



Innovate  
UK

The background of the cover is a dark blue to purple gradient. It features a complex network of glowing red and orange lines that form a grid-like structure, with small white and pink nodes at the intersections. On the right side, there are vertical green lines that curve and ripple, creating a sense of movement and depth. The overall aesthetic is futuristic and technological.

# Innovate UK Global Regulation Index

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# Foreword

By Dr Ian Brotherton



Innovate UK is pleased to present the inaugural edition of the Global Regulation Index (GRI) - a pioneering tool, developed in partnership with ICF, marking a significant milestone in regulatory analysis and collaboration.

Regulation wields the transformative power to propel innovation forward, instilling confidence in innovators, mitigating investment risks, and fostering consumer trust. It serves as a cornerstone in the journey of ushering ground-breaking innovations into our lives, addressing contemporary challenges from achieving net zero emissions to promoting healthy aging.

Forward-thinking governments recognize the pivotal role of regulation in fuelling innovation, enhancing productivity, and fostering healthy competition. Nevertheless, striking the delicate balance remains a universal challenge, transcending national boundaries and industry sectors.

In response to this challenge, Innovate UK proudly presents the Global Regulation Index (GRI), a ground-breaking tool designed to offer insights into how nations harness regulation to foster innovation. With a keen focus on four distinct innovation-driven sectors, the GRI endeavours to disseminate valuable insights gleaned from successful regulatory frameworks, aiming to inspire both the UK and other nations to refine their regulatory

approaches in alignment with the pillars critical to fostering innovation.

While acknowledging the UK's third place ranking on the GRI, there is a collective recognition of the imperative to continuously learn and fortify the UK's innovation ecosystem. The GRI stands as a catalyst for fresh perspectives on the regulatory landscape, inviting regulators to collaborate with Innovate UK in driving greater investments in novel products, services, and processes.

We welcome feedback on the GRI tool, as we remain committed to its ongoing enhancement through iterative updates to both the model and the data. We extend a warm invitation to regulators worldwide to embrace the GRI and share their own narratives.

By offering this initial version of the framework, we extend an open invitation to regulators to collaborate with us as we seize the opportunities presented by more refined and strategic regulation. Together, let us unlock the full potential of smarter regulation and pave the way for a future defined by innovation and progress.

A handwritten signature in black ink, appearing to read 'I. Brotherton', written in a cursive style.

**Dr Ian Brotherton**

Head of Government Levers, Innovate UK

# Executive Summary

An aerial night view of a city street, likely in London, showing a yellow grid overlay on the road and green dashed lines extending across the scene. The background is a dark purple gradient with a white rectangular area in the top right corner.

Innovate UK takes a holistic approach to driving innovation. This includes working with key stakeholders across the public sector to consider how regulations and standards can support innovation in the UK.

As part of our work, we have commissioned ICF to develop the **Global Regulation Index (GRI)**, a first of its kind product that compares and ranks countries based on how successfully their regulatory environments support innovation and enable economic growth.

By examining policies and practices that enable and support innovation across four key sectors – Transport, Fintech, Energy and Telecoms – as well as cross-cutting themes, the GRI aims to provide valuable insights and data that will help policymakers and regulators better understand how regulatory levers can be developed that encourage innovation to enable economic growth and delivery of wider social and environmental objectives.



## Key Findings

- The UK performs well in this Index, ranking third globally. It scores especially highly in collaboration between regulators, both domestically and internationally. There are, however, clear opportunities for improvement in areas such as clarity and reliability.
- Sector-specific metrics boost the UK's performance, with high rankings in Energy, Fintech and Transport. Telecoms is an area requiring further improvement.
- The UK is a global leader in regulatory experimentation, leveraging tools like the Financial Conduct Authority's (FCA) sandbox to enable innovation. There is an opportunity to scale and expand these approaches to remain a 'first mover' in shaping the regulation of emerging technologies globally.
- Countries with a coherent, unified approach to innovation-friendly regulation score higher on the GRI. Dedicated programmes, financial incentives and rigorous eligibility criteria for participation are key markers of high performing countries.
- Effective regulation that stimulates business innovation requires cross-sectoral collaboration between regulators.
- Success lies in making regulations easier to navigate rather than reducing them, as deregulation could risk public safety and consumer trust in the long term.
- Regulatory sandboxes and neutral platforms facilitate mutual learning between regulators and businesses, enabling the development of more innovation-friendly future regulations.
- Despite having many of the right ingredients for an enabling innovative regulatory ecosystem, the UK can learn from best practice globally to build a world-leading system for engaging effectively with business around the design and delivery of regulatory innovation. This would help address widespread perceptions by businesses of the UK's regulatory system being challenging to navigate, with approximately 40% of innovating firms reported regulations and legislation had constrained their innovation in one recent survey.<sup>1</sup>

<sup>1</sup> Innovate UK, Innovation State of the Nation, 2024 <https://www.enterpriseresearch.ac.uk/wp-content/uploads/2024/04/ERC-Report-Innovation-State-of-the-Nation-2023-Roper-Nana-Cheraa-Stanfield.pdf>



## Recommendations and Next Steps

- Innovate UK will update the GRI regularly, and expand it to incorporate other sectors. In particular, future iterations may include the five critical technologies identified in the Government's Science and Technology Framework.<sup>2</sup> This will result in richer, more comprehensive data sets, ensuring that the GRI realises its potential as an essential tool for policymakers aiming to strike a balance between encouraging innovation and ensuring consumer protection and systemic stability.
- Government has a role to play in developing a whole-of-government approach which sets an overall vision for pro-innovation regulatory reform, while continuing to support sectoral expertise across individual departments and regulators. This will ensure that innovators are always supported at each step of the way towards bringing new products and services to market.
- Innovate UK will commission further research to understand the disconnect between business perception and actual regulatory conditions, to ensure that this does not inadvertently have a stifling effect on innovation. Innovate UK has a pivotal role to play in exploring both its causes and identifying appropriate solutions.
- The UK has an excellent opportunity to cement its position as a global leader in regulatory experimentation by expanding opportunity and exporting best practice to sectors that have historically been less proactive in developing innovation-friendly approaches. Innovate UK will help develop the tools and mechanisms that build the evidence base of what works, making experimentation a less risky proposition for regulators.

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<sup>2</sup> Department for Science, Innovation and Technology, The UK Science and Technology Framework, 2023 <https://www.gov.uk/government/publications/uk-science-and-technology-framework/the-uk-science-and-technology-framework>

# Context

Forward-thinking governments recognise that regulation, when used effectively, can boost innovation and productivity, as well as stimulate competition.

Regulation can drive innovation by setting market conditions, standards and incentives. Adopting a pro-innovation regulatory system also allows governments to demonstrate their commitment to innovation as a driver of economic growth, sending a clear signal to businesses and investors that innovation is encouraged and rewarded and making investment more attractive.







## **Innovation-friendly regulation is a key policy priority for the UK**

From the 2019 White Paper on Regulation for the Fourth Industrial Revolution to the 2023 Science and Technology Framework, the UK government has repeatedly demonstrated its commitment to using regulation as a lever to stimulate innovation and productivity. It has also spearheaded international efforts to facilitate closer collaboration on experimental regulatory approaches to new technologies, through initiatives such as the creation of the Agile Nations network in 2021.

## **The Global Regulation Index – a first of its kind tool**

The GRI is a unique tool that ranks 21 countries on how well their regulations support innovation, with a focus on the content and application of regulations rather than on investment in innovation. The GRI offers valuable insights, including case studies (at Annex 1), to help policymakers develop policies and practices that promote innovation and growth.

# Structure & approach

The GRI is built using data around five pillars. These pillars have been developed based on a review of relevant literature and where there is evidence that regulators can enable and stimulate innovation through the levers they control.

## 1. Adaptability

How well the overall regulatory framework is able to adapt to new and emerging technologies.

## 2. Clarity and reliability

Transparency and reliability of regulation and trust in regulated markets.

## 3. Collaboration

The extent to which regulators collaborate with each other.

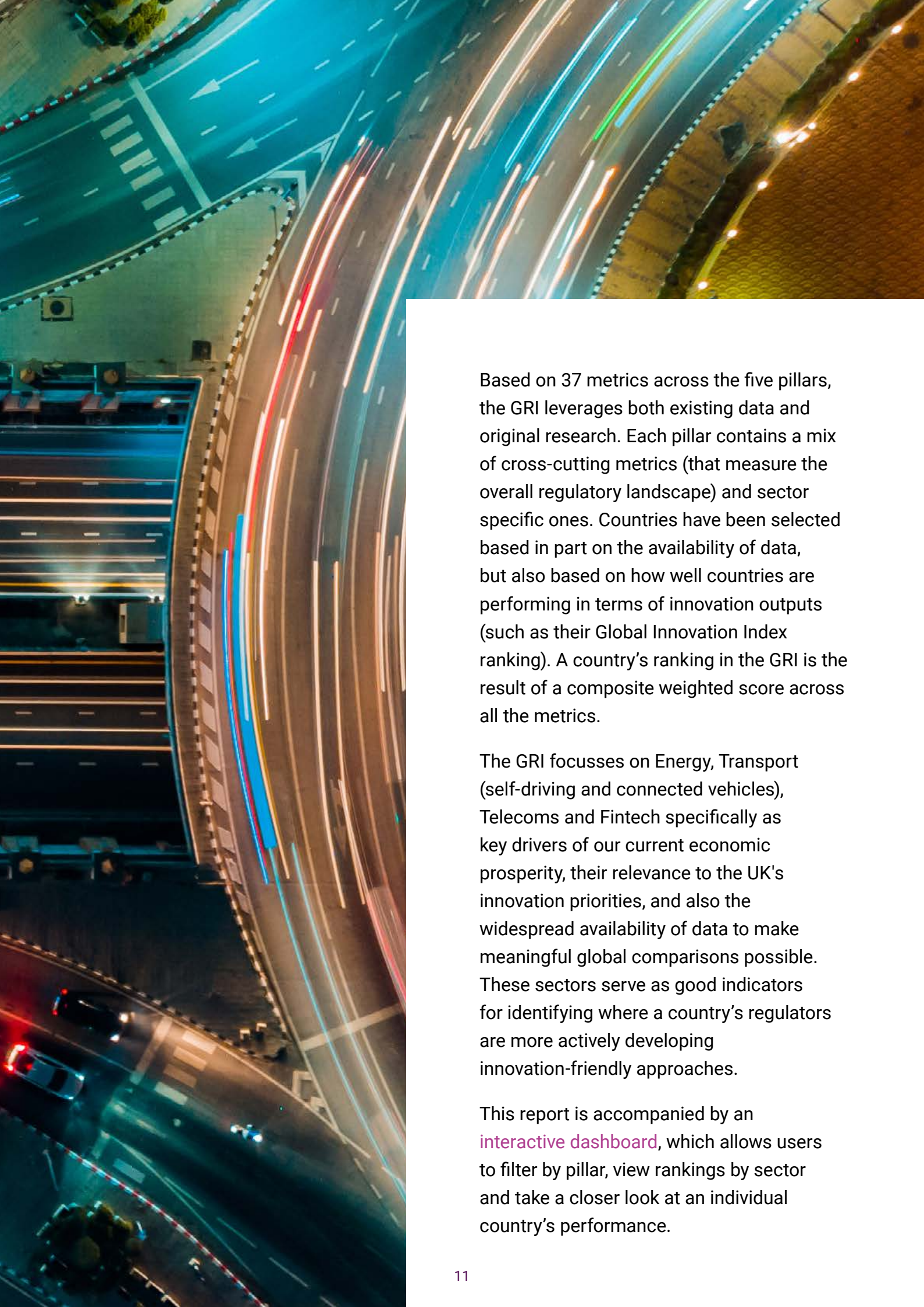
## 4. Experimentation

Whether regulators are providing space for experimenting with new, emerging technologies (through sandboxes, testbeds etc).

