

strategy&

Part of the PwC network



Creating a fully autonomous vehicle ecosystem

The future of mobility

Contacts

Dubai

Dr. Andreas Gissler
Partner
+971-4-436-3000
andreas.gissler
@strategyand.pwc.com

Mark Haddad
Partner
+971-4-436-3000
mark.haddad
@strategyand.pwc.com

Ruggero Moretto
Principal
+971-4-436-3000
ruggero.moretto
@strategyand.pwc.com

Roy Yammine
Manager
+971-4-436-3000
roy.yammine
@strategyand.pwc.com

Munich

Jonas Seyfferth
Director
+49-89-545-25-0
jonas.seyfferth@pwc.com

About the authors

Dr. Andreas Gissler is a partner with Strategy& Middle East, part of the PwC network. Based in Dubai, he is a member of the mobility, aerospace, infrastructure, and tourism practice in the Middle East. He has more than 24 years of experience in advising clients from the automotive, mobility, and industrial sectors in China, Europe, the Middle East, and the United States. His expertise includes connected car, autonomous driving, and shared- and e-mobility strategies.

Mark Haddad is a partner with Strategy& Middle East. He is a member of the mobility, aerospace, infrastructure, and tourism practice in the Middle East. He specializes in all aspects of surface transport and the future of mobility. He has 18 years of experience in Europe, the Middle East, and North Africa, advising top leaders and senior business executives in government-owned and private entities. He has led large-scale mobility and transport infrastructure programs in major cities focusing on strategy, financial planning, and innovation.

Ruggero Moretto is a principal with Strategy& Middle East. Based in Dubai, he is a member of the urban mobility team within the mobility, aerospace, infrastructure, and tourism practice in the Middle East. He supports an array of clients in the Middle East, including transport authorities, service providers, and regulators. He specializes in urban mobility, focusing on strategic and financial planning, infrastructure development, smart mobility, and innovation.

Roy Yammine is a manager with Strategy& Middle East. Based in Dubai, he is a member of the mobility, aerospace, infrastructure, and tourism practice in the Middle East. He supports an array of clients in the Middle East including transport authorities and regulators. He specializes in strategic and financial planning, operating model development, and transformations.

Jonas Seyfferth also contributed to this report.

EXECUTIVE SUMMARY

Gulf Cooperation Council (GCC)¹ countries are on the brink of a mobility and industrial revolution. Fully autonomous vehicles (FAVs) will redefine mobility in major cities. Across the region, robo-taxis, robo-shuttles, robo-buses,² and passenger drones could make transport accessible to all within fully automated, integrated, and demand-responsive networks. We forecast that the global market for these technologies could be US\$182 billion by 2035, including \$18.7 billion in the GCC. The region could become a global FAV innovation leader, achieving the economic diversification and technology advances that are at the heart of national development plans.

Already, these countries have made significant investments and launched visionary pilot projects. However, there are challenges. The fragmented institutional ecosystem hampers coordination when companies introduce transformative technologies. Regulation can be inconsistent or undeveloped. In thinking about FAVs, the public worries about safety, reliability, ethical decision-making in accidents, and data privacy. Infrastructure does not meet FAV needs. Roads are designed for human drivers, whereas FAVs use sensors and communication networks. Also, immediate infrastructure repairs can appear more important than readying cities for FAVs.

In response, GCC cities need a new mindset to push FAV technology to mass commercialization through three tipping points: ready for a pilot project, ready to operate commercially, and ready to scale. To get through these tipping points, GCC cities should:

- Institute holistic program management that allows FAV technologies to reach the scale needed for implementation. Coordinate among government entities, technology companies, and mobility providers.
- Define and activate the most relevant pilot projects for each technology.
- Collaborate with national governments and regulators on legislation, regulations, and liability frameworks.
- Invest in infrastructure to enable FAV piloting and scaling.
- Cultivate an ecosystem of technology providers, operating companies, and startups. Regulators should supervise the ecosystem, using publicly funded incentives.
- Ensure convenience and integration into transport networks to encourage public and consumer acceptance.



THE PROMISE OF FAVs

Imagine living in a city in which robo-taxis and robo-buses make mobility accessible to everyone. Imagine these robotic transportation options being available to you at the touch of a button. Imagine having access to a fully automated, integrated, and demand-responsive network that takes you smoothly, swiftly, and safely to your destination. Imagine a robotic fleet operating on cleaner energy sources and resulting in a fraction of today's emissions. Imagine the improvement in your quality of life and the urban environment. This dream could become reality in the Gulf Cooperation Council (GCC) region within the coming decades if the correct policies are implemented.

