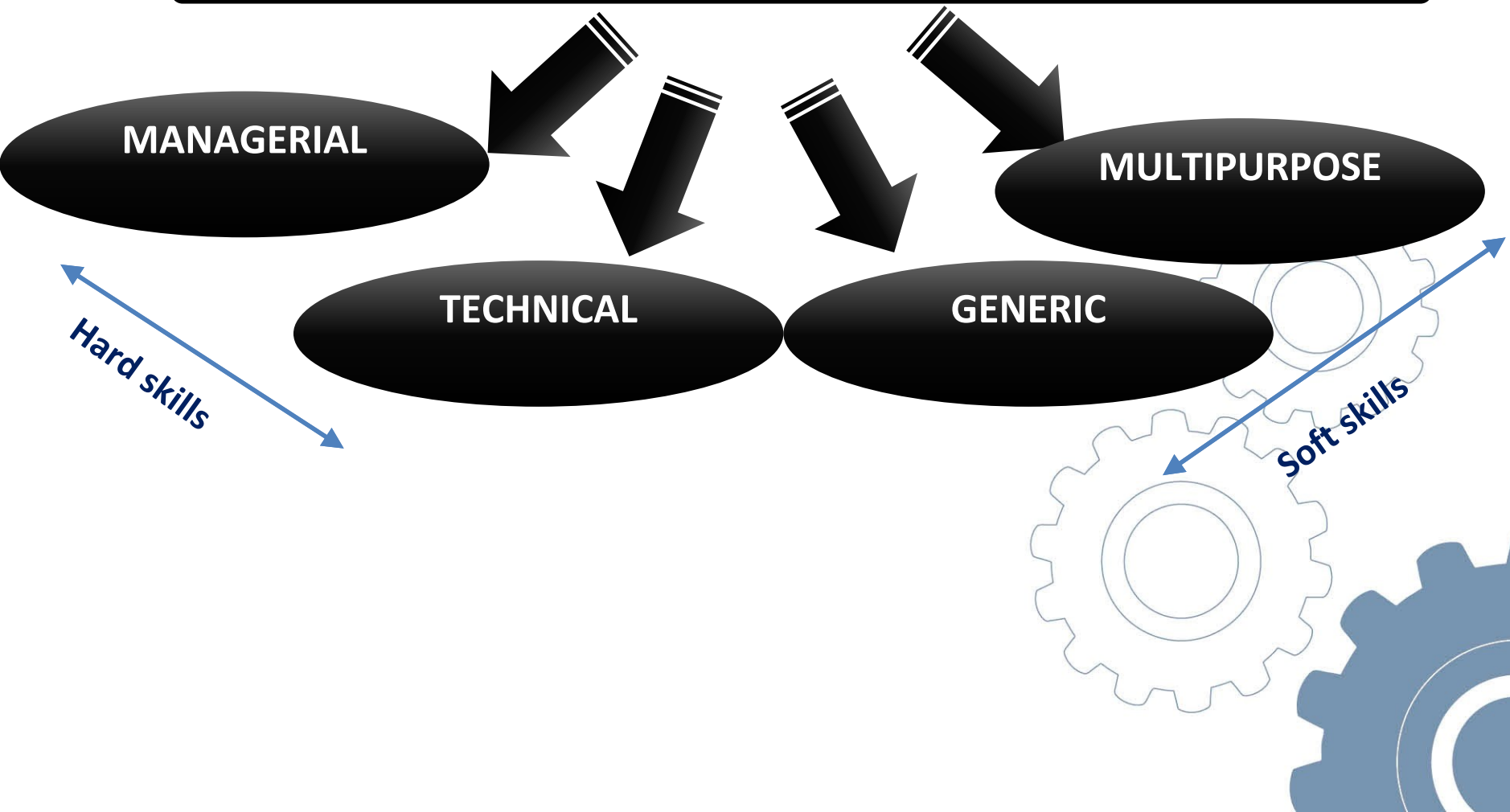
Study of pilot at New Zealand firm finds staff were happier and 20% more productive

Employees taking part in the trial reported significantly lower job stress and burnout. Photograph: Alamy

The founder of one of the first big companies to switch to a four-day working week has called on others to follow, claiming it has resulted in a 20% rise in productivity, appeared to have helped increase profits and improved staff wellbeing.