## 5. Entrepreneurship

How regulations help or hinder the creation and operation of innovative business ideas.





Based on 37 metrics across the five pillars, the GRI leverages both existing data and original research. Each pillar contains a mix of cross-cutting metrics (that measure the overall regulatory landscape) and sector specific ones. Countries have been selected based in part on the availability of data, but also based on how well countries are performing in terms of innovation outputs (such as their Global Innovation Index ranking). A country's ranking in the GRI is the result of a composite weighted score across all the metrics.

The GRI focusses on Energy, Transport (self-driving and connected vehicles), Telecoms and Fintech specifically as key drivers of our current economic prosperity, their relevance to the UK's innovation priorities, and also the widespread availability of data to make meaningful global comparisons possible. These sectors serve as good indicators for identifying where a country's regulators are more actively developing innovation-friendly approaches.

This report is accompanied by an [interactive dashboard](#), which allows users to filter by pillar, view rankings by sector and take a closer look at an individual country's performance.



## Metrics and pillars were weighted to reflect relative importance

GRI metrics were weighted using a three-stage process:

1. Each metric was scored for its relevance to the GRI and the reliability of data, using a five-point Likert scale.<sup>3</sup> Data from various sources were also normalised to a common scale.
2. In each pillar, sector specific metrics were weighted based on their relative importance compared to cross-cutting metrics.
3. Each pillar received a relative weighting to establish a final score, based on its overall relevance to the GRI. This approach was determined by an expert Delphi workshop to produce quantitative outputs from a qualitative process.<sup>4</sup>



The final ranking is based on a composite of the five pillars. Scores are shown relative to their weighted contribution, not as a percentage out of 100. For example, the Adaptability score is out of 27.5. The relative contributions of each pillar to is illustrated in Figure 1, below.

While these pillars are not always distinct, and any given initiative may well span multiple pillars, their individual scores help highlight where there are opportunities for improvement.



Figure 1 Contribution of pillars to overall score

- 3 Likert Scale Analysis - ScienceDirect
- 4 The Delphi method is used to elicit scores from a group and typically includes the following features: anonymity of participants to avoid groupthink or halo effects; controlled

feedback to make explicit the views of other participants; iteration to enable participants to evolve their thinking based; some form of statistical aggregation.

# Overall Ranking



The GRI finds that different countries vary in their use of the levers identified.

Singapore tops the list with an overall score of 86.6, while the average score across countries is 71.3.

The Netherlands and the UK rank second and third respectively; both do well across all pillars without leading or lagging in any area. Their position in the rankings would appear to stem from having a well-rounded regulatory approach.

Australia and South Korea – both also in the top five – stand out in one pillar each (Collaboration and Experimentation respectively) while scoring moderately elsewhere.

Finland ranks second in 'Adaptability' and third 'Clarity and Reliability' but scored more poorly in 'Experimentation.' Though middle-ranked overall in the GRI, Finland excels in specific areas of innovation-friendly regulation.

The GRI and Global Innovation Index (GII) rankings do not necessarily match. For example, Switzerland leads in the GII but ranks thirteenth in the GRI, while Singapore tops the GRI but is seventh in the GII. This discrepancy exists because the GII has a much broader focus on innovation as a whole, while the GRI concentrates on factors within a regulator's control.

	<b>Overall rank</b>	<b>Score</b>
1	Singapore	86.6
2	The Netherlands	83.5
3	United Kingdom	83.0
4	Australia	79.4
5	South Korea	78.8
6	Germany	78.2
7	Canada	77.2
8	United States	76.5
9	Austria	75.1
10	United Arab Emirates	73.1
11	Finland	72.0
12	Japan	69.0
13	Switzerland	68.7
14	Norway	68.3
15	France	67.8
16	Sweden	67.0
17	Denmark	66.6
18	Israel	65.1
19	China	57.3
20	Brazil	54.1
21	Mexico	49.8



Several countries face a trade-off between 'Adaptability' and 'Clarity and Reliability'. Singapore, Germany, the United States and the United Arab Emirates all score highly on 'Adaptability' but lower in 'Clarity and Reliability'. Conversely, Denmark, Austria and Switzerland show the opposite trend.

In general, 'Clarity and Reliability' correlates least with the overall ranking; none of its top three scorers appear in the overall top ten. The table below lists the top three countries in each pillar.

<b>Adaptability</b>	<b>Clarity &amp; reliability</b>	<b>Collaboration</b>	<b>Experimentation</b>	<b>Entrepreneurship</b>
1 Singapore	1 Switzerland	1 Germany	1 Singapore	1 Singapore
2 Finland	2 Denmark	2 Australia	1 Canada	2 The Netherlands
3 United Arab Emirates	3 Finland	3 UK	1 South Korea	3 Japan

## Overall rankings broken down by pillar

Figure 2 illustrates the composition of the total scores, based on the five pillars. The relative rankings by pillar, and more detail on the regulatory levers that are clustered within each pillar, are provided in the following pages.





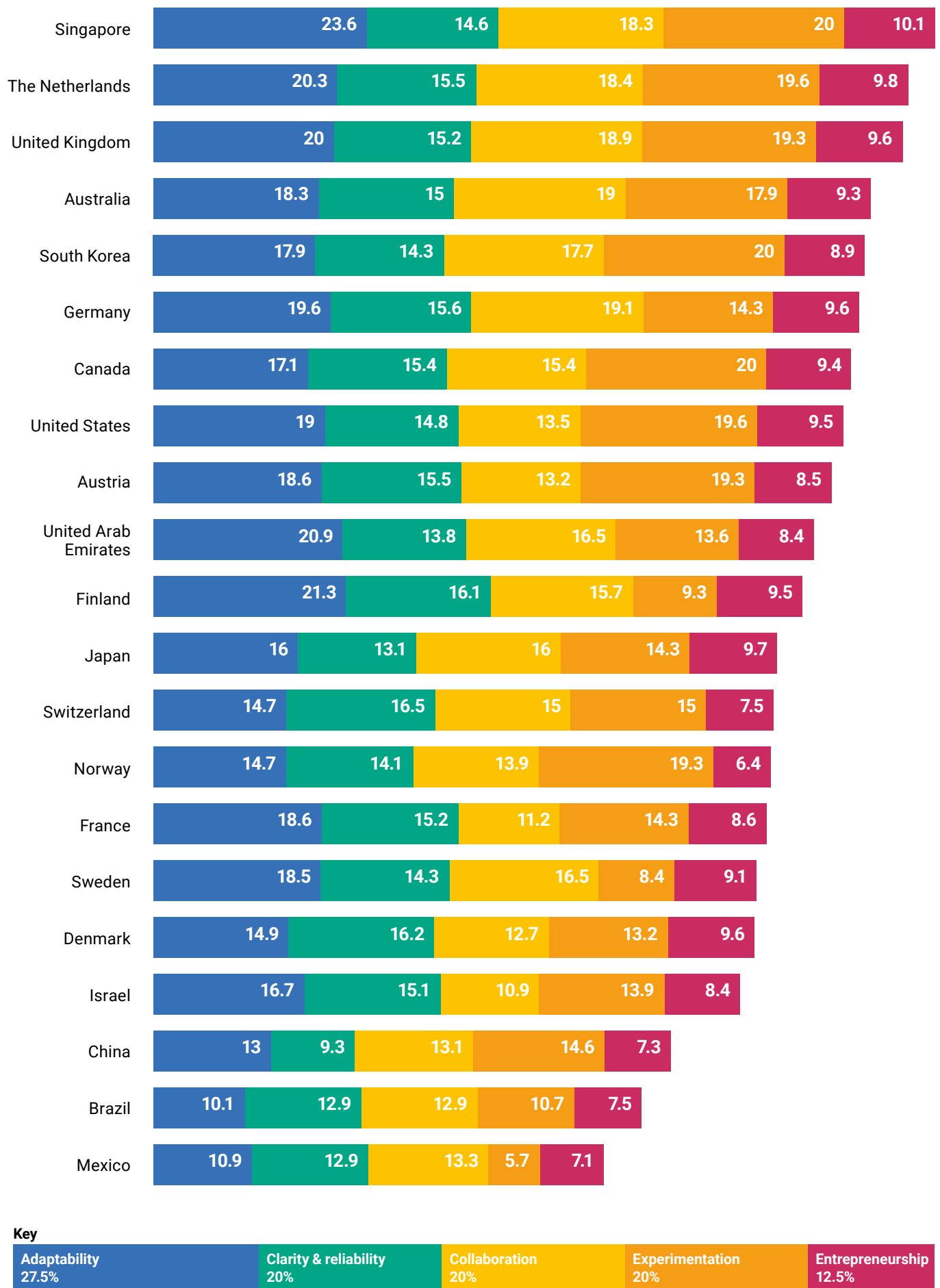


Figure 2 Overall rankings, broken down by pillar

# Adaptability



This pillar considers how well a country's regulatory framework is able to adapt to new technologies and approaches. **Scores for Adaptability make up 27.5% of the final ranking.** The average score for this pillar is 17.4 out of a maximum 27.5. Singapore (ranked first overall) leads this pillar with a score of 23.6.

Countries scoring highly in this area should answer 'yes' to the following:

- Does their approach to regulation anticipate current and future developments?
- Is there a framework in place for new technologies and markets?
- Is there an enabling legal environment?
- Are government and regulators responsive to change?

An adaptable regulatory framework is crucial for encouraging and safeguarding innovations, especially in highly regulated sectors. Highly adaptable regulatory frameworks allow new products and services to come to market quickly, while ensuring consumer safety.

Inflexible regulation has the potential to stifle innovation. Conversely, inadequate regulation can lead to market failure and erode consumer trust. Thus, it's vital for regulation to stay updated and effective. It is therefore important that regulation keeps pace and remains fit for purpose. This requires both strong foresight research and mechanisms for translating findings into policies.



## Adaptability

		Score
1	Singapore	23.6
2	Finland	21.3
3	United Arab Emirates	20.9
4	The Netherlands	20.3
5	United Kingdom	20.0
6	Germany	19.6
7	United States	19.0
8	Austria	18.6
8	France	18.6
10	Sweden	18.5
11	Australia	18.3
12	South Korea	17.9
13	Canada	17.1
14	Israel	16.7
15	Japan	16.0
16	Denmark	14.9
17	Switzerland	14.7*
17	Norway	14.7
19	China	13.0
20	Mexico	10.9
21	Brazil	10.1

\*Significant data is missing for Switzerland in this pillar  
– see Annex 2 for full information

## Metrics

Adaptability has been measured using the metrics described below. Measurement has focused on the extent to which regulatory frameworks are suitable for emerging technologies. No metrics are included in this pillar for Energy or Telecoms due to the limited availability of data relevant to this pillar.

Sector	Metric	Source
<b>Cross-cutting</b>	Efficiency of legal framework in challenging regulations	World Economic Forum
	Government's responsiveness to change	World Economic Forum
	Legal framework's adaptability to digital business models	World Economic Forum
	Regulation of emerging technologies	World Economic Forum
	Existence of regulatory framework for enabling technologies	New metric (study team)
<b>Transport (CAVs)</b>	AV-focused agency	KPMG AV Readiness Index
	AV regulations	KPMG AV Readiness Index
<b>Fintech</b>	Existence of regulatory framework for fintech activities	New metric (study team)

# Clarity & Reliability

The Clarity and Reliability pillar considers the transparency and reliability of regulation and trust in regulated markets. **Scores for Clarity and Reliability make up 20% of the final ranking.** The average score for this pillar is 14.5 out of 20.0. Switzerland (ranked thirteenth overall) leads this pillar with a score of 16.5.