Although many cities around the world are committed to encouraging new forms of transportation, cities in the GCC region are on the brink of a true mobility transformation. That is because the region has the ambition, the capital, and the environment in which fully autonomous vehicles (FAVs) can thrive. The GCC's ambition to lead the deployment of FAVs such as passenger drones, robo-taxis, robo-shuttles, and robo-buses will redefine the meaning of mobility in major cities. GCC countries have sovereign wealth funds with considerable resources that can make significant long-term investments. Additionally, the regulatory structure in GCC countries, although in need of an update, is not a structural impediment to growth and innovation. For GCC governments, with their bold national development plans, the full adoption of FAVs would mark the start of a new industrial era with significant economic impact. The GCC region already has plans to be a creative digital hub that attracts top talent; it could also become a global epicenter of FAV innovation.



Although many cities around the world are committed to encouraging new forms of transportation, cities in the GCC region are on the brink of a true mobility transformation. That is because the region has the ambition, the capital, and the environment in which fully autonomous vehicles (FAVs) can thrive.

Use cases galore

The case for FAVs is compelling. Some of these technologies are already on the streets. Others are in testing or development.



Robo-taxis

Large-scale commercial pilot initiatives already exist for electric-powered robo-taxis with paying customers in Chinese and U.S. cities.³ Robo-taxis cause less congestion, are more reliable, and are safer than human-driven cabs. They could become a viable alternative by 2028.



Robo-shuttles

Some parts of Europe are testing robo-shuttles now.⁴ There is considerable potential for robo-shuttle deployment within controlled environments such as university and corporate campuses. Robo-shuttles work well for such areas because they need supporting infrastructure such as dedicated lanes, reserved carriageways, and established stops. Also, robo-shuttles have potential for “last mile” applications, as they could be cheaper and more effective than human-operated services.



Robo-buses and robo-trucks

Ongoing passenger (robo-bus) and freight (robo-truck) studies are examining the operational and safety aspects of these vehicles.⁵ This research is vital given the cargo, whether human or goods, and the deployment in complex urban and highway environments. Such robotic vehicles would be safer and more efficient as they could stay on the road most of the day and night, returning to base only for charging, cleaning, and maintenance.



Passenger drones

Passenger drones hold strong potential in that they take advantage of the unused lower altitudes of urban airspace. They are particularly appealing for cities that are on large bodies of water, which can act as landing pads for amphibious drones and offer safer routes than dense urban areas. Passenger drones are also of interest to cities that can provide strategic locations for vertical take-off airports (verti-ports, which are larger versions of helipads).⁶ Passenger drones can ferry people along selected routes or in specific areas, for example, from the city center to a transport hub such as an airport. The use of urban airspace, however, does create complex regulatory requirements and air traffic management issues.

A market in which GCC countries can win

The promise of FAVs exceeds their ability to reinvent cities. We estimate that the total value of the market for ground FAVs (robo-buses, robo-shuttles, and robo-taxis) could be in excess of \$105 billion by 2035, with combined sales of 1.4 million units. The GCC could win \$12.5 billion of this market by 2035. We expect that robo-taxis will be the largest segment of the FAV market, with at least 1.1 million units worth \$55 billion sold in 2035. The GCC could achieve an 18 percent share of that market, \$10 billion, and sell 200,000 units (see *Exhibit 1*).





Over the longer term, GCC countries could take advantage of planned investments in automotive manufacturing to also build robo-taxis in the region.⁷ GCC countries could use the software and functionality of these car manufacturing joint ventures to build the FAV ecosystem. Further, the introduction of FAVs could be an opportunity to localize all automotive maintenance within the region. Saudi Arabia has already invested in robo-shuttles and robo-taxis.⁸



