Goldman Sachs Research

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Global Technology

Robotaxi

China's Robotaxi market - the road to commercialization

With 500,000 Robotaxis expected to be operating across 10+ cities in China by 2030, we believe the question is no longer if L4 autonomous technology is ready, but one of how companies will commercialize the rapid pace of autonomous development. We see Robotaxis as one of the earliest and most visible avenues to commercialization of the autonomous technology, with growing consumer acceptance across large Tier 1 cities, a tightening supply of human drivers as the fleets mature and drivers retire, and with Government and insurance industry as enablers to support growth. We see both a sizeable TAM opportunity ahead – US$47bn by 2035, as well as a path to profitability, modelling positive gross margins in early 2026 for Tier 1 cities. Key factors to watch:

1 **Decreasing costs of hardware and algorithms:** Our forecast for China's Robotaxi TAM of $47bn by 2035E vs. $54mn in 2025 is driven by decreasing costs of hardware and algorithms and lowering operating costs for fleet owners. The form factor is a swing factor: Robotaxis have the potential to transform productivity of time spent in cars, turning vehicles into entertainment hubs or private workspace, gains that may significantly increase consumer demand. Supportive Government policies/licensing, and the development of insurance for the industry are both needed to support growth. Accident rates remain a crucial swing factor for expanding customer acceptance and reputation risk.

2 **Unit economics turning profitable, encouraging more suppliers:** By 2035E, we expect revenues per Robotaxi in Tier-1 cities to reach $31,000, higher than current ride hailing vehicles, due to longer operating hours and efficient route planning. We model positive gross margin at the vehicle level by 2026E/2031E/2034E in T1/ T2/ other cities.

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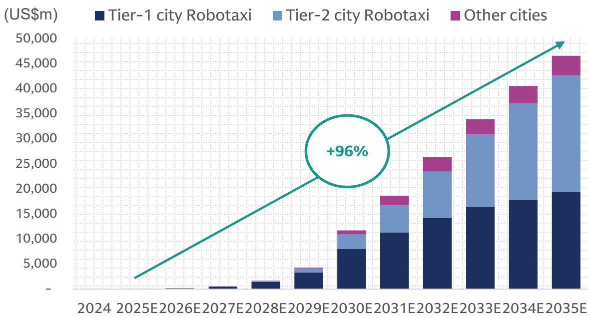
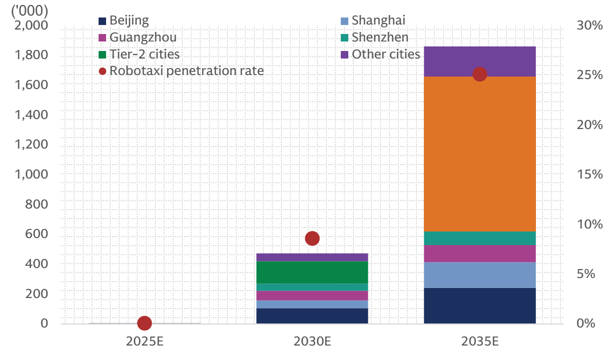
Table of Contents

China Robotaxi TAM Snapshot

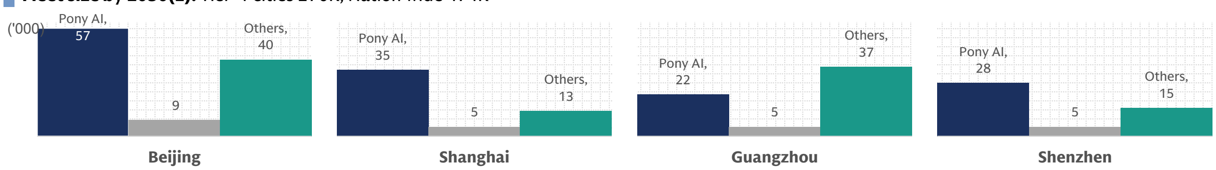
China Robotaxi market: US$47B opportunity by 2035E, compared to US$54m in 2025



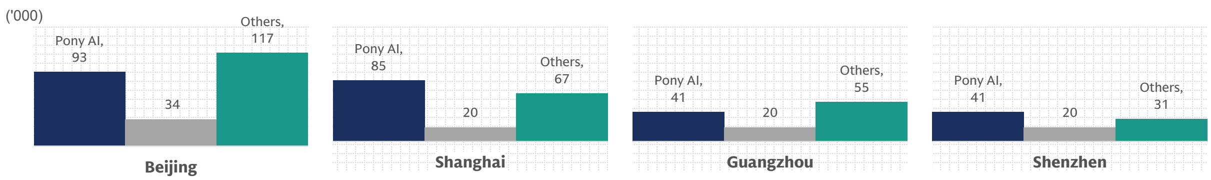
China Robotaxi Fleet: 1.9M by 2035E with 25% penetration to total shared mobility vehicles, vs. 4,000 in 2025E with 0.1% penetration



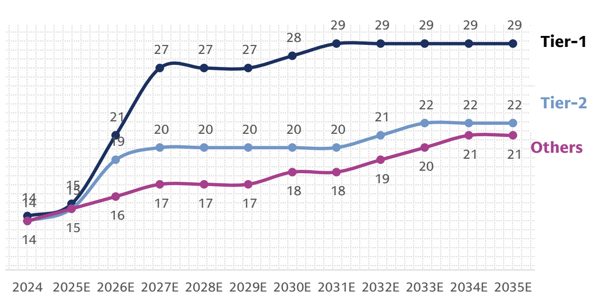
Fleet size by 2030(E): Tier-1 cities 270K; Nation wide 474K



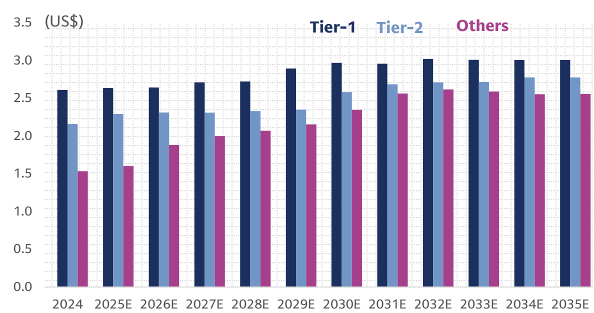
Fleet size by 2035(E): Tier-1 cities 622K; Nation wide 1.9M



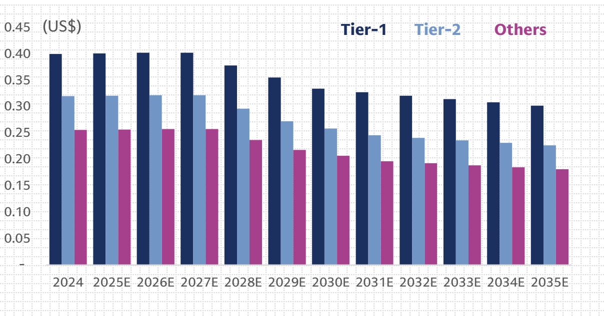
Orders per day: 29 orders per day in Tier-1 cities by 2035E



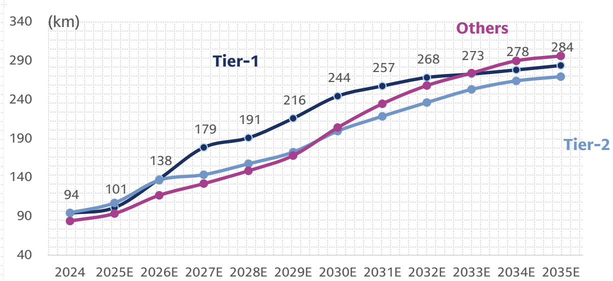
ASP per order (US$): $3.0 per order in Tier-1 cities by 2035E



