

Where Is Musk Taking His Empire?

Another stunt in the service of excess

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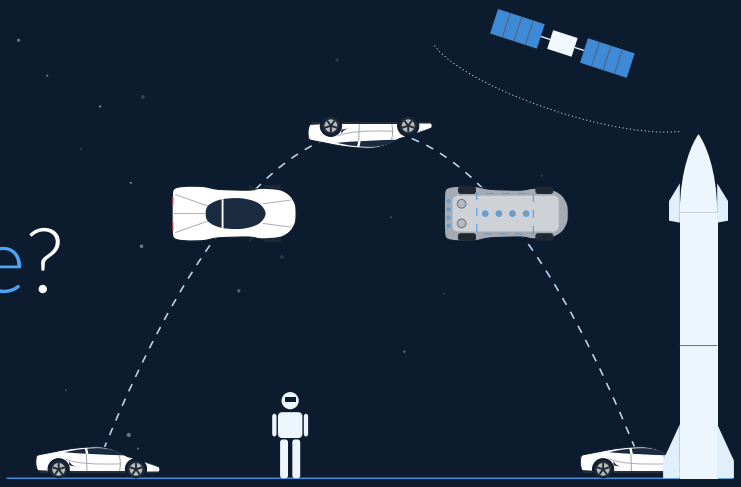

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Biosphere Economics · October 2026

SUMMARY

On October 15, 2026, Tesla unveiled its new "flying" Roadster at a SpaceX test site in Texas. Powered by compressed air, the car jumped over five vehicles while performing a barrel roll, and the footage went around the world. Beyond the car itself, this latest stunt by Elon Musk, one of the figures shaping the planetary age, raises a question: where is Musk taking his empire?

Musk's companies remain separate, but they are drawing closer together around him. SpaceX, the rocket and satellite company, has absorbed xAI, Musk's artificial intelligence company, which had itself acquired X, formerly Twitter. SpaceX also supplies the US military with satellites and military communications networks. Tesla is investing in xAI and is preparing a joint chip factory with SpaceX, and a merger of the two companies has been floated. The group, which started with electric cars and rockets, is thus turning toward artificial intelligence and defense. October 15 put this convergence on stage, with a Tesla fitted with SpaceX-designed thrusters, in front of a spellbound audience.

Part A of this article analyzes what drives this fascination and how Musk uses it to build his narrative and his empire. It shows that this stunt is only the latest in a long series, from humanoid robots to computing satellites in orbit, that give his empire an almost magical value. Some of these bets could still pay off. Musk has already tipped the car industry toward electric and revolutionized space transport with reusable rockets, and Starlink could become an essential service, whose control by a single man would then raise a question of governance.

The calculations in Part B then show that the October 15 stunts are indeed possible without trickery, but that the car can stay in the air for only a few seconds. So it does not fly, and its stunts are of no use on the road. The show serves the narrative of an empire driven by excess, the *hubris* of the Greeks. Its value rests on promises, and it must grow without end to survive, while humanity has already crossed most of the planetary boundaries. Musk thus appears as an ambivalent figure, who put his genius at the service of planetary challenges and whom his growth now pulls toward war and political power, like Anakin Skywalker turned Darth Vader, though a return to the light remains possible. This headlong rush brings us back to the question the philosopher Bruno Latour asked in *Down to Earth*: where should we land? It applies to Musk as much as to us. To answer it, humanity will need coordination and planning far more than stunts.

Keywords. Elon Musk, Tesla, SpaceX, xAI, conglomerate, defense, narrative, anthropology of power, magical thinking, society of the spectacle, social acceleration, Tsiolkovsky rocket equation.

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Biosphere Economics and the Planetary Lab

Biosphere Economics is a consulting and research firm devoted to the planetary age. It helps leaders make decisions in a world where AI, energy, geopolitics and the biosphere are changing at the same time. It was founded by Jean-Pierre Goux, a mathematician, winner of the SIAM Optimization Prize, former executive of the European energy exchange, author and speaker.

The Planetary Lab is the research arm of Biosphere Economics. It develops the concepts and models that humanity needs to understand the planetary age and find its way through it, in order to prepare the transition to *Homo biospheris*. Its publications are open access, and custom analyses are produced for companies, organizations and local governments.

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Introduction

On October 15, 2026, in Texas, a Tesla Roadster rose above five vehicles, completed a full barrel roll and landed on its wheels. The scene took place at a SpaceX test site, in front of more than a thousand guests, and it went around the world within a few hours. The footage shows a car that flies. Musk presents it as the start of a new era for the automobile.

Whether one likes him or not, Musk is one of the forces shaping the planetary age. His companies have changed the car and access to space, they surround the Earth with satellites, and they now weigh on artificial intelligence and defense. Understanding where he is taking his empire sheds light on part of our era.

The calculations in Part B of this article show that the stunts are real, with no trickery, but that none of these maneuvers has any use on the road. The October 15 demonstration therefore announces no real product. It does serve the direction in which Musk is taking his companies, and that is where his purpose lies.

Investors value Tesla far above what its cars earn, on the strength of promises about artificial intelligence and robots. SpaceX absorbed xAI, Musk's artificial intelligence company, and then went public in June 2026 in the largest IPO in history, at a valuation of more than $2 trillion. Since then, the Pentagon has asked Musk to think about the warfare of the future. Musk's companies remain legally separate, but their capital and their projects are intertwined, and the whole is coming to resemble a technology, AI and defense conglomerate.

Part A describes this evolution. It starts from the October 15 show and the psychological and anthropological mechanisms that make it effective. It then examines Tesla's market value and the promises that support it, as well as the convergence of Tesla, SpaceX and xAI, their new promise of orbital computing and their turn toward defense. It shows that this stunt is only the latest in a series, from humanoid robots to computing satellites in orbit, and closes on the endless growth that drives the whole enterprise. Part B examines the October 15 demonstration itself. It calculates how much compressed air each stunt costs and how long the car can stay in the air. A single stunt almost empties the tank, and the car stays airborne for no more than a few seconds. Despite what many social media posts claimed, Musk has not invented the flying car.

The Greeks called this endless growth *hubris*, excess, and Nemesis eventually caught up with those who overstepped the measure. In 2017, in *Down to Earth*, the philosopher Bruno Latour asked a question that applies here: where should we land?[1] It applies to Musk, who must keep growing ever faster to sustain his market value. It also applies to a humanity caught up in the same acceleration on a planet where it has already crossed most of the planetary boundaries. Answering it will take coordination and planning far more than stunts.

[1] Bruno Latour, *Où atterrir ? Comment s'orienter en politique*, La Découverte, 2017.

PART A

The Musk empire

The stunts of a stubborn magician

A . 1

October 15: a demonstration of power

On October 15, 2026, Tesla presented the new generation of the Roadster at SpaceX's test site in McGregor, Texas. More than a thousand guests watched the stunts, and the livestream ran on X, Musk's social network. The car's compressed-air thrusters were developed with SpaceX, and Musk presented the project as the union of "the world's best car company and the world's best rocket company"[2]. The date fell in the week when automakers from around the world were showing their new models at the Paris Motor Show. Those cars were made only to drive, and the car that drew attention was one shown outside the show and presented as flying. The scene became a global meme: parodies flooded social networks, and some websites already offer to make your own car "fly" with AI[3]. Yet these stunts herald no new generation of road vehicles. The version able to perform them is not allowed on public roads, and the Federal Aviation Administration (FAA) does not consider it an aircraft[4]. Legally, then, it is neither a road car nor a flying machine, and the purpose of this staging lies elsewhere.

A.1.1 The staging of power

The anthropologist Georges Balandier showed that power rests neither on force alone nor on reason alone. It also exists through the images it produces and through the ceremonies in which it arranges them. "Every system of power is a device designed to produce effects," he wrote in 1980[5]. On October 15, the setting was a rocket site, the broadcast ran on a channel owned by the speaker, and the stunts followed one another in a set order up to the final barrel roll.

Musk himself explained the role of the guests: "We need an audience to prove that it's not AI or SI," SI standing for superintelligence[6]. In the early twentieth century, the anthropologist James George Frazer described a "public magician" whose authority arises from a successful demonstration before witnesses, and who can rise in this way to the rank of chief[7]. The thousand guests of October 15 stood in for those witnesses, and millions of viewers relayed them. Musk has never said he draws on this work. He has, however, adopted a phrase he has often posted on X: "The most entertaining outcome is the most likely"[8]. Frazer left the question of intent open. In his view, the magician is often one of the "more or less conscious deceivers," but "he is often sincerely convinced" of his powers as well[9]. No one knows whether Musk calculates his effects, and the staging produces its own in either case.

[2] CBS News and *Inc.*, October 16, 2026.

[3] *Twitchy*, October 16 and 17, 2026; *OneIndia*, October 2026; flyingcar.fun, accessed October 20, 2026.

[4] *Fortune*, October 17, 2026, citing CBS News and *Politico*.

[5] Georges Balandier, *Le Pouvoir sur scènes*, Balland, 1980, chapter 1, read in a Spanish translation; quotation re-translated.

[6] Remarks made on stage, reported by *Engadget*, October 15, 2026.

[7] James George Frazer, *The Golden Bough*, abridged edition, Macmillan, 1922, chapters 5 and 6, English text read online. Frazer's evolutionist theses are now widely rejected; only his description of the public magician is used here.

[8] Phrase posted several times by Musk on X, including in 2022, according to Matt Levine, Bloomberg, October 24, 2022; date of first posting not independently verified.

[9] Frazer, *op. cit.*, chapter 3, section 4, "The Magician's Progress."

A.1.2 Signaling a merger

Frazer also describes a "law of contact." In magical thinking, an object that has touched a person or a thing keeps a link with it and carries away part of its qualities. The sorcerer thus believes he can act on someone through their hair or their clothes[10]. The Roadster was designed with SpaceX and presented at a launch site, with thrusters derived from rocket technology. In the public's eyes, it has touched the rocket and keeps its prestige. This contact goes back to February 2018, when the first Falcon Heavy rocket carried Musk's personal red Roadster, a first-generation model, into space, with a mannequin in a spacesuit at the wheel. In October 2026, a Tesla car borrows the prestige of rockets from SpaceX, and that prestige reflects on Tesla just as a merger of the two companies is being discussed. Bloomberg's headline read "Tesla Launches Roadster at SpaceX Site in Latest Merger Hint," and CNBC described a car "developed with SpaceX, fueling merger speculation"[11].

A.1.3 Spectacle and fascination

In 1957, Roland Barthes devoted one of the essays in his *Mythologies* to the Citroën DS, presented at the Paris Motor Show in 1955. He saw in it an object "consumed in image if not in usage by a whole population," and noted that the DS "manifestly falls from the sky"[12]. It is also the car of power. On August 22, 1962, at Petit-Clamart, General de Gaulle's DS, hit by fourteen bullets and running on two flat tires, allowed him to escape an assassination attempt. Legend credits this escape to its hydropneumatic suspension, although the suspension's role has not been established[13]. Three years later, the movies made it fly. In André Hunebelle's *Fantômas se déchaîne*, released in 1965, the criminal played by Jean Marais escapes Commissioner Juve, played by Louis de Funès, in a DS whose wings unfold at takeoff. The film drew more than 4 million viewers in France, and the three-film *Fantômas* series about 12 million[14]. The image of the flying DS has endured, to the point that in 2023 the DS brand designed a "modern reinterpretation" of it for an exhibition at the National Automobile Museum in Mulhouse[15]. The 2026 Roadster replays the scene with a real car and real thrusters, and it is consumed in the same way: its image has traveled the world, and no one will be able to drive it before 2028.

Guy Debord defined the spectacle as "a social relation between people that is mediated by images"[16]. The images of October 15 link the car to Musk, who presented the stunts on stage himself.

The anthropologist Alfred Gell showed that technical virtuosity captivates those who do not know how an object was made, and that it gives social power to those who master it[17]. The writer Arthur C. Clarke had summed it up in 1968: "Any sufficiently advanced technology is indistinguishable from magic"[18]. The viewer sees a car fly without understanding how. The

[10] Frazer, *op. cit.*, chapter 3, "Sympathetic Magic," section "Contagious Magic."

[11] Bloomberg, "Tesla Launches Roadster at SpaceX Site in Latest Merger Hint," October 15, 2026; CNBC, "Tesla unveils long-delayed Roadster developed with SpaceX, fueling merger speculation," October 15, 2026.

[12] Roland Barthes, "La nouvelle Citroën," *Mythologies*, Seuil, 1957, excerpt read.

[13] *Caradisiac*, "La DS de l'attentat du Petit-Clamart : la tragédie évitée qui l'a immortalisée."

[14] Wikipédia, "Fantômas se déchaîne"; *Ciné Série*, April 10, 2024, citing Box-office Story.

[15] *L'argus*, April 5, 2023.

[16] Guy Debord, *La Société du spectacle*, Buchet-Chastel, 1967, thesis 4.

[17] Alfred Gell, "The Technology of Enchantment and the Enchantment of Technology," in J. Coote and A. Shelton (eds.), *Anthropology, Art and Aesthetics*, Clarendon Press, 1992, cited from secondhand excerpts.

[18] Arthur C. Clarke, letter to *Science*, 159(3812), January 19, 1968, according to secondary sources.

calculations in Part B reveal the trick: the stunts are real, but a single one of them almost empties the air tank, and the car cannot stay in the air for more than a few seconds.

Six minutes after the successful roll, the reservation page opened: $50,000 for one version, $250,000 for another, with no final price[19]. Tesla has published no reservation figures. Still, asking such sums for a car with no price presupposes confidence acquired in advance, and that confidence is what the magic produces.