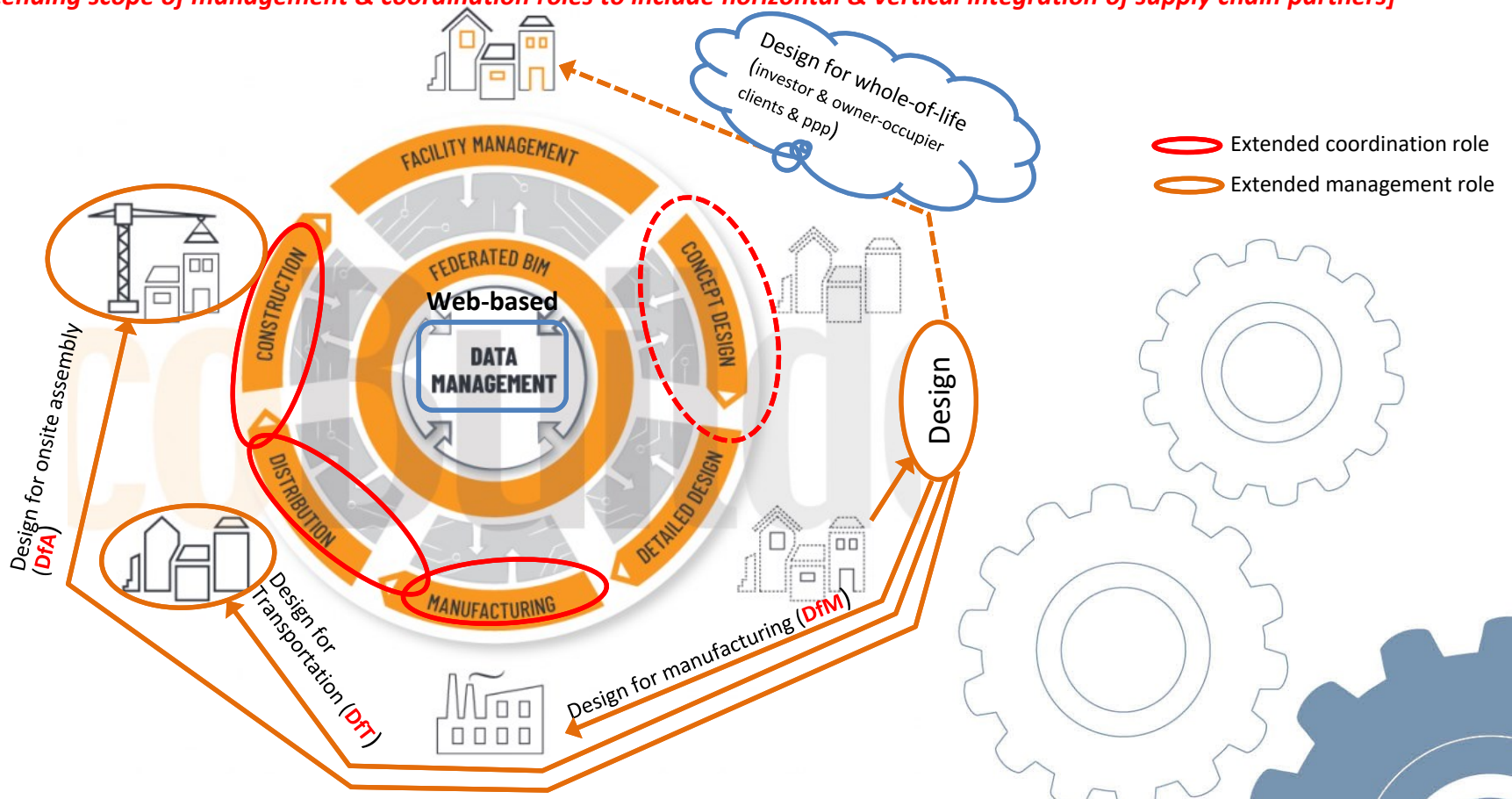
[*Source*: The Guardian (2019, 20 Feb). *Four-day week: Trial finds lower stress & increased productivity*. https://www.theguardian.com/money/2019/feb/19/four-day-week-trial-study-finds-lower-stress-but-no-cut-in-output]

IMPACTED SKILLSETS: MAJOR CATEGORIES



1] INTEGRATION MANAGEMENT & COORDINATION SKILLS

[Extending scope of management & coordination roles to include horizontal & vertical integration of supply chain partners]



[*Source:* *dapted from co-Builders, https://cobuilder.com/en/berkeley-modular-cobuilder/*]

TECHNICAL SKILLS: IMPACT SCENARIOS

DECLINING ONSITE SKILLS

- ✓ Onsite technical skills rooted into traditional methods.
- ✓ E.g. wet construction (superstructure insitu concreting, masonry & finishings); onsite stick & frame construction.