Fares per km (US$): $0.3 in Tier-1 cities by 2035E



Operating distance per day (km): 284 in Tier-1 cities by 2035E



Source: Company data, Goldman Sachs Global Investment Research

China Robotaxi TAM in details

Exhibit 2: China Robotaxi TAM: increasing from US$54mn to US$47bn in 2025-35E

China Robotaxi TAM												
1. China Robotaxi TAM (US$m)	**2024**	**2025E**	**2026E**	**2027E**	**2028E**	**2029E**	**2030E**	**2031E**	**2032E**	**2033E**	**2034E**	**2035E**
China Robotaxi TAM	**10**	**54**	**206**	**606**	**1,703**	**4,313**	**11,711**	**18,637**	**26,306**	**33,924**	**40,538**	**46,568**
Tier-1 city Robotaxi	6	40	156	484	1,457	3,335	8,064	11,351	14,189	16,492	17,866	19,457
Tier-2 city Robotaxi	3	12	29	66	181	785	2,835	5,374	9,272	14,334	19,161	23,150
Other cities	1	3	21	56	65	193	812	1,912	2,845	3,098	3,512	3,961
Mix	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Tier-1 city Robotaxi	60%	73%	76%	80%	86%	77%	69%	61%	54%	49%	44%	42%
Tier-2 city Robotaxi	29%	22%	14%	11%	11%	18%	24%	29%	35%	42%	47%	50%
Other cities	10%	5%	10%	9%	4%	4%	7%	10%	11%	9%	9%	9%
By operators	**10**	**54**	**206**	**606**	**1,703**	**4,313**	**11,711**	**18,637**	**26,306**	**33,924**	**40,538**	**46,568**
Pony AI	1	9	31	88	371	1,305	4,964	7,803	10,918	12,807	14,631	16,416
Baidu	9	33	124	378	569	757	1,247	2,119	3,073	3,687	4,204	4,624
Others	0	13	51	140	764	2,251	5,501	8,714	12,315	17,430	21,704	25,529
2. Robotaxi Revenues per vehicle	**2024**	**2025E**	**2026E**	**2027E**	**2028E**	**2029E**	**2030E**	**2031E**	**2032E**	**2033E**	**2034E**	**2035E**
Revenues per vehicle (US$ '000)	**8**	**13**	**18**	**23**	**24**	**24**	**25**	**25**	**25**	**25**	**25**	**25**
Tier-1 city	9	14	20	26	26	28	30	31	31	31	31	31
Tier-2 city	8	12	16	17	17	17	19	20	21	22	22	22
Other cities	5	8	11	12	13	13	15	17	18	19	20	20
YoY%	**107%**	**62%**	**36%**	**25%**	**6%**	**0%**	**3%**	**0%**	**1%**	**1%**	**0%**	**-1%**
Tier-1 city	40%	51%	43%	29%	0%	6%	6%	3%	2%	0%	0%	0%
Tier-2 city	104%	59%	33%	5%	1%	1%	10%	4%	6%	5%	2%	0%
Other cities	133%	56%	31%	13%	3%	4%	15%	9%	8%	4%	4%	0%
A. By distance												
Fares per km (US$)												
Tier-1 city	0.40	0.40	0.40	0.40	0.38	0.36	0.33	0.33	0.32	0.31	0.31	0.30
Tier-2 city	0.32	0.32	0.32	0.32	0.30	0.27	0.26	0.25	0.24	0.24	0.23	0.23
Other cities	0.26	0.26	0.26	0.26	0.24	0.22	0.21	0.20	0.19	0.19	0.19	0.18
YoY%												
Tier-1 city	0%	0%	0%	0%	-6%	-6%	-6%	-2%	-2%	-2%	-2%	-2%
Tier-2 city	0%	0%	0%	0%	-8%	-8%	-5%	-5%	-2%	-2%	-2%	-2%
Other cities	0%	0%	0%	0%	-8%	-8%	-5%	-5%	-2%	-2%	-2%	-2%
Operating distance per day (km)												
Tier-1 city	94	101	138	179	191	216	244	257	268	273	278	284
Tier-2 city	95	107	137	144	158	173	200	219	236	253	264	270
Other cities	84	94	117	132	149	168	204	235	258	274	290	296
Travelled distance per day (km)												
Tier-1 city	200	220	300	360	360	380	420	440	440	440	440	440
Tier-2 city	225	275	350	350	350	375	475	475	525	550	550	550
Other cities	240	240	300	330	330	420	510	510	600	630	630	630
Utlization rate												
Tier-1 city	47%	46%	46%	50%	53%	57%	58%	59%	61%	62%	63%	65%
Tier-2 city	42%	39%	39%	41%	45%	46%	42%	46%	45%	46%	48%	49%
Other cities	35%	39%	39%	40%	45%	40%	40%	46%	43%	44%	46%	47%
Revenues per vehicle day (US$)	**22**	**36**	**49**	**62**	**66**	**66**	**68**	**68**	**68**	**69**	**69**	**69**
Tier-1 city	38	41	56	72	72	77	82	84	86	86	86	86
Tier-2 city	30	34	44	46	47	47	52	54	57	60	61	61
Other cities	22	24	30	34	35	37	42	46	50	52	54	54
Operating days												
Tier-1 city	250	350	365	365	365	365	365	365	365	365	365	365
Tier-2 city	250	350	365	365	365	365	365	365	365	365	365	365
Other cities	250	350	365	365	365	365	365	365	365	365	365	365
B. By orders												
Number of orders per day												
Tier-1 city	14	15	21	27	27	27	28	29	29	29	29	29
Tier-2 city	14	15	19	20	20	20	20	20	21	22	22	22
Other cities	14	15	16	17	17	17	18	18	19	20	21	21
ASP per order (US$)												
Tier-1 city	2.6	2.6	2.6	2.7	2.7	2.9	3.0	3.0	3.0	3.0	3.0	3.0
Tier-2 city	2.2	2.3	2.3	2.3	2.3	2.4	2.6	2.7	2.7	2.7	2.8	2.8
Other cities	1.5	1.6	1.9	2.0	2.1	2.2	2.3	2.6	2.6	2.6	2.6	2.6
Fleet size												
1. Robotaxi volume	**2024**	**2025E**	**2026E**	**2027E**	**2028E**	**2029E**	**2030E**	**2031E**	**2032E**	**2033E**	**2034E**	**2035E**
Robotaxi volume (units '000)	**1.3**	**4.1**	**11.4**	**26.9**	**71.0**	**179.3**	**473.5**	**756.3**	**1,054.1**	**1,347.7**	**1,609.4**	**1,861.3**
Tier-1 cities	**0.7**	**2.8**	**7.7**	**18.5**	**55.3**	**119.1**	**270.4**	**368.9**	**451.2**	**526.5**	**571.0**	**621.7**
Beijing	0.2	0.9	2.8	6.3	20.7	44.2	105.9	134.8	172.2	205.3	221.8	243.2
Shanghai	0.1	0.5	0.7	2.6	8.9	20.5	53.2	86.5	114.5	137.3	152.4	171.3
Guangzhou	0.2	1.0	3.0	6.6	17.6	34.8	63.5	84.4	93.4	104.9	111.1	115.5
Shenzhen	0.1	0.5	1.2	3.0	8.1	19.6	47.8	63.2	71.0	78.9	85.6	91.7
Tier-2 cities	**0.4**	**1.0**	**1.8**	**3.9**	**10.7**	**45.8**	**150.4**	**274.0**	**446.2**	**657.3**	**859.2**	**1,037.6**
Other cities	**0.2**	**0.3**	**1.9**	**4.6**	**5.1**	**14.4**	**52.7**	**113.5**	**156.7**	**163.9**	**179.3**	**202.0**
YoY%	**95%**	**224%**	**178%**	**136%**	**164%**	**152%**	**164%**	**60%**	**39%**	**28%**	**19%**	**16%**
2. Shared Mobility and Penetration (Taxi + Ride hailing + Robotaxi)												
Shared mobility fleet volume by city (m)	**4.6**	**4.8**	**4.9**	**5.0**	**5.0**	**5.1**	**5.5**	**5.9**	**6.3**	**6.7**	**7.0**	**7.4**
Tier-1 cities	**1.0**	**1.1**	**1.2**	**1.2**	**1.3**	**1.3**	**1.4**	**1.5**	**1.5**	**1.6**	**1.7**	**1.8**
Tier-2 cities	**2.5**	**2.6**	**2.6**	**2.7**	**2.7**	**2.8**	**2.9**	**3.1**	**3.2**	**3.4**	**3.5**	**3.7**
Other cities	**1.1**	**1.2**	**1.1**	**1.1**	**1.0**	**1.0**	**1.2**	**1.4**	**1.5**	**1.7**	**1.8**	**1.9**
YoY%	**10%**	**6%**	**2%**	**2%**	**1%**	**2%**	**7%**	**7%**	**7%**	**6%**	**6%**	**5%**
Shared mobility fleet volume by operation (m	**4.6**	**4.8**	**4.9**	**5.0**	**5.0**	**5.1**	**5.5**	**5.9**	**6.3**	**6.7**	**7.0**	**7.4**
Ride hailing fleet	3.2	3.5	3.5	3.6	3.6	3.6	3.7	3.8	3.9	4.0	4.1	4.3
Taxi fleet	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3
Robotaxi fleet	0.0	0.0	0.0	0.0	0.1	0.2	0.5	0.8	1.1	1.3	1.6	1.9
YoY%	**10%**	**6%**	**2%**	**2%**	**1%**	**2%**	**7%**	**7%**	**7%**	**6%**	**6%**	**5%**
Robotaxi penetration rate	**0%**	**0%**	**0%**	**1%**	**1%**	**3%**	**9%**	**13%**	**17%**	**20%**	**23%**	**25%**
Tier-1 cities	**0%**	**0.3%**	**1%**	**2%**	**4%**	**9%**	**19%**	**25%**	**29%**	**33%**	**34%**	**35%**
Beijing	0%	0.2%	1%	1%	4%	9%	20%	24%	29%	33%	34%	35%
Shanghai	0%	0.1%	0%	1%	3%	6%	14%	22%	27%	31%	33%	35%
Guangzhou	0%	0.5%	1%	3%	7%	14%	24%	31%	32%	35%	35%	35%
Shenzhen	0%	0.3%	1%	2%	4%	10%	23%	29%	31%	33%	34%	35%
Tier-2 cities	**0%**	**0.0%**	**0%**	**0%**	**0%**	**2%**	**5%**	**9%**	**14%**	**19%**	**24%**	**28%**
Other cities	**0%**	**0.0%**	**0%**	**0%**	**0%**	**1%**	**4%**	**8%**	**10%**	**10%**	**10%**	**11%**
3. Robotaxi fleet by company	2024	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Robotaxi volume by company (units '000)	**1.3**	**4.1**	**11.4**	**26.9**	**71.0**	**179.3**	**473.5**	**756.3**	**1,054.1**	**1,347.7**	**1,609.4**	**1,861.3**
Pony AI	0.1	0.6	1.6	3.9	15.2	51.2	180.8	294.4	404.8	465.5	521.3	573.5
Baidu	1.0	2.1	5.4	12.1	18.2	25.5	45.0	76.5	110.9	133.1	151.7	166.9
Others	0.1	1.4	4.4	10.9	37.6	102.5	247.7	385.5	538.4	749.1	936.4	1,120.9

Source: Company data, Goldman Sachs Global Investment Research

Global Robotaxi TAM scenarios

Our Autonomous Vehicles (AVs) forecast implies that a global fleet of a few million commercial AVs used for rideshare could be on the road in 2030. Although this would comprise less than 1% of the global car parc of over 1 bn vehicles, it could result in a >$25 bn market for personal mobility from robotaxis (depending on factors such as ASPs, trips per day, and average miles traveled per trip). We assume the international mix of the business affects revenue per trip in this 2030 scenario. More optimistic scenarios on utilization and ASPs would imply a $100 bn+ market in 2030.

Exhibit 3: We estimate the market in 2030 for robotaxis could be >$25 bn

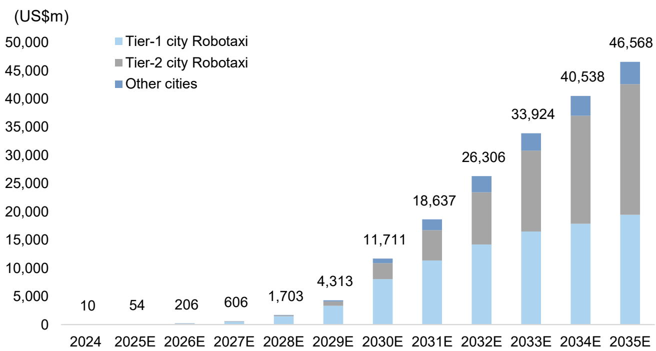
2030 market scenarios for robotaxis ($ mn)								
Revenue per trip	Trips per robotaxi per day	Global AVs in operation (000s) 150	750	1,350	2,000	2,650	3,300	4,000
$5	2	$548	$2,738	$4,928	$7,300	$9,673	$12,045	$14,600
	4	$1,095	$5,475	$9,855	$14,600	$19,345	$24,090	$29,200
	6	$1,643	$8,213	$14,783	$21,900	$29,018	$36,135	$43,800
	8	$2,190	$10,950	$19,710	$29,200	$38,690	$48,180	$58,400
	10	$2,738	$13,688	$24,638	$36,500	$48,363	$60,225	$73,000
	12	$3,285	$16,425	$29,565	$43,800	$58,035	$72,270	$87,600
	14	$3,833	$19,163	$34,493	$51,100	$67,708	$84,315	$102,200
$7	2	$767	$3,833	$6,899	$10,220	$13,542	$16,863	$20,440
	4	$1,533	$7,665	$13,797	$20,440	$27,083	$33,726	$40,880
	6	$2,300	$11,498	$20,696	$30,660	$40,625	$50,589	$61,320
	8	$3,066	$15,330	$27,594	$40,880	$54,166	$67,452	$81,760
	10	$3,833	$19,163	$34,493	$51,100	$67,708	$84,315	$102,200
	12	$4,599	$22,995	$41,391	$61,320	$81,249	$101,178	$122,640
	14	$5,366	$26,828	$48,290	$71,540	$94,791	$118,041	$143,080
$9	2	$986	$4,928	$8,870	$13,140	$17,411	$21,681	$26,280
	4	$1,971	$9,855	$17,739	$26,280	$34,821	$43,362	$52,560
	6	$2,957	$14,783	$26,609	$39,420	$52,232	$65,043	$78,840
	8	$3,942	$19,710	$35,478	$52,560	$69,642	$86,724	$105,120
	10	$4,928	$24,638	$44,348	$65,700	$87,053	$108,405	$131,400
	12	$5,913	$29,565	$53,217	$78,840	$104,463	$130,086	$157,680
	14	$6,899	$34,493	$62,087	$91,980	$121,874	$151,767	$183,960

Source: Company data, Goldman Sachs Global Investment Research

(1) Market size? 700x China Robotaxi TAM growth in the next 10 years

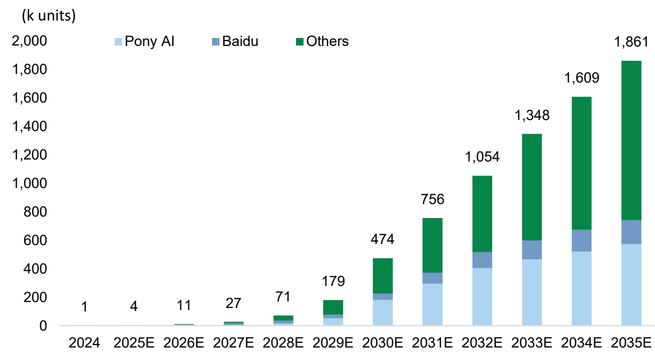
We expect China's Robotaxi market to grow from USS$54 million in 2025 to US$12 billion in 2030 and US$47 billion in 2035 (Exhibit 4). The TAM will grow 757x in the 10 years of 2025-35, indicating a strong market opportunity. Revenue generation is mainly from riding fare charges, which we will discuss further in the revenue generation session of the report. Overall, we expect each Robotaxi can generate US$69 per day by 2035 (vs. US$36 in 2025), which will be higher than traditional ride-hailing vehicles which on average generate US$28-56 (Rmb200-450) per day, due to longer operating times.