On SpaceX's test grounds, Musk thus staged his power and the coming together of his companies. The fascinated public saw a car fly without seeing the apparatus of which it was itself a part. By sharing the scene and remixing it, each viewer served a narrative that reaches far beyond the car, the narrative of an empire in the making.

[19] *Fortune*, October 17, 2026.

A.2

A car valued at $850,000

On October 16, 2026, the stock market valued Tesla at about $1.4 trillion. The company had delivered 1.64 million cars in 2025. If all of that value came from the cars, each one would be worth about $850,000. The market values other automakers at between $4,000 and $25,000 per car sold (Table 1).

Table 1. Market value per car sold: October 2026 market capitalization divided by 2025 sales.

Automaker	Market cap ($ bn)	2025 sales (millions)	Value per car ($)
Tesla	1,400	1.64	**855,000**
BYD	114	4.6	24,800
Toyota (group)	229	11.3	20,200
BMW (group)	38	2.46	15,600
Volkswagen (group)	39	8.98	4,300

Sources: market capitalizations from *The Motley Fool* (Tesla, October 16, 2026) and companiesmarketcap.com (October 2026); sales from Tesla, BYD (Bloomberg, January 1, 2026), Toyota and Volkswagen (*AutoIndustriya*, January 2026) and BMW (group press release, January 2026).

On the stock market, then, a Tesla is worth 35 times a BYD, 42 times a Toyota and 200 times a Volkswagen. This gap translates into dollars the magical thinking described above. For Frazer, an object that has touched a powerful thing carries away its qualities, and for Gell, technical virtuosity gives power to the one who masters it. A Tesla has touched the rocket, artificial intelligence and the robot, and the market credits it with a value forty times that of a Toyota. No difference in quality between the two cars is enough to explain such a ratio, even though the share due to belief cannot be measured directly. If Tesla were valued like other automakers, its automotive business would be worth between $40 billion and $180 billion, depending on the method used[20]. The rest, between 87 and 97% of the company's value, rests on businesses that do not yet exist at scale: robotaxis, humanoid robots and artificial intelligence. These businesses are themselves promises. Demonstrations like the one on October 15 make them credible, even though these feats keep being postponed, as the next section shows.

This gap takes nothing away from Tesla's industrial success. The company made the electric car desirable and produced it at scale. In 2023 its Model Y was the best-selling car in the world, across all powertrains, a first for an electric car, and it remains among the best sellers[21].

Tesla delivered 1.81 million cars in 2023 and 1.64 million in 2025, and BYD overtook it in that last year with 2.26 million fully electric cars[22]. Between the end of 2023 and the end of 2025, Tesla's net income fell by a factor of four, and its market value almost doubled[23]. Tesla is therefore bound to produce spectacle. Without new promises, its value would rest on its cars alone,

[20] Value of the automotive business calculated at BYD's price per vehicle, at Toyota's earnings multiple, and according to Morgan Stanley (*TheStreet*, April 25, 2026).

[21] JATO Dynamics, January 2024; for 2024 and 2025, *Jalopnik* and Focus2Move, according to which the Toyota RAV4 overtook it.

[22] CnEVPost, February 4, 2026.

[23] Calculations based on stockanalysis.com and Tesla's annual reports; J.-P. Goux, *Le contrôle du récit planétaire*, Planetary Lab, forthcoming.

between $40 billion and $180 billion instead of $1.4 trillion. The share price would then fall by a factor of between 8 and 35, and this is the drop that Musk and his shareholders fear.

A.3

Promises running late

Musk keeps some of his industrial promises, but delay is the rule. In a survey of 41 promises made by him and his companies between 2008 and 2026, those that were kept were generally kept after about twice the announced time[24]. Yet these delays concern projects that few industrial companies dare to take on. In 2025, SpaceX carried out 165 of the world's 320 orbital launches, and it recovered 162 first stages for reuse. Before 2015, no orbital rocket had ever been recovered[25].

The Roadster. Unveiled in 2017, it was promised for 2020[26]. Nine years later, no customer has received one, and the model presented on October 15 entirely replaces the 2017 one. Tesla announces production for 2028[27]. If the factor-of-two rule applies, the first deliveries would take place around 2030, and the first Roadster ran much further behind schedule than that. In any case, these deliveries will involve versions without stunts. The version seen in flight on October 15 is reserved for invited customers and is not allowed on public roads. It was never designed for the road, since its function is spectacle.

Self-driving. Announced in 2015 for 2017, full self-driving remains in 2026 a system the driver must supervise. In April 2019, Musk promised a million robotaxis by the end of 2020. In September 2026, about 476 vehicles were registered as robotaxis in Texas[28]. The Cybercab, a robotaxi with no steering wheel or pedals presented in October 2024, was to be produced in volume from 2026, at a rate of at least two million a year. Its production did start in April 2026, but on October 10 only 319 units were registered in Texas[29].

The Optimus humanoid robot. In June 2024, before Tesla's shareholders, Musk claimed that Optimus would one day lift the company's value to $25 trillion, more than forty times its value at the time and more than half that of the 500 largest US companies combined[30]. Tesla has published no Optimus production figures. In January 2025, Musk announced about 10,000 robots for the year, and that figure was not reached. According to a single source, no robot was mass-produced that year[31]. Nor is there any evidence that the robot works on its own. In October 2024, at the "We, Robot" event, Optimus robots served drinks while partly teleoperated by employees, and in January 2026 Musk acknowledged that no Optimus was doing useful work in Tesla's factories[32]. The same month, he announced the end of the Model S and X in order to install in their place, at Fremont, a line able to produce up to a million robots a year[33]. These two models were selling only about 30,000 units a year, on a line built for 100,000[34]. In the

[24] Survey of 41 promises by Musk and his companies made from 2008 to 2026; J.-P. Goux, *Le contrôle du récit planétaire*, Planetary Lab, forthcoming.
[25] *Jalopnik* and *Space.com*, January 2026. The first landing of a Falcon 9 first stage took place on December 21, 2015.
[26] Reuters, October 15, 2026, republished by *Zawya*.
[27] *Jalopnik*, October 15, 2026.
[28] List of Musk's predictions on self-driving, Wikipedia, accessed October 2026; The Charge Port, robotaxi tracker, September 21, 2026.
[29] Wikipedia, "Tesla Cybercab," accessed October 20, 2026; *Quartz*, April 24, 2026.
[30] CNBC, June 13, 2024; *InsideEVs*, June 14, 2024. Tesla was then worth about $580 billion; ratio calculated.
[31] *PacketNebula*, July 28, 2026; *Electrek*, April 22, 2026.
[32] *Electrek*, January 28, 2026.
[33] KTVU, citing CNBC, January 29, 2026.
[34] *Electrek*, April 22, 2026.

narrative, the closure of an underused line thus becomes a conversion to the robot. In July 2026, the Optimus lines were being installed, and the third generation of the robot had still not been shown[35].

The target market remains small. In the first half of 2026, about 19,100 humanoid robots of all brands were delivered worldwide, more than 97% of them by Chinese manufacturers, including 8,400 by AgiBot and 5,900 by Unitree[36]. The Fremont line alone is sized for about twenty-five times this global market, and Musk's pay package sets him the goal of delivering a million robots.

Sales growth. In January 2021, Tesla announced that its deliveries would grow by 50% a year for several years. In October 2023, Musk acknowledged: "It's not possible to have a compound growth rate of 50% forever, or you will exceed the mass of the known universe." The target disappeared from Tesla's outlook in January 2024[37].

Starship. In September 2016, Musk presented the rocket meant to carry humans to Mars, then called the Interplanetary Transport System and since renamed Starship. In late September 2019, he hoped to put it into orbit within six months. Its first orbital flight took place on September 28, 2026, seven years later[38]. Starship is also the largest rocket ever built, and since October 2024 the launch tower has caught its first stage on its return.

Mars. At SpaceX, Musk announced in 2016 the first crew on Mars for 2024. In 2025, he placed it between 2029 and 2031. For twelve years, the deadline has stayed between four and eight years ahead of the date of the announcement (Figure 1), and in February 2026 SpaceX gave priority to the Moon[39].

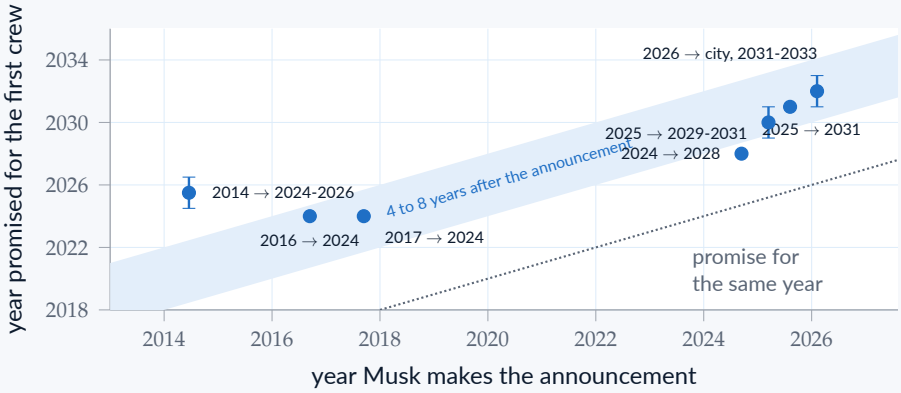

Figure 1. SpaceX and Mars: the dates Musk has promised for the first crew. Each point is a statement by Musk: its horizontal position gives the year he spoke, its height the year he promised. The bars show the announced ranges, and the last point concerns the start of a Martian city. The blue band shows that, since 2014, the deadline has always stayed between four and eight years ahead of the announcement.

These delays do not shake shareholders' confidence. Thirteen months after the "We, Robot" event of October 2024, more than 75% of Tesla shareholder votes approved a pay package that

[35] *PacketNebula*, July 28, 2026, citing Tesla's earnings call of July 22, 2026.

[36] TechNode, August 11, 2026, citing IT Home.

[37] *The Motley Fool*, February 5, 2021; Bloomberg, republished by *Advisor Perspectives*, January 28, 2024; *Electrek*, January 24, 2024.

[38] *Engadget*, September 29, 2019; *NASASpaceFlight* and *Space.com*, September 28, 2026.

[39] Statements by Musk reported by *Universe Today* (2014), *Al Jazeera* (2025), *Verdict* (2025), *Wccftech* (2025) and Fox 7 Austin, February 9, 2026.

sets Musk, among other goals, a million robotaxis in commercial service and ten million active self-driving subscriptions[40]. Shareholders reward a bigger promise instead of penalizing the one that was not kept. They are also betting on Musk's tenacity, which his supporters sum up in a saying: "never bet against Elon"[41]. Some of his promises did come true, late, when few industrial leaders set themselves such goals. These outsized promises are part of his method: they rally his engineers and his investors, and without them SpaceX and Tesla would probably not exist in their current form. This magic also works inside his companies. His outsized goals pushed his engineers to feats that others considered out of reach, such as rockets that come back and land. Yet his management remains heavily criticized for its harshness: in November 2022, he asked Twitter employees to commit to "extremely hardcore" work, or leave[42].

[40] *Al Jazeera*, November 6, 2025; "2025 CEO Performance Award," Exhibit 10.2 to Tesla's Form 8-K, SEC, September 2025.

[41] A saying common among investors and on social media; origin not established.

[42] AFP, " 'Hardcore' Musk drives into a culture clash at Twitter," November 23, 2022, via *Gulf News*.

A.4

Tesla and artificial intelligence

Since 87 to 97% of its value rests on future businesses, Tesla has to convince investors that it is an artificial intelligence company. Its AI serves first of all self-driving, the Cybercab and Optimus. It depends on two things: chips that run the models in the car or the robot, and data centers that train them (Figure 2).

A.4.1 Compute: Dojo abandoned, Cortex in service

Tesla first wanted to build its own training supercomputer, Dojo, presented in 2021. In January 2024, the company announced $500 million for a Dojo supercomputer in Buffalo, New York. The targets set, including 100 exaflops by October 2024, were never reached. In August 2025, Tesla disbanded the team, and its head, Peter Bannon, left. Musk called Dojo 2 "an evolutionary dead end"[43].

Self-driving is trained on GPUs bought from Nvidia. Tesla grouped them in Cortex, a data center at Giga Texas, which had about 50,000 H100 GPUs at the end of 2024 and the equivalent of 67,000 by mid-2025[44].

A.4.2 Tesla's chips

Tesla designs in-house the chips that run its models in its cars. The current chip is called AI4. The next one, AI5, is to be produced in small series in 2026 and in volume in 2027. In July 2025, Tesla gave Samsung the contract to manufacture the AI6 generation, for $16.5 billion[45].

In January 2026, Musk revived Dojo under the name Dojo3, with a different purpose: "AI7/Dojo3 will be for space-based AI compute"[46]. The chip stays at Tesla, because Tesla's team designs it, but it is to equip the SpaceX computing satellites described in Section A.5.

A.4.3 The links with xAI

xAI is the AI company Musk founded in 2023. In March 2025 it absorbed X, formerly Twitter, and in February 2026 it was in turn absorbed by SpaceX. A rocket company has no obvious reason to buy a social network and a language model. Musk justified the deal by orbital computing: SpaceX will launch the satellites on which xAI's AI will run (Section A.5)[47]. xAI develops the Grok model and trains it in Memphis, in its Colossus data centers. At the end of September 2026, according to Musk, these centers held about 780,000 Nvidia GPUs. According to xAI, the first Colossus was built in 122 days, an unprecedented timeline for a data center of this size. Colossus 2 is the largest AI compute cluster in the world, and its electrical capacity, about one gigawatt, equals that of Amazon's largest site[48]. Part of this electricity comes from gas turbines:

[43] *TechCrunch*, "Tesla Dojo: the rise and fall of Elon Musk's AI supercomputer," September 2, 2025.
[44] *Ibid.*, citing Tesla's quarterly presentations.
[45] *TechCrunch*, September 2, 2025; *Electrek*, March 22, 2026.
[46] *TechCrunch*, January 20, 2026, citing a post by Musk on X.
[47] Letter "xAI joins SpaceX," February 2, 2026, according to *Shacknews*; *The Journal*, June 2026.
[48] Post by Musk on X, September 25, 2026, reported by Bloomberg; Epoch AI, *Frontier Data Centers*, estimates as of October 2026.

in July 2026, Reuters counted 59 of them operating without permits[49]. The world's largest data center thus runs largely on gas (see the box below).