EXHIBIT 1

GCC countries can win a large share of the FAV market

Market forecast for Level 5 automation,¹ 2035

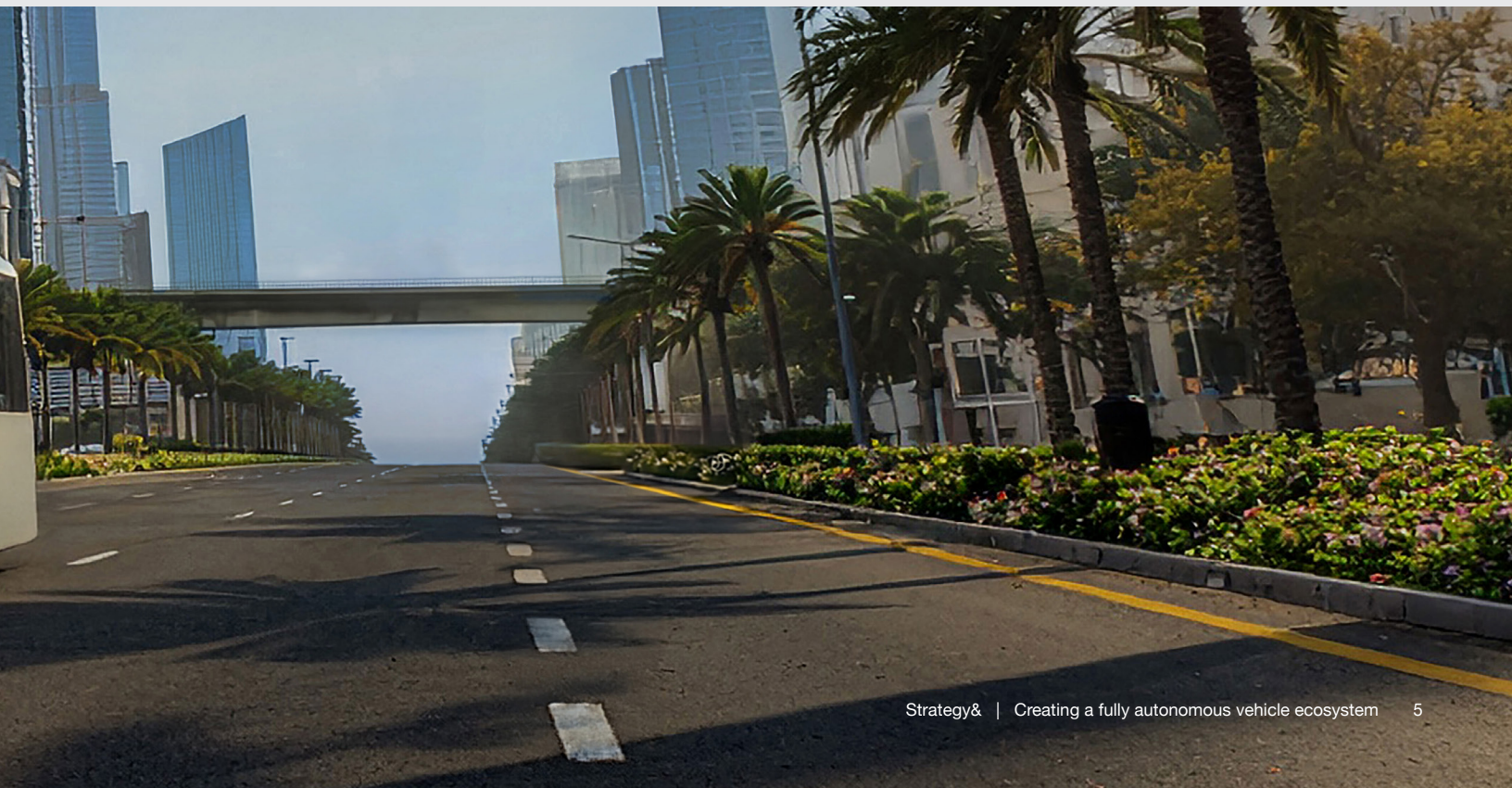
		Global		GCC	
		Units sold	Market (US\$)	Units sold	Market (US\$)
	Robo-taxis	1.1 million–1.5 million	55 billion–75 billion	110,000–220,000	5.5 billion–11 billion
	Robo-shuttles	200,000–250,000	30 billion–37 billion	10,000–20,000	1.5 billion–3 billion
	Robo-buses	100,000–150,000	20 billion–30 billion	5,000–15,000	1 billion–3 billion
	Passenger drones	12,000–15,000	32 billion–40 billion	~400–700	1 billion–1.7 billion

Note: Forecast unit prices by 2030: Robo-taxi US\$50,000, robo-shuttle US\$150,000, robo-bus US\$200,000.