Exhibit 4: Robotaxi TAM in China: increasing to US$47bn in 3035



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 5: Robotaxi fleet in China: increasing to 1.9m by 2035, based on forecast of multiple robotaxi companies



Source: Company data, Goldman Sachs Global Investment Research

We model China's total Robotaxi fleet size to grow from 4.1 thousand by 2025 to 0.5 million by 2030 and 1.9 million by 2035 (Exhibit 5). We expect the existing players, including Pony AI, WeRide, Baidu Apollo to continue to be among the major players, considering the high technological entry barrier and leaders' edge in algorithm, data, high definition map, operations, and partnership with the car OEMs and local governments. Robotaxis will be an effective supplement to China's public transport ecosystem, in our view, considering potential driver shortages due to the aging population.

Exhibit 6: China's total number of ride hailing vehicle, taxis and buses

('000)	Ride hailing vehicles	Taxi	Bus
('000)	Ride hailing vehicles	Taxi	Bus
2019	1,040	1,392	693
2020	1,120	1,394	704
2021	1,558	1,391	709
2022	2,118	1,362	703
2023	2,792	1,367	683
YoY %	Ride hailing vehicles	Taxi	Bus
2020	8%	0%	2%
2021	39%	0%	1%
2022	36%	-2%	-1%
2023	32%	0%	-3%

Source: Ministry of Transport of PRC

(2) Penetration? 25% by 2035 to fill the labour gap of taxi drivers

4 million drivers retiring by 2035, per our estimate. A survey by Tsinghua University shows that taxi drivers aged above 46 accounted for 31% of the ride hailing drivers in China in 2021. With 13 million active ride-hailing and taxi drivers in China, those within the 46-65 age group in 2021 will mostly retire by 2035 (aged over 60), suggesting that 4 million drivers will retire during 2021-2035. We expect the labor gap to be partially fulfilled by our estimated 1.9m units of robotaxis (Exhibit 7).

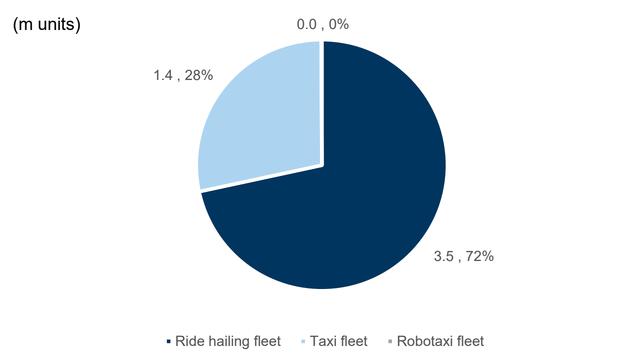
Exhibit 7: We estimate there will be 4m of taxi/ ride hailing drivers to retire by 2035

Age group	Age structure of shared mobility drivers as of 2021		
	%	# of drivers (m)	Remarks
56-65	6%	0.8	Retiring by 2025
46-55	25%	3.2	Retiring by 2035
26-45	65%	8.5	
25 and below	4%	0.5	
Total	**100%**	**13.0**	
# of drivers retiring by 2035		4.0	
# of robotaxi per GSe by 2035		1.9	
# of new drivers needed		2.2	

Source: Research report on travel platforms in China's first-tier cities by Tsinghua University , Goldman Sachs Global Investment Research, Company data

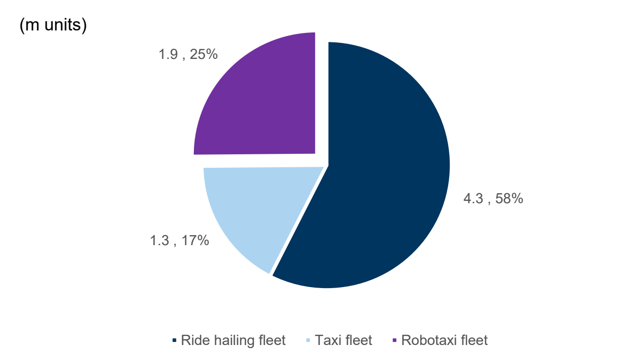
The driver shortage has become increasingly prevalent in China due to demographic change and a declining interest among young people in pursuing this profession (according to media reports). In 2024, multiple cities including Shenzhen, Hangzhou, Ningbo and Chengdu announced to extend the maximum age of taxi drivers to 65 years old, in order to cope with the potential driver shortages.

Exhibit 8: Shared mobility fleet in China (2025E, m units)



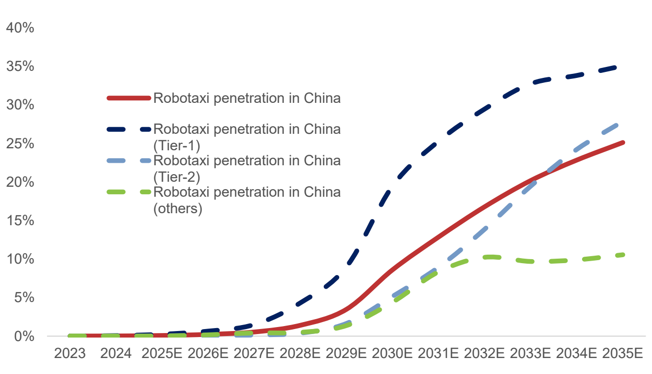
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 9: Shared mobility fleet in China (2035E, m units)



Source: Company data, Goldman Sachs Global Investment Research

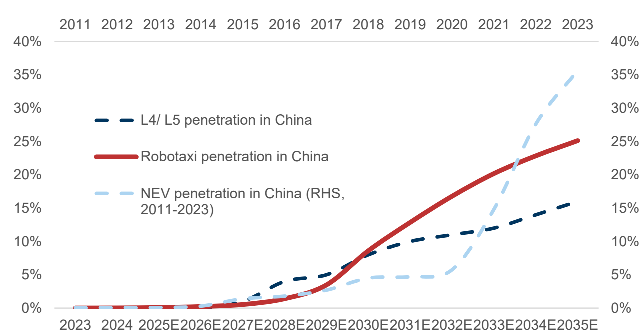
Exhibit 10: Penetration cycle of Robotaxis in China: Tier-1/ Tier-2/ Others cities



Robotaxi penetration = Robotaxi fleet / (Robotaxi + traditional taxi + shared riding vehicle fleet)

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 11: Penetration cycle of Robotaxis in China: vs. NEV and L4/L5 technology



Robotaxi penetration = Robotaxi fleet / (Robotaxi + traditional taxi + shared riding vehicle fleet)

Source: Company data, Goldman Sachs Global Investment Research

The penetration of robotaxi to the overall shared mobility fleet in China will increase from <1% in 2025, gradually to 9% by 2030 and accelerate to 25% by 2035E, in our view. The initial ramp up of robotaxi adoption will be gradual, as we expect robotaxi players to stay prudent, expanding carefully to test the algorithm and ensuring safety. They will also need time to build up a customer feedback system and improve service quality.

(3) Elements of success? Technology and experience

Technology and experience remain the competitive moat. We believe that mileage, disengagement, and accident rate are important elements to measure the readiness of a robotaxi player to conduct large scale deployment: (1) **Testing mileage**: mileage is important, as it indicates experience and successful track record. (2) **Miles per disengagement:** The need for human interventions reflect the difference in the level of intelligence. (3) **Active traffic accident rate:** Accident rate will be a key metric to monitor when robotaxis begin large scale business operations. Traditional taxis can cause 0.036 fatal accident per bn km traveled (Link), and robotaxis need to have a better performance than that.

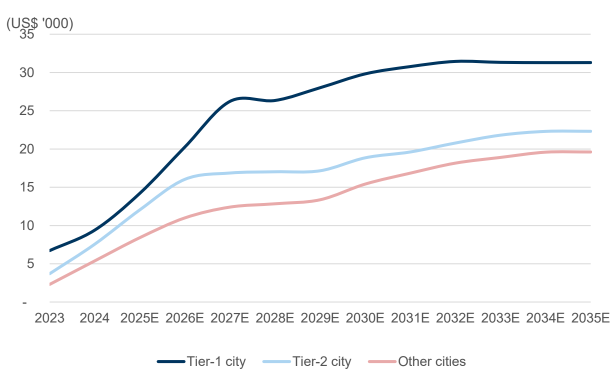
Exhibit 12: Commonly used tech terms to measure robotaxi's safety level

Key metrics	How to benchmark and measure the safety level
Accumulated testing mileages	The higher the better, with more experiences
Average testing speed	The higher the better, showing company's capabilites to ensure safety amid high speed
MPD	Miles per Disengagement, the lower the better
MPC	Miles per Collision, the lower the better
Remote assistant	Number of vehicles per remote assistant staff could handle, the lower the better
Basic safety function	AEB (Autonomous Emergency Braking), FCW (Forward Collision Warning) etc.
Emergency	Robotaxi capabilities to handle emergency
Cybersecurity	C-V2X, automotive cloud safety test

Source: Company data, Goldman Sachs Global Investment Research

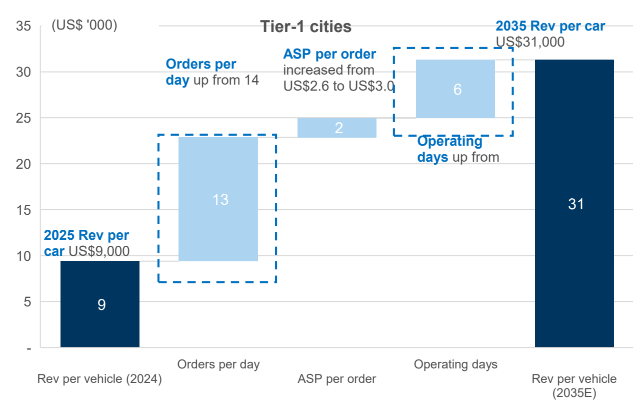
(4) Revenues generation? Up to $31k per vehicle in tier-1 cities by 2035E

Exhibit 13: Robotaxi revenues per vehicle
Increasing from US$5k~9k per year in 2024 to US$20k~31k in 2035E



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 14: Robotaxi in Tier-1 cities: Revenue per vehicle increases to US$31k by 2035E
Largely driven by increasing orders per day and increasing operating days



Source: Company data, Goldman Sachs Global Investment Research

The revenues of robotaxis are mainly contributed by the **fares charged from**

passengers. In our analysis, we evaluate robotaxi's revenue generation by (1) the number orders per day, (2) the ASP per order, and (3) the number of operating days per year. **We estimate that by 2035E, Revenue per vehicle can reach US$31,000/ US$22,000/ US$20,000 in tier-1 / tier-2/ other cities in China.**

Breaking down the source of per vehicle revenue growth

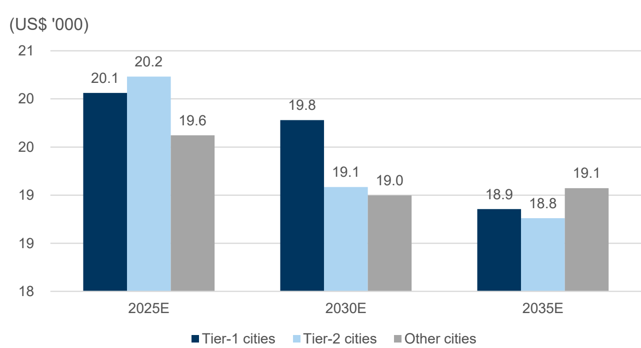
Orders per day up to 29 orders by 2035E: Pony AI's average daily orders per vehicle has reached **15** in 2024, surpassing the average ride-hailing drivers in Shenzhen (12 orders per day in 2H24, but below full time taxi drivers (25 orders per day in 2H24. We estimate the industry level orders per day to be **15/ 15/ 15** in tier-1/ tier-2/ other cities in 2025, increasing to **29/ 22/ 21** in 2035E. Robotaxis can take more orders than traditional taxis given their longer operation hours - each robotaxi can run up to 22 hours per day with 2 hours for maintenance and charging in the future, per our channel checks, compared to up to 15 hours for traditional ride-hailing vehicles/ taxis.