COLOSSUS 1 AND 2: WHERE DOES THE ELECTRICITY COME FROM? WHAT IS ITS FOOTPRINT?

Colossus 1, in Memphis, is connected to the grid, which has supplied it with 150 megawatts since May 2025, and 150 more were approved in February 2026. Fifteen permitted gas turbines, totaling about 250 megawatts, and more than 240 Megapack batteries take over when the congested grid asks it to cut its consumption.

Colossus 2 is barely connected to the grid, and the local utility says it does not supply it. It runs on gas, from a power plant built across the state line in Southaven, Mississippi, which is to reach about 1.2 gigawatts. Until the permanent plant, approved in March 2026, is in place, temporary turbines, some of them without permits, provide the power, and an agreement calls for their removal around mid-2027.

According to its permit application, the permanent plant may emit up to about 6.4 million tonnes of CO_2 equivalent per year. This permitted ceiling, which is not a measurement, amounts to nearly 2% of France's annual emissions. For the temporary turbines, an expert retained by the plaintiffs estimates nitrogen oxide emissions at about 5,300 tonnes per year[a].

[a] *Measured AI*, June 25, 2026, based on permit filings and court documents; single source for the emissions figures. Wikipedia, "Colossus (data center)"; *Mississippi Today*, March 10, 2026; SELC, 2026.

Grok makes little use of this computing capacity. In May 2026, xAI's GPUs reportedly ran at about 11% of capacity, compared with 43 to 46% at Meta and Google[50]. Grok accounted for 3.4% of global chatbot traffic in February 2026, and subscriptions to X and Grok brought in $365 million in 2025[51]. xAI therefore rents out most of its data centers to its competitors. Anthropic pays $1.25 billion a month through May 2029, Google $920 million a month, and other customers add to that, for an announced total of about $41 billion a year. All of these contracts can be terminated on 90 days' notice[52]. In 2025, xAI posted an operating loss of $6.4 billion on $3.2 billion in revenue, and it invested $12.7 billion[53]. Musk's GPUs mainly serve his competitors, who in this way finance the infrastructure of his empire.

Tesla is tied to xAI through several flows. It supplies Megapack batteries to xAI's data centers. Grok serves as the voice assistant in Tesla's cars, and since the summer of 2026 it controls on request more than a hundred vehicle functions[54]. In January 2026, Tesla invested $2 billion in xAI and signed a framework collaboration agreement, even though its shareholders' advisory vote on the matter had failed in November 2025, with abstentions counted as votes against. xAI has also told its investors that it wants to build the AI for humanoid robots such as Optimus[55]. The financial terms of these exchanges, what each company pays and what it receives, are not public.

[49] Reuters, July 14, 2026, based on public records, republished by *The Next Web*. xAI considers them mobile units exempt from permitting.

[50] *The Information*, May 2, 2026, republished by *Wccftech*; paywalled source not read in full.

[51] Similarweb, cited by *The Decoder*, February 2026; *TechCrunch*, May 20, 2026, citing the SpaceX prospectus.

[52] SpaceX IPO prospectus (S-1), SEC, May 20, 2026; *TechCrunch*, June 5, 2026; *DatacenterDynamics*, 2026; total calculated from *Crypto Briefing*.

[53] SpaceX S-1, AI segment data (xAI and X).

[54] *Drive Tesla Canada*, August 31, 2026.

[55] *TechCrunch*, January 28, 2026, citing Tesla's shareholder letter and Bloomberg.

A.4.4 The acquisition of Cursor

To find the revenue that Grok does not bring in, the empire tried another stunt. Cursor is an AI-assisted code editor widely used by developers. It puts other companies' models to work for its customers, mainly those of Anthropic and OpenAI. Its annualized revenue passed $1 billion in November 2025, and it reportedly reached $4 billion in June 2026 according to unconfirmed estimates[56]. A large part of this revenue goes back to the model providers. In mid-2025, according to an unnamed investor, Cursor was paying Anthropic about $650 million a year on $500 million in revenue[57].

In April 2026, xAI obtained an option to buy Cursor for $60 billion. SpaceX exercised it on June 16, four days after its IPO, and the acquisition closed on August 14. It was paid in stock, about 390 million SpaceX shares, so that the almost magical value of the empire, described in Section A.2, served as currency[58]. The price amounts to more than three times SpaceX's annual revenue, and twice Cursor's last valuation, $29.3 billion in November 2025, seven months earlier[59]. For a company that passes a large share of its revenue on to model providers, this is a very high price. It was, however, paid in stock, with no cash outlay. The option was taken a month before the IPO prospectus was filed, at a time when the empire's AI was losing $6.4 billion a year. Cursor brought to the prospectus revenue and revenue prospects that Grok lacked, and this is probably the main reason for the acquisition. Its users' programming sessions also provide training data for Grok. This is our interpretation, and no SpaceX document details the reasons for the acquisition.

Two weeks after the acquisition closed, OpenAI announced that it would cut off Cursor's access to its models on November 12, 2026. It said it could not be sure SpaceX would comply with its terms of use, and recalled that Musk had acknowledged that xAI had trained its models on the outputs of OpenAI's[60]. Cursor now depends on Anthropic, which rents Colossus and competes directly with Grok, and on Grok itself. Anthropic and OpenAI also sell their own programming tools, Claude Code and Codex, so that Cursor competes with its own suppliers[61]. The empire thus paid $60 billion in stock for a customer of its competitors' models, just as those competitors are turning against it.

Figure 2 shows the shape of the whole. A single chain runs from the chip to the end use, and Musk controls almost every link, but none of them stands on its own. Tesla designs chips it does not manufacture, xAI owns machines that none of its products is enough to keep busy, and Cursor sells a service built on its competitors' models. The links that make money today, Nvidia's GPUs and Anthropic's models, are held by others. The empire has thus built the infrastructure for an AI whose market it does not yet have. To justify this infrastructure, the narrative had to change scale, and Musk moved it into space.

[56] Wikipedia, "Anysphere," citing *VnExpress International*, November 18, 2025; June 2026 estimates from Latka and Clink, sources not independently verified.
[57] *SaaStr*, December 24, 2025; secondhand figures, not independently verified.
[58] Wikipedia, "SpaceXAI"; *AI Weekly*, August 2026; CBS News, June 2026.
[59] *SaaStr*, December 24, 2025, citing Cursor's funding round announcement.
[60] *Engadget*, August 29, 2026; CNBC, August 29, 2026.
[61] IDC, "OpenAI's Cursor Withdrawal Heats Up the Battle for Agentic Coding," September 3, 2026.

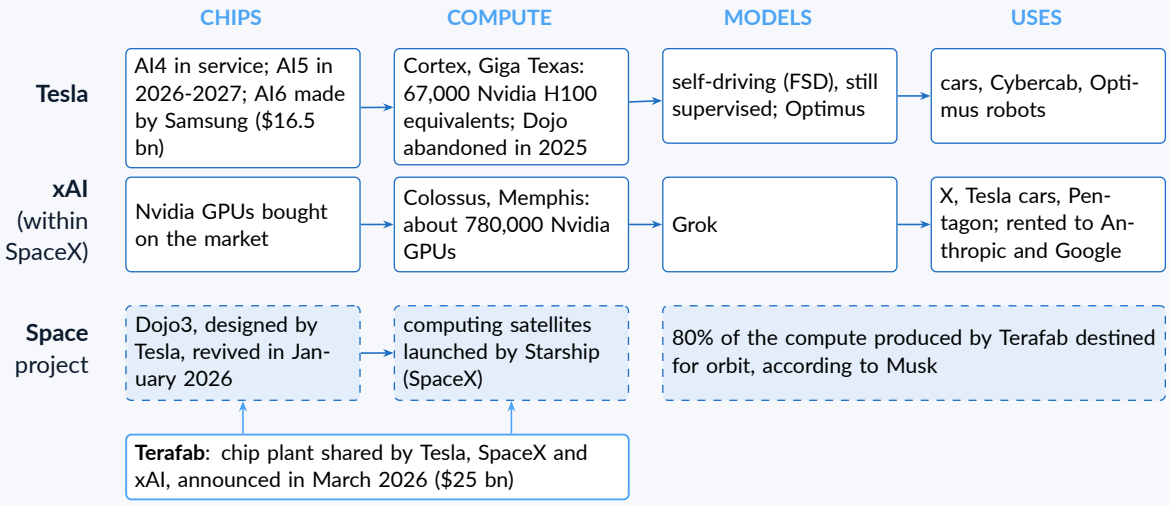

Figure 2. The place of AI in Musk's companies. Tesla designs chips and trains its models on its own Nvidia servers. xAI does the same for Grok. The space project links the two: a chip designed by Tesla is to equip SpaceX computing satellites. Dashed boxes are projects. Sources: *TechCrunch* (2025, 2026), *Electrek* (2026).

A.5

The new frontier: computing in orbit

Since late 2025, Musk has moved the promise of AI into space. Solar-powered satellites would run AI models there, far from saturated power grids and building permits.

A.5.1 An ambition that grows with each announcement

In late 2025, Musk claimed that Starship could put 100 gigawatts of computing into orbit each year within four to five years[62]. For scale, the whole world adds about 10 gigawatts of data centers each year according to projections by the International Energy Agency, and about 23 gigawatts were under construction at the end of September 2025[63]. The 100 gigawatts per year announced by Musk therefore amount to ten times what the planet adds each year on the ground, to be installed in orbit. On January 30, 2026, SpaceX asked the US Federal Communications Commission (FCC) for permission to launch up to one million satellites[64]. On February 2, in the letter announcing that SpaceX was absorbing xAI, Musk spoke of one terawatt per year launched from Earth, then of 500 to 1,000 terawatts per year produced in factories built on the Moon, from which an electromagnetic launcher would send the satellites into space. The letter invoked a civilization able to use all the energy of its star, the "Type II" of the Kardashev scale (box below)[65].

THE KARDASHEV SCALE

In 1964, the Soviet astronomer Nikolai Kardashev proposed classifying civilizations by the energy they control.

Type I. It uses all the energy available on its planet, starting with the sunlight that reaches it.
Type II. It captures all the energy emitted by its star, which for us would mean surrounding the Sun with collectors. The Sun radiates about 20 trillion times the energy humanity consumes today.
Type III. It controls the energy of its entire galaxy, that is, hundreds of billions of stars.

Other authors extended the scale after Kardashev. A **Type IV** civilization would control the energy of the entire universe, and some have imagined a **Type V**, able to move from one universe to another. By the calculation of the astronomer Carl Sagan, humanity has not yet reached Type I: he placed it at about 0.7 in the 1970s. In its application for one million satellites, SpaceX presented the project as "a first step towards becoming a Kardashev II-level civilization"[a].

[a] N. Kardashev, "Transmission of Information by Extraterrestrial Civilizations," 1964, and C. Sagan, according to CNN, reprinted by KRDO, July 10, 2026; power of the Sun (about 3.8×10^{26} W) divided by about 19 TW of human consumption, our calculation. Types IV and V do not appear in Kardashev's work and are speculative.

In the same escalation, Musk announced Terafab in March 2026, a chip factory costing $20 to $25 billion in Austin, shared by Tesla, SpaceX and xAI, with about 80% of its output meant to go into orbit. The website *Electrek* considers the project unrealistic, given Tesla's lack of experience

[62] *DatacenterDynamics*, November 3, 2025, based on Musk's posts on X.
[63] IEA, *Energy and AI*, 2025, rise in data center consumption from 415 TWh in 2024 to about 945 TWh in 2030, converted to average power; BloombergNEF, March 24, 2026.
[64] *Engadget*, January 30, 2026.
[65] Letter "xAI joins SpaceX," February 2, 2026, according to *Shacknews* and *The Register*, February 3, 2026.

in semiconductor manufacturing[66]. That same month, Musk's pay package at SpaceX set him a target of space-based data centers of at least 100 terawatts, with no deadline[67]. This power equals about five times all the energy humanity consumes, which averaged about 19 terawatts in 2024[68]. Starship's first orbital flight, on September 28, 2026, deployed 26 communication satellites.

A.5.2 The IPO story

This story carried the SpaceX IPO. On June 12, 2026, the company raised $75 billion, then $85.7 billion with the additional shares sold by the banks, nearly three times Saudi Aramco's record in 2019[69]. Its prospectus claims to have identified "the largest actionable total addressable market ('TAM') in human history," estimated at $28.5 trillion, of which $26.5 trillion is for AI. It announces the first computing satellites "as early as 2028" and a goal of 100 gigawatts put into orbit each year[70]. No customer has signed a public contract for orbital computing. Anthropic has only "expressed interest" in developing several gigawatts of orbital compute with SpaceX, and Google has held talks with SpaceX as with other launch providers. The Anthropic and Google contracts, worth around $1 billion a month, are for data centers on the ground[71].

According to the same prospectus, SpaceX had $18.7 billion in revenue in 2025 and an operating loss of $2.6 billion. Starlink is the only profitable business, with $4.4 billion in operating income, and AI lost $6.4 billion while absorbing 61% of capital spending[72]. The prospectus warns that several of its projects, including orbital computing, rely on "unproven technologies or technologies that do not exist." It also states that Musk will keep control of the company, with about 82% of the voting rights: "This will limit or preclude your ability to influence corporate matters and the election of our directors"[73].