¹ SAE International, "SAE Levels of Driving Automation™ Refined for Clarity and International Audience," May 3, 2021 (<https://www.sae.org/blog/sae-j3016-update>).

Level 5 is full automation under all conditions.

Source: Strategy&



BUMPS ON THE ROAD

GCC cities must overcome two sets of challenges if they are to weave robotic mobility into the fabric of urban life, related to technological adoption and the region-specific environment.

Through the tipping points

In terms of adoption, robotic mobility, like all other technologies, must proceed through several tipping points. Each tipping point represents a threshold regarding technological readiness, regulatory acceptance, cost-effectiveness, and in the final tipping point, consumer acceptance. Once the technology has passed the tipping point, it is ready for increased adoption and greater market share (see *Exhibit 2*). We project that each of these technologies will be ready for deployment between 2035 and 2040 both in the GCC and globally (see *Exhibit 3, page 6*).



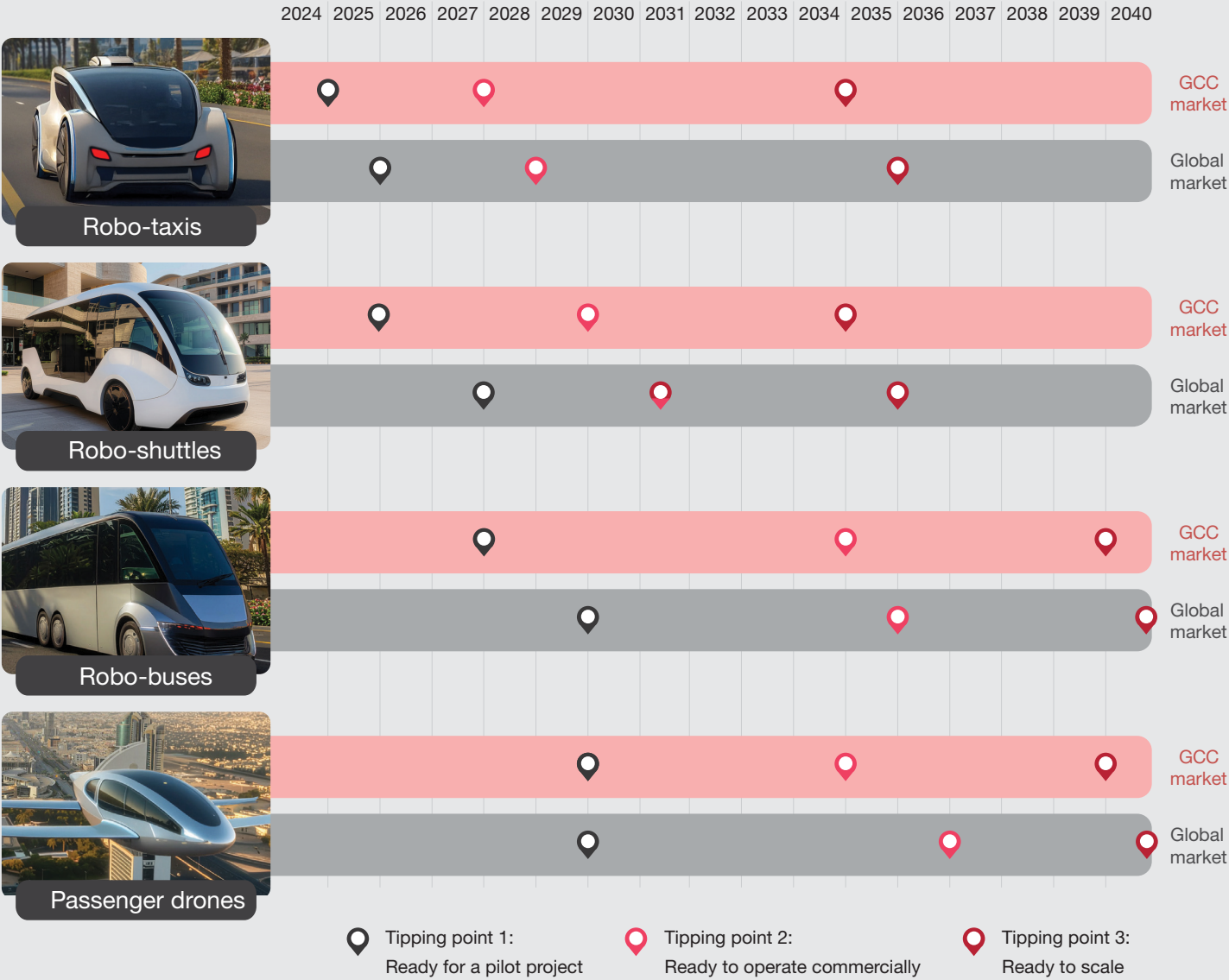
EXHIBIT 2

Technology reaches widespread adoption by passing three tipping points



EXHIBIT 3
Each technology is expected to proceed through the tipping points by 2040

Tipping point timing



Tipping point 1: Ready for a pilot project

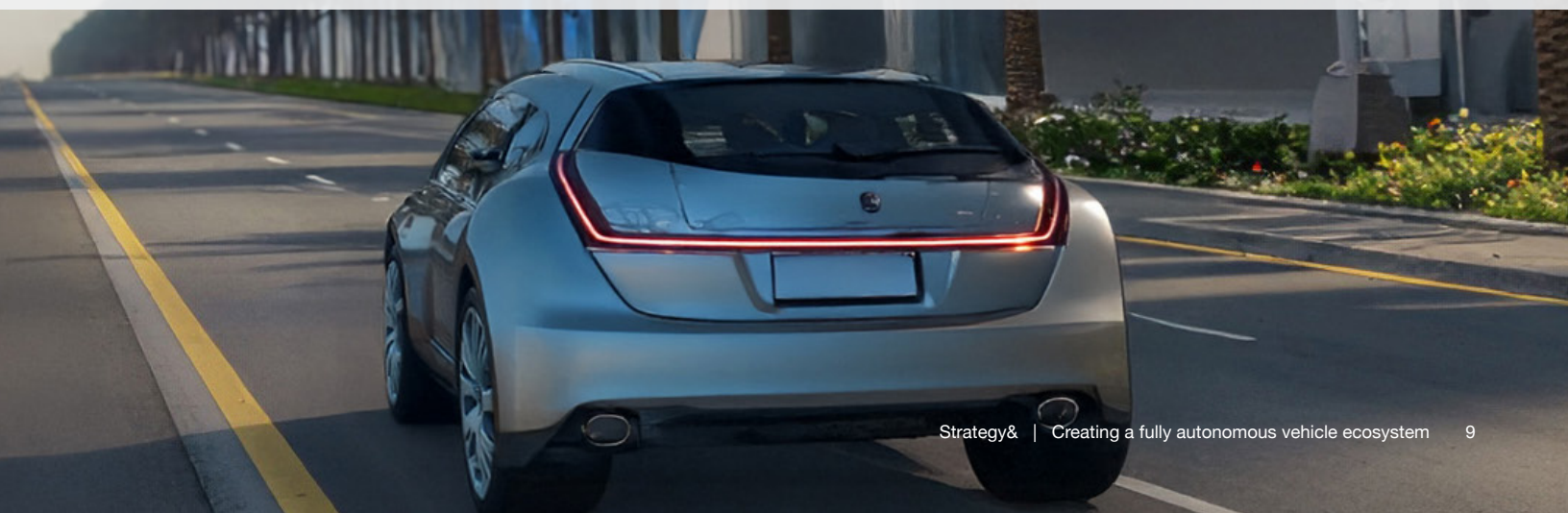
The first tipping point is when an emerging technology performs well under test conditions. That means it is ready for a pilot project in controlled conditions. Given that the technology may not yet meet all regulatory requirements, it may require special exemptions, such as a “sandbox.”⁹ At this stage, it is premature to consider whether the technology is economically viable and what the size of the market might be. Today, robo-taxis have completed their pilot projects. Other robotic mobility technologies are still at this stage.

Tipping point 2: Ready to operate commercially

The second tipping point is when the technology can operate with full reliability in a set of diverse, real-world scenarios and complies with all regulatory requirements. There also is significant user interest in the technology, such that it has the potential to become a cost-effective competitor with existing alternatives. After this second tipping point, the technology still needs the government to enable its ability to operate in a scalable fashion through access to infrastructure and various incentives and subsidies. For example, the government could provide incentives for taxi operators to acquire robo-taxi fleets. Also, the government could provide subsidies on a per-ride basis to make robo-taxis competitive with conventional cabs and ride-share options. Today, many robo-taxi projects are at this stage.