Countries that score highly on this pillar should answer 'yes' to the following:

- Does the regulatory approach create a stable climate for investment?
- Do the public have trust in regulatory systems?
- Do regulators have a clear mandate and governance mechanisms?
- Do regulators and government have outcome-based targets in place?
- Can all stakeholders access information on regulations?

Many of the elements of this pillar are crucial for a good regulatory system more generally, and not just for stimulating innovation. Without clarity and reliability, regulators are not providing the stability needed to encourage investment. While adaptability may be more important for radical



innovation, stability is key for incremental innovation that does not require regulatory change. For regulators, this means following best practices in policy design and long-term strategic planning, particularly in areas such as environmental regulation with specific output targets for businesses.



## Clarity & Reliability

		Score
1	Switzerland	16.5
2	Denmark	16.2
3	Finland	16.1
4	Germany	15.6
5	Austria	15.5
5	The Netherlands	15.5
7	Canada	15.4
8	United Kingdom	15.2
8	France	15.2
10	Israel	15.1
11	Australia	15.0
12	United States	14.8
13	Singapore	14.6
14	Sweden	14.3
14	South Korea	14.3
16	Norway	14.1*
17	United Arab Emirates	13.8
18	Japan	13.1
19	Mexico	12.9
19	Brazil	12.9
21	China	9.3

\* Significant data is missing for Norway in this pillar  
 – see Annex 2 for full information

## Metrics

Clarity and Reliability has been measured using the metrics below. Transport or Fintech metrics have been excluded due to the limited availability of data.

Sector	Metric	Source
Cross-cutting	Government long-term vision	World Economic Forum
	Policy design principles	ITU G5 Benchmark
	Trust in government	OECD
Energy	Legal framework for renewable energy	RISE
	National energy efficiency planning	RISE
	Energy efficiency entities	RISE
Telecoms	Digital strategy for development	ITU G5 Benchmark
	Codes of conduct	ITU G5 Benchmark
	Regulatory mandate	ICT Regulatory Tracker
	Regulatory authority	ICT Regulatory Tracker
	Regulatory regime	ICT Regulatory Tracker

# Collaboration



The Collaboration pillar considers the extent to which regulators collaborate with each other. **Scores for Collaboration make up 20% of the final ranking.** The average score for this pillar is 15.3 out of a maximum 20.0. Germany (ranked sixth overall) leads this pillar with a score of 19.1.

Countries that score highly on this pillar should answer 'yes' to the following:

- Do national regulators have mechanisms to collaborate on shared objectives?
- Do digital regulators collaborate internationally?
- Do regulators seek to align digital standards to enable cross-border innovation?

Collaboration is key for regulators both nationally and internationally, especially for innovations that span traditional regulatory boundaries such as Transport and Telecoms. Formal structures for regular collaboration

enhance regulators' adaptability and streamline their approaches to new innovations. International collaboration can offer insights into best practices from markets where technologies are more mature, establishing coherent guidelines that ease market access for innovators and facilitate cross-border trade.



## Collaboration

		Score
1	Germany	19.1
2	Australia	19.0
3	United Kingdom	18.9
4	The Netherlands	18.4
5	Singapore	18.3
6	South Korea	17.7
7	Sweden	16.5
7	United Arab Emirates	16.5
9	Japan	16.0
10	Finland	15.8
11	Canada	15.4
12	Switzerland	15.0
13	Norway	13.9
14	United States	13.5
15	Mexico	13.3
16	Austria	13.2
17	China	13.1
18	Brazil	12.9
19	Denmark	12.7
20	France	11.2
21	Israel	10.9

## Metrics

Collaboration has been measured using the metrics described below.

Sector	Metric	Source
<b>Cross-cutting</b>	National collaborative governance	ITU G5 Benchmark
<b>Energy</b>	ICT Collaboration with energy regulator	ITU G5 Benchmark
<b>Transport (CAVs)</b>	ICT Collaboration with transport regulator	ITU G5 Benchmark
<b>Telecoms</b>	Regulatory collaboration in digital core areas	ITU G5 Benchmark
	International collaboration and harmonisation	ITU G5 Benchmark
<b>Fintech</b>	ICT Collaboration with Finance Regulator	ITU G5 Benchmark

# Experimentation



The Experimentation pillar considers whether regulators provide the controlled environments to test and develop new approaches to regulation for emerging technologies that are either not yet ready for market and/or do not fit into the traditional regulatory approaches. This may be in the form of sandboxes or testbeds. This allows innovators to de-risk new ideas prior to wider deployment, and regulators to learn and adapt. **Scores for Experimentation make up 20% of the final ranking.** The average score for this pillar is 15.4 out of a maximum 20.0. Canada, Singapore and South Korea (ranked seventh, first and fifth overall respectively) are joint leaders in this pillar with scores of 20.0.

Countries that score highly on this pillar should answer 'yes' to the following:

- Do regulators support innovators in trialling new products, services and business models in a real-world environment without some of the usual rules applying?
- Do regulators provide other types of support to help innovators test new products, services and business models (such as, for example, synthetic data sets)?

Not all sectors need space for experimentation, but it is widespread and effective in areas such as Fintech, Telecoms and Connected and Autonomous Vehicles (CAVs). Sandboxes and testbeds are especially valuable for ground-breaking innovations, allowing regulators to directly observe and understand their impact. In some countries, however, legal constraints can prevent the establishment of such sandboxes.



# Experimentation

		Score
1	Canada	20.0
1	Singapore	20.0
1	South Korea	20.0
4	The Netherlands	19.6
4	United States	19.6
6	Austria	19.3
6	Norway	19.3
6	United Kingdom	19.3
9	Australia	17.9
10	Switzerland	15.0*
11	China	14.6
12	France	14.3
12	Germany	14.3
12	Japan	14.3
15	Israel	13.9
16	United Arab Emirates	13.6
17	Denmark	13.2
18	Brazil	10.7
19	Finland	9.3
20	Sweden	8.6
21	Mexico	5.7

\*Significant data is missing for Switzerland in this pillar  
 – see Annex 2 for full information



## Metrics

Experimentation was measured using the metrics below. No cross-cutting metrics are included in this pillar. Many of the metrics

included in this pillar are based on the presence or absence of experimentation in a given sector, rather than on the quality of the experimentation.

Sector	Metric	Source
<b>Cross-cutting</b>	Use of sandboxes/testbeds in the energy sector	New metric (study team)
<b>Transport (CAVs)</b>	Government-funded AV pilots	KPMG AV Readiness Index
<b>Telecoms</b>	Regulatory experimentation	ITU G5 Benchmark
<b>Fintech</b>	Use of sandboxes/testbeds in the fintech sector	New metric (study team)

# Entrepreneurship



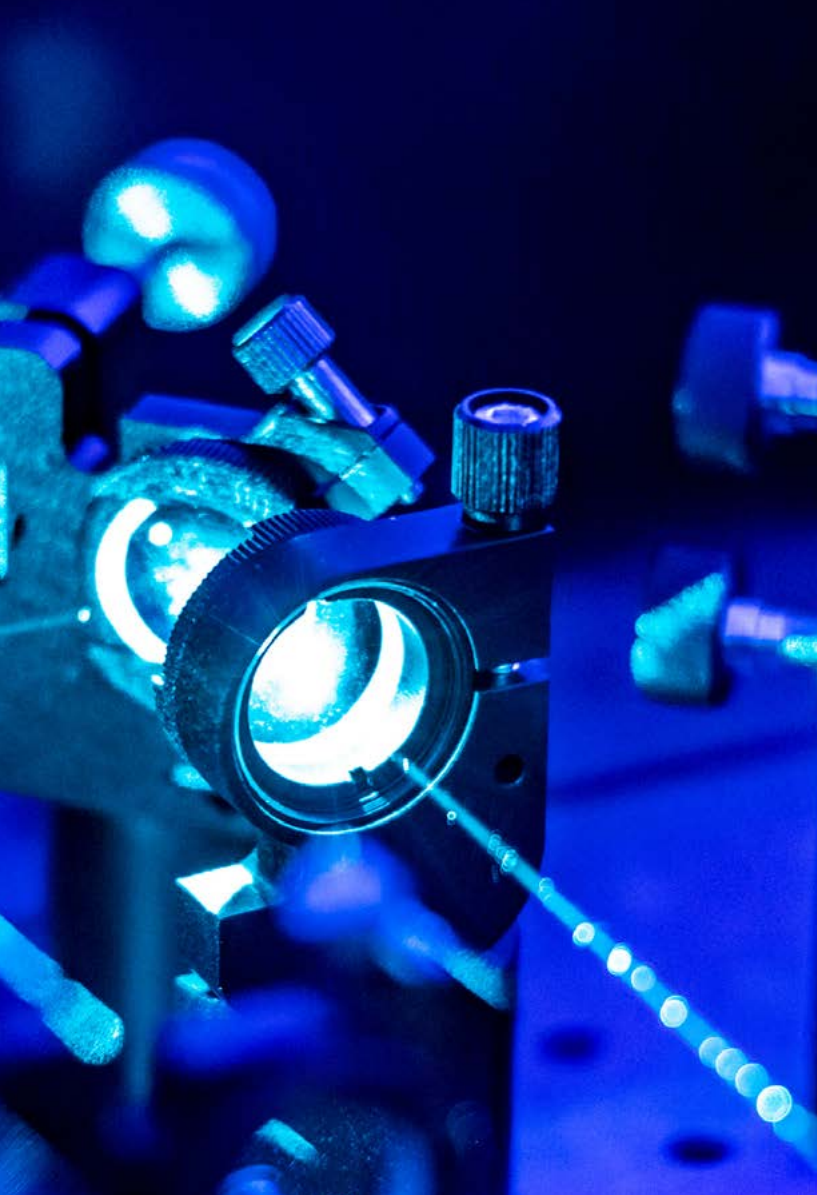
The Entrepreneurship pillar considers the extent to which regulation supports the creation and operation of innovative business ideas. **Scores for Entrepreneurship make up 12.5% of the final ranking.** The average score for this pillar is 8.8 out of a maximum 12.5. Singapore (ranked first overall) leads this pillar with a score of 10.1.

Countries that score highly on this pillar should be able to answer 'yes' to the following questions:

- Are regulations proportionate and not overly burdensome?
- Do regulators provide regulatory support to new entrants?
- Do companies embrace disruptive business ideas?

- Are regulations and incentives in place to encourage a transition to net zero?

For sectors that are heavily regulated and/or involve many small and medium-sized enterprises, a focus on making business' experience of regulation easier can make a difference to innovation outcomes. Similarly, regulatory approaches can help to create markets for innovations that would not otherwise exist. This is particularly the case for environmental regulations, where market forces alone are not enough to move toward more efficient products, and where businesses may not otherwise feel able to justify investment in these types of innovations.



## Entrepreneurship

		Score
1	Singapore	10.1
2	The Netherlands	9.8
3	Japan	9.7
4	United Kingdom	9.6
4	Germany	9.6
4	Denmark	9.6
7	United States	9.5
7	Finland	9.5
9	Canada	9.4
10	Australia	9.3
11	Sweden	9.1
12	South Korea	8.9
13	France	8.6
14	Austria	8.5
15	Israel	8.4
15	United Arab Emirates	8.4
17	Switzerland	7.5
17	Brazil	7.5
19	China	7.3
20	Mexico	7.1
21	Norway	6.4*

\* Significant data is missing for Norway in this pillar  
 – see Annex 2 for full information

## Metrics

Entrepreneurship has been measured using the metrics below. No metrics are included in this pillar for Transport (CAVs) or Telecoms due to limited data available.