These warnings did not deter buyers. On the first day, the stock rose 19%, and SpaceX was worth about $2.1 trillion at the close[74]. Independent valuations are much lower: about $1.3 trillion for the finance professor Aswath Damodaran, who considers the estimate of the AI market close to "fantasy," and $780 billion for Morningstar[75]. Four days after the IPO, these shares were used to exercise the purchase option on Cursor, for $60 billion (Section A.4). By the end of July, the stock had fallen below its IPO price[76].

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[66] *Electrek*, March 22, 2026; *Supply Chain 247* and *Data Centre Magazine*, March 2026. The split of ownership among the companies has not been published.

[67] Reuters, April 28, 2026.

[68] Calculated from the Energy Institute, *Statistical Review of World Energy 2025*: 592 exajoules of primary energy in 2024.

[69] Reuters, June 11, 2026, reprinted by *Chronicle.lu*; *Broadband Breakfast*, June 2026; Fox Business.

[70] SpaceX S-1, SEC, May 20, 2026.

[71] Anthropic, "Higher usage limits and a SpaceX compute deal," May 2026 ("we have also expressed interest in partnering with SpaceX to develop multiple gigawatts of orbital AI compute capacity"); *The Wall Street Journal*, via *Drive Tesla Canada*, May 12, 2026; transcripts of SpaceX's earnings calls of August 11 and October 20, 2026. A Yahoo Finance article of September 6, 2026 attributes to Gwynne Shotwell the claim that orbital compute rental deals had been struck with Anthropic and Google; it gives no amount, no duration and no direct source, and the claim could not be verified.

[72] SpaceX S-1, segment tables; share of capital spending calculated from these tables.

[73] SpaceX S-1. Share of voting rights according to Reuters, June 11, 2026.

[74] *Fortune* and NPR, June 12, 2026.

[75] Aswath Damodaran, post on X on June 4, 2026, according to *Bloomberg Línea*; Morningstar, June 2026.

[76] 24/7 Wall St., reprinted by Yahoo Finance, July 27, 2026.

A.5.3 The view of engineers and analysts

Studies published in 2026 estimate that an orbital data center today costs between one and a half and four times as much as one on the ground, chips included, and three to ten times as much if only the infrastructure is counted[77]. The spread comes mostly from what each study chooses to count.

Cost items. A data center breaks down into two blocks. Chips and servers cost the same on the ground and in orbit, about $25 billion per gigawatt. The infrastructure differs. On the ground, it means the power supply, cooling and the building; in orbit, the solar panels, radiators, satellite structure and launch. The gap would close only if launch fell to around $50 to $200 per kilogram, compared with $1,500 to $3,000 today, and if satellites became both lighter and much cheaper[78].

Two accounting choices explain the lowest ratios. The first inflates the cost on the ground. Some studies charge the full price of the building, power and cooling over five years, although these last fifteen to twenty years. The second reduces the cost in orbit. About 9% of chips fail each year, close to half over five years[79]. On the ground, a technician replaces them. In orbit, no one can intervene, and a new satellite has to be launched. Yet some studies count only the price of a spare chip. Both choices narrow the gap between orbit and ground, so the published ratios are best read as minimums.

Physical limits. In orbit, each new generation of chips requires relaunching the entire satellite about every five years, whereas on the ground the building and power supply last fifteen to twenty years[80]. In a vacuum, the heat from the processors can only be shed by radiation, and one gigawatt of computing would require hundreds of thousands of square meters of radiators[81]. Launch cadence sets another limit. With SpaceX's target of 100 kilowatts of computing per tonne, 100 gigawatts per year means one million tonnes of satellites, or 5,000 to 10,000 Starship launches every year. The FAA authorizes 145, and Starship reached orbit only on September 28, 2026[82]. The terawatt per year of the February 2 letter would require 50,000 to 100,000 launches a year, or 140 to 270 per day, not counting replacement satellites. The 100-terawatt target in Musk's pay package would require millions of launches, which explains the appeal to lunar factories.

The power grid. The queues to connect to the power grid are real, with a median wait of more than five years in the United States. Data centers with on-site power already bypass them, at an extra cost of a few tens of percent, far below the extra cost of orbit[83]. This is the choice xAI made in Memphis and Southaven with its gas turbines.

Sam Altman, the head of OpenAI, calls the idea "ridiculous" for this decade, and the firm Gartner describes it as "peak insanity"[84].

[77] BCG, August 2026; Bain, July 2026; Wood Mackenzie, June 2026; SemiAnalysis, June 3, 2026; Deutsche Bank, January 2026; *IEEE Spectrum*, February 26, 2026, based on Andrew McCalip's model; Space Capital, August 20, 2026.

[78] Forethought, May 22, 2026; Bain, July 2026; Google Research, Project Suncatcher, November 2025.

[79] Failure rate based on Meta's data on the training of Llama 3, cited by Forethought, May 22, 2026, and by Andrew McCalip's model.

[80] SemiAnalysis, June 3, 2026; Forethought, May 22, 2026.

[81] M. Bara, former European Space Agency engineer, blog, February 4, 2026; *Universe Magazine*, 2026.

[82] Calculated from the SpaceX S-1, with 100 to 200 tonnes per launch; launch cap according to Forethought, May 22, 2026.

[83] Lawrence Berkeley National Laboratory, 2026; SemiAnalysis, June 3, 2026; Forethought, May 22, 2026.

[84] *DatacenterDynamics*, February 2026.

The need itself has not been established. According to the International Energy Agency, all the world's data centers will consume about 945 terawatt-hours of electricity in 2030, an average power of about 110 gigawatts[85]. SpaceX's target would amount to adding in orbit, every year, the equivalent of all the data centers on the planet, and none of the demand forecasts consulted reaches the terawatt scale. Orbital computing has thus become the new frontier of Musk's story. This promise has no verifiable deadline, and its size grows with each announcement. Nothing allows us to predict a fall in the stock price, but orbital computing already forms a bubble of promises, on which part of the largest IPO in history rests (box below).

ORBITAL DATA CENTERS: A COLLECTIVE HYSTERIA?

a. Stories that spread. The economist Robert Shiller, winner of the 2013 Nobel Prize in economics, showed that major economic movements are driven by simple stories. These stories spread like epidemics[a].

b. A loop between beliefs and prices. Investors' beliefs push the stock price up. The price gives the company resources, which in turn reinforce the beliefs. In June 2026, an economist at the University of Hong Kong described a "reflexive feedback loop" in SpaceX's valuation in these terms[b].

c. Precedents.

- **Tulip mania (1636-1637).** It is the most cited example, and the most exaggerated. The historian Anne Goldgar found only about 350 people involved in the trade, and no bankruptcies[c].
- **The South Sea Bubble (1720).** It rested on real innovations, Atlantic trade and marine insurance. Three financial historians conclude from it that a bubble needs "a plausible story"[d].
- **The British Railway Mania (1840s).** The lines that were built served for a century, but shareholders expected about four times the revenue they actually brought in[e].
- **The dot-com bubble (1995-2000).** The Nasdaq index lost nearly 78% between March 2000 and October 2002, even though the internet did transform the economy.
- **Orbital computing (2026).** The SpaceX prospectus acknowledges that several of its projects, this one included, rely on "technologies that do not exist." Two days before the IPO, the short seller Jim Chanos summed it up: "We really can build whatever stories we want: colonies on Mars, factory tunnels, data centers in space"[f].

None of these episodes provides a timetable. What they share is a real technology wrapped in promises that go far beyond what it can deliver.

[a] R. J. Shiller, *Narrative Economics*, Princeton University Press, 2019.
[b] Y. Zhang, HKU Business School, June 17, 2026.
[c] A. Goldgar, *Tulipmania*, University of Chicago Press, 2007, according to her interviews with History.com (2020) and *Smithsonian* (2017); P. Garber, *Journal of Political Economy*, 1989.
[d] R. Frehen, W. Goetzmann and K. G. Rouwenhorst, "New Evidence on the First Financial Bubble," *Journal of Financial Economics*, 108(3), 2013.
[e] A. Odlyzko, "Collective hallucinations and inefficient markets: The British Railway Mania of the 1840s," working paper, University of Minnesota, 2010; expected revenue reconstructed by the author.
[f] Reuters, June 10, 2026, reprinted by MarketScreener.

Another limit could, however, stop Musk in his tracks: that of material resources and planetary boundaries. Orbital computing requires metals, electricity and launches in unprecedented quantities, and its releases reach the upper atmosphere (box below).

[85] IEA, *Energy and AI*, 2025; conversion to average power is our calculation.

MATERIAL RESOURCES

Musk's projects rest on complete industrial chains, from the mine to the chip factory, and each link has its limits.

Copper. On the ground, an AI data center needs 20 to 40 tonnes of copper per megawatt[a]. The 100 gigawatts a year announced by Musk would require 2 to 4 million tonnes, about a tenth of world mine production (author's calculation).

Gallium. China produces 99 % of the world's primary gallium[b]. This metal is used in power chips and in high-efficiency space solar cells. Beijing made its exports subject to licensing in 2023, then banned sales to the United States in December 2024[c].

Electricity. TSMC, the world's largest chipmaker, already uses about 8 % of Taiwan's electricity. According to S&P Global, this share could reach 24 % in 2030[d].

Launches. A Starship launch emits about 2,700 tonnes of CO_2 from burning its methane alone, six times more than a Falcon 9 (about 425 tonnes), for a payload six to eight times heavier[e]. Starship's environmental assessments put it at 2,300 to 3,500 tonnes of CO_2 equivalent per launch[f]. The 5,000 to 10,000 launches a year needed for 100 gigawatts would emit 12 to 35 million tonnes, 3 to 10 % of France's annual emissions[g].

Reentries and the ozone layer. The ozone layer filters the Sun's ultraviolet rays. When it thins, skin cancers and cataracts increase, and crops as well as plankton suffer. Since the 1987 Montreal Protocol, which banned CFCs, it has been recovering, and the Antarctic ozone hole should close around 2066[h]. Spent satellites could slow this recovery. As they burn up in the atmosphere, their aluminum forms particles of aluminum oxide, which speed up the destruction of ozone by chlorine without being consumed. A 2024 study puts these releases at 17 tonnes in 2022 and at 360 tonnes a year with the planned constellations, an increase of 646 % over natural levels[i]. A 2025 study simulates 10,000 tonnes a year, the level expected around 2040. The temperature of the upper atmosphere would then change by about 1.5 °C over Antarctica, and the winds of the polar vortex would weaken by 10 %, with effects on ozone that remain poorly understood[j]. Launches matter too: at 2,040 launches a year, the ozone layer would lose 0.3 % on average and nearly 4 % during the Antarctic spring, mainly because of engine soot[k]. A million tonnes of satellites renewed every five years would release about 120,000 tonnes of aluminum oxide a year, twelve times the 2040 scenario (author's calculation, using the ratio of 30 kg of oxide for a 250 kg satellite adopted by Ferreira *et al.*). No study has assessed the effects of such a quantity, which would be released before it is understood.

AI removes none of these constraints. Every gigawatt of computing requires mines, factories and launches.

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[a] SMM, based on data compiled by *MINING*, October 16, 2026.

[b] USGS, *Mineral Commodity Summaries 2026*, gallium.

[c] Stimson Center, March 19, 2025.

[d] *DatacenterDynamics*, October 7, 2024, based on S&P Global.

[e] I. Khrapach, *Space Ambition*, August 30, 2024, based on Everyday Astronaut's calculations for Falcon 9. Payloads announced by SpaceX for the reusable versions.

[f] FAA, environmental assessment of Starship/Super Heavy at Boca Chica, table 4: 58,450 t for 25 launches a year; SpaceX assessment for the Kennedy Space Center: 83,794 t for 24 launches a year. Per-launch values calculated.

[g] 366 million tonnes of CO_2 equivalent in 2025, excluding carbon sinks, Citepa estimate, October 10, 2025.

[h] UNEP and WMO, Scientific Assessment of Ozone Depletion, January 2023.

[i] J. P. Ferreira *et al.*, "Potential ozone depletion from satellite demise during atmospheric reentry in the era of mega-constellations", *Geophysical Research Letters*, June 12, 2024.

[j] C. Maloney *et al.*, *Journal of Geophysical Research: Atmospheres*, April 28, 2025.

[k] L. E. Revell *et al.*, *npj Climate and Atmospheric Science*, 2025. This scenario mostly involves kerosene rockets, which emit more soot than Starship, which burns methane.

A.6

SpaceX, xAI and defense

A.6.1 A mission on future warfare

On September 30, 2026, Secretary of War Pete Hegseth announced "Project Meridian," a 120-day mission to "reimagine what warfare will look like in the future." He entrusted it to Elon Musk, Palmer Luckey and former Speaker of the House Newt Gingrich. Luckey founded Oculus, the virtual reality headset bought by Facebook, then Anduril, a defense company that makes drones and autonomous weapons systems. The mission covers automated weapons, AI and the military capabilities the United States will need. The study is run by the MITRE organization, and its recommendations could shape the Pentagon's future purchases. The same day, Hegseth announced the creation of an autonomous warfare command[86].

Two of the mission's three leaders run companies that sell to the Pentagon. In 2026, SpaceX signed defense contracts with a total value of more than $8 billion, spread over several years, and Anduril a Marine Corps contract worth up to $642 million. The mission could therefore recommend buying technologies sold by its own leaders. The lawyer Richard Painter, a former White House ethics official, summed up this conflict of interest: "They all want to sell stuff"[87].