Tipping point 3: Ready to scale

The third tipping point is when the technology is ready to scale, as it is well integrated with the mobility ecosystem. The technology attracts high levels of demand, and the market expands. The public accepts the technology. The companies making and operating the technology do so in a financially sustainable manner. Today, no robotic mobility technology is at this stage, although robo-taxis may reach it by the end of this decade.



Regional challenges

GCC countries have a global competitive edge in this field. They possess the resources to fund these ventures, obtaining licenses is easier in the region than it is elsewhere, and these countries have unrivaled testing grounds in their futuristic giga projects. The difficulty in the GCC region is that despite bold investments and visionary FAV pilot projects, significant challenges exist for companies wishing to move past the second tipping point. If GCC countries do not resolve these issues, they risk losing their competitive edge. Worse, failure to act could exacerbate urban challenges, including congestion, pollution, and inefficient supply chains.

Too many cooks

Many parties are involved in piloting and applying FAV technologies, but their coordination is less than ideal. Despite the eagerness of cities to introduce FAV technologies, incorporating them into the urban mobility ecosystem takes time and demands ongoing coordinated efforts. FAV technology is new. There are no foundations to build on. Even when a technology is “ready to deploy” and the city has a willing tech company partner, it still needs to undergo local testing, such as heat testing for the region’s climate, and customization, such as the creation of an Arabic interface.

Underdeveloped regulation

Regulatory frameworks are fragmented and underdeveloped, which discourages private-sector investment. For example, safety standards are not harmonized, and liability and operational rules remain unclear. Also, FAVs lack clear licensing requirements. There is no dedicated insurance coverage or liability allocation. It would help if more countries allowed for FAV testing in sandboxes, as described above, which Saudi Arabia does for FAV regulation.

Lack of public trust

The public does not yet trust FAV technology. Public wariness restrains consumer adoption. People are worried about safety, reliability, ethical decision-making in accidents, and data privacy, although international studies show that attitudes are becoming more positive. For example, a 2023 survey by PwC’s Strategy& found that 29 percent of respondents in the U.S. were very, or rather, comfortable with using an FAV, compared with 18 percent in 2021. In China, 81 percent were very, or rather, comfortable with a journey in an FAV, compared with 39 percent in 2021.¹⁰ A particular concern is how FAVs interact with human-driven cars in urban environments.

Insufficient infrastructure

Infrastructure availability for FAVs is patchy. Cities such as Abu Dhabi, Dubai, and NEOM are pioneering smart infrastructure initiatives. However, the broader region lacks clarity on what technological components of infrastructure are necessary for problem-free deployment of FAVs, such as vehicle-to-everything (V2X) communication systems and dedicated FAV lanes and hubs (places where these vehicles can go to recharge their batteries and receive support).

Readying infrastructure for FAVs presents its own prioritization problems. Cities must maintain safe roads even as they integrate FAVs. Much existing infrastructure needs repair, work that cannot wait for FAV technology. It is cheaper and quicker to maintain current infrastructure than to build new roads and highways that support FAVs. Further, cities could spend now to incorporate today's FAV requirements, only to discover that their expensive new infrastructure will not work for the FAVs that eventually drive on their roads. On the other hand, delay could also prove costly, as it could deter innovation.

Impatient funding

Although GCC countries have financial means, funders may not have the patience and the long-term view required to develop FAVs. Ultimately, they should aim to give FAVs a profitable business model. That could take another decade or even longer. Funders need to grasp the importance of having FAV technology proceed through the tipping points. Additionally, some legacy taxi operators may regard FAVs as a threat to their existence and may need funding to help convince them to move to the new technology.



GCC countries have a global competitive edge in this field. They possess the resources to fund these ventures, obtaining licenses is easier in the region than it is elsewhere, and these countries have unrivaled testing grounds in their futuristic giga projects.



CLEARING THE WAY FOR FAVs

The most effective FAV strategy involves more than implementing recommendations and overcoming the region's challenges. Policymakers need to think in a wholly different, more imaginative way. They need to create the conditions that enable the commercially viable deployment of FAV technologies so that FAVs reach the scale enabling them to reshape the mobility ecosystem of the GCC's major cities.