Sector	Metric	Source
Cross-cutting	Burden of government regulation	World Economic Forum
	Government online services	UNDESAO
	Extent of market dominance	World Economic Forum
	Companies embracing disruptive ideas	World Economic Forum
Energy	Financing mechanisms for energy efficiency	RISE
	Energy labelling systems	RISE
	Carbon pricing	RISE
Fintech	Presence of innovation hub	New metric (study team)

# Conclusions and insights

From the data gathered and analysed during the preparation of the GRI, we have arrived at several key conclusions and insights that we believe will valuably assist policymakers and regulators in making informed decisions when designing approaches that stimulate innovation-friendly regulation.



## General observations

### A coherent approach maximises innovation

Countries that have adopted a comprehensive, unified regulatory approach to regulating innovation achieved the highest scores in the GRI.<sup>5</sup> These countries have in place a range of measures, including special programmes and financial incentives, that optimise the use of regulatory levers as a catalyst for innovation. Participation in these schemes often requires meeting strict eligibility requirements and undergoing a rigorous qualification process that more effectively screen both the viability of the innovation, and a business's capacity to deliver.

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5 Following the definition in the Oslo Manual (OECD, 2018): "An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products."



## Interconnected pillars

Regulators are less effective when they work in silos. The case studies accompanying this report illustrate how pillars interact, with a single initiative often spanning multiple regulatory domains. Effective collaboration between regulators is critical to making regulation easier for businesses to navigate and plan for, and better able to accelerate the commercialisation of new products and services based on emerging technologies.

## Better not less regulation

The evidence would suggest that successful regulators prioritise making rules easier to navigate and adapt, and that a system which expedites the approval process of bringing new products and services to market in a timely way matters more to innovators and investors than dismantling regulations.





## Continuous learning for regulators and businesses

Many of the case studies showcase ways in which regulators are embracing opportunities to learn from businesses innovating in collaborative environments. This allows the formulation of future regulations that enable innovation, while at the same time providing businesses with more clarity and certainty on how regulations would apply to their innovative products and services.

Using platforms for regulatory experimentation that bring together regulators, businesses and researchers to discuss and observe new developments in practice – of which sandboxes and testbeds are two notable examples – in a more systematic and strategic way is an important tool for achieving that goal. Several case studies within Annex 1 highlight the critical role sandboxes have played in facilitating innovation in a number of sectors in countries as diverse as Singapore, Norway, Australia and the United States.

## Adopting more interactive approaches

Some regulators are exploring less structured, more interactive ways of working with businesses to foster mutual learning and trust, helping to reduce time to market for products undergoing regulatory approval. While this may not be suitable for all sectors, it presents a viable strategy for UK government to adopt.

## Cross-sectoral and technology-based approaches

Regulatory innovation need not be confined to specific sectors. For example, Norway's sandbox for responsible artificial intelligence case study involves a cross-sectoral approach to regulating AI technologies. A more widespread adoption of such approaches would have a catalytic effect on innovation.





# The UK context

## Strengths and weaknesses

The UK ranks third overall in the GRI, with a performance across pillars generally higher than the average. It excels in Collaboration, with strong networks in place between regulators both domestically and internationally. Systematic collaboration between regulators is vital to our future prosperity and productivity as the number of emerging technologies and their applications that span existing regulatory remits – and require better coordination between regulators and business – continues to grow. We perform less well in Clarity and Reliability, despite pockets of best practice here through the case studies on Fintech and financial incentives for decarbonisation from which other sectors stand to benefit.

## Global leadership on Experimentation

Ranking sixth in Experimentation, the UK's score compared with the average across countries shows that the UK is a leader in this area. Case studies and wider evidence support this: the Financial Conduct Authority (FCA) was one of the first to develop and promote the concept of a 'regulatory sandbox'. The ranking is due, in part, to the fact that several of the underlying metrics in this pillar are binary and do not incorporate a judgment of quality. It may be worth considering how to leverage this leadership further, and how options for regulatory experimentation (including but not limited to sandboxes) could be adopted more systematically to pull through learnings and best practice from other sectors.

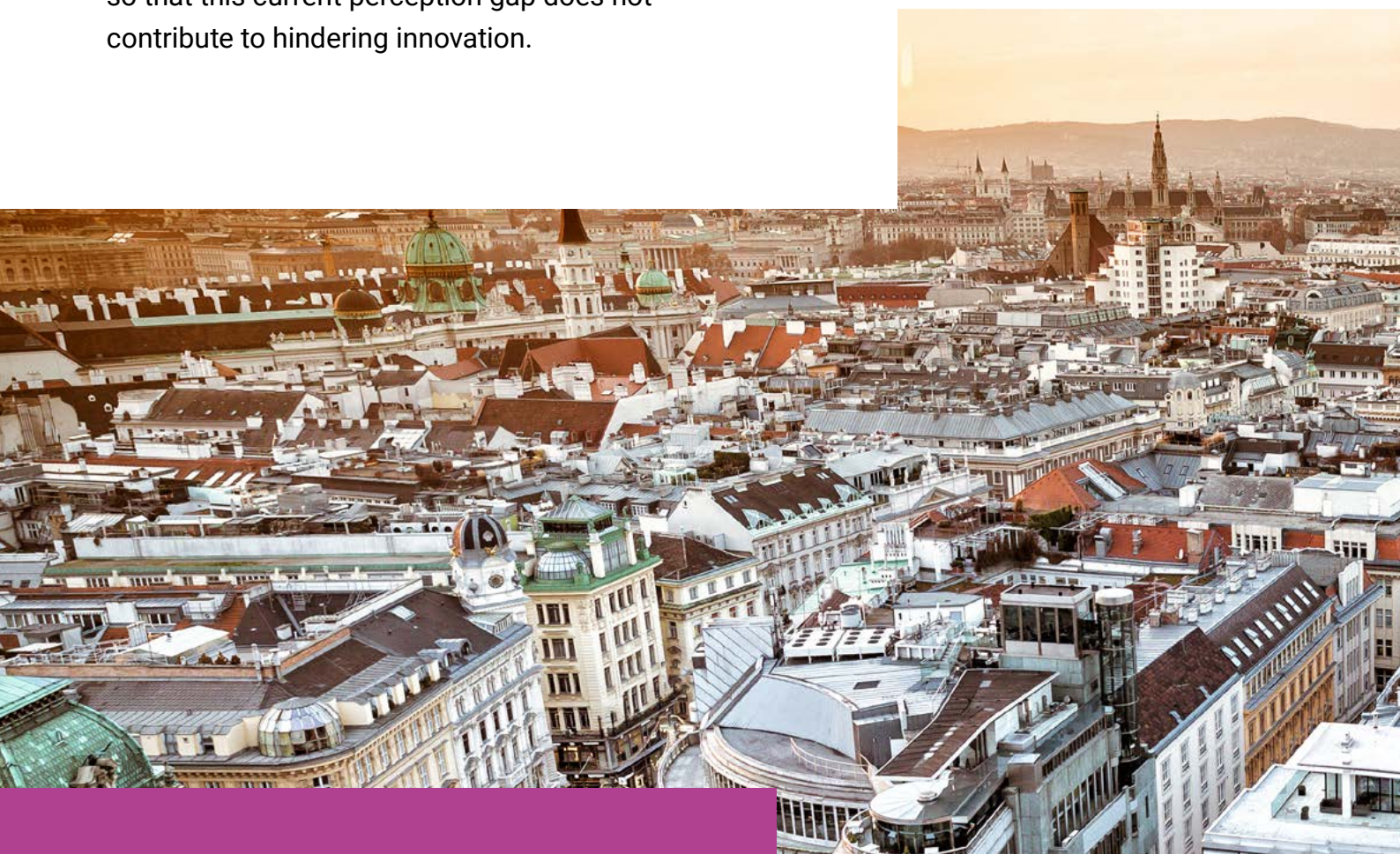


## Perception gap

Across a number of sectors, there is a clear disconnect between what regulators in the UK are doing and how businesses perceive the current state of regulation. For example, many of the metrics for which the UK has received comparatively lower scores come from the World Economic Forum's Executive Opinion Survey. Innovate UK's wider analysis of the innovation ecosystem highlights the need for further research in this area, noting that the data gathered for the Index is insufficiently granular to analyse the factors behind that disconnect. Innovate UK has an opportunity to work with policymakers and regulators to develop the tools that help gain deeper insight into how innovative businesses' perceptions about regulation are formed, how regulatory change is communicated, and strengthen dialogue between regulators and innovators so that this current perception gap does not contribute to hindering innovation.

## Innovate UK – helping government drive change

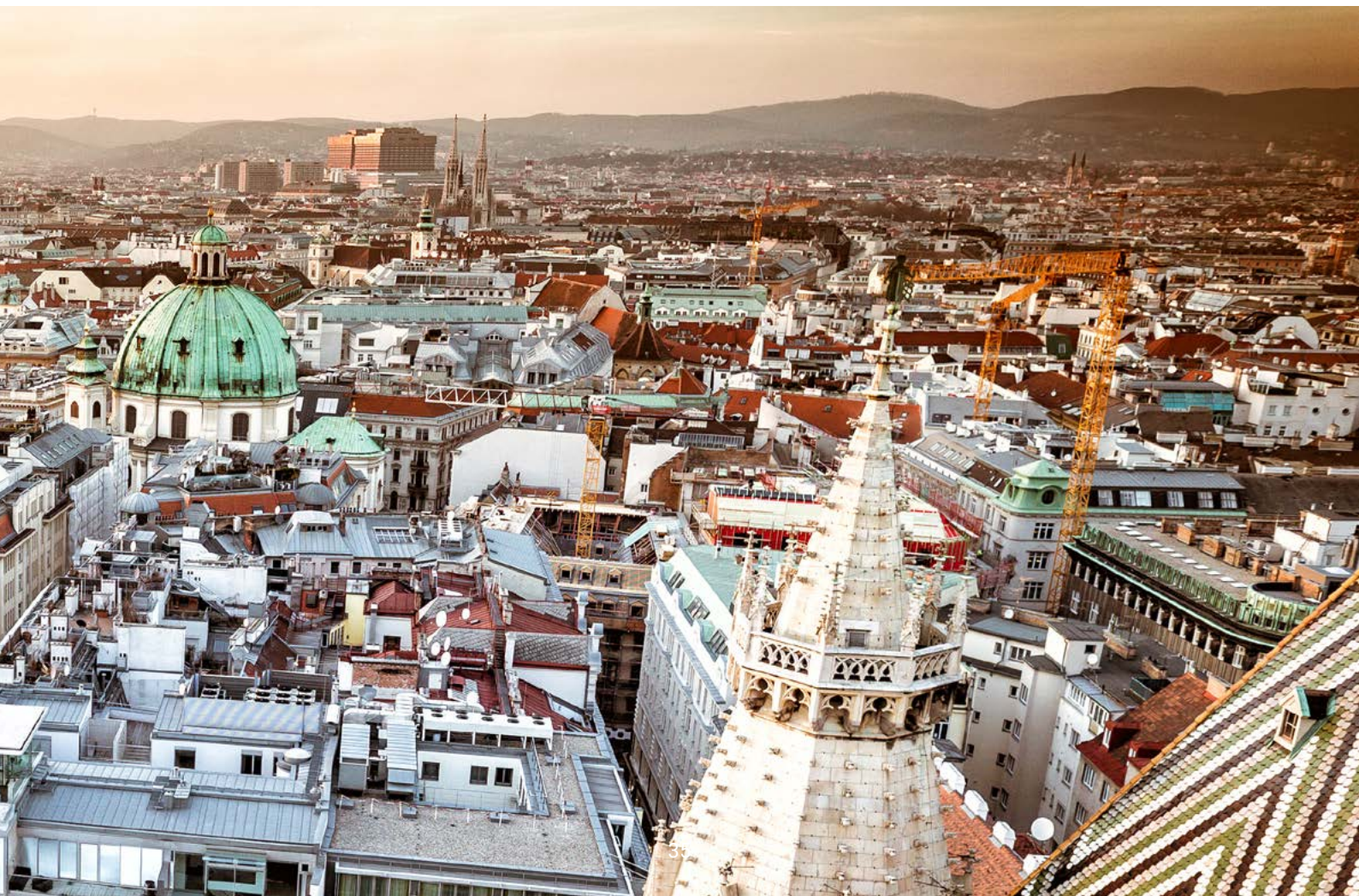
Through its suite of products – including the GRI – Innovate UK can be a vital partner supporting government and regulators in shaping innovation-friendly regulatory policy. Our programmes will help generate high-quality evidence and insights about the effectiveness of different approaches to regulating new technologies, and assist policymakers in identifying the right tools and approaches to assess the safety and efficacy of innovative products and services, and to accelerate their journey to market.