A.6.2 Musk against his own warnings

For a long time, Musk warned against these weapons. In October 2014, he compared developing AI to summoning a demon. In December 2015, he cofounded OpenAI, presented as a nonprofit laboratory meant to develop AI for the benefit of humanity. In July 2017, he told the nation's governors that AI was "a fundamental risk to the existence of human civilization," and he called for preemptive regulation[88]. The following month, he signed an open letter to the United Nations with 115 other leaders in robotics and AI against lethal autonomous weapons, which "threaten to become the third revolution in warfare." The letter warned: "Once this Pandora's box is opened, it will be hard to close"[89]. In 2026, Musk co-leads a Pentagon mission on automated weapons, announced on the very day an autonomous warfare command was created. Nothing indicates that he will lead this command. But the man who called for protecting the world against these weapons now helps define the needs of the military that wants to deploy them. Musk himself speaks of a "robot army" in connection with Optimus, and the Pentagon says it is exploring prototypes of militarized humanoid robots, but nothing so far indicates that Tesla intends its robot for the military[90].

[86] UPI, September 30, 2026; Bloomberg and *The Washington Post*, October 1, 2026; *The Washington Times*, October 13, 2026, citing CNBC and NPR; *Alaska Native News*, October 2026.

[87] *The Washington Times*, October 13, 2026, citing NPR and CNBC. The Pentagon says MITRE will apply safeguards against conflicts of interest.

[88] *Fortune*, July 15, 2017; *SiliconANGLE*, July 18, 2017.

[89] Open letter published on August 21, 2017, at the opening of the IJCAI conference in Melbourne, according to the University of New South Wales.

[90] Tesla investor call of October 22, 2025, according to *Futurism*, October 23, 2025; *Time*, March 9, 2026, to which Tesla did not respond on this point.

A.6.3 The military contracts of SpaceX and xAI

In 2025, the US federal government accounted for about one fifth of SpaceX's revenue, about $3.7 billion out of $18.7 billion[91]. This total combines civilian customers, such as NASA for flights to the International Space Station, and military customers, such as the Space Force and the National Reconnaissance Office (NRO). The prospectus does not give the military share. Yet that share is growing, and the customer is the Pentagon, which the Trump administration now calls the Department of War, headed by Pete Hegseth.

The Starlink network has already shown its military weight. In 2022, after the Russian invasion, its terminals allowed Ukraine to keep its communications running, and they remain at the heart of its army[92].

- SpaceX operates Starshield, the military version of its Starlink satellite network. Its largest military contract until now was a classified network for the NRO, with a reported value of $1.8 billion.
- In May 2026, SpaceX won two Space Force contracts tied to the Golden Dome missile shield: $2.29 billion for a military communications network, and $4.16 billion for threat-detection satellites[93].
- In February 2026, xAI, then being absorbed by SpaceX, reached an agreement with the Pentagon to use Grok in classified systems[94].

The military contracts signed in 2026 exceed $8 billion, to be paid over several years. Their duration has not been published. Spread over three to four years, they would bring in $2 to $3 billion a year, or 11 to 15% of 2025 revenue[95]. These future military revenues are distinct from the $3.7 billion in federal revenue in 2025, which includes NASA. Defense therefore remains a minority share of SpaceX's revenue, far behind Starlink. It could still become a new source of growth. The Congressional Budget Office estimates the Golden Dome shield at about $1.2 trillion over twenty years, and space-based interceptors, SpaceX's line of business, would account for about 70% of procurement[96]. Unlike those of orbital computing, these revenues would be guaranteed by the government. They are still far from justifying a $2.1 trillion valuation on their own, because markets value defense companies at one to two times their revenue[97].

[91] Associated Press, May 2026, based on the SpaceX S-1, reprinted by *Investment Executive*.
[92] Wikipedia, "Starlink in the Russo-Ukrainian war," accessed October 21, 2026.
[93] *Yahoo Finance*, May 27, 2026; CNBC, May 29, 2026.
[94] Axios, February 23, 2026, according to *Newsquawk*.
[95] Our calculation. The three-to-four-year duration is an assumption, based on the planned 2028 entry into service of the constellation under the $4.16 billion contract (*The Signal*, June 2026).
[96] Congressional Budget Office, May 2026, according to *Federal News Network* and *DefenseScoop*, May 12, 2026. The administration estimates the program at $175 to $185 billion.
[97] Order of magnitude for the large US defense groups, not verified in detail for this note.

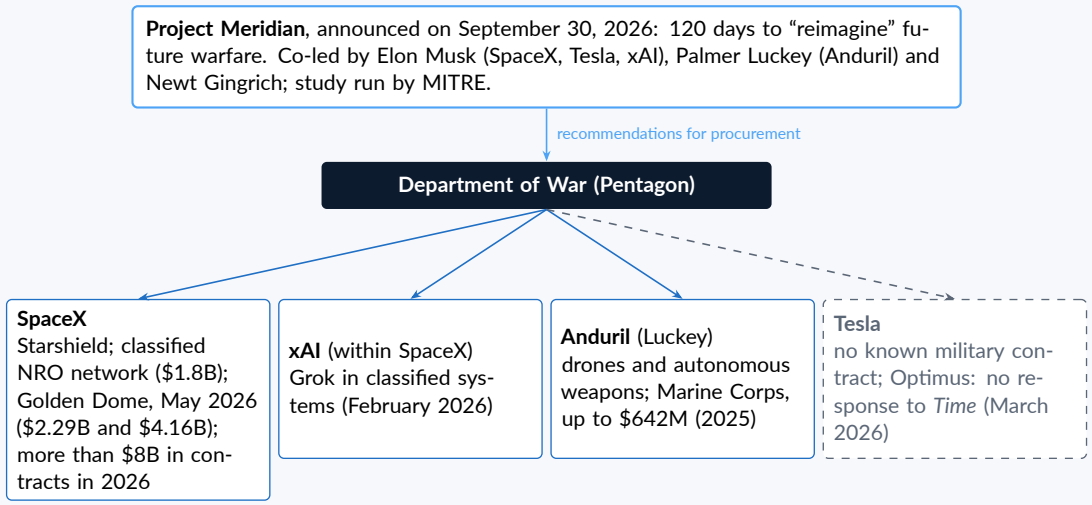

Figure 3. The military turn. Defense contracts involve SpaceX and xAI, and Musk co-leads a Pentagon mission on future warfare with the founder of a defense company. Tesla has no known military contract. Sources: CNBC, *Yahoo Finance*, Axios, UPI, *The Washington Times*, *Time* (2026).

A.7

Toward a conglomerate

No parent company owns Musk's businesses, and Tesla has its own shareholders, its own board and its own accounts. Yet the empire already exists, and it has a center: Musk himself. He is Tesla's largest individual shareholder and controls about 82% of the voting rights of SpaceX, which owns xAI and X. He runs these companies, and his image carries their value, so the group's unity rests on his person. Few industrialists have run such different companies at the same time: cars, rockets, satellites, artificial intelligence, a social network, brain implants and tunnels. His vision spans all these fields at once, at the risk of scattering. Yet several of his companies came close to failure before prevailing: in 2008, SpaceX had just suffered three failed launches of its first rocket, and Tesla was running out of cash[98]. Both nonetheless became the leaders of their sectors, SpaceX by number of launches and Tesla by market value. Musk has most often managed to land on his feet. These companies are also increasingly tied to one another.

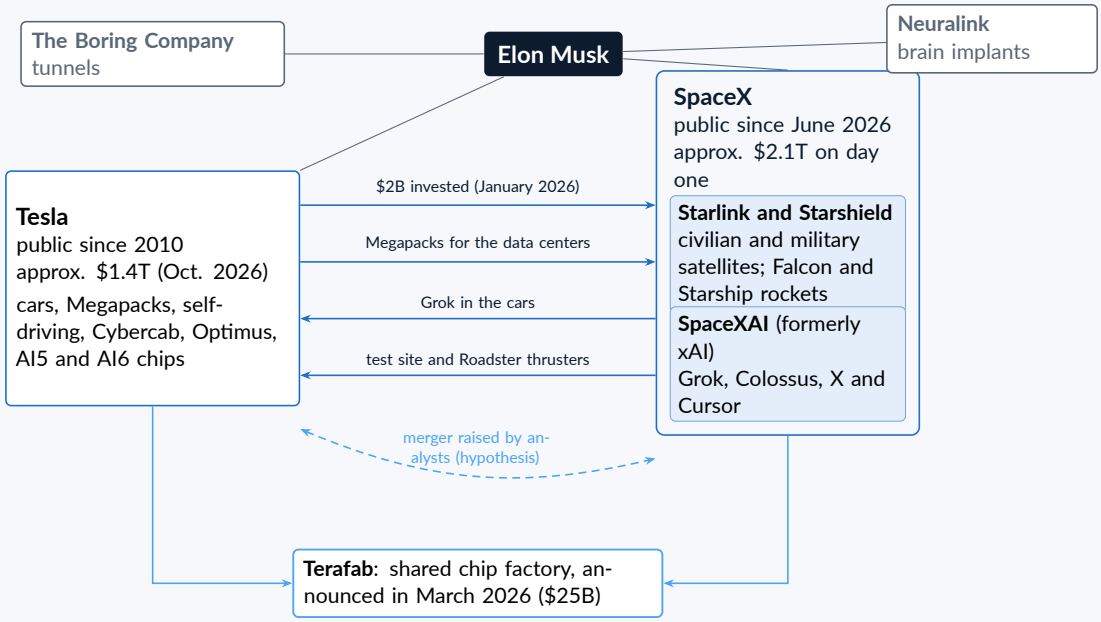

Figure 4. Musk's companies and the flows between them. No parent company brings them together, but SpaceX has absorbed xAI and X, and Tesla exchanges capital, batteries, software and technology with SpaceX. Market values rounded. Sources: *TechCrunch*, *Electrek*, *Fortune*, NPR, Bloomberg (2026).

Figure 4 brings together the flows described in the previous sections. The links run in every direction: capital, batteries, software, chips, a shared factory, a test site. Almost all of them point toward markets that do not yet exist, such as robotaxis, humanoid robots and orbital computing. Today these markets live only through the story that announces them, and the value of the whole rests on them.

[98] The fourth Falcon 1 launch succeeded on September 28, 2008; Tesla was rescued in December 2008 by a last-minute funding round. Based on Wikipedia, "Falcon 1" and "History of Tesla, Inc.," accessed October 21, 2026.

A.7.1 Companies drawing closer

The social network Twitter, bought by Musk in 2022 and renamed X, was placed under xAI. On February 2, 2026, SpaceX absorbed xAI through a share exchange[99]. On June 12, 2026, SpaceX went public (Section A.5). A single company now combines rockets, civilian and military satellites, an AI model and a social network. In July 2026, xAI took the name SpaceXAI, and Cursor joined it in August (Section A.4). Neuralink, which develops brain implants, and The Boring Company, which digs tunnels, remain separate.

Tesla is drawing closer to this group through a growing number of flows: $2 billion invested in xAI, batteries for its data centers, Grok in the cars, the Terafab chip factory, and a Roadster developed with SpaceX and presented at its site. Approved by Tesla shareholders in November 2025, Musk's pay package grants him shares in tiers of market capitalization ranging from $2 trillion to $8.5 trillion, up to six times Tesla's current value. Each tranche also requires operational goals, and these disappear in the event of a change of control of the company[100]. A merger of Tesla with SpaceX would therefore benefit Musk, though this does not prove an intention. In October 2026, several analysts considered such a merger possible before the end of 2027[101].

If the merger happened, the whole would become a single company, from cars to rockets and from AI to defense, which could be called Musk Inc. The name is ours, and it refers to a conglomerate still in formation.

A.7.2 A Tesla backed by SpaceX

A merger with SpaceX would give Tesla support. Its car business is shrinking, its robotaxis and robots are late, and its value depends on promises that must be renewed. Backed by SpaceX and xAI, that value would rest on businesses that already generate revenue, such as Starlink and the military contracts, and on a larger story, that of AI in orbit. This is our interpretation: it is consistent with the known facts, but no public document confirms it.

The group taking shape recalls Stark Industries, Tony Stark's company in the *Iron Man* films. Musk makes a cameo in 2010 in *Iron Man 2*, partly filmed at SpaceX, and the *Wall Street Journal* wrote in 2015 that he had inspired the character[102]. Yet the 2008 film tells the opposite path from the one Musk's companies are taking. Stark Industries makes weapons, and its head decides to stop. Musk's companies started with electric cars and solar energy, and they are turning toward defense.

[99] *Drive Tesla Canada*, February 2026, citing Bloomberg; *The Journal*, June 2026.
[100] "2025 CEO Performance Award," Exhibit 10.2 to the Form 8-K filed by Tesla with the SEC in September 2025.
[101] Barclays and Wedbush, according to Bloomberg and *Benzinga*, October 2026; *The Motley Fool*, August 6, 2026.
[102] Snopes, fact check on Musk's cameo in *Iron Man 2*, citing the *Wall Street Journal* (2015) and an interview with Jon Favreau on the *Recode Decode* podcast (2016).

A.8

A headlong rush

A.8.1 The obligation to grow

To receive all the shares in his Tesla pay package, Musk must increase the company's value sixfold. At SpaceX, his package requires a colony of at least one million people on Mars and orbital data centers of at least 100 terawatts[103]. Musk therefore can no longer slow down without destroying the value his promises have created. Each missed deadline is replaced by another, more distant or larger: car volumes by the robotaxi and the robot, Mars by the Moon, computing on the ground by computing in orbit.

Asked by *The Economist* in July 2026 about the AI race, he said: "even if I wanted to stop it, I couldn't," and added that "It just seems like all roads lead to acceleration of AI... you can just sort of be sad about it or join the club, I suppose"[104]. He is trapped in a mechanism he built himself, with his promises and his pay package, and of which he remains the main beneficiary.