ASP per order up to US$3.0 by 2035E: The pricing of robotaxi benchmarks are lower than that of traditional ride hailing vehicles/ taxis, and vary across cities. We expect the fares per km to decline in the long term, however, we expect the ASP per order to continue to increase, from US$2.6/ 2.3/ 1.6 in tier-1/ tier-2/ other cities in 2025E to US$3.0/ 2.8/ 2.6 in 2035E, driven by larger operating area and longer trips per order.

Number of operating days up to 365 by 2035E: We expect the total number of operation days to be 350 days in 2025E, increasing to 365 days in 2026-35E in order to make full use of the vehicles.

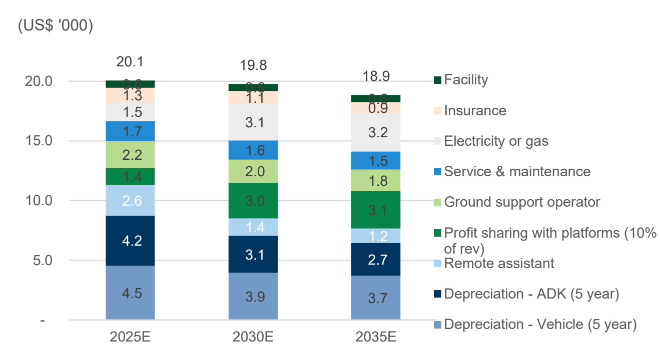
(5) Costs reduction? Down to $19k per vehicle in tier-1 cities in 2035E

Exhibit 15: Robotaxi COGS per vehicle
Decreasing from ~US$20k per year in 2025E to ~US$19k in 2035E, in tier-1/ tier-2/ other cities



Source: Company data, Goldman Sachs Global Investment Research

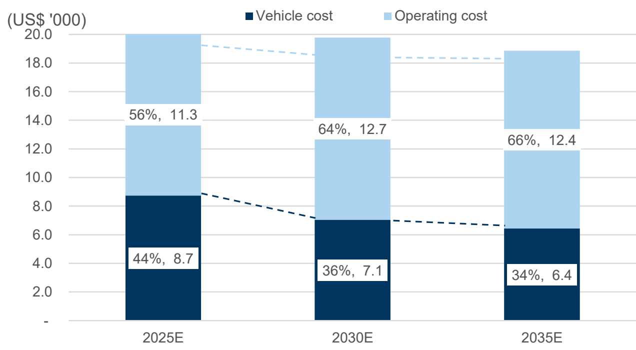
Exhibit 16: Robotaxi COGS per vehicles in Tier-1 cities: Vehicle and ADK price deceasing, but operating costs and profit sharing increasing



Source: Company data, Goldman Sachs Global Investment Research

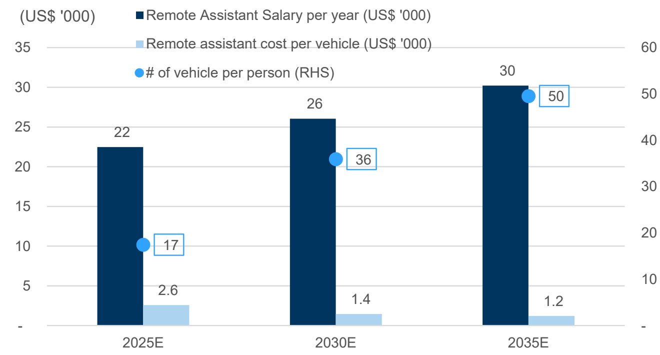
We expect per vehicle COGS of a robotaxi to decline from US$20.1k to US$18.9k per year in 2025-35E in tier-1 cities (Exhibit 16). However, we expect some operating costs to increase as fleet scales, partially offset by the continuous downward trend of vehicle and intelligent driving ADK (Assessment and Deployment Kit) costs.

Exhibit 17: Robotaxi COGS per vehicles in Tier-1 cities: Vehicle costs deceasing, but operating costs increasing



Source: Company data, Goldman Sachs Global Investment Research

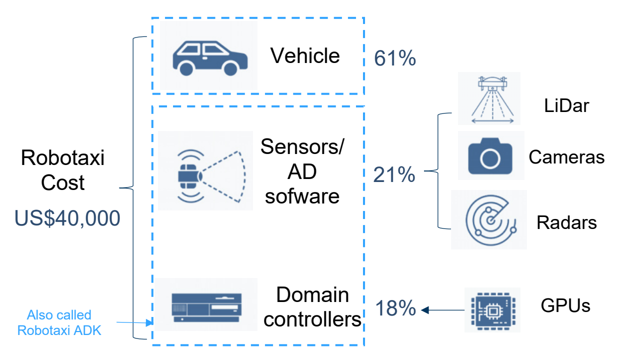
Exhibit 18: Remote Assistant cost per vehicle per year in Tier-1 cities: decrease from US$2,600 per vehicle to US$1,200



Source: Company data, Goldman Sachs Global Investment Research

Operating costs have a mixed trend. Among operating expenses, we expect the spending on remote assistant to decrease as technology evolves, requiring less monitoring and intervention (Exhibit 18). Chinese robotaxi players expect per remote staff to monitor 50-100 vehicles at the same time in an ideal case vs. now <= 20 vehicle per person. On the other hand, we expect maintenance, charging, cleaning and operation costs to increase as the fleet scales, as these should be a function of usage and the number of trips per day. Profit sharing costs with platforms will also increase along with the increase of robotaxi revenues, given the common practice of taking 10% of GMV to share with the 3rd party ride hailing platforms who provide traffic and accessibility to users.

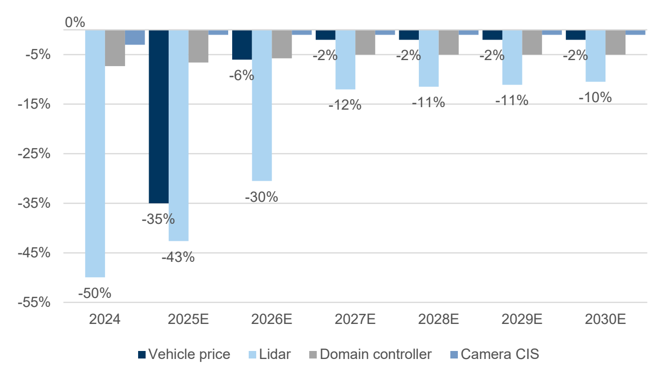
Exhibit 19: Robotaxi vehicle costs breakdown



A typical robotaxi comes with 4x LiDar, 11x cameras, 2x radars, and domain controllers with 1000+ TOPS computing

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 20: Typical price down trend of robotaxi components



Vehicle price according to GS China robotaxi TAM; Lidar price based on GSe ASP of Hesai; Domain controller price based on GSe ASP of Desay SV's high end product lines; Camera CIS based on GSe 8MPx CIS ASP of Will Semi

Source: Company data, Goldman Sachs Global Investment Research

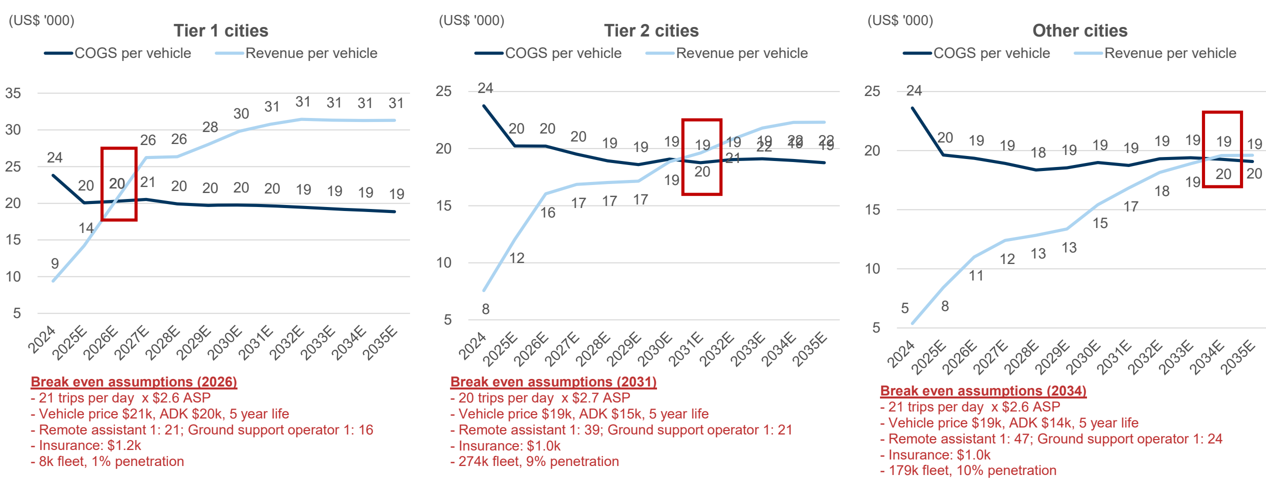
Robotaxi vehicle costs declining. The Robotaxi hardware costs will quickly trend down in 2025 as major players release new models that come with lower costs and ready for mass production. For example, Pony AI's Gen7 models will be rolling out in 2H25 with 70% BoM costs savings, WeRide's GXR model launched in Oct 2024 also costs lower than its previous generation, and Baidu's Apollo Go Gen 6 model costs only US$29,000, or 60% lower than its Gen5 (According to Media reports). **We expect the**

vehicle cost (basic vehicle + intelligent driving ADK) of China's robotaxi industry to be at US$44,000 in 2025E, decreasing to US$35,000 by 2030E and US$32,000 by 2035E. The faster than expected Robotaxi car models expansion to local car models or mid / low-priced models, or faster than expected pricing decline under fierce competition could bring potential upside to our vehicle costs estimates.