Holistically manage the FAV program

GCC cities need comprehensive program management and coordination among all stakeholders to push the technology through the tipping points. Stakeholders include government entities, technology companies, and mobility providers. City leaders must think holistically, as there are many dimensions to these technologies and how they integrate into urban mobility. During this multiyear process, cities must remain focused on the goals of a high level of FAV integration, quality service, and cost competitiveness through economies of scale. Only through such an attitude can they justify current investments and generate positive business cases.

Urban transport authorities should orchestrate the FAV ecosystem. That will require them to develop their own capabilities. Transport authorities will need to avoid getting bogged down with the demands of managing the current mobility system. They also should choose which operating model works best for managing their FAV program. They could opt for an asset-heavy approach, buying their own FAVs. Or they may feel a light asset model works better, providing incentives to taxi fleet operators to acquire FAVs or convert fully to FAVs. A light approach also could rely on FAV companies to contribute more. Transport authorities could also consider quotas for adoption as a means of pushing a particular technology toward the tipping point faster.

Carefully define pilot projects

Cities need to define which pilot projects they want to launch for each technology. They should base the choice on environmental conditions, availability of infrastructure, the presence or absence of regulatory sandboxes, and relevance to large-scale application, by considering, for example, the geographic area and user base. Cities must ensure that pilot projects are closely coordinated with overall FAV objectives. For instance, it would be pointless to implement a robo-bus pilot project in a low-density residential neighborhood in a major city with low public transport ridership and multiple individual destinations, such as private houses and villas. Such a location might instead be ideal for piloting robo-taxis.



Activate regulations

Cities need to coordinate closely with national governments and regulators so that regulations stimulate innovation while ensuring safety. Cities should convene an ongoing dialogue with stakeholders, such as urban transport operators and insurers, to design proper liability frameworks. Regulations also need to guarantee safety and coordinate with existing transportation modes even while they integrate FAVs, which is vital to gaining public trust.

Enable FAV infrastructure

Cities need to build and upgrade infrastructure so that it enables FAVs. Given that much smart infrastructure benefits other parts of the economy, some of the funding will come from the national government. Smart infrastructure is particularly important because it allows FAVs to communicate with each other, other vehicles, and controllers. That necessitates 5G networks in some areas, which telecom operators could fund. However, not all infrastructure has to be smart. Some FAVs, for example, do not require universal 5G coverage.

In terms of physical provision, cities need dedicated FAV lanes, which make the vehicles easier to operate. Cities need to build FAV vehicle hubs. They also must create control centers, which remotely operate FAVs and coordinate them with existing mobility providers.

Cultivate the ecosystem

Cities should foster an ecosystem of technology providers, operating companies, and startups. Regulators should supervise the ecosystem. National and municipal governments should provide incentives. Cities can consider instituting innovation districts and special economic zones in which companies can test their technologies. The region's giga projects provide excellent, and unique, test beds for FAVs.

Persuade through demonstrating convenience and safety

Cities can win public trust by showing that FAVs are convenient and safe. People need proof, through experience, that FAVs are as accessible as their current mobility solution, be it a private car or human-driven public transport. Convenience comes from the full integration of FAVs into the existing mobility ecosystem, such as through apps that provide mobility-as-a-service (MaaS). With MaaS, users go online to find mobility options that include FAVs.

Price is also a persuader. International surveys indicate that in some countries, younger riders—the more numerous and most likely adopters—expect to pay less for a robo-taxi. That was true for 36 percent of respondents in China and 56 percent in the U.S. who were between 18 and 34 years old.¹¹

Cities can use media campaigns to popularize FAVs. However, the most effective education will come from people who see FAVs driving on the roads safely, who hear how FAVs serve priority groups such as the elderly, and who are able to use FAVs with ease.

CONCLUSION

By thinking imaginatively and taking the correct actions, GCC cities can foster the development and growth of FAV technology. They can deploy it successfully. If they act now, GCC cities can take the pole position in the emerging FAV industry.