In 2003, the philosopher Nick Bostrom imagined an AI tasked with making paper clips, which would end up turning all available matter into paper clips because nothing bounds its objective[105]. In 2017, the writer Ted Chiang turned the image around. In his view, the fear of an AI that pursues a single goal without limit describes first of all the companies of Silicon Valley, engaged in growth that nothing bounds[106]. An empire that must grow in order to survive resembles this maximizer.

A.8.2 A society that must accelerate to hold together

The sociologist Hartmut Rosa describes the same constraint at the scale of modern societies. In his view, a modern society needs to grow, accelerate and innovate simply to maintain itself. He compares it to a bicycle, which stays upright better the faster it goes[107]. The tech giants are subject to the same constraint. Microsoft, Alphabet, Amazon and Meta together plan to invest about $700 billion in 2026, mostly in AI infrastructure[108], and Microsoft's emissions rose 25% in 2025, although the company had pledged to become carbon negative by 2030[109].

In the United States, this constraint draws on the myth of the frontier. In 1893, the historian Frederick Jackson Turner started from a finding of the 1890 census: there was no longer a frontier line of settlement in the West. For him, free land, constantly pushed westward, had shaped the development of the United States. With the disappearance of the frontier, "the first period of American history" had therefore closed. Turner warned, however, that "American energy will

[103] Reuters, April 28, 2026.
[104] Interview with Zanny Minton Beddoes, *The Economist*, July 23, 2026, according to the BBC, reprinted by Capital FM.
[105] N. Bostrom, "Ethical Issues in Advanced Artificial Intelligence," 2003.
[106] T. Chiang, "Silicon Valley Is Turning Into Its Own Worst Fear," *BuzzFeed News*, December 2017. Chiang uses the example of an AI tasked with picking strawberries rather than making paper clips.
[107] Hartmut Rosa, "La logique d'escalade de la modernité," *Libération*, November 20, 2014.
[108] Forecasts published by the companies in April 2026, according to Om Malik, om.co, April 30, 2026.
[109] *Engadget*, July 10, 2026, based on Microsoft's 2026 sustainability report.

continually demand a wider field for its exercise"[110]. The same observation returns in 2023 from the investor Marc Andreessen: "while the physical frontier, at least here on Earth, is closed, the technological frontier is wide open"[111]. In September 2025, Tesla's fourth master plan stated that "Growth is infinite"[112]. Infinite growth requires new territories, and Musk is looking for them in orbit, on the Moon and on Mars.

A.8.3 The collision with planetary boundaries

In the 2010s, Tesla's project was to move away from hydrocarbons through electric cars, batteries and solar power. Its mission at the time was "to accelerate the world's transition to sustainable energy." On December 24, 2025, Musk replaced it with "amazing abundance," and the word "sustainable" disappeared[113]. In 2026, SpaceX plans about $2.8 billion in gas turbines to power xAI's data centers, the largest of which runs almost entirely on gas (Section A.4)[114]. In 2025, global carbon dioxide emissions reached about 42 billion tonnes[115], and seven of the nine planetary boundaries have been crossed[116]. Tesla's project of moving the economy away from hydrocarbons is now carried by a growth that exceeds the limits it was meant to help respect.

Worldwide interest in the Roadster as measured by Google Trends fell back to 40% of its peak about twelve hours after the demonstration[117], so a new spectacle will be needed to revive attention. The fascination of October 15 thus comes paired with a kind of stupor, that of spectators who watch the race and feel unable to stop it.

A.8.4 Hubris

The Greeks had a word for this slope, *hubris*, excess. At the entrance to the temple of Apollo at Delphi, a maxim attributed to the Seven Sages greeted visitors: "Nothing in excess"[118]. Herodotus has Artabanus, who wants to dissuade the Persian king Xerxes from invading Greece, give this warning: "God is wont to cut short all things which stand out above the rest." Xerxes ignores it. When a storm destroys the bridge of boats he had built across the Hellespont, he has the sea whipped[119]. Nemesis struck those who stepped out of their condition in this way, and Hesiod calls her a "scourge for mortal humans"[120]. In 1948, Albert Camus made her the goddess of measure rather than of vengeance, and he set the Greek thought of limits against a modern Europe bent on conquering totality[121].

[110] Frederick Jackson Turner, "The Significance of the Frontier in American History," 1893, according to the excerpt published by *The American Yawp*; full text not reviewed.
[111] Marc Andreessen, "The Techno-Optimist Manifesto," a16z, October 16, 2023.
[112] Tesla, *Master Plan Part IV*, September 2025.
[113] *Electrek*, December 26, 2025.
[114] *WIRED*, May 20, 2026, based on the SpaceX IPO prospectus, cited by *Yahoo Finance*.
[115] Global Carbon Budget 2025, CICERO press release, November 13, 2025; preliminary estimate.
[116] Potsdam Institute for Climate Impact Research and Stockholm Resilience Centre, *Planetary Health Check 2025*, September 24, 2025.
[117] Google Trends, worldwide web search over seven days, retrieved October 17, 2026.
[118] Pausanias, *Description of Greece*, 10.24.1; Plato, *Protagoras*, 343a-b. Pausanias was read in the English translation by Jones and Ormerod; the Greek text was not checked.
[119] Herodotus, *Histories*, VII.10 and VII.35, after the English translation by G. C. Macaulay.
[120] Hesiod, *Theogony*, 223, French translation by Vinciane Pirenne-Delforge, Collège de France, 2022.
[121] Albert Camus, "L'Exil d'Hélène" ("Helen's Exile"), 1948, collected in *L'Été*, 1954. Paraphrase based on an English translation; the French text was not reread for this note.

Planetary boundaries can be read as a quantified version of "nothing in excess." For nine processes of the Earth system, they set thresholds beyond which the stability of the planet is threatened, and seven have already been crossed. Their authors do not invoke the Greeks, and the comparison is ours[122]. The Musk empire offers an extreme case. Its value rests on promises, and when Earth is no longer enough for its growth, it looks for outlets in orbit, on the Moon and on Mars.

A.8.5 Room for uncertainty

This assessment is made in 2026, and the future may prove it wrong. Projects launched for bad reasons have often ended up providing essential services. GPS was designed for the needs of the US military, and today it guides billions of phones. The internet grew out of a network funded by the US Department of Defense.

Musk has already transformed two industries. Tesla showed that an electric car could sell in large numbers, and other carmakers followed, even if Tesla is now losing ground. SpaceX revolutionized space transport: its rockets come back, land and fly again, and it now carries out more than half of the world's orbital launches. Starlink brings the internet to places that ground networks do not reach, and it has more than 12 million subscribers[123]. SpaceX is also preparing a mobile service: it bought nearly $20 billion of spectrum from EchoStar, and it is aiming for a direct-to-phone service by the end of 2027. If it succeeds, the service could compete with the major telecom carriers[124]. Some sorting will therefore be needed. Orbital computing remains the weakest of these promises, for the reasons set out above, but other projects could become essential services, and Musk's tenacity could win him part of his bet.

An essential service held by a single company, and run by a single man, then raises a governance question that no technical success can settle. Ukraine experienced this in October 2026. On the night of October 13 to 14, its drones and vehicles lost their Starshield link above about 160 km/h (100 mph), while its interceptor drones have to fly faster than the Russian drones they hunt. Musk says these limits are set by the US military, and Washington denies having given the order. To date, no one knows who made the decision[125]. Either way, an army saw its means of defense depend on a choice made elsewhere, by a private company or by a foreign government.

A.8.6 Conclusion of Part A

In a few seconds of flight, October 15 showed the logic of the whole empire. A spectacular demonstration feeds an almost magical valuation. This valuation calls for new promises, larger than the previous ones, and these promises push ever further against the limits of the planet. For the Greeks, Nemesis eventually caught up with those who overstepped measure. Planetary boundaries play this role today, with one difference: crossing them strikes all of humanity, not only the one who oversteps them.

Part B takes up a very different question: the physical analysis of each stunt. It calculates the

[122] Johan Rockström et al., "A safe operating space for humanity," *Nature*, 2009, not reread for this note; Potsdam Institute for Climate Impact Research, *Planetary Health Check 2025*.

[123] Figure published by SpaceX, reported by *Drive Tesla Canada*, August 5, 2026.

[124] *TechCrunch*, September 8, 2025; Reuters, via *MacRumors*, August 5, 2026.

[125] *Fortune*, October 19, 2026; *Al Jazeera*, October 14, 15 and 18, 2026. The cutoff was reported by Serhii Beskrestnov, an adviser to Ukraine's president.

compressed air each one consumes and the time the car can spend in the air. Reading it is not necessary to follow the general conclusions. To see these calculations at work without going into the equations, a simulator is available online at biosphere-economics.com/musk-empire.

KEY POINTS OF PART A

1. Whether one likes him or not, Musk is one of the forces shaping the planetary age. His companies have transformed the car and access to space, and they now weigh on artificial intelligence and defense.
2. On October 15, Musk staged his power and the drawing together of Tesla and SpaceX before a fascinated audience. The car, which is not allowed on public roads, heralds no product.
3. The stock market values Tesla at about $850,000 per car sold, forty times more than a Toyota. This gap is magical thinking expressed in dollars, while sales are falling and profit has been cut by a factor of four.
4. Musk's promises arrive late, when they arrive at all: the Roadster, Full Self-Driving, robotaxis, Optimus and Mars. His tenacity has still brought some of them to fruition.
5. xAI rents most of its data centers to its competitors, for about $41 billion a year, and the empire's AI business lost $6.4 billion in 2025. SpaceX bought Cursor for $60 billion in stock, and OpenAI immediately cut off Cursor's access to its models.
6. Orbital computing has become the empire's new promise. It went from 100 gigawatts to 100 terawatts in a few months, and it carried the largest IPO in history, on "technologies that do not exist."
7. Musk, who in 2017 called for protecting the world against autonomous weapons, in 2026 co-leads a Pentagon mission on future warfare, while SpaceX and xAI sell to the military.
8. The empire has no parent company, but it has a center, Musk. SpaceX has already absorbed xAI and X, and several signs point to all of his companies, Tesla included, coming together in a single company. This consolidation would make it possible to extend the promises and the stock market exuberance, by backing the most fragile businesses with those that bring in money.
9. This assessment may be proved wrong. Musk tipped the car industry toward electric and revolutionized space transport with reusable rockets, and Starlink could become an essential service, right down to phones. But in October 2026, Ukraine saw its drones lose their Starshield link without knowing who had decided it. An essential service in the hands of a single man raises a question of governance.
10. This forced growth exceeds the limits of the planet. It is the excess the Greeks called *hubris*.

PART B

The math behind the stunt

Mathematical modeling of the October 15, 2026 demonstrations

B . 1

The demonstration put to the test

The October 15 demonstration had three scenes. Scene 1, a standing start from 0 to 60 mph in under one second, is not studied here. In Scene 2, the car climbs a C-shaped ramp, hangs upside down, releases, flips over in midair and lands. In Scene 3, it drives toward a row of five vehicles, lifts off vertically, clears them while performing a full barrel roll, and lands. During both stunts the car was empty and remotely controlled.

In the footage, the rotations look fast and the car appears light. Some commentators spoke of prerecorded or even doctored footage, and Musk presented the car as a flying car. To judge, one needs to know whether a car weighing 1.3 to 1.9 tonnes and carrying 250 kg of compressed air can perform these stunts, and how long its air supply can keep it aloft.

To answer, we treat the car as a rocket. The model draws on mechanics for the car's motion, on thermodynamics for the expansion of the air in the tank, and on gas dynamics for the flow through the nozzles. Space engineers measure the cost of a maneuver by its "delta-v," written Δv. The Greek letter Δ denotes a change, and v a velocity. Delta-v is the change in velocity that the thrust of the nozzles would produce on its own, if no other force acted on the car. It differs from the observed change in velocity, because gravity acts at the same time. To stay still in the air for one second, for example, the car does not change speed, but the maneuver costs about 9.8 m/s of Δv, the amount needed to offset its weight. In the same way, placing a satellite in low Earth orbit costs about 9 to 10 km/s. We compute the Δv that each stunt requires, then the Δv that the air supply can provide, and the stunt is possible if the second exceeds the first.

All calculations are reproducible: the Python script that produces the values and charts in this document can be downloaded from biosphere-economics.com/musk-empire. The simulator on the same page runs these calculations and lets the user vary the assumptions, such as the mass of the car or the air pressure.

Section B.2 gathers the published data and the assumptions used, and B.3 builds the physical model. The model is applied to the two stunts: the release from the ramp and the flip in B.4, the jump with a barrel roll in B.5. Their results are compared in B.6. Two consequences follow: the roll speed that would reveal a fake (B.7), then the time the car can spend in the air and the possible uses of these stunts (B.8). The last sections estimate the size of the nozzles (B.9) and discuss the limits of the model (B.10).

B . 2

Data and assumptions

Table 2 gathers the published data, whose status varies. The telemetry values come from the readouts displayed on screen during the broadcast, as reported by the press. The statements come from Tesla executives on stage. None has been independently verified.

Table 2. Published data used in this note.

Quantity	Value	Source and status
Release height (Scene 2)	about 68 feet (20.7 m); 65 feet according to another source	Tesla Oracle, The AGI Clock; telemetry
Peak load at landing (Scene 2)	3.2 g	Tesla Oracle; telemetry
Fan suction	up to 2 g	L. Moravy (Tesla); statement
Air on board	250 kg in 600 L, two composite tanks	L. Moravy; statement
Nozzles	10, under the body, on the sides and at the rear	E. Musk, L. Moravy; statement
System thrust	more than 80 kN	BigGo, Electrek; press
Height of the Semi	13.5 feet (4.1 m)	InsideEVs; press
Clearance above the Semi	close to the height of the Semi	InsideEVs; press
Jump duration (Scene 3)	about 3 s	Tesla Oracle; press
Approach speed (Scene 3)	“normal speed”	Tesla Oracle; press
Driver	none, remote-controlled car	E. Musk; statement

The mass of the car, the main unknown of the problem, has not been published. The calculations are done for three masses that bracket the plausible cases: 1300 kg for a demonstration car without a battery, 1900 kg for a complete car, and 1600 kg in between. These masses include the air and its tanks. Table 3 gives the other assumptions.