We estimate 61% of the vehicle cost to be contributed by the vehicle itself, followed by 21% by sensors/ autonomous driving software and 18% by domain controllers (Exhibit 19). We expect further price decrease across major components, as shown in Exhibit 20, and the software costs will be lower as more robotaxis are put into use to share the R&D spending.

(6) Unit economics? Profit making by 2026E/ 31E/ 34E in Tier-1/ -2 / other cities

Exhibit 21: Breakeven roadmap in Tier-1/ Tier-2/ Other cities



Source: Company data, Goldman Sachs Global Investment Research

Tier-1/ Tier-2/ Other cities in China to see positive gross profit per vehicle in 2026E/ 2031E/ 2034E, respectively (Exhibit 21). Along with the increasing revenues and decreasing COGS per vehicle, we expect the average per vehicle gross profits of robotaxis in China to turn positive before 2035E. Tier-1 cities will achieve positive profits by 2026E with 0% gross margin, increasing to 34%/ 40% by 2030E /35E. Tier-2 cities' breakeven point will be 2031E with 4% gross margin, increasing to 16% by 2035E. Tier-3 cities will not see positive income per vehicle until 2034E (2% gross margin), which will increase to 3% by 2035E.

Exhibit 22: Unit economics in details

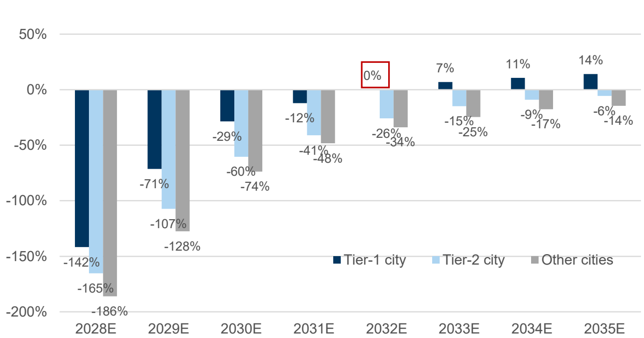
Unit economics summary (Tier-1 cities)

(US$ '000)	2025E	2030E	2035E	GM break-even year (2026)	Remarks
Revenues	**14.2**	**29.8**	**31.3**	**20.3**	21 orders per day x $2.6 ASP
# of orders	15	28	29	21	
ASP (US$)	2.6	3.0	3.0	2.6	
Fleet size ('000)	3	270	622	8	The increase of coverage area supports orders/ ASP growth
Penetration rate	0%	19%	35%	1%	
Vehicles D&A (5 year)	4.5	3.9	3.7	4.3	Vehicle price: $21k
ADK D&A (5 year)	4.2	3.1	2.7	3.9	ADK price: $20k
Remote assistant	2.6	1.4	1.2	2.2	Annual salary $22k, 2 shifts, 21 vehicles per person
Profit sharing with platforms	1.4	3.0	3.1	2.0	10% of revenues to platforms like Didi/ Amap
Ground support operator	2.2	2.0	1.8	2.2	Annual salary $22k, 1.5 shifts, 16 vehicles per person
Service & maintenance	1.7	1.6	1.5	1.7	Cleaning, testing and maintenance
Electricity or gas	1.5	3.1	3.2	2.2	$0.02 per km for EV
Insurance	1.3	1.1	0.9	1.2	Already lower than human drivers
Facility	0.6	0.6	0.6	0.6	Facility and warehouse for parking and maintenance
COGS	**20.1**	**19.8**	**18.9**	**20.3**	
Among which: Fixed cost	*15.4*	*12.1*	*11.0*	*14.4*	*D&A, remote assistant, ground support, facility, insurance*
Variable cost	*4.6*	*7.6*	*7.9*	*5.9*	*Profit sharing, service & maintenance, Electricity*
Among which: Fixed cost	*77%*	*61%*	*58%*	*71%*	
Variable cost	*23%*	*39%*	*42%*	*29%*	
Gross profit	**(5.9)**	**10.0**	**12.4**	**(0.0)**	Breaking even at GP level in tier-1 cities by 2026
GM	-41%	34%	40%	0%	
R&D expenses	270.0	12.2	5.0	135.0	
% R&D to Revenues	*1900%*	*41%*	*16%*	*666%*	
SG&A expenses	80.0	6.4	3.0	40.0	
% SG&A to Revenues	*563%*	*21%*	*10%*	*197%*	
Operating profit	**(355.9)**	**(8.5)**	**4.4**	**(175.0)**	OP break-even will take longer
OPM	-2504%	-29%	14%	-863%	

Source: Company data, Goldman Sachs Global Investment Research

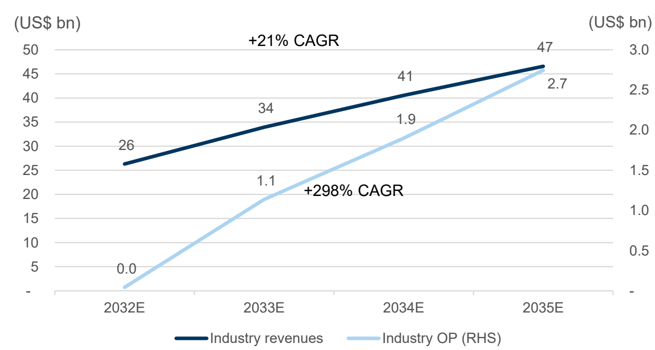
(7) Operating leverage? Increasing operating profits as business scales

Exhibit 23: Robotaxi industry OPM in 2028-35E



Source: Goldman Sachs Global Investment Research

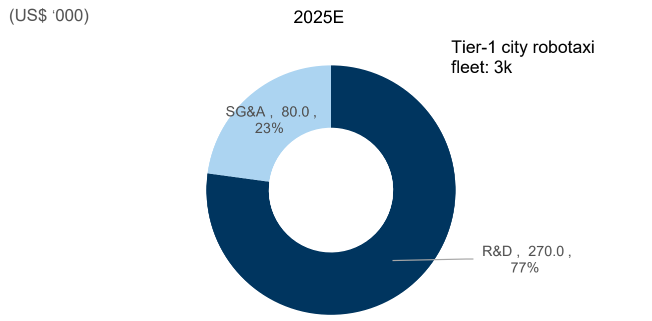
Exhibit 24: Tier-1 cities: Operating leverage



Source: Goldman Sachs Global Investment Research

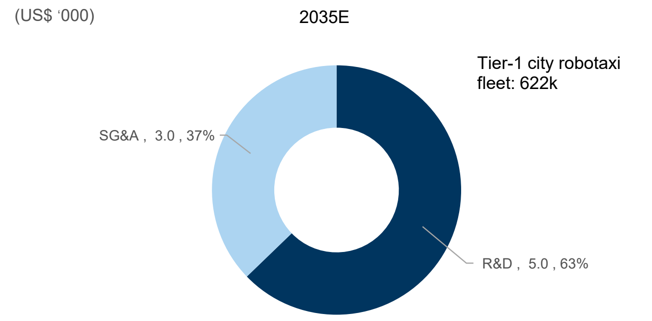
We expect China's robotaxi industry to break-even in the OP level in Tier-1 cities by 2032E. Our unit economics analysis shows that robotaxis will achieve break even in the unit GM level by 2026E/ 2031E/ 2034E in Tier-1/ Tier-2/ other cities. However, it takes longer to achieve scale efficiency at the operating income level. **At break-even point, we expect robotaxi's R&D expenses to decrease to US$7,800 per vehicle year, with SG&A expenses decreasing to US$4,100 per vehicle year.** For Tier-2 cities and others, we expect it to take a longer time to turn positive on the operating income level, considering a relatively small fleet size.

Exhibit 25: Robotaxi in tier-1 cities: $270,000 expenses on R&D and $80,000 on SG&A per vehicle in 2025E



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 26: Robotaxi in tier-1 cities: $5,000 expenses on R&D and $3,000 on SG&A per vehicle in 2035E



Source: Company data, Goldman Sachs Global Investment Research

Operating leverage: Tier-1 cities' industry revenues will grow at 21% CAGR from $26bn to $47bn in 2032-35E, and operating profits will grow faster at 298% CAGR from $43m to $2.7bn. As shown in our units economic analysis, 23% ~ 42% of COGS are variable - the relatively low variable costs would support the companies to improve profitability as it scales. Also, the increasing fleet size will quickly dilute the burden of R&D / SG&A spending, supporting robotaxis to achieve operating profits.

(8) Downside risk? Profitability is sensitive to competition

Exhibit 27: Our sensitivity analysis on operating margin in tier-1 cities
The impact of changes in # of orders and ASP

2035 Operating margin in Tier-1 cities

# of orders	ASP per order (US$) 1.5	2	2.5	3	4.5	6	7.5
4	-1303%	-952%	-742%	-601%	-368%	-251%	-181%
9	-478%	-333%	-247%	-189%	-93%	-44%	-16%
14	-264%	-173%	-118%	-82%	-21%	9%	27%
19	-165%	-99%	-59%	-33%	12%	34%	47%
24	-109%	-57%	-25%	-4%	30%	48%	58%
29	-72%	-29%	-3%	14%	43%	57%	66%
34	-47%	-10%	12%	27%	51%	63%	71%
39	-28%	4%	23%	36%	57%	68%	74%
44	-13%	15%	32%	44%	62%	72%	77%

Source: Company data, Goldman Sachs Global Investment Research

Competition will be a major risk to the industry's long-term profitability. While currently there are only a few players in the market, we see increasing interest from tech giants, traditional OEMs and ride hailing platform players to enter the business. In our base case, we expect tier-1 cities' robotaxis to enjoy 14% OPM by 2035E, with 29 orders per day and $3 ASP per order. Nevertheless, there's downside risks to pricing and order volume should there be greater competition. Our sensitivity analysis shows that robotaxi players' profitability is sensitive to the changes in orders and ASPs: **(1)** If the ASP declines from $3 to $2.5 due to competition, the industry level OPM will decline to -3%. **(2)** If the # of orders per day declines from 29 to 24 due to competition, the industry level OPM will decline to -4%.

(9) Downside risks? Accidents can damage reputation

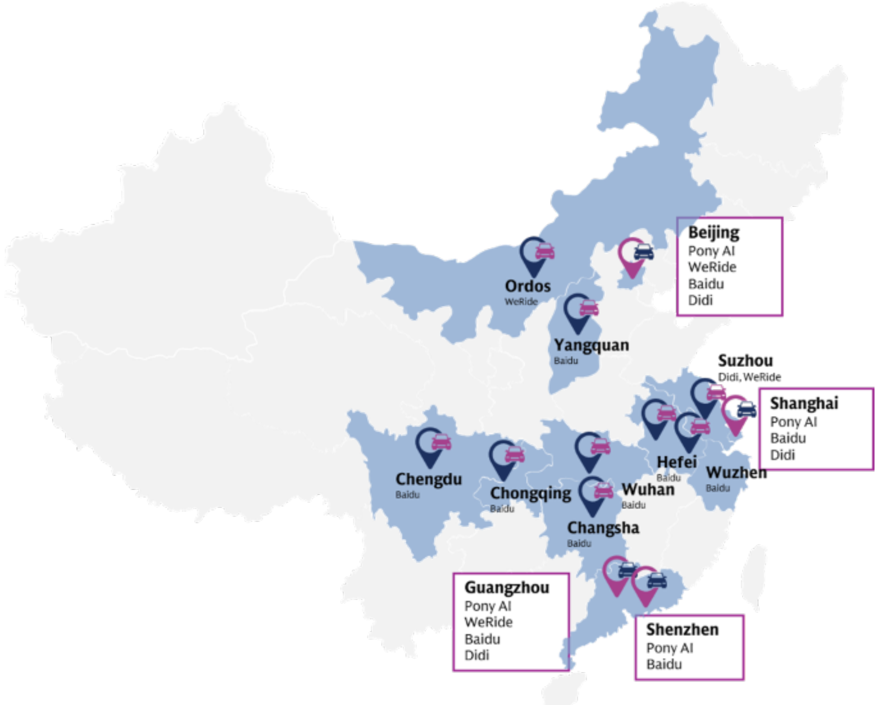
Safety and accidents are key downside risks to the industry. From past experience, a fatal accident can impact the business by causing a loss of trust. Also, the overall adoption of robotaxi technology may be delayed if there is a significant accident, as it takes time to regain trust. While robotaxi makers have prioritized safety in vehicle designs and their daily operations, there remains a possibility of unforeseen risks. Robotaxi companies need to have emergency plan for accidents, building on-the-ground fast response teams to deal with emergencies and be responsible to its users.