CONTINUING ONSITE SKILLS

- ✓ Onsite technical skills not transferrable to offsite.
- ✓ E.g. Substructure works (earthworks, services first fix, onsite substructure wet construction).
- ✓ Tilt-up construction

EMERGING SKILLS

- ✓ Automated and digital construction skills
- ✓ E.g. CAM, 3D house printing, 3D scanning, IoT, robotics.

GENERIC SKILLS: IMPACT SCENARIOS

DECLINING SKILLS

- ✓ Paper based documentation and document control
- ✓ Siloed/lone-ranger work approach.
- ✓ Site-based project management.
- ✓ Co-located teamwork

CONTINUING SKILLS

- ✓ Negotiating skills
- ✓ Team building & team work skills
- ✓ Networking skills
- ✓ Market intelligence
- ✓ Client relationship management
- ✓ Partnering.
- ✓ Multi-skilling/multi-tasking

EMERGING SKILLS

- ✓ Computing & ICT
- ✓ Paperless business environment
- ✓ Smart contracting
- ✓ Data analytics
- ✓ Cloud-based project management, workflow and collaboration.
- ✓ Distributed agile team working

The Green Star Accredited Professional

G**eneral comprehension of the Green Star - rating tools**.

MULTI-PURPOSE SKILLS & ATTITUDE: IMPACT SCENARIOS

EXISTING &EMERGING SKILLS

- ✓ Continuous learning
- ✓ Stress management
- ✓ Time management
- ✓ Networking
- ✓ Teamwork
- ✓ Creative thinking
- ✓ Conflict resolution

EXISTING &EMERGING ATTITUDES

- ✓ Risk-taking
- ✓ Can do
- ✓ Resilience
- ✓ Adaptability
- ✓ Flexibility
- ✓ Perseverance
- ✓ Positive disposition
- ✓ Inquisitiveness/curiosity
- ✓ Charisma

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

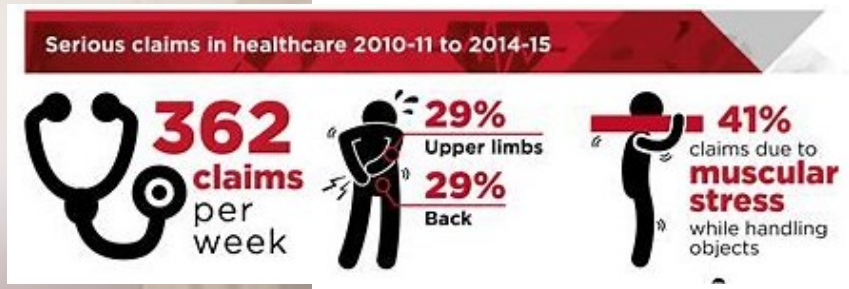
- ✓ New or retrofitted existing construction equipment with sensors and AI-driven robotics such as self-operating excavators, bulldozers, compactors, self-driving cars, etc on very hazardous construction sites

[*Source*:
CNBC (2021). *How Autonomous Robots Are Changing Construction*. Retrieved 10Feb22 from https://www.youtube.com/watch?v=zBvvbOLq3t0]

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

✓ Drywall finishing autonomous robots now replacing tedious and time-consuming manual labour operations such as plastering



AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

- ✓ Machine works alongside the labour gang, helping them to expedite the process and ramp up productivity, obviating health risks such as Musculo-skeletal injuries

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

- ✓ Machine works alongside the labour gang, helping them to expedite the process and ramp up productivity, obviating health risks such as Musculo-skeletal injuries

A worker can operate multiple autonomous robots where the workflow is streamlined for consistency

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

- ✓ Machine works alongside the labour gang, helping them to expedite the process and ramp up productivity, obviating health risks such as Musculo-skeletal injuries

Re-allocate current workers' time and efforts away from mundane, repetitive tedious and risky operations on the machines and tools to higher skill, high value tasks and to safer internal environment while remotely operating the robots to accomplish the jobs:

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

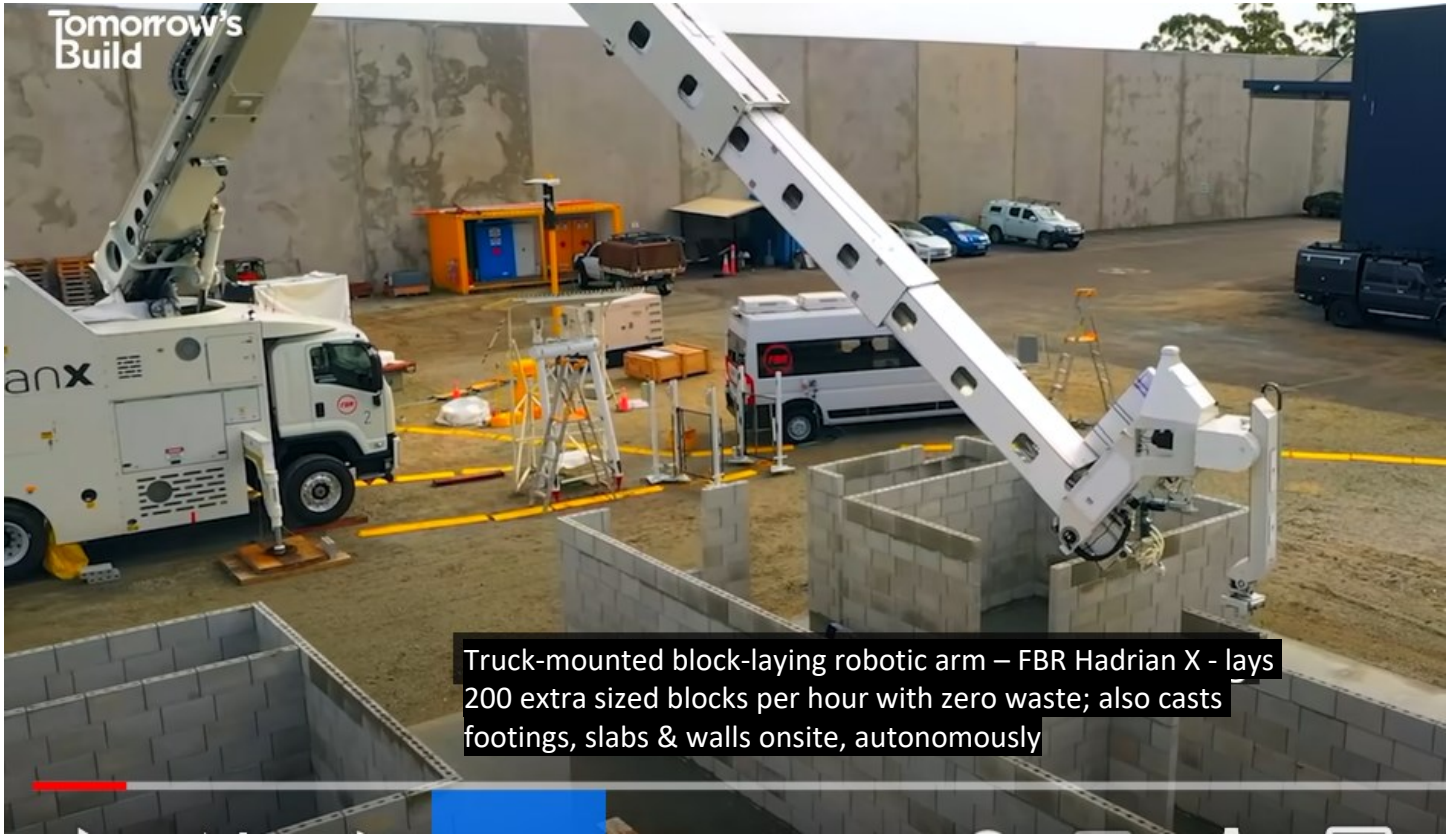
Imagine a construction site where, due to COVID-restrictions, only autonomous construction equipment are working

Deep basement excavation

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT

Bricklaying



[*Source*:
FBR (2021). *How Autonomous Robots Are Changing Construction*. Retrieved 10Feb22 from https://www.youtube.com/watch?v=zBvvbOLq3t0]

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT: OFFSITE APPLICATIONS

Offsite applications are increasingly used where prefab conditions & benefits can be maximised using AI- driven computer aided manufacturing; applications range from framed/componentized, through panellized, modular/pods, to whole buildings & hybrid types

[*Source*:
Tomorrow's Build (2021). *Robot built house*. Retrieved 10Feb22 from https://www.youtube.com/watch?v=0wrQLDoJ6cw]

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT: PAINTING ROBOTS

The robot scans the structure, and with its 6 axes robotic arm and precision spray nozzle, the robot achieves a more even and consistent coats than a human painter. The robot is also able to paint on more complex surfaces and architectural features, with capability of painting even in the dark with no lighting on construction sites, making it feasible to deploy them overnight for faster job completion