Table 3. Calculation assumptions.

Symbol	Value	Rationale
m	1,300; 1,600; 1,900 kg	bracketing range, mass not published
$l \times h$	2.0 m × 1.2 m	body outline seen from the rear
$\kappa = I/m$	0.453 m^2	uniform box, $(l^2 + h^2)/12$
d	0.9 m	lever arm of the attitude nozzles
H	20 m	telemetry, center of gravity at release
z_0	0.5 m	center of gravity, wheels on the ground
n	3.2	telemetry, read as the thrust-to-weight ratio during braking
t_s	1 s	short hover before touchdown (Scene 2)
t_r	1.5 s (Scene 2), 2.0 s (Scene 3)	estimated duration of the rotations
Δz	7.5 m	apex of the center of gravity at 8 m (Scene 3)
v_x	30 km/h	visual estimate (Scene 3)
$p_{\min}$	40 bar	pressure below which thrust becomes insufficient
T_0	20 °C	initial air temperature

Figure 5 summarizes the vehicle as modeled. The drawing is a generic silhouette: it sets the

orders of magnitude and the nozzle layout described by Tesla, not the styling of the car.

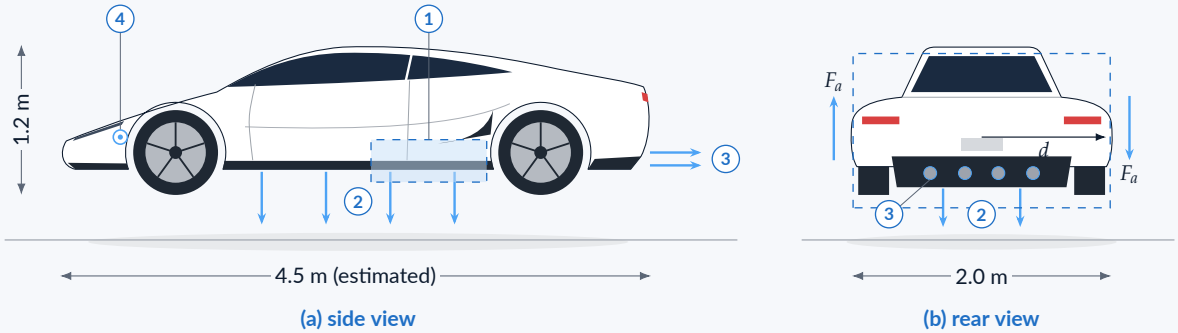

Figure 5. Modeled vehicle, hovering. Generic silhouette with assumed dimensions: the mass, the dimensions and the location of the tanks have not been published. **1** air tanks, two times 300 L at 437 bar (assumed position); **2** lift nozzles under the body, at least four; **3** four rear nozzles, for acceleration; **4** attitude nozzles (approximate position). In (a), the arrows show the direction in which the gas is ejected. In (b), the dashed frame is the uniform $l \times h$ box used to compute the moment of inertia, and the forces F_a form the roll torque, with lever arm d.

B.3

Physical model

The car behaves like a compressed-air rocket: by ejecting air downward, its nozzles push it upward. The model first establishes the cost of a maneuver and what the air supply can provide, then the exhaust velocity of the air, the cost of a flight phase and the cost of a rotation.

B.3.1 The Δv budget

As explained in Section B.1, Δv measures the cost of a maneuver as a change in velocity. The nozzles eject air at velocity c. They exert on the car a thrust $F(t)$, the sum of the thrusts of all active nozzles. We therefore define the cost of a maneuver as the quantity

$$\Delta v = \int_0^T \frac{F(t)}{m(t)}\,\mathrm{d}t. \tag{1}$$

Each kilogram ejected delivers an impulse c. The mass therefore changes as $\mathrm{d}m = -F\,\mathrm{d}t/c$. Integrating gives the Tsiolkovsky equation, which gives the air consumed by a maneuver of cost Δv:

$$m_{\text{air}} = m_0\left(1 - e^{-\Delta v/c}\right). \tag{2}$$

Conversely, a supply of m_u kilograms of usable air provides at most

$$\Delta v_{\text{avail}} = c\,\ln\frac{m_0}{m_0 - m_u}. \tag{3}$$

A stunt is possible if $\Delta v_{\text{avail}} \geq \Delta v$. For a given trajectory and thrust-to-weight ratio, the cost Δv does not depend on the mass. Only Δv_{avail} depends on it, so the unknown mass enters only on the resource side.

B.3.2 The tank and its blowdown

The 250 kg of air occupy 600 L, a density of 417 kg/m^3. At this density, air no longer behaves as an ideal gas. The equation of state for air in the CoolProp library gives a pressure of 437 bar at 20 °C, with a compressibility factor of 1.25.

The tank does not empty completely, because below a pressure of about 40 bar the thrust becomes too weak for the stunts studied. Two limiting cases bracket the amount of usable air.

- Adiabatic blowdown. The gas expands without receiving heat. It cools sharply: at 40 bar, its temperature drops to −122 °C. Cold gas is dense, so a lot of air remains in the tank. The usable fraction is 69% of the mass, or 172 kg.
- Isothermal blowdown. The walls warm the gas, which stays at 20 °C. The usable fraction is then 88%, or 221 kg.

Since a stunt lasts only a few seconds, heat exchange with the walls has little time to act, and the real case lies closer to the adiabatic case. Figure 6 shows how pressure, temperature and exhaust velocity evolve during an adiabatic blowdown.

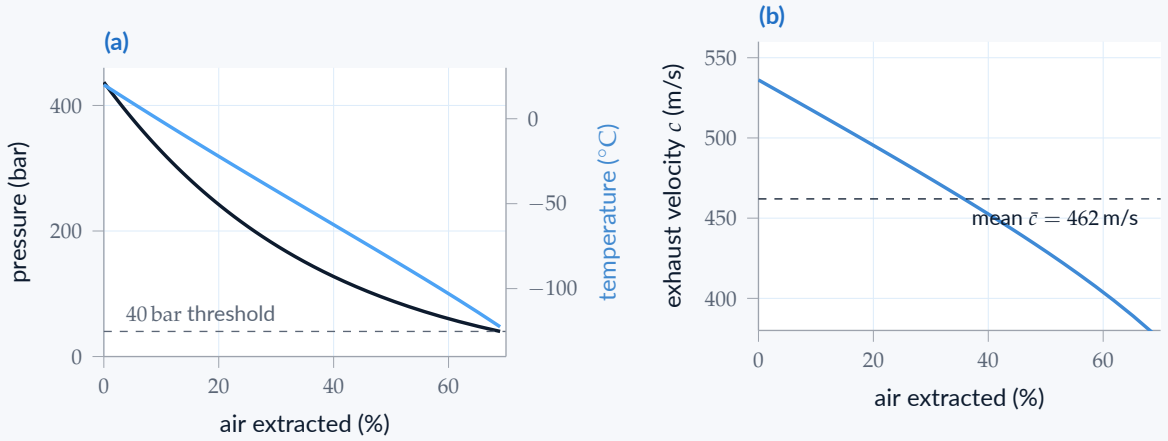

Figure 6. Adiabatic blowdown of the tank, from 437 bar to 40 bar. (a) Pressure (dark blue) and gas temperature (bright blue). (b) Exhaust velocity of a sonic nozzle, which drops as the gas cools. The average weighted by ejected mass is 462 m/s.

B.3.3 Exhaust velocity

We assume simple nozzles with a sonic throat and no diverging section. The air reaches the speed of sound at the throat, at temperature $T^* = 2T_0/(\gamma+1)$ and pressure p^*. The thrust per unit mass flow is $c = v^* + (p^* - p_a)A^*/\dot{m}$. Since $\dot{m} = \rho^* v^* A^*$ and $p^*/\rho^* = RT^*$, and since the ambient pressure p_a is negligible compared with p^*, this expression simplifies to

$$c \simeq \sqrt{\frac{2(\gamma+1)}{\gamma}\, R\, T_0}. \tag{4}$$

With $\gamma = 1.4$, $R = 287\,\mathrm{J\,kg^{-1}\,K^{-1}}$ and $T_0 = 293\,\mathrm{K}$, we get $c = 536\,\mathrm{m/s}$. An ideal nozzle, with a matched diverging section, would reach 696 m/s. To stay conservative, we do not use this case. The exhaust velocity depends on the temperature of the gas in the tank (Figure 7). We keep two cases for what follows.

- Case A, unfavorable: adiabatic blowdown, $m_u = 172\,\mathrm{kg}$ and $c = 462\,\mathrm{m/s}$.
- Case B, favorable: isothermal blowdown, $m_u = 221\,\mathrm{kg}$ and $c = 536\,\mathrm{m/s}$.

B.3.4 Vertical cost of a flight phase

Consider a flight phase that begins and ends with zero vertical velocity. During this phase, the only non-gravitational force is the thrust, directed upward. The change in vertical velocity is zero, so

$$\int_0^T \left(\frac{F}{m} - g\right) \mathrm{d}t = 0 \quad\Longrightarrow\quad \boxed{\Delta v_{\text{vertical}} = g\,T}\,. \tag{5}$$

The vertical cost of a stunt equals g multiplied by its duration. It depends neither on the mass nor on how the thrust is distributed over time. One second of flight costs 9.81 m/s, whether the car is hovering, braking or climbing.

The cost of a stunt can therefore be estimated by timing the video. For a given height, the cheapest stunt is the shortest one. To stop a fall from height h with a maximum thrust-to-weight ratio n, the car must therefore fall freely as long as possible, then brake at full thrust. The car first

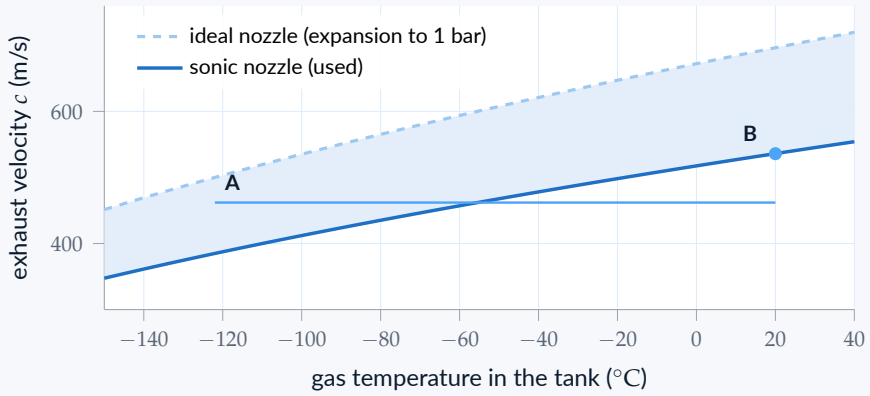

Figure 7. Exhaust velocity as a function of gas temperature, for a tank pressure of 437 bar. Point B corresponds to isothermal blowdown ($c = 536\,\mathrm{m/s}$). Segment A covers the temperature range traversed during an adiabatic blowdown, with a mean velocity $\bar{c} = 462\,\mathrm{m/s}$.

falls a distance $s = h(n-1)/n$, then brakes over h/n. The total duration is $\sqrt{2s/g}\; n/(n-1)$, hence

$$\Delta v_{\text{brake}}(h, n) = \sqrt{2gh}\,\sqrt{\frac{n}{n-1}}. \tag{6}$$

The first factor is the free-fall velocity. The second measures gravity losses, that is, the time spent holding the car up while it is braking. For $n = 3.2$, it equals 1.21: the losses add 21% to the cost (Figure 8). By symmetry, the same formula gives the cost of a vertical takeoff to height h.

B.3.5 Rotation

Both stunts include a rotation about the longitudinal axis of the car (roll). We model it as the rotation of a rigid body with moment of inertia $I = \kappa m$. The attitude nozzles create a torque $M = F_a d$. The simplest strategy is to accelerate the rotation during the first half of the duration t_r, then decelerate it during the second half. To rotate through an angle $\Delta\theta$:

$$\Delta\theta = \frac{M}{I}\left(\frac{t_r}{2}\right)^2 \quad\Longrightarrow\quad M = \frac{4I\Delta\theta}{t_r^2}, \qquad \Delta v_{\text{rot}} = \frac{F_a t_r}{m} = \frac{4\kappa\,\Delta\theta}{d\,t_r}. \tag{7}$$

The cost of the rotation does not depend on the mass either. It scales as $1/t_r$, while the required thrust scales as $1/t_r^2$. A rotation twice as fast requires four times the thrust.

B.3.6 An orientation constraint

The main nozzles on the underside push the car toward its roof. When the car is upside down, they push it toward the ground. They can therefore neither stop a fall nor hold the car up until it is upright. This constraint sets the order of the phases: the rotation must take place during a phase of free fall or ballistic flight.