The table below summarises what pillars are demonstrated in each of the case studies included. This is not to say that if a pillar is not covered in a case study, it is something

that the regulator is necessarily lacking, only that it is not covered in the text of this report.

Case Study	Adaptability	Clarity & reliability	Collaboration	Experimentation	Entrepreneurship
Novel foods in Singapore	X		X		X
MedTech in the United States	X		X		X
Fintech in the UK		X	X	X	X
Regulatory interventions to diversify the Japanese telecoms market					X
Norway's sandbox for responsible artificial intelligence	X			X	X
UK financial incentives to decarbonise supply of gas into the gas grid		X			X
Australian Energy Innovation Toolkit	X			X	X



# Annex 1

# Case Studies

## Case Study: Novel foods in Singapore

The Singapore Food Agency's (SFA) approach to regulating novel foods contains elements across the pillars, most notably adaptability and entrepreneurship. Their approach is based on continuous learning on the part of both businesses and the regulator, and regular updates to their guidelines based on this learning. It also contains a strong element of business support. In a sector where many of the most innovative businesses are start-ups, this type of support and collaboration can ensure that the regulatory process does not pose a barrier to innovation. Singapore has also shown initiative in collaboration, sharing their knowledge and experiences in this area with other countries.

In the case of novel foods, Singapore has also benefitted from significant policy support and funding. Food security is a concern for the city-state, where over 90% of food is currently imported. The government has set

an explicit goal to increase the percentage of domestically-produced food to 30% by 2030, setting a strong incentive to encourage food innovation. Much of what the SFA has been able to achieve in terms of novel foods regulation is likely due to this policy support.

### Background

Innovation in the agri-food sector takes many forms. In addition to process innovations and the development of new production techniques for existing foods, some of the innovation in this sector has led to the development of entirely new foods (i.e. novel foods). These include, for example, products such as cultivated meat.

Food businesses in general are subject to a range of regulations (e.g. hygiene and safety rules, standards, labelling rules). For novel foods, there is also a requirement in many jurisdictions that these must receive approval before being brought to market. This



is to ensure consumer safety, but also helps consumers trust the safety of new products. This can create a challenge for regulators: for foods that have no significant history of human consumption, how can you best establish enough evidence to deem a food safe, balancing the benefits of innovation with the protection of consumers? This process can add significant burden to both regulators and businesses, and is a challenge regulators across the world are currently considering. The failure to provide an adequate pathway to market for novel foods can contribute to stifling innovation in this sector at one extreme, and exposing consumers to potentially harmful foodstuffs at the other.

## The Singapore Food Agency's Approach

Singapore is the first country in the world to issue regulatory approval for cultivated meat, and more generally their approach

to regulating novel foods has attracted investment in companies working on innovative food products. Singapore's success in regulating this area appears to be based on several elements.

First, they have taken a more collaborative and informal approach to helping businesses through their application, including prioritising "early-stage engagement".<sup>6</sup> This helps businesses understand what information needs to be shared, and helps the regulator understand what has gone into the novel food process. This has also manifested in the establishment of a research hub, FRESH, that brings together regulators, researchers and industry in a neutral platform. This is intended to both help regulators understand new methods, products and food safety issues early on. By contrast, in the current EU approach to regulating novel foods, there is no channel for engagement before the application process. This means that both businesses and regulators are more likely to have questions or require clarification along the way, adding to the length and uncertainty of application timelines.<sup>7</sup>

Second, they are continuously updating their guidelines. These updates have been intended to continuously clarify the process for businesses in an area of regulation that is still evolving, building on what the SFA has learnt through collaboration and early engagement with businesses.

6 <http://foodhealthlegal.eu/?p=1081>

7 <https://www.foodnavigator.com/Article/2022/10/31/Why-is-EFSA-yet-to-receive-a-novel-food-dossier-on-cell-based-meat>



Third, the SFA has offered businesses full confidentiality for the information they share with the regulator as part of their application. This issue (the degree to which regulators provide businesses with confidentiality) can present a significant barrier to innovation. If the regulatory process also means that business data will be published (even if that publication is delayed), this can mean the loss of trade secrets for businesses.

In addition to these initiatives, Singapore has also made an effort to share their ideas and approach with other countries. For example, in October 2022, the SFA hosted a Roundtable on Novel Food Regulations, meant for both regulators and industry stakeholders from across the world to “share current thinking and experiences on the safety assessment of novel foods.”

## In practice

Singapore made headlines for being the first country to issue an approval for cultivated meat, but it has also issued ‘first’ approvals for other examples of novel foods. One example, Solein, is a protein powder made from CO<sub>2</sub>, air and electricity. It has been developed by a Finnish start-up, but Singapore marks its first regulatory approval.

The CEO and co-founder was interviewed by Food Navigator about their experience of the system. They shared that the process with the SFA was “efficient” and involved regular (weekly) communication, but that the submissions and evidence required felt similar to that required by the EU.

The product has not yet been commercialised, and the CEO indicated that receiving regulatory approval is an important step toward receiving more investor funding, which should allow for commercialisation. Before a product receives regulatory approval, especially for novel food products that lack precedent, it can be difficult to attract investment because the risk of not receiving regulatory approval is too high.

# Case Study: MedTech in the United States

The US Food and Drug Administration's (FDA) approach to regulating MedTech has focused on improving their adaptability as well as encouraging entrepreneurship. This has involved introducing new pathways for approval, as well as establishing a platform for regulators, businesses and researchers to share knowledge, and feeding that back into the regulatory approach. The FDA's approach also includes an element of international collaboration.

The FDA has not always been a leader in this space, and this case study provides an example of a regulator enacting a series of new initiatives and programmes in a sector, designed to both reduce time-to-market and to help ensure that the most innovative and beneficial new developments can navigate a historically difficult area of regulation.



## Background

The Medical Technology (MedTech) sector is responsible for producing a range of medical technologies and devices, from single-use syringes to complex medical equipment. As they are intended for use in healthcare, products produced in this sector are subject to a range of regulations and new products developed are required to go through an approval process before entering the market.

Significant innovations in the MedTech sector are in areas such as the application of artificial intelligence and machine learning, the use of nanotechnologies, and advances in telemedicine and personalised healthcare technologies. In all of these instances, and especially in the application of Artificial Intelligence/Machine Learning to technologies, these innovations present unprecedented types of risk to regulators, adding complexity to an already strict regulatory regime.

## The FDA's Approach

For the MedTech sector, the EU has in the past been considered the best market for launching products, but in recent years this perception has shifted, due to both changes in EU regulation and a concerted effort by the FDA in the United States to improve their approach to regulation.<sup>8</sup>

Much of the FDA's work has been to improve the adaptability of their regulatory approach, ensuring that their approach keeps pace with the types of technologies being developed. As part of this, the FDA has established the "Digital Health Center of Excellence". This Center is meant to provide a platform for regulators, researchers and businesses working in the sector to build connections, provide support, share knowledge and to develop innovations for the regulatory process. It means that businesses and researchers can benefit from a better understanding of the FDA, but also allows the FDA to better understand the latest innovations. In a recent study comparing the US and EU approaches to MedTech regulation, 64% of respondents rated the FDA as doing well in responding to digital technology innovation (compared to 34% for the EU's regulators). This difference was attributed to initiatives like the Digital Health Centre.<sup>9</sup>





Another element of the FDA’s approach has been to focus their resources and support on innovative products that are likely to have significant impact. The establishment of the Breakthrough Devices Program, which allows for greater regulatory support and prioritisation from the FDA during pre-market approval, specifically for products that are intended to provide “more effective treatment or diagnosis of life-threatening or irreversibly debilitating diseases or conditions.” This includes opportunities to interact with the FDA’s experts directly, allowing for questions and uncertainties to be addressed quickly. More generally, the FDA has established multiple pathways for approval, helping regulators to set priorities between different types of application. By contrast, where this is not the case, regulators can end up with a backlog that means equal (and often long) times to market for new products, regardless of their significance or wider benefit.

The FDA’s approach to regulating MedTech also points to some interesting examples of international collaboration. The U.S.-Japan Medical Device Harmonization by Doing (HBD) collaboration seeks to promote convergence in the regulatory approaches between the two countries, particularly in relation to cardiovascular technology. This involves working toward a single global clinical trial protocol, as well as working toward standardising the ways data is collected and analysed. This collaboration has also involved a survey of businesses in Japan, the U.S. and the EU to understand what challenges are faced in bringing innovative devices to market from a global perspective.

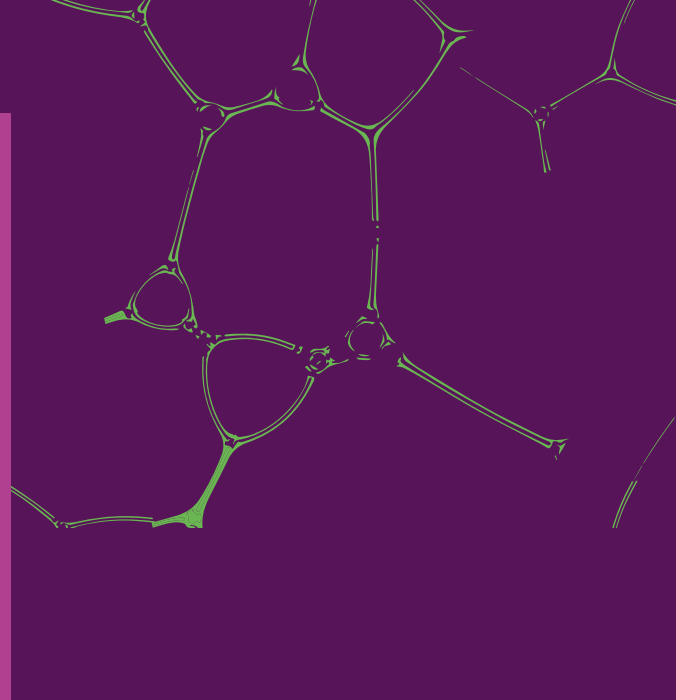
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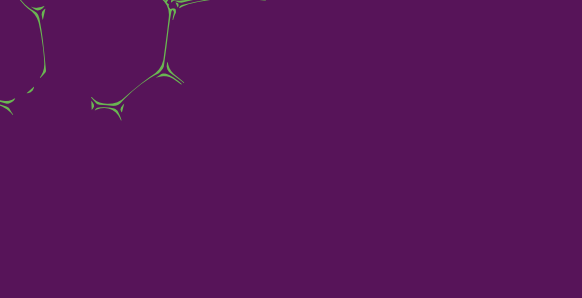
8 Johnson et al (2022) *Interstates and Autobahns: Global Medtech Innovation and Regulation in the Digital Age*. Available online at: <https://web-assets.bcg.com/8c/f0/06744e8848ea9654bbd0765bf285/bcg-interstates-and-autobahns-mar-2022.pdf>

9 Ibid

# Case Study: Fintech in the UK

The Financial Conduct Authority (FCA)'s approach to regulating innovative businesses in the financial services sector relies on both encouraging experimentation and entrepreneurship. The FCA has been at the forefront of developing different types of sandboxes for the sector. They have also developed a formalised approach to supporting businesses through the regulatory process, focusing on those businesses that are truly innovative and most in need of support and providing them with a consistent contact and advice throughout the process. By evaluating their work and sharing the results of this with the public, the FCA also demonstrates clarity & reliability, and through their leadership in the Global Financial Innovation Network (GFIN), a strong example of collaboration.