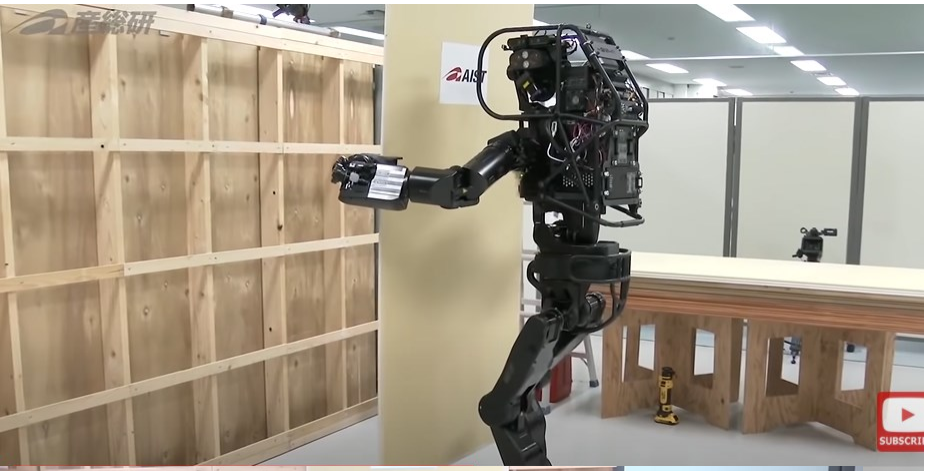
Autonomous painting robots can speed-up painting by over 20% with higher precision, quality and zero waste

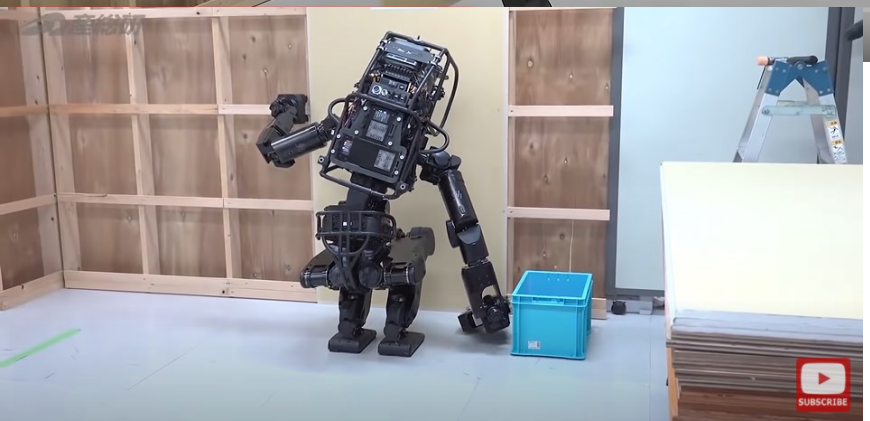
[*Source*:
VentureX (2021). *Futuristic construction robots.* Retrieved 10Feb22 from https://youtu.be/2fmRejSRkss?t=463]

AUTONOMOUS CONSTRUCTION ROBOTS

AUTONOMOUS CONSTRUCTION EQUIPMENT: ONSITE DRYWALL CONSTRUCTION

The robot scans the structure, and with its 6 axes robotic arm and precision spray nozzle, the robot achieves a more even and consistent coats than a human painter. The robot is also able to paint on more complex surfaces and architectural features, with capability of painting even in the dark with no lighting on construction sites, making it feasible to deploy them overnight for faster job completion





Autonomous robots capable of operating powertools with higher precision, quality and zero waste

[*Source*:
TerkRecoms (2020). *Construction AI humanoids & industrial robots.* Retrieved 10Feb22 from https://youtu.be/Jky9l1ihAkg?t=350]

CONCLUSIONS

Construction skillsets transformations:

***As focus shifts from*:**

- ✓ **Empowering onsite workforce with more productive plant & equipment**
- ✓ **Minimising hazards and inefficiencies inherent in working at heights through onsite ground fabrication and tilt-up approaches**
- ✓ **Minimising onsite hazards & inefficiencies through transfers to factory controlled and conducive work environment**

To:

- ✓ **Partial automation of offsite work processes through robotised approaches**
- ✓ **Replacement as much as possible labour inputs in routine/repeated work processes with digital workflows**
- ✓ **Digital twin technologies (robotics, AI, IoT, blockchain) for optimised scalability, reliability, visibility and productivity**

THANK YOU