(10) Where to find Robotaxis? 10+ cities with Robotaxi services in China

More than 10 cities in China with robotaxis available to the public (Exhibit 30). Availability is expanding into more cities and operating areas. Nationwide, the current milestone for robotaxi players is to achieve ***fare charging fully driverless*** services, which will begin commercialization (fare charging) and establish the foundation of large scale deployment (fully driverless).

Fully driverless in Beijing, Shanghai, Guangzhou, Shenzhen, Wuhan and Chongqing etc. In Shenzhen, fully driverless robotaxis can operate in Nanshan district, one of center hubs of the city (such as Pony AI). In Beijing, fully driverless robotaxis operate in Yizhuang (Beijing Economic-Technological Development Area) with 225 square km, such as WeRide. In Guangzhou, fully driverless fare-charging services are in Nansha district; in Shanghai, fully driverless robotaxi services are open to the public. The fully driverless fare charging service is also available in Wuhan and Chongqing (such as Baidu Apollo).

Exhibit 30: Robotaxi: Service availibility map in China



Source: Company data, Data compiled by Goldman Sachs Global Investment Research

(11) Policy progress? Supportive policies with more operating areas

Exhibit 31: Supportive policies for robotaxi from national to city level

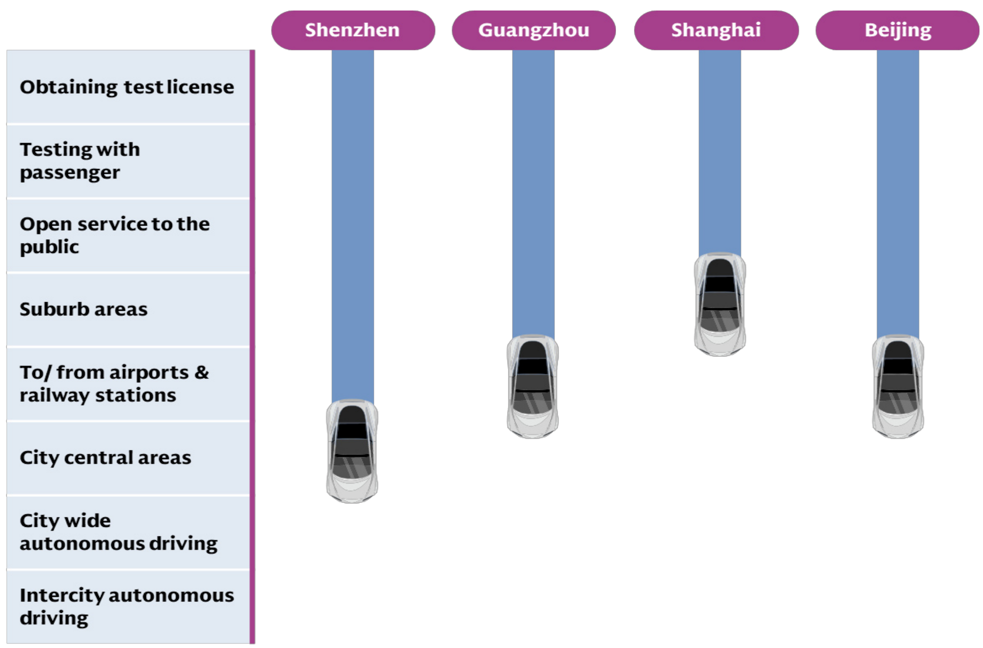
National level policies			
Department	Policy name	Date (MM-YY)	Key points
State Council	The 14th Five-Year Plan for the Development of the Digital Economy	Jan-22	Provide systematic artificial intelligence services for key emerging fields such as government services, smart cities, intelligent manufacturing, **autonomous driving**, and language intelligence.
Ministry of Industry and Information Technology, Ministry of Public Security, Ministry of Housing and Urban-Rural Development, Ministry of Transport	Notice on the pilot work of intelligent connected vehicle access and road access	Nov-23	Select **intelligent connected vehicle products with autonomous driving functions** that meet the conditions for mass production and **carry out pilot projects**; for intelligent connected vehicle products that have obtained access, **carry out on-road driving pilot projects in limited areas.**
Responsibility for autonomous driving and accidents			
City	Policy name	Date	Key points
Shenzhen	Regulations on the Administration of Intelligent Connected Vehicles in Shenzhen Special Economic Zone	Jun-22	If a fully autonomous smart connected car violates road traffic safety laws while there is no driver, the responsibility goes to **the vehicle owner and manager.**
Shanghai	Regulations of Shanghai Pudong New Area on Promoting the Innovative Application of Driverless Intelligent Connected Vehicles	Nov-22	The company to which the driverless smart connected car belongs shall first pay compensation and may seek reimbursement **from the responsible autonomous driving system developers, car manufacturers, equipment providers**
Beijing	Beijing Autonomous Driving Vehicle Regulations	Jan-25	**Autonomous driving vehicle manufacturers** shall bear the main responsibility for the **quality and production consistency** of autonomous driving vehicles.
Supportive policies on road-test and commercialization			
City	Policy name	Date	Key points
Wuhan	Wuhan City Intelligent Connected Vehicle Road Testing and Demonstration Application Management Implementation Rules	Jun-22	Remote driving demonstration application refers to the demonstration application and commercial pilot of intelligent connected vehicles carrying people, cargo or special operations **with no human driver in the driving seat.**
Wuhan	Wuhan Regulations on Promoting the Development of Intelligent Connected Vehicles	Nov-24	Encourage the promotion and application of new technologies and products for intelligent connected vehicles, and **support road testing, demonstration applications, commercial pilots and commercial operations of intelligent connected vehicles**
Beijing	Ten measures to promote high-quality development of the intelligent connected vehicle industry	Nov-24	For demonstration applications in public service fields such as sanitation cleaning, urban management, convenience services, public transportation, travel services, and logistics distribution, **financial support of 6 yuan per kilometer will be provided based on the test mileage, with a maximum annual support amount of 3 million yuan per enterprise.**
Guangzhou	Guangzhou Regulations on the Innovation and Development of Intelligent Connected Vehicles	Jan-25	The city **supports intelligent connected vehicles to carry out commercial operations** based on sufficient verification through road testing and demonstration applications.

Source: Government websites, Data compiled by Goldman Sachs Global Investment Research

China's policy support for robotaxi is across national to city level.

- **High-level national support:** In 2022, autonomous driving technology was listed in the 14th 'Five-Year Plan for the development of Digital Economy' by the state council**.** Back in 2023, four major ministries of the state established notice to promote the market and road access for autonomous driving vehicles.
- **Clarify the responsibility.** Local governments have been active in establishing policies on responsibilities for accidents, which some robotaxi players may have thought that was a major obstacle that had stopped the robotaxi from large scale development. For example in Shanghai, the government stated that the owner for the robotaxi should pay the compensation upfront and may see reimbursement from system developers, car manufacturers, equipment providers. Only when responsibilities are clarified, Robotaxi players can accurately measure their operation risks and manage their fleet accordingly.
- **Supportive policies for road test and commercialization.** Local governments are open to road test, pilot operations and even full commercialization of robotaxi, providing a supportive environment. Wuhan has already started allowing driverless (no human driver in the driving seat) vehicles to conduct demonstration application in 2022; Beijing provides financial support based on test mileage in 2024; and Guangzhou in 2025 supports robotaxi companies to start carrying out commercial operations.

Exhibit 32: Key milestones to achieve robotaxi services in China



Shanghai is still in non-faring charging demonstration stage

Source: Company data, Goldman Sachs Global Investment Research

Major cities in China are opening more operating areas for robotaxi. In the four tier-1 cities in China, robotaxis are only operated in predetermined areas, yet to achieve full city coverage. Some cities allow operations in suburbs, some allow several selected routes to connect Airports / Railway stations to the city center/ city suburban areas, and some have started to open up core areas of the city's urban area.

Overseas expansions. Apart from the domestic market, Chinese robotaxi players are exploring overseas markets. WeRide has obtained autonomous driving license in five countries (China, UAE, Singapore, France, United States) and is performing autonomous driving R&D, testing and operations in 10+ countries. Pony AI also recently announced it is among the first companies to get the robotaxi testing permit in Luxembourg. Pony AI has established an R&D center in the US, established technology partnership and deployment in South Korea, Saudi Arabia and UAE, and is partnering with ComfortDelGro with the aim to expand robotaxi deployment in different cities and countries.

(12) Insurance support? Still in early stage of development

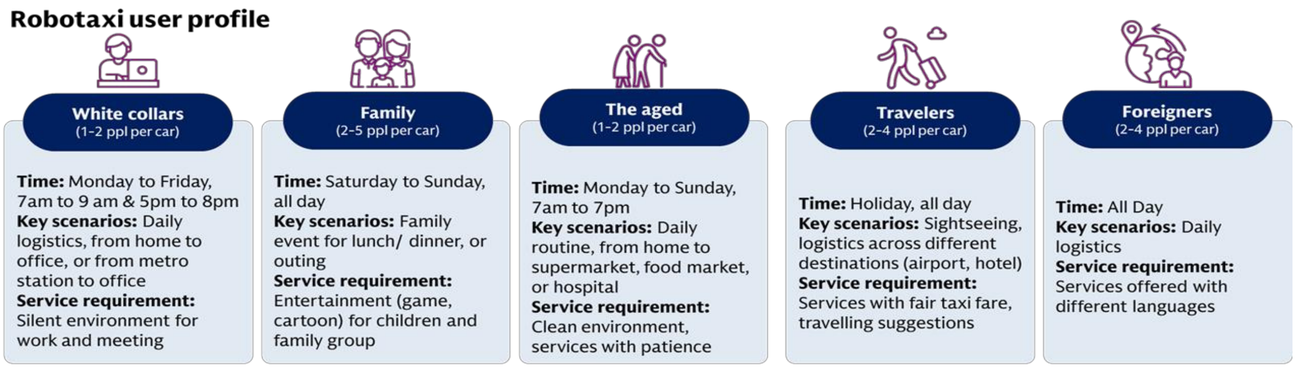
Insurance coverage is important for robotaxi operators and users to mitigate potential risks. Per our checks with the robotaxi players, currently insurance for robotaxis is still in the early stage of development:

- **Insurance is a requirement.** For example, in Beijing, the local government requires robotaxis to have Compulsory motor vehicle traffic accident liability insurance and carrier liability insurance. Meanwhile, the Beijing government supports insurance companies to work with robotaxi supply chain to come up with products that can more comprehensively cover the risks in robotaxi operations.
- **Challenges in identifying liabilities.** While more robotaxis are now driverless, there are still remote safety assistants who would be responsible for the monitoring per our checks, making it difficult to identify if faults lie with humans or the system. Moreover, multiple parties involved in robotaxi operations would further complicate liability identification. Per our supply chain checks, currently robotaxi owners and operators would bear the primary responsibility and coordinate with their insurance companies to pay the compensation. After the payment, owners/ operators can seek reimbursement from manufacturers and suppliers if they are found liable.
- **Accident rate as a factor for insurance fees.** Per comments from Robotaxi operators current data suggest that the accident rates of robotaxis are lower than traditional taxis, and therefore the pricing of robotaxi insurances should be lower than traditional ones. The coverage of risks are not including the risks of human drivers, such as drunk driving, etc.