## Background

Financial regulation is complex and can present a significant hurdle to smaller firms without the resources to focus staff on compliance. For businesses bringing in new technologies or business models, existing approaches or guidelines may not necessarily apply, creating additional hurdles to bringing products to market. In some instances, this may mean that new innovations in this sector proceed without regulation, but this can lead to significant failures that risk damaging consumer confidence and setting back innovation.

## The FCA's approach

The FCA, along with many financial regulators around the world, have brought in a number of initiatives to support Fintech businesses in navigating regulations.<sup>10</sup>

This includes:

- Encouraging experimentation through their Regulatory Sandbox, allowing innovative firms to test products in the market. The Regulatory Sandbox began in 2016 and initially operated on a cohort basis. Since 2021, this has changed, and interested companies can now submit applications at any point throughout the year, meaning that they can choose to participate at a time that suits their needs best. The Regulatory Sandbox provides businesses with regulatory expertise and a selection of tools they can use to facilitate testing. The parameters of the 'sandbox' will differ depending on the business that applies and the product or service they are seeking to test.

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10 <https://www.fca.org.uk/firms/innovation>

- Encouraging experimentation through their Digital Sandbox, which provides innovative firms with synthetic data sets that they can use to test new ideas. The Digital Sandbox has undergone two pilots and the FCA is currently looking into developing a permanent operating model for the digital sandbox. For both pilots, the FCA issued evaluation reports (Pilot 1 and Pilot 2), which include details on the set up and development, what types of data sets were provided, as well as lessons learnt.
- Supporting entrepreneurship through its Innovation Pathways programme, a service that assigns eligible businesses a dedicated case manager to provide advice on what regulations are relevant, understand and work through any potential grey areas and provide supervisory support for the first year. This launched in 2022 as an update and enhancement to the FCA's previous Direct Support and Advice Unit Services. The service is not open to everyone: there is an application process and eligibility criteria, meaning that this is only available to businesses that are

innovative, provide consumer benefit, and offer evidence for needing regulatory support. In this way, the regulator can target their resources and the available support toward businesses that are truly innovative and that most need the support. Beyond these requirements, however, the service is open to businesses across the range of sectors regulated by the FCA and across technologies.

- In addition to these initiatives, the FCA also leads the Global Financial Innovation Network (GFIN). The GFIN is a collaborative effort, bringing together 66 financial regulators from across the world. It provides a network for sharing knowledge, but has also worked to explore the possibility of cross-border testing, essentially a type of global sandbox. The first attempts at cross-border tests occurred in July 2021. This provided both learning for firms about what might be needed to bring their solutions to other jurisdictions, as well as insight to regulators on how to practically work across borders.





# Case Study: Regulatory interventions to diversify the Japanese telecoms market

This case study outlines financial incentives and regulatory interventions developed by the Japanese government and regulator to encourage diversification of its telecom market, innovation in new technologies and services, and remove barriers for new entrants. It is most closely linked to the entrepreneurship pillar.

For markets with high barriers to entry, regulatory intervention can be required to stimulate innovation by incumbents and new suppliers; and facilitate market entry of new vendors. Japan has taken a holistic approach to considering a package of regulatory measures to meet policy objectives.

## Background

There are several challenges that new entrants in the 5G market face:

- **High capital costs:** Building a 5G network requires a significant investment in infrastructure and equipment. This can be a barrier for new entrants, particularly for those with limited financial resources.
- **Spectrum allocation:** Securing the necessary spectrum to operate a 5G network can be challenging for new entrants, as spectrum is typically allocated through government-run auctions that can be costly and competitive.
- **Competition with established players:** New entrants will face competition from established players in the telecommunications market, who may have a larger customer base and more resources to invest in 5G technology.
- **Interoperability and standardisation:** Ensuring that equipment and services are compatible with other 5G networks and devices can be a challenge, particularly for new entrants who may not have the same level of resources and expertise as established players.
- **Regulation:** New entrants may find it difficult to navigate the regulatory environment and comply with the technical and safety standards set by the government.
- **Limited access to existing infrastructure:** New entrants may not have the same access to existing infrastructure such as towers and buildings for installing 5G base stations and antennas.



## The Japanese government's approach

Over recent years, the Japanese government and telecoms regulator (MIC) have introduced tax reforms, financial incentives and regulatory measures (in particular on allocation of spectrum for 5G) aimed at encouraging companies to invest in start-ups and 5G in order to stimulate innovation and economic growth.

The 2020 Tax Reform Act introduced tax benefits to promote the introduction of 5G technology and use. Accredited corporations were eligible to receive either a 30% special depreciation rate or a 15% tax credit on qualifying 5G investments (as outlined by the Act) from the enactment of the new Act (the 'Act to Promote Introduction of Specified Advanced Information Communication Systems') through to 31 March 2022. Both Mobile Network Operators (MNOs) and private network developers supporting smart factories or smart agriculture in rural areas are eligible.

The Japanese government also introduced a tax deduction for start-up investments equal to 25% of the capital investment for investments over 100 million yen, subject to an upper ceiling. Both domestic and foreign venture capital companies that are less than 10 years old are eligible under the Industrial Competitiveness Enhancement Law.

Spectrum in Japan is assigned administratively by the MIC. The most recent award involving 5G frequencies was a "beauty contest" in April 2019, in which some frequencies were retained for local licensing of private 5G networks. A beauty contest for spectrum frequencies prioritises the achievement of policy objectives (including innovation and market entry) as opposed to a spectrum auction, where licences are granted on the basis of a highest bidder for an allocation frequency range. For 5G spectrum licences, MNOs are required to meet a range of conditions including a plan



to open up their network as part of a move to encourage open networks and enable smaller vendors to enter the market.

In December 2019, in order to ensure fair competition and encourage innovation by new entrants, MIC issued a request for the dominant mobile carriers to open their 5G networks to other vendors. This request included the following:

- Carriers open their own 5G networks when launching their own 5G services
- Carriers promptly provide other vendors with information necessary for 5G services (such as timing of opening the network, service areas, telecommunication speed, connection fees, connection spots, technological details for connection, etc)
- Carriers give other vendors enough time for discussions, facility upgrade, network tests or other actions required to deploy new technologies into the network.

These measures have enabled the entry of Rakuten into the telecommunications market, through the following activities:

- **Mobile services:** Rakuten launched its own mobile network in Japan in April 2019, becoming the country's fourth mobile network operator. Rakuten's mobile services have been successful due its use of an open network system, which allows it to use the infrastructure of existing mobile network operators.
- **Internet and television services:** Rakuten also offers internet and television services to customers through partnerships with other companies. This allows Rakuten to offer a wide range of services to customers and to compete with established players in the telecommunications market.
- **Innovation:** Rakuten has been investing in new technologies such as 5G and Internet of Things (IoT) to provide more advanced services to customers.

On an international level, Japan has recently agreed several initiatives with the UK aimed at aligning policy approaches to build a more competitive and diverse global market for telecoms equipment, including 5G and future wireless networks. Work is underway to cooperate on open and interoperable network technologies such as Open RAN which removes barriers to entry for smaller vendors into the network.

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<https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/japan>

[https://www.ofcom.org.uk/\\_\\_\\_data/assets/pdf\\_file/0028/231877/mobile-strategy-plum-report.pdf](https://www.ofcom.org.uk/___data/assets/pdf_file/0028/231877/mobile-strategy-plum-report.pdf)

<https://www.gov.uk/government/news/uk-and-japan-forge-closer-links-on-telecoms>

# Case Study: Norway's sandbox for responsible artificial intelligence

The Norwegian regulatory sandbox for responsible innovations using artificial intelligence (AI) links to several pillars, most notably experimentation, adaptability and entrepreneurship. The main mission for the Data Protection Authority's regulatory sandbox is to stimulate the innovation of responsible artificial intelligence. Collaboration and transparency is at the heart of the philosophy behind the sandbox. The sandbox provides free guidance to a handful of carefully selected companies, of varying types and sizes, across different sectors, in exchange for full openness about the assessments that are made.

In an emerging and rapidly developing field such as AI, there are many grey areas and adaptive regulation is challenging. Space to experiment, to test innovation applications of AI and explore legal and ethical issues at an early stage provides innovators with greater clarity on whether new products and services are likely to gain approval. The involvement of public sector organisations in the sandbox engenders collaboration in a safe space.

For the regulator, practical use cases develop organisation competence and inform development of an enabling legal and regulatory environment that takes into account ethical and privacy concerns.







## Background

AI is a rapidly growing field that has the potential to drive significant innovation in a wide range of industries. AI is driving innovation in a variety of ways, through for example, automation, predictive analytics, Natural Language Processing (NLP), Computer Vision, robotics and personalisation. These technologies are not limited to any one sector, but rather are likely to bring benefits in different ways across sectors and disciplines. However, AI also poses ethical and regulatory challenges, related to, for example, privacy, transparency and bias. It is important for researchers, policymakers, and industry leaders to work together to ensure that the benefits of AI are maximised while minimising negative impacts, and that the regulatory challenges are approached in a cohesive manner.

## The Norwegian government's approach

In response to the regulatory issues around AI and to promote the development of innovative artificial intelligence solutions, the Norwegian Data Protection Authority (Datatilsynet) has created a regulatory sandbox. The purpose of the sandbox is to enable companies and public sector organisations to explore responsible and ethical AI innovations. The sandbox provides free guidance to a handful of carefully selected companies, of varying types and sizes, across different sectors, in exchange for full openness about the assessments that are made.

The sandbox helps organizations ensure compliance with relevant regulations and the development of solutions that take privacy

into account. To date, 25 organisations have participated in the sandbox ranging from start-ups to large public organisations. Thematically, this ranges from innovative products and services in finance and insurance to health, education and FoodTech. The Data Protection Authority uses examples and insights arising from sandbox projects to develop guidelines relevant for organizations implementing artificial intelligence and to further develop their competence in this area.

The regulatory sandbox provides exploratory, dialogue-based guidance to selected projects in exchange for full openness about the assessments that are made. In this way, the sandbox builds up a base of practical examples in a field where both the technology and the law are complicated and relatively new.

In the sandbox, participants and the Norwegian Data Protection Authority jointly explore issues relating to the protection of personal data in order to help ensure the service or product in question complies with the regulations and effectively safeguards individuals' data privacy.

The Norwegian Data Protection Authority offers guidance in dialogue with the participants. The conclusions drawn from the projects do not constitute binding decisions or prior approval. Participants are at liberty to decide whether to follow the advice they are given.