ENDNOTES

1. The GCC countries are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
2. Robo-shuttles are for urban applications in compact environments, such as airports and university compounds. Robo-buses serve intercity or on-demand routes, including on public roads.
3. Waymo, “Waymo One Is Now Open to All in Los Angeles,” November 12, 2024 (<https://waymo.com/blog/2024/11/waymo-one-open-to-all-in-los-angeles>); WeRide, “WeRide Chosen Technology Supplier for New Pilot Project on Autonomous Driving in Switzerland,” January 14, 2025 (<https://ir.weride.ai/news-releases/news-release-details/weride-chosen-technology-supplier-new-pilot-project-autonomous>); Businesswire, “Pony.ai Approved to Deploy Fully Driverless L4 Autonomous Vehicles in Beijing,” December 30, 2022 (<https://www.businesswire.com/news/home/20221230005186/en/Pony.ai-Approved-to-Deploy-Fully-Driverless-L4-Autonomous-Vehicles-in-Beijing>).
4. Adithya Gopal, “WeRide Introduces Robobus Shuttle Service at Zurich Airport,” ADAS & Autonomous Vehicle International, January 13, 2025 (<https://www.autonomousvehicleinternational.com/news/mobility-solutions/weride-introduces-robobus-shuttle-service-at-zurich-airport.html>).
5. Derryn Wong, “Singapore to Expand Autonomous Minibus Studies with Public Bus Operator,” *The Business Times*, November 6, 2024 (<https://www.businesstimes.com.sg/singapore/singapore-expand-autonomous-minibus-studies-public-bus-operator>); Ed Garsten, “Kodiak Intros Next-Gen Robo Truck with No Safety Driver at CES 2024,” *Forbes*, January 9, 2024 (<https://www.forbes.com/sites/edgarsten/2024/01/09/kodiak-robotics-intros-next-gen-robo-truck-with-no-safety-driver/>).
6. For example, Skyports (<https://skyports.net/vertiports/>).
7. Stella Nolan, “Ceer Teams Up with Rimac for High-Performance EVs,” *EV Magazine*, December 4, 2024 (<https://evmagazine.com/news/ceer-teams-up-with-rimac-for-high-performance-evs>); “Lucid Group, Inc. Announces Public Investment Fund Commitment of \$1.5 Billion,” August 5, 2024 (<https://ir.lucidmotors.com/news-releases/news-release-details/lucid-group-inc-announces-public-investment-fund-commitment-15/>).
8. The Business Year, “Driving the Future of Automotive and Mobility with TASARU,” November 26, 2024 (<https://thebusinessyear.com/article/driving-the-future-of-automotive-and-mobility-with-tasaru/>).
9. Sandboxes are controlled environments that allow for experimentation without full regulatory compliance.
10. Strategy&, “Digital Auto Report 2023 (Volume 1): Understanding Consumer Preferences and Implications,” 2023 (<https://www.strategyand.pwc.com/de/en/industries/automotive/digital-auto-report/volume1.html>).
11. Strategy&, “Digital Auto Report 2023 (Volume 1): Understanding Consumer Preferences and Implications,” 2023 (<https://www.strategyand.pwc.com/de/en/industries/automotive/digital-auto-report/volume1.html>).

Strategy&

Strategy& is a global strategy consulting business uniquely positioned to help deliver your best future: one that is built on differentiation from the inside out and tailored exactly to you. As part of PwC, every day we're building the winning systems that are at the heart of growth. We combine our powerful foresight with this tangible know-how, technology, and scale to help you create a better, more transformative strategy from day one.

As the only at-scale strategy business that's part of a global professional services network, we embed our strategy capabilities with frontline teams across PwC to show you where you need to go, the choices you'll need to make to get there, and how to get it right.

The result is an authentic strategy process powerful enough to capture possibility, while pragmatic enough to ensure effective delivery. It's the strategy that gets an organization through the changes of today and drives results that redefine tomorrow. It's the strategy that turns vision into reality. It's strategy, made real.

Read the latest Ideation Center insights



ideationcenter.com

Connect with Strategy& Middle East



twitter.com/strategyandme



linkedin.com/company/strategyandme



strategyand.pwc.com/me

Connect with Strategy&



twitter.com/strategyand



linkedin.com/company/strategyand



youtube.com/user/strategyand

strategy&

Part of the PwC network

www.strategyand.pwc.com/me

© 2025 PwC. All rights reserved. PwC refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details. Mentions of Strategy& refer to the global team of practical strategists that is integrated within the PwC network of firms. For more about Strategy&, see www.strategyand.pwc.com. No reproduction is permitted in whole or part without written permission of PwC. Disclaimer: This content is for general purposes only, and should not be used as a substitute for consultation with professional advisors.