(13) Reasons to use Robotaxi? A new riding experience with entertainment

With technology enhancement, we expect the costs on hardware and software would continue to reduce, supporting large scale deployment and shortening passengers' waiting time. The enhancing technology could also bring better riding experience, for example, a normal driving speed that allows passengers to arrive at the destinations at the same time if they choose human-driven shared mobility.

Exhibit 33: Robotaxi for different user groups across white collars, family etc.



Source: Company data, Goldman Sachs Global Investment Research

Reasons to use Robotaxis includes: (1) for fleet owners, robotaxi could transform their idle assets to assets generating cash flow and could theoretically operate longer hours as it is operated by robots. Robotaxi could also avoid the potential difficulties to hire human drivers in the long term, as other jobs could be more attractive, (2) for passengers, robotaxis could avoid drowsy driving, dangerous driving, detours, social contact (which could be appreciated for those tired of social interaction after a long day of work, or could be vital during pandemic periods), etc.

Exhibit 34: Robotaxi as a mobility space to bring enhanced experience

	Robotaxi experiences
Voice	Silent environment, and passengers could listen to music or meeting through external sound
Special request	Remote assistants take longer time to react and assist on-site help for Robotaxi
Social contact	Avoid social contact which could be appreciated for those tired of social interaction after a long day of work, or could be vital during pandemic period
Tidiness	Standard cleaning processes to ensure the tidiness of Robotaxi
Customization	Customized setting for users to enjoy music or videos on Robotaxi, and users could book special content in advance
Interaction	AI assistant to provide travelling, weather or other suggestions
Driving route	Automatically select the best driving route based on system recommendation
Entertainment	More entertainment offered by Robotaxi, like 4D movie, in-cabin KTV, MR/ VR, catering services

Source: Company data, Goldman Sachs Global Investment Research

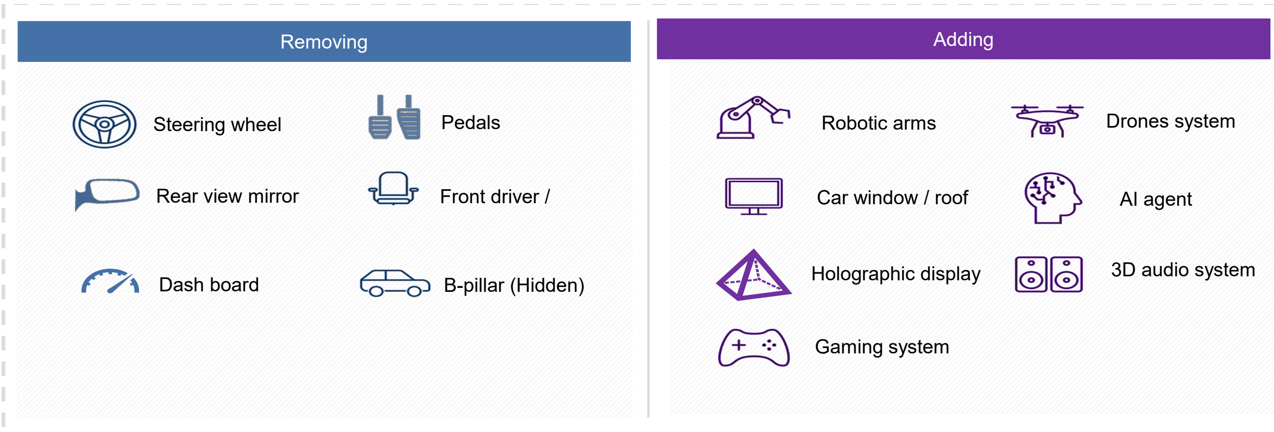
A new riding experience: Robotaxi allows vehicles to be redesigned to better fit passengers' needs. For example, a wider room for 4D movie, KTV, gaming, MR/ VR or catering services for passengers. Passengers could also book movie or music in advance before using Robotaxi services, or customize the services based on their previous preferences. Robotaxi could also come with robotic arms, which can help handle the luggage, or even making a cup of tea for the passenger.

(14) Future form factors? Without steering wheels, but with robotic arms, AI and drones

Without human drivers, the future car design would change focus from the

driver's features to passengers' in-vehicle experience. Traditional components like steering wheels, rear view mirrors, dash boards and pedals are likely to disappear, leaving the car computer to take full control of the vehicle. In our view, there may be no need for front seats, leaving more space for passengers. WeRide has already introduced an innovative design of hidden B pillar, integrated with the car doors, allowing a large space for getting in and out of the vehicle.

Exhibit 35: Future robotaxis will likely have different designs from today's vehicles



Source: Company data, Goldman Sachs Global Investment Research

We expect innovative designs for future robotaxis. Car windows and roofs could be turned into displays, with the transparent OLED / Micro LED technology that has been evolving in recent years. Holographic 3D projections could be ideal for in-car display, turning the whole cabin into an immersive virtual space. AI agents could enhance human-machine interaction, assisting passengers in scheduling or route planing. A drone launching system on the car, similar to what BYD and DJI have presented (Link), could allow passengers to take photos and videos and get deliveries along the way.

Exhibit 36: Pony AI's Gen7 Robotaxi models

Provided by Pony AI

Source: Company data

Exhibit 37: WeRide's Robobus in new form factor

Provided by WeRide

Source: Company data

(15) Future market segmentation? Widening choice of car models

Widening car models for passengers to choose: As robotaxi is still in the early stage, currently there is no distinguished service segmentation for different groups of targeted users. We expect robotaxi companies to begin with daily commute individual users, and later launch a range of services from cost-effective to high-end robotaxi models with different interior designs and functionalities to improve the user experience, and the fare charging of a single ride would also range from low to high.

Exhibit 38: Potential future robotaxi models and functionalities

Potential future robotaxi models	Model	Passenger capacity	Functionality	Vehicle Price (US$ k)
For individual user	SUV / sedan	4 - 8	Mainstream models to offer individual users cost-effective daily communtes	14 - 25
For family	SUV / sedan	4 - 8	Equipped with gaming devices, movie projector, and KTV funtion to enhance the family's travel enjoyment	15 - 35
For business	MPV / mini bus	8 - 15	Equipped with sound proof materials, microphone, meeting slide projector, and large size screens to enable the high quality business meeting	25 - 65
For aged / disabled user	Sedan	1 - 3	Barrier-free design with automatic door and ramp to help disabled / aged users get in / off the car	14 - 25
For luxury service	SUV / sedan	1 - 2	High-end models with large space and luxury interior materials, equipped with AI models to follow users' command	50 - 65

Vehicle prices of future robotaxi models are GSe (based on current taxi-hailing models' price segmentation in China)

Source: Company data, Goldman Sachs Global Investment Research

(16) Potential up-scaling methods? Collaboration with riding platforms

Exhibit 39: Five types of platforms to call for robotaxis in China

	In-house App	Taxi-hailing platform	Map platform	Fintech platform	Social media platform
User volume	Pony AI: ~0.2m registered	34.5m registered	30 - 800m MAU	890m MAU	1,385m MAU
Downloads Available cities	<15	>300	>360	>360	>360
Taxi-hailing operators integrated	1	>5	>10	>10	>10
How to call for a robotaxi	- Run the App - Set the pick-up and drop-off location	- Run the App - Choose robotaxi - Set the drop-off location	- Run the App - Choose taxi-hailing - Set up pick-up and drop-off location - Choose Robotaxi	- Run the App - Search the robotaxi mini software - Set the pick-up and drop-off location	- Run the App - Open the Service tab - Choose taxi-hailing - Set the pick-up and drop-off location - Choose Robotaxi

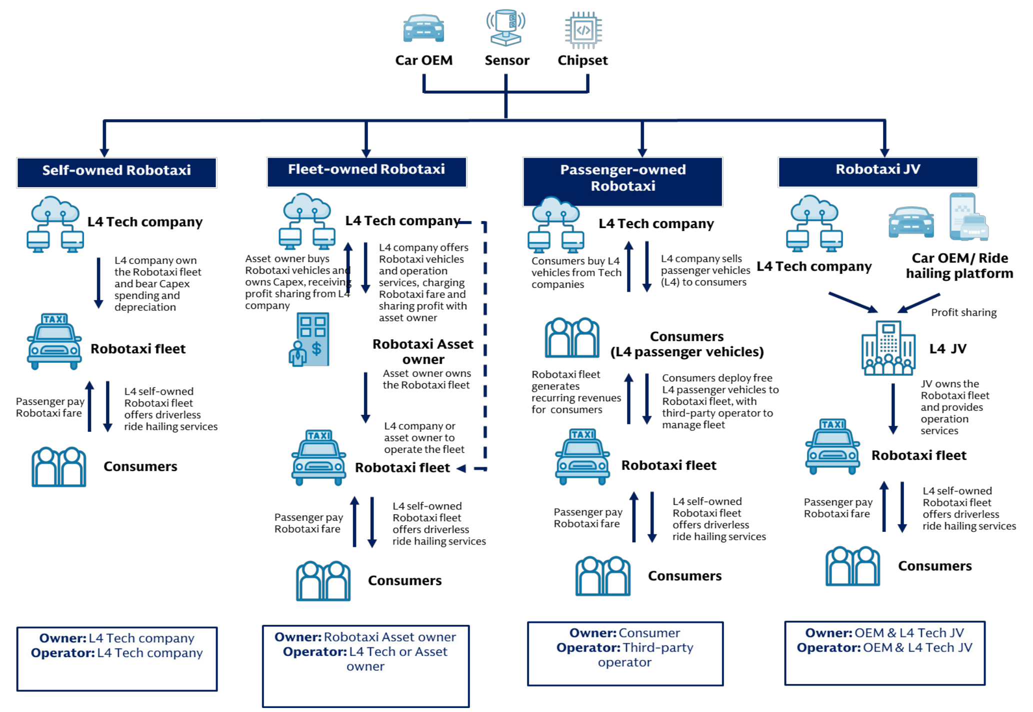
Source: Company data, Data complied by Goldman Sachs Global Investment Research

There are five available platforms for users to call for robotaxis. Each robotaxi operator has its in-house App, whose user volume is still small. Traditional shared mobility platforms (taxi-hailing apps, map apps, Fintech app's mini programs, social media) have also integrated robotaxi-hailing function, although the feature is not yet displayed at the most obvious place.

We expect the integration of robotaxi into the traditional taxi-hailing platforms as an efficient way to promote usage. Traditional platforms' large user base and mature platform design can bring exposure to robotaxi fleets. Although robotaxi vendors usually need to share ~10% of the GMV (gross merchandise value) with the platforms, the cost of acquiring users from scratch can be higher.