The sandbox has proved to be a useful method for exploring issues where there are few legal precedents, with conclusions and assessments shared with other stakeholders addressing similar issues. It was originally funded on a two-year pilot phase and has recently secured permanent funding from the Norwegian government (through the Data Protection Authority).

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<https://www.datatilsynet.no/en/regulations-and-tools/sandbox-for-artificial-intelligence>



# Case Study: UK financial incentives to decarbonise supply of gas into the gas grid

The Green Gas Support Scheme (GGSC) is a programme implemented by the UK energy regulator Scheme to provide financial support for production of renewable natural gas (biomethane) and its injection into the natural gas grid.

The use of financial incentives by regulations to stimulate innovation and create new markets is an important tool when there

are market barriers (such as economies of scale) for new entrants to invest in technologies and infrastructure.

In the GGSS/GGL case, Ofgem conducted broad stakeholder engagement and consultation prior to introduction of the incentive scheme to tailor the intervention and communicate its intentions to industry.



## Background

Green gas is an important component of the decarbonisation of national energy supplies. It is a form of renewable energy that can help to reduce greenhouse gas emissions and reduce future impacts of climate change. Green gas is made from renewable sources such as biomethane, which is produced by breaking down organic material such as agricultural waste or sewage. When used as a fuel, green gas produces fewer emissions than traditional natural gas, and can help to reduce dependence on fossil fuels.

The cost of biomethane production is generally higher than that of natural gas, due to the additional costs of sourcing and processing the organic material. However, the cost of biomethane production is decreasing as technology advances and economies of scale are reached.

In order to stimulate supply-side innovation in terms of biomethane production, some regulators have introduced financial incentives and/or subsidies to speed up the green transition.

## Ofgem's approach

To replace comparable low-carbon schemes that were coming to an end, such as the Non-Domestic Renewable Heat Incentive Scheme, the GGSS and associated GGL was introduced by the UK government, running from November 2021 for four years. To increase deployment of new anaerobic digestion (AD) biomethane plants (and therefore green gas), a GGL was introduced for all suppliers of gas which supply under 95% green gas. Funds collected through the GGL are being used to fund the GGSS, thus the provision of support to biomethane producers.



The two complementary schemes act to increase the price of natural gas supplied into the gas grid, and reduce the price of green gas supplied, through levy and incentive mechanisms:

- The GGL places obligations on licensed gas suppliers, including a requirement to make quarterly levy payments, to fund the GGSS.
- Regular support payments are provided to registered biomethane producers based on the volume of eligible biomethane, produced from AD, that they inject into the gas grid.

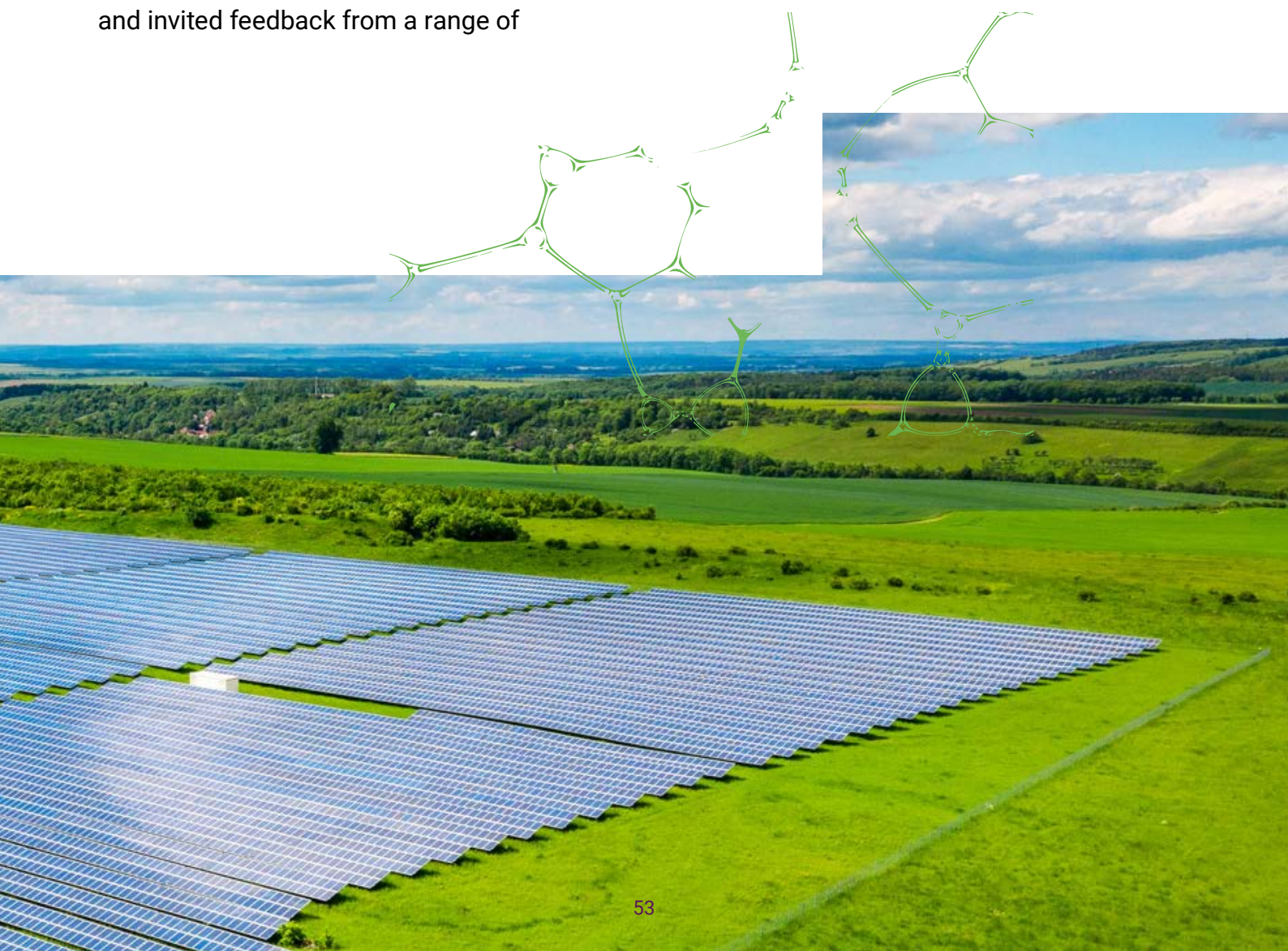
To inform its final position on the GGSS and GGL, Ofgem published two public consultations in July of 2021, which set out a proposed administrative approach and invited feedback from a range of

stakeholders, including biomethane producers, industry, trade associations and consultancies. The 31 responses received were collated, reviewed, considered carefully and responded to by Ofgem. In addition, a stakeholder event was held in July 2021 for the GGL consultation. Based on this feedback, Ofgem published responses setting out its final position, including where its proposed approach had been changed in response to feedback received.

The GGSS launched in Autumn 2021, with over £2 million of support provided to biomethane producers to date.

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<https://www.ofgem.gov.uk/environmental-and-social-schemes/green-gas-support-scheme-and-green-gas-levy>





# Case Study: Australian Energy Innovation Toolkit

The Australian energy innovation toolkit contains a range of tools to support proof-of-concept trials in the Australian national electricity market. It was established to encourage innovation that has potential to contribute to the long-term interest of consumers. The main innovation goals include new technological solutions, products and services; new tariff-models; new business models; and new regulatory arrangements.

The toolkit contains a range of supporting measures that cover adaptability, experimentation and entrepreneurship.

The Energy Innovation Toolkit provides a user-friendly, one-stop-shop for innovators. The approach is designed to provide a range

of tools from initial ideas, feasibility tests through to practical trials. Use-cases help illustrate potential innovations and enable stakeholders to scope new business models.

This approach is also a two-way street, with promotion of knowledge sharing across public and private stakeholders in order to develop evidence-based policies and regulations that support innovation.

## Background

Electricity generation and transmission is undergoing major changes. Developing and implementing policies and regulations that enable innovation and support the integration of renewable energy sources into the grid can be challenging. There are several challenges



for stable, green, and reliable electricity transmission, including:

- **Grid integration of renewable energy sources:** As the amount of renewable energy on the grid increases, it can be challenging to ensure that the grid remains stable and reliable. This is because renewable energy sources such as solar and wind are variable and weather dependent.
- **Grid infrastructure:** Upgrading and expanding grid infrastructure can be costly and time-consuming. It's important to ensure that investments in new infrastructure are cost-effective and can accommodate the integration of renewable energy sources.
- **Energy storage:** As more renewable energy is added to the grid, energy storage solutions are needed to balance the variability of renewable energy sources.
- **Grid security:** As the grid becomes more complex and decentralised, it becomes increasingly important to ensure that it is secure and resilient against physical and cyber threats.
- **Consumer behaviour and demand management:** As the grid becomes more decentralised, it becomes increasingly important to engage with consumers and manage their demand for electricity in order to ensure that the grid remains stable and reliable.

## The Australian Energy Regulator's Approach

The Energy Innovation Toolkit (EIT) was developed by the Australian Energy Market Commission to support energy innovators and start-ups navigate complex regulatory frameworks, and trial new products and services that will deliver greater choice and cheaper energy options for consumers. It has three components.

1. An Innovation Enquiry Service providing innovators with guidance on how their new technologies or business models can be delivered under the current regulatory framework. This includes an interactive regulation navigator which provides on-the-spot guidance on key regulatory obligations which may apply to certain scenarios inputted by users and detailed step-by-step case studies based on likely scenarios to assist innovators in planning similar projects.
2. The Australian Energy Regulator is able to grant time-limited trial waivers for eligible projects, exempting an innovator from having to comply with specified rules for a period of time to allow a trial to proceed. Trial waivers are subject to a number of conditions, including consumer protection measures, reporting requirements and other obligations that may be specific to the trial.
3. A trial rule change process allowing for temporary changes to existing rules or the introduction of a new rule to allow a trial to proceed.

Trials provide a structured framework for innovative products and services to be tested in a real-world environment while still protecting consumers. Using trial waivers and time-limited rule changes, trial projects provide proponents with evidence on the feasibility of new business models.

The Energy Innovation Toolkit also aims to promote knowledge-sharing through reporting on trial outcomes and service usage to policy makers, to make sure that learning fuels evidence-based change.

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<https://www.aer.gov.au/networks-pipelines/regulatory-sandboxing-%E2%80%93-energy-innovation-toolkit>

[https://www.iea-iskan.org/wp-content/uploads/2019/05/ISGAN\\_Casebook-on-Regulatory-Sandbox-A2-1.pdf](https://www.iea-iskan.org/wp-content/uploads/2019/05/ISGAN_Casebook-on-Regulatory-Sandbox-A2-1.pdf)

<https://energyinnovationtoolkit.gov.au/>







## In practice

One recent example is the Cobargo and District Energy Transition (CaDET) which hopes to build an electricity microgrid that allows a portion of the town to continue to operate, using locally stored and generated electricity (island mode), when the network connection to the interconnected system ('the grid') is offline.

Following meetings between EIT and the project partners work is now underway to create more detailed operational and technical plans for the microgrid. Next steps could include a desktop trial, a formal sandboxing trial through the EIT or making a formal rule change request.

# Annex 2

## Metrics and data

### Note on metrics

The tables in this section present the underlying metrics used to calculate the overall scores for each pillar. A few points to consider regarding this data:

- The numbers presented may not match the original source as all metrics have been standardised to a 0-100 scale.
- In some instances, qualitative assessments have been translated into a quantitative assessment.
- The metrics presented here are unweighted. When calculating the final scores for each pillar, the relative relevance and reliability of each of the metrics has been considered, meaning that the final score is not a straight average of the metrics shown.
- The tables indicate the relative contributions of cross-cutting and sector-specific metrics for each pillar. In general, a greater weight is given to cross-cutting metrics across all pillars.