(17) Potential up-scaling methods? Shared-ownership to encourage adoption

Exhibit 40: Robotaxi fleet ownership: Self-owned, Fleet-owned, Passenger-owned, Robotaxi JV



Source: Company data, Goldman Sachs Global Investment Research

We reviewed different potential business models of Robotaxi fleets, and note that the industry started with the Self-owned business model, then migrated to fleet-owned or passenger-owned with improving Unit Economics per Robotaxi.

(1) Self-owned Robotaxi fleet: L4 companies own and operate the fleet, which is asset heavy. **(2) Fleet-owned Robotaxi fleet:** Asset owners purchase Robotaxi vehicles and bear the depreciation cost. L4 companies either operate the fleet and share the profit with asset owners, or purely offer virtual driver solution for asset owners by charging annual subscription fee. **(3) Passenger-owned Robotaxi:** Individual consumers buy L4 vehicles for daily life usage, and they could deploy their vehicles to Robotaxi fleet to generate revenues. **(4) Robotaxi JV:** L4 companies set up JV with car OEMs or ride-hailing platform to own and operate the Robotaxi fleet, then share profits.

(18) What to improve? Density and fleet coverage

Exhibit 41: Fleet density: Robotaxi vs. non-robotaxi

	Shanghai	Beijing	Shenzhen	Guangzhou
Traditional taxi fleet in 2024 (k units)	282	399	148	189
Robotaxi fleet in 2024 (k units)	0.1	0.2	0.1	0.1
Long-term residents in 2023 (mn of people)	Around 24.9	Around 21.9	Around 17.8	Around 18.8
Traditional taxi per mn people	11,339	18,225	8,303	10,032
Robotaxi per mn people	4	10	7	12

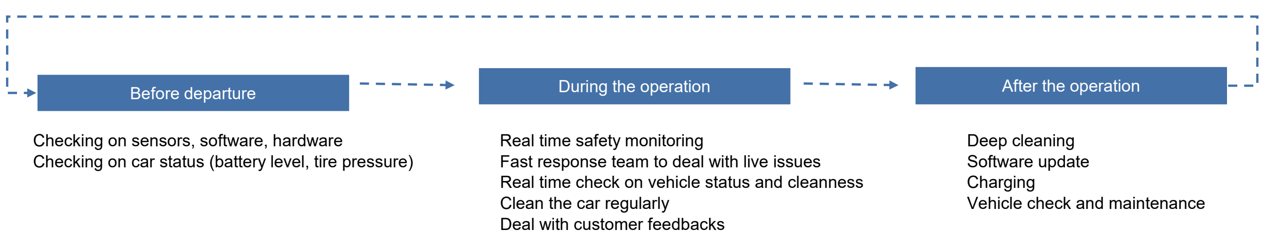
Long-term residents are 2023 data from Provincial Statistics Bureau, Traditional and Robotaxi fleet sizes are GSe, Traditional taxi includes taxi fleet and ride-hailing fleet

Source: Goldman Sachs Global Investment Research

Rising density to shorten waiting time: Robotaxi's development in China is still at the initial stage with only a few vehicles offering service to the public. The average available robotaxi per million people is lower than traditional taxi fleet (taxi and ride-hailing) in China's major cities (Shanghai, Beijing, Shenzhen, Guangzhou). Currently, pricing promotion is one of the main measures to attract initial user base. We expect more robotaxis deployment in major cities in the next few years, attracting more users.

(19) What to improve? Cleaning and maintenance

Exhibit 42: Key steps of robotaxi daily mainenance



Source: Company data, Goldman Sachs Global Investment Research

As the robotaxi fleet scales up, maintenance becomes increasingly important

Apart from daily vehicle maintenance such as checking the battery and replacing the tires, robotaxis require extra maintenance for sensitive sensors as well as upgrades of software. Due to the longer operating hours, robotaxis would need more frequent checks to ensure safety. As there are no drivers in the vehicles, remote safety monitors would need to track the vehicles in real time and a fast response team would need to stand by in case of any emergency.

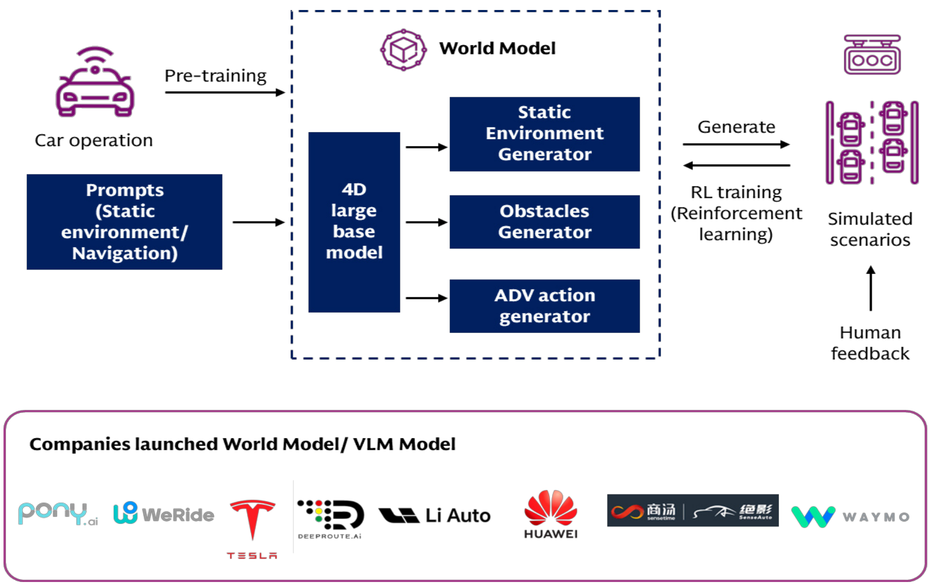
Cleanliness a key factor for consumer adoption

The operators can install in-vehicle cameras to monitor cleanliness, and call back the vehicle for cleaning when needed. Extra cleaning fees can be charged to users where appropriate. The operators can also install air circulation and purifier/sterilizer systems in the robotaxi to maintain fresh air.

Robotaxi operators may outsource some of their daily maintenance to third-party experts due to its complexity and labour intensity. For example, Waymo has been partnered with Avis since 2017. Intelligent cleaning robotics can also be a potential solution in the future, as showcased by Tesla in a video that a robot can clean the interior of the vehicle automatically.

(20) What to improve? Algorithm enhanced by world model

Exhibit 43: Enhanced autonomous driving data leverage both driving data and simulated driving scenarios



Source: Company data

From human driver data to simulated scenarios to scale-up: The smart driving industry is upgrading from human data driven L2 algorithm to World Model/ VLM (Visual Language Model) that use simulated driving scenarios for Reinforcement Learning training. L4 autonomous driving requires the virtual driver to outperform human drivers, and therefore needs generative data from world models, in our view. Many companies have launched in-house World Model or VLM Model for driving functions with high autonomous level (Exhibit 43). Currently, some companies only use real-world data for pre-training and rely more on simulation from World Model, and some companies leverage more from human driving mileage and use simulated driving scenario for compensation.

(21) How to evaluate safety? Sensors, driving styles and emergency measures

A full set of sensors including Lidar, cameras and radars. These major three types of sensors are used for different ranges (25m-300m) and scenarios (raining or foggy). Compared to L2 passenger cars that come with 1-2 front view cameras and 0-1 Lidar, a typical robotaxi would have 10+ cameras for different range of views, multiple Lidar to achieve a wide angle, and multiple radars to detect short range/ long range. For example, WeRide's GXR model has 20+ sensors to ensure safety.

Style of driving is also a major consideration. The robotaxi algorithm has different characteristics, similar to those of different human drivers, which are the combined result of the robotaxi supplier's preference and its training data-set. A safe algorithm can brake early and slowly, strictly follow the traffic rules, accurately communicate with the other drivers on the road (e.g. turning on the left-turn/ right turn signals), and slow down for pedestrians and non-motor vehicles.

Exhibit 44: Pony AI's robotaxi in traffic

Provided by Pony AI

Source: Company data

Exhibit 45: Pony AI's driverlss operations

Provided by Pony AI

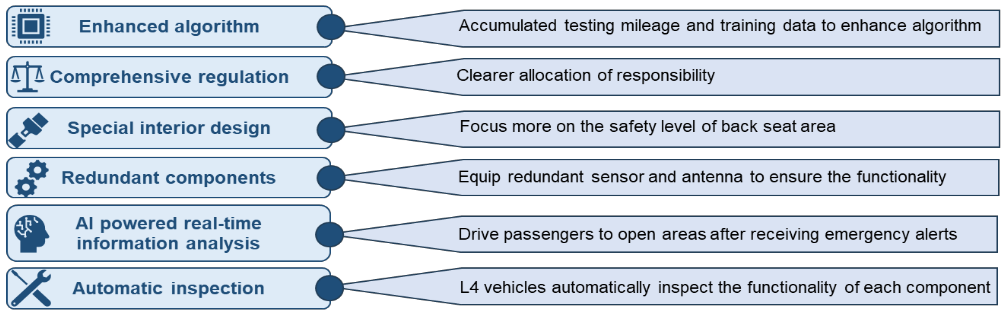
Source: Company data

Emergency measures. Extra emergency measures need to be added inside and outside the robotaxi. For example, WeRide's GXR has a safety button inside the vehicle that can ask the car to park slowly, safety hammer for emergency and safety door handle for evacuation. We believe it could be helpful for the robotaxi to have an emergency call button to contact the control center, external sirens for passengers to warn pedestrians, and a door button that can unlock and open all car doors at the same time.

(22) How to enhance safety? Combined effort in software, hardware, and regulations

We expect the robotaxi industry to enhance safety through: **(1) Algorithm updates; (2) More comprehensive regulations; (3) Interior design; (4) Redundant components; (5) AI powered real-time information analysis; (6) Automatic inspection**.

Exhibit 46: How to improve the overall safety of robotaxi



Source: Goldman Sachs Global Investment Research

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Reg AC

We, Allen Chang, Verena Jeng, Mark Delaney, CFA, Ronald Keung, CFA, Kota Yuzawa, Lincoln Kong, CFA, Tina Hou, Thomas Wang, Eric Sheridan, Ben Miller and Xuan Zhang, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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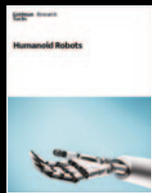
MINDCRAFT: OUR THEMATIC DEEP DIVES

Artificial Intelligence

Humanoid Robots

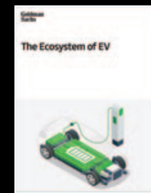


China in Transition

China Resilience

Japan Value in Action

The Ecosystem of EV



The Ecosystem of Batteries

Tracking Greater China's activity

Autonomous driving

China Property

China Consumer

CHIPS Act Impact

Investing in India

Carbonomics

China Grid Tech

Healthcare Innovation

Suppy Chain Shifts

Trade and tariffs

Market Concentration

Top of Mind

Balanced Bear

Market Cycles

Tracking the Consumer

Korea Value in Action

Cybersecurity and Defense

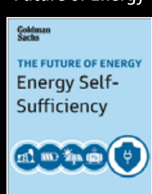
Computing Advances

Magnificent 7

Top Projects

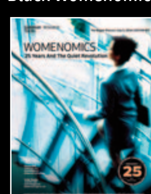
China Battery Energy Storage System (BESS)

Future of Energy



Power Demand

Black Womenomics



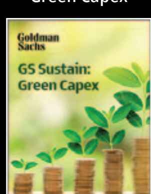
Music in the Air

Robotics & Automation

Understanding China's Statistics

Clean Hydrogen

Green Capex



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