# Adaptability

## Underlying Metrics

Country	Cross-cutting 70%					Fintech 10%	Transport (CAVs) 20%	
	Efficiency of legal framework in challenging regulations	Existence of regulatory framework for enabling technologies	Government's responsiveness to change	Legal framework's adaptability to digital business models	Regulation of emerging technologies	Existence of regulatory framework for fintech activities	AV regulations	AV-focused agency
Source	World Economic Forum	New metric	World Economic Forum	World Economic Forum	World Economic Forum	New metric	KPMG AV Readiness Index	KPMG AV Readiness Index
Australia	50.4	56.3	52.9	56.7	70.7	83.3	100.0	71.4
Austria	53.4	75.0	58.0	55.3	67.9	66.7	85.7	92.9
Brazil	27.7	43.8	29.2	33.5	48.4	66.7	28.6	14.3
Canada	56.0	37.5	54.2	58.0	77.7	66.7	78.6	71.4
China	51.5	56.3	49.8	59.5	-	33.3	78.6	64.3
Denmark	59.0	56.3	60.7	60.2	-	66.7	71.4	85.7
Finland	78.1	62.5	69.9	67.7	100.0	66.7	100.0	71.4
France	56.1	87.5	56.0	50.8	77.9	66.7	78.6	71.4
Germany	63.6	62.5	60.0	67.3	77.6	83.3	78.6	85.7
Israel	55.4	31.3	54.6	65.3	85.1	50.0	71.4	64.3
Japan	57.6	68.8	54.9	54.0	63.4	50.0	57.1	57.1
Mexico	32.0	50.0	33.4	46.6	50.4	66.7	14.3	14.3
Norway	56.9	62.5	58.5	60.3	-	50.0	92.9	64.3
Singapore	59.4	87.5	85.2	76.5	86.8	100.0	100.0	100.0
South Korea	40.7	50.0	54.6	55.2	67.5	100.0	85.7	85.7
Sweden	56.6	62.5	56.1	67.9	84.2	66.7	71.4	71.4
Switzerland	71.0	87.5	67.1	60.5	85.1	16.7	-	-
The Netherlands	68.1	75.0	62.5	65.5	82.0	66.7	100.0	71.4
United Arab Emirates	70.4	43.8	78.6	72.5	75.0	100.0	85.7	92.9
United Kingdom	59.1	75.0	58.4	64.8	74.3	83.3	92.9	85.7
United States	66.2	50.0	68.9	78.0	88.1	33.3	85.7	71.4

# Clarity & Reliability

## Underlying Metrics

Country	Cross-cutting 60%			Energy 20%			Telecoms 20%				
	Government long-term vision	Policy design principles	Trust in government	Legal framework for renewable energy	National energy efficiency planning	Energy efficiency entities	Digital strategy for development	Codes of conduct	Regulatory Mandate	Regulatory Authority	Regulatory Regime
Source	World Economic Forum	ITU G5 Benchmark	OECD	RISE	RISE	RISE	ITU G5 Benchmark	ITU G5 Benchmark	ICT Regulatory Tracker	ICT Regulatory Tracker	ICT Regulatory Tracker
Australia	43.9	78.7	51.9	100.0	100.0	92.0	100.0	100.0	88.6	90.0	100.0
Austria	55.8	83.4	61.0	100.0	87.0	83.0	100.0	100.0	79.5	85.0	93.3
Brazil	23.9	83.4	32.7	80.0	60.0	100.0	75.0	100.0	86.4	95.0	93.3
Canada	57.0	87.9	61.0	60.0	100.0	75.0	100.0	100.0	75.0	95.0	100.0
China	57.9	37.0	-	100.0	83.0	75.0	50.0	0.0	50.0	40.0	80.0
Denmark	62.8	83.4	65.2	100.0	80.0	100.0	100.0	100.0	95.5	90.0	93.3
Finland	67.9	69.5	71.4	100.0	93.0	100.0	100.0	100.0	90.9	95.0	100.0
France	58.8	78.7	43.4	100.0	93.0	92.0	100.0	100.0	93.2	90.0	100.0
Germany	59.0	87.9	60.5	100.0	100.0	100.0	100.0	-	88.6	85.0	100.0
Israel	54.2	78.7	63.4	100.0	100.0	92.0	100.0	100.0	61.4	50.0	86.7
Japan	60.8	78.7	29.1	80.0	67.0	67.0	100.0	100.0	52.3	40.0	93.3
Mexico	32.9	78.7	48.3	80.0	93.0	92.0	50.0	0.0	90.9	95.0	93.3
Norway	62.6	78.7	77.4	100.0	-	-	100.0	100.0	79.5	100.0	100.0
Singapore	91.2	74.1	-	80.0	100.0	100.0	100.0	100.0	97.7	85.0	93.3
South Korea	56.9	78.7	43.4	80.0	93.0	100.0	100.0	100.0	70.5	50.0	80.0
Sweden	55.6	74.1	63.4	100.0	73.0	92.0	100.0	0.0	90.9	95.0	73.3
Switzerland	70.1	74.1	83.8	100.0	73.0	100.0	100.0	100.0	84.1	90.0	100.0
The Netherlands	64.2	74.1	58.5	80.0	100.0	100.0	100.0	100.0	79.5	90.0	100.0
United Arab Emirates	81.7	64.8	-	80.0	100.0	100.0	100.0	100.0	90.9	95.0	86.7
United Kingdom	51.4	83.4	39.5	100.0	100.0	100.0	100.0	100.0	88.6	100.0	93.3
United States	66.2	83.4	40.5	60.0	88.0	92.0	80.0	100.0	79.5	95.0	100.0

# Collaboration Underlying Metrics

Country	Cross-cutting 60%	Energy 10%	Transport (CAVs) 10%	Telecoms 10%		Fintech 10%
	National collaborative governance	ICT Collaboration with energy regulator	ICT Collaboration with transport regulator	Regulatory collaboration in digital core areas	International collaboration and harmonisation	ICT Collaboration with Finance Regulator
Source	ITU G5 Benchmark	ITU G5 Benchmark	ITU G5 Benchmark	ITU G5 Benchmark	ITU G5 Benchmark	ITU G5 Benchmark
Australia	95.7	100.0	100.0	100.0	50.0	100.0
Austria	77.2	100.0	0.0	91.7	100.0	0.0
Brazil	77.2	100.0	0.0	91.7	75.0	0.0
Canada	80.2	100.0	100.0	100.0	75.0	0.0
China	74.1	0.0	100.0	66.7	50.0	50.0
Denmark	64.8	100.0	0.0	91.7	100.0	50.0
Finland	83.3	50.0	100.0	75.0	100.0	50.0
France	55.6	50.0	50.0	50.0	100.0	50.0
Germany	92.6	100.0	100.0	100.0	100.0	100.0
Israel	64.8	0.0	100.0	66.7	50.0	0.0
Japan	80.2	50.0	100.0	66.7	75.0	100.0
Mexico	71.0	100.0	50.0	75.0	100.0	0.0
Norway	86.4	100.0	0.0	100.0	50.0	0.0
Singapore	86.4	100.0	100.0	91.7	100.0	100.0
South Korea	86.4	100.0	100.0	83.3	50.0	100.0
Sweden	80.2	100.0	50.0	91.7	100.0	100.0
Switzerland	80.2	100.0	100.0	91.7	50.0	0.0
The Netherlands	86.4	100.0	100.0	100.0	100.0	100.0
United Arab Emirates	77.2	100.0	100.0	75.0	50.0	100.0
United Kingdom	95.7	100.0	100.0	91.7	50.0	100.0
United States	64.8	0.0	100.0	100.0	75.0	100.0

# Experimentation Underlying Metrics

Country	Energy 25%	Transport (CAVs) 25%	Telecoms 25%	Fintech 25%
	Use of sandboxes/ testbeds in the energy sector	Government-funded AV pilots	Regulatory experimentation	Use of sandboxes/ testbeds in the fintech sector
Source	New metric	KPMG AV Readiness Index	ITU G5 Benchmark	New metric
Australia	100.0	57.1	100.0	100.0
Austria	100.0	85.7	100.0	100.0
Brazil	0.0	14.3	100.0	100.0
Canada	100.0	100.0	100.0	100.0
China	0.0	92.9	100.0	100.0
Denmark	0.0	64.3	100.0	100.0
Finland	0.0	85.7	100.0	0.0
France	100.0	85.7	100.0	0.0
Germany	100.0	85.7	100.0	0.0
Israel	0.0	78.6	100.0	100.0
Japan	0.0	85.7	100.0	100.0
Mexico	0.0	14.3	0.0	100.0
Norway	100.0	85.7	100.0	100.0
Singapore	100.0	100.0	100.0	100.0
South Korea	100.0	100.0	100.0	100.0
Sweden	0.0	71.4	100.0	0.0
Switzerland	100.0	-	100.0	100.0
The Netherlands	100.0	92.9	100.0	100.0
United Arab Emirates	0.0	71.4	100.0	100.0
United Kingdom	100.0	85.6	100.0	100.0
United States	100.0	92.9	100.0	100.0

# Entrepreneurship Underlying Metrics

Country	Cross-cutting 65%				Energy 25%			Fintech 10%
	Burden of government regulation	Government online services	Extent of market dominance	Companies embracing disruptive ideas	Financing mechanisms for energy efficiency	Energy labelling systems	Carbon pricing	Presence of innovation hub
Source	World Economic Forum	UNDESAO	World Economic Forum	World Economic Forum	RISE	RISE	RISE	New metric
Australia	39.8	93.8	54.6	52.8	100.0	96.0	100.0	100.0
Austria	44.7	88.3	67.3	45.7	77.0	79.0	50.0	100.0
Brazil	11.4	89.6	46.2	46.8	83.0	100.0	25.0	100.0
Canada	48.3	84.0	59.0	55.1	100.0	92.0	100.0	100.0
China	56.3	88.8	58.9	53.8	75.0	67.0	50.0	0.0
Denmark	47.9	98.0	72.7	64.5	75.0	67.0	100.0	100.0
Finland	64.9	98.3	53.0	59.3	65.0	79.0	100.0	100.0
France	42.8	87.7	59.2	52.3	75.0	50.0	100.0	100.0
Germany	56.9	79.1	71.7	63.3	75.0	96.0	100.0	100.0
Israel	42.2	87.5	47.2	68.5	42.0	63.0	100.0	100.0
Japan	50.1	90.9	76.2	48.7	83.0	96.0	100.0	100.0
Mexico	31.1	82.5	43.3	43.0	90.0	88.0	100.0	0.0
Norway	47.5	80.1	63.4	57.7	-	-	0.0	100.0
Singapore	74.4	96.2	63.8	59.6	77.0	92.0	100.0	100.0
South Korea	37.6	98.3	42.8	49.6	75.0	100.0	100.0	100.0
Sweden	45.9	90.0	63.7	59.6	40.0	100.0	100.0	100.0
Switzerland	63.2	76.8	80.1	53.8	-	75.0	100.0	0.0
The Netherlands	56.6	90.3	70.6	62.3	100.0	67.0	100.0	100.0
United Arab Emirates	70.3	90.1	66.9	61.6	65.0	67.0	100.0	0.0
United Kingdom	55.6	88.6	60.2	59.3	100.0	79.0	100.0	100.0
United States	57.7	93.0	70.6	68.1	100.0	88.0	40.0	100.0



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