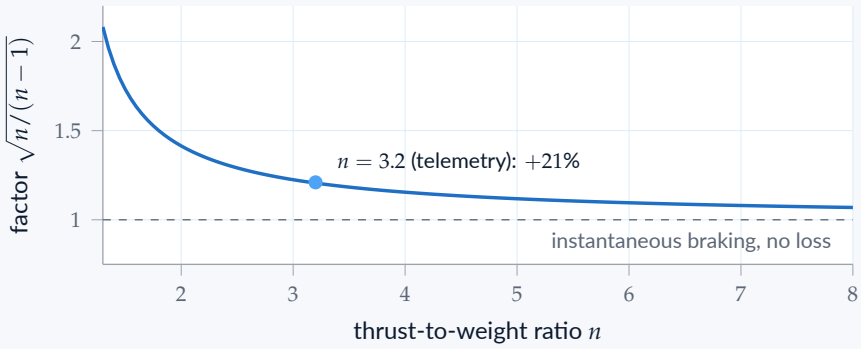

Figure 8. Gravity losses during vertical braking or takeoff. The cost equals the free-fall velocity multiplied by this factor. Above $n = 3$, more thrust brings almost no further gain.

B.4

Scene 2: release from the ramp and flip

Figure 9 breaks the scene into two phases. The car first falls freely while flipping over, then brakes on its underside nozzles.

B.4.1 Holding on to the ramp

On the vertical part of the ramp, the car is held only by the friction of its tires. The fan suction, written σmg, presses the car against the wall. If the car moves at speed v along an arc of radius R, centripetal acceleration adds to it. With a friction coefficient μ, the grip condition is

$$\mu\left(\sigma g + \frac{v^2}{R}\right) \geq g \quad \Longleftrightarrow \quad \sigma \geq \frac{1}{\mu} - \frac{v^2}{gR}. \tag{8}$$

On the ceiling, the contact condition is $\sigma \geq 1 - v^2/(gR)$. A witness reports that the car stopped halfway up the vertical wall. At a standstill, with $\mu = 0.9$, this requires $\sigma \geq 1.11$. Tesla states $\sigma = 2$. The car can therefore hold on to the ramp, even at a standstill, with a margin of a factor close to two (Figure 10).

B.4.2 Fall, flip and braking

The car leaves the ceiling almost at rest. Its center of gravity must descend $h = H - z_0 = 19.5\,\text{m}$. With $n = 3.2$, Equation (6) sets the optimal sequence:

- free fall over $s = h(n-1)/n = 13.4\,\text{m}$, in $\sqrt{2s/g} = 1.65\,\text{s}$;
- speed reached $\sqrt{2gs} = 16.2\,\text{m/s}$, or 58 km/h;
- braking over 6.1 m, in $t_b = 0.75\,\text{s}$, with a thrust nmg of 41 kN at 1.3 t and 60 kN at 1.9 t.

The half roll takes place during the free fall, in 1.5 s. At 1.9 t, the moment of inertia is 861 kg·m^2, the torque 4.8 kN·m and the lateral thrust 5.3 kN. Figure 11 shows altitude, velocity and roll angle over time.

B.4.3 Scene 2 assessment

The total cost is the sum of braking, hover and rotation:

$$\Delta v_2 = \underbrace{23.6}_{\text{braking}} + \underbrace{9.8}_{\text{hover}} + \underbrace{4.2}_{\text{rotation}} = 37.6\,\text{m/s}. \tag{9}$$

This agrees with rule (5): the stunt lasts $1.65 + 0.75 + 1 = 3.4\,\text{s}$, and $g \times 3.4 = 33.4\,\text{m/s}$, which is the sum of braking and hover.

SCENE 2: RESULT

The stunt costs 37.6 m/s. The hover, though brief, accounts for a quarter of it. At 1.9 t, the stunt consumes 149 kg of air in Case A, or 86% of the usable air, and 129 kg in Case B. The stunt is possible for all the masses studied. At 1.9 t in the unfavorable case, the margin is small.

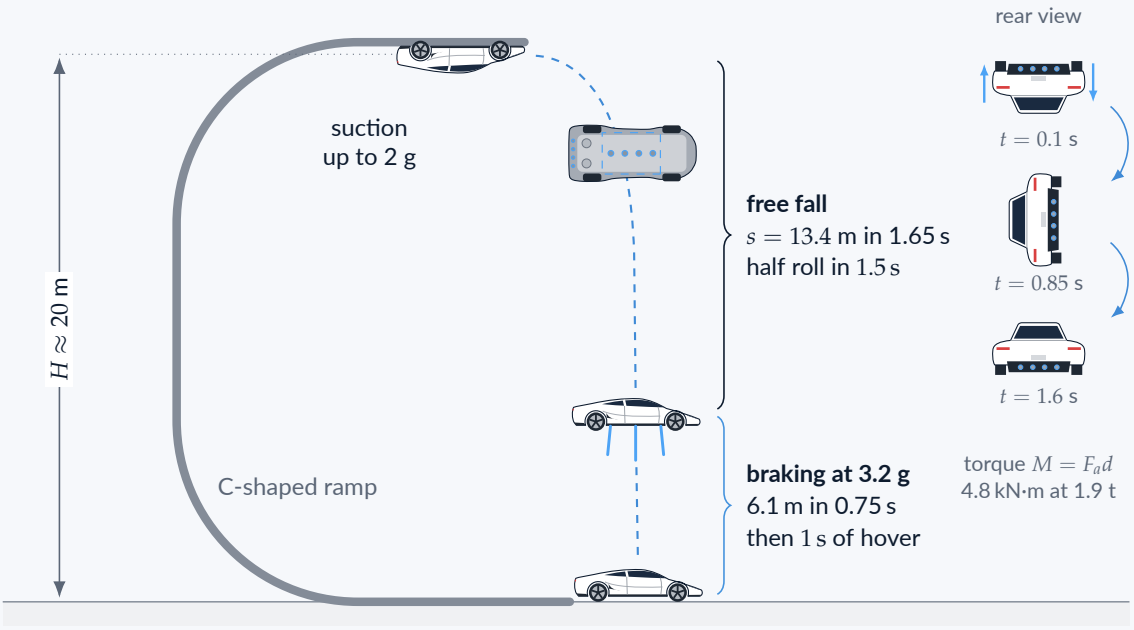

Figure 9. Diagram of Scene 2. Heights and the car are to scale; horizontal distances are schematic. The car falls freely while it flips over, then brakes on its underside nozzles. Halfway through the fall, the car shows its underside to a spectator standing to the side. On the right, the same rotation seen from the rear.

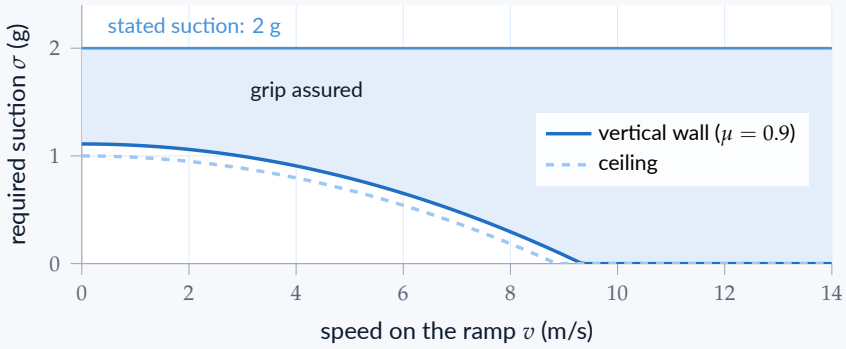

Figure 10. Suction needed to hold on to the ramp, with an assumed radius of curvature of 8 m. The most demanding case is a stop on the vertical wall, which requires 1.11 g.

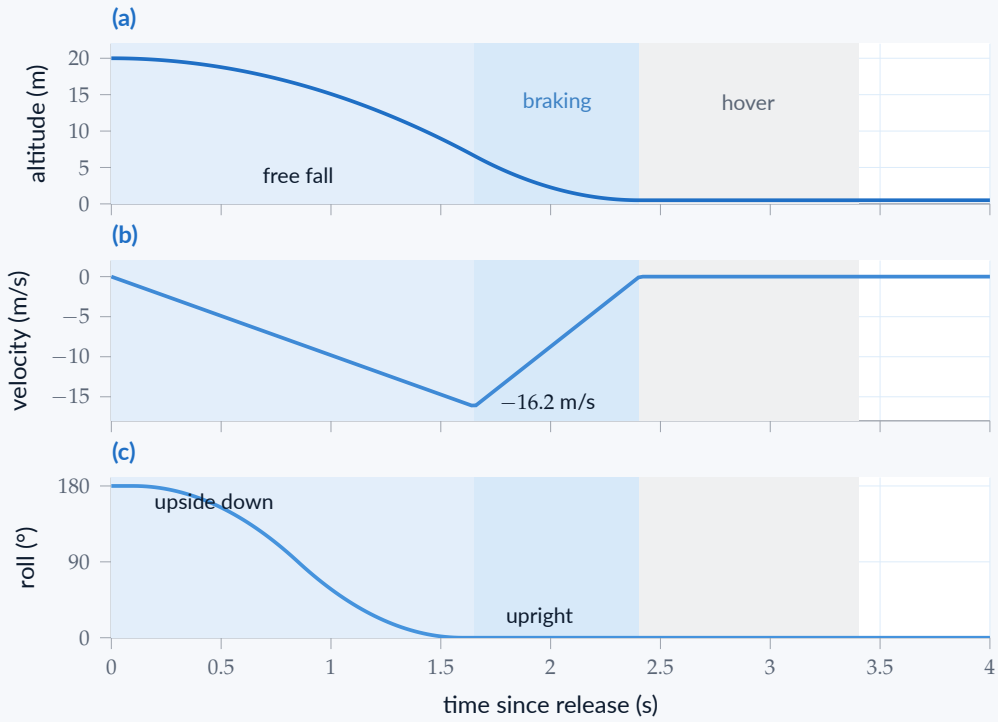

Figure 11. Scene 2: (a) altitude of the center of gravity, (b) vertical velocity, (c) roll angle. The flip is complete before braking begins, as the orientation constraint requires.

B . 5

Scene 3: jump with a barrel roll over five vehicles

B.5.1 Ascent and descent

The car drives at 30 km/h, fires its downward nozzles and takes off without a ramp. Its center of gravity must rise by $\Delta z = 7.5\,\text{m}$. It thrusts at $n = 3.2$ up to the speed v_b, then climbs in ballistic flight to the apex. The total height is

$$\Delta z = \frac{v_b^2}{2g}\,\frac{n}{n-1} \quad\Longrightarrow\quad v_b = \sqrt{2g\Delta z\,\frac{n-1}{n}} = 10.1\ \text{m/s}. \tag{10}$$

The thrust phase lasts $t_i = v_b/((n-1)g) = 0.47\,\text{s}$ and lifts the car by 2.3 m. The ballistic climb lasts $v_b/g = 1.03\,\text{s}$. The descent is symmetric: a ballistic fall, then braking at $n = 3.2$. The total duration is

$$T(n) = \frac{2v_b}{g}\,\frac{n}{n-1} = 2.98\ \text{s}. \tag{11}$$

B.5.2 An independent check

Press reports give a duration of about 3 s. This figure was not used in any calculation, so it can serve as a check. Figure 12 plots the jump duration as a function of n. A duration between 2.75 s and 3.25 s corresponds to a thrust-to-weight ratio between 2.4 and 5.2. The value of 3.2 taken from the Scene 2 telemetry falls within this interval. Two independent sources therefore give the same thrust-to-weight ratio.

B.5.3 Trajectory and clearance

At 8.3 m/s, the car travels 25 m during the jump. The row of vehicles is about 14.2 m wide, gaps included. Figure 13 plots the trajectory to scale. To compute the clearance, we take the worst case: the car is tilted, and its lowest point lies 1.17 m below the center of gravity. The minimum clearance is then 1.8 m above the outermost vehicles and 2.6 m above the Semi. A level car would pass about 3.5 m above the Semi, which matches the margin "close to its height" described by InsideEVs.

B.5.4 Scene 3 assessment

The full roll ($\Delta\theta = 2\pi$) in 2 s requires, at 1.9 t, a torque of 5.4 kN·m and a lateral thrust of 6.0 kN. The total cost is

$$\Delta v_3 = \underbrace{14.6}_{\text{takeoff}} + \underbrace{14.6}_{\text{braking}} + \underbrace{6.3}_{\text{rotation}} = 35.6\ \text{m/s}. \tag{12}$$

The rule (5) holds here as well: $g \times 2.98 = 29.3\,\text{m/s}$, which is the sum of takeoff and braking.

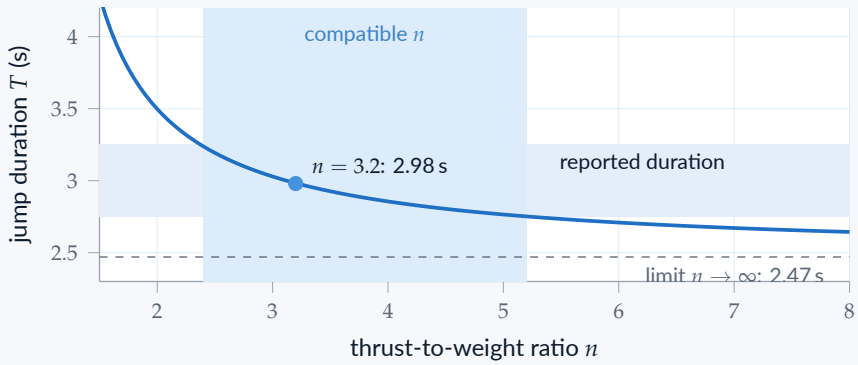

Figure 12. Jump duration as a function of the thrust-to-weight ratio. The horizontal band corresponds to the duration reported in the press, the vertical band to the compatible values of n.

SCENE 3: RESULT

The stunt costs 35.6 m/s, slightly less than Scene 2. The jump itself accounts for more than 80% of it. The roll costs only 6.3 m/s. At 1.9 t, the stunt uses 141 kg of air in Case A (82% of the usable air) and 122 kg in Case B. It is feasible for all the masses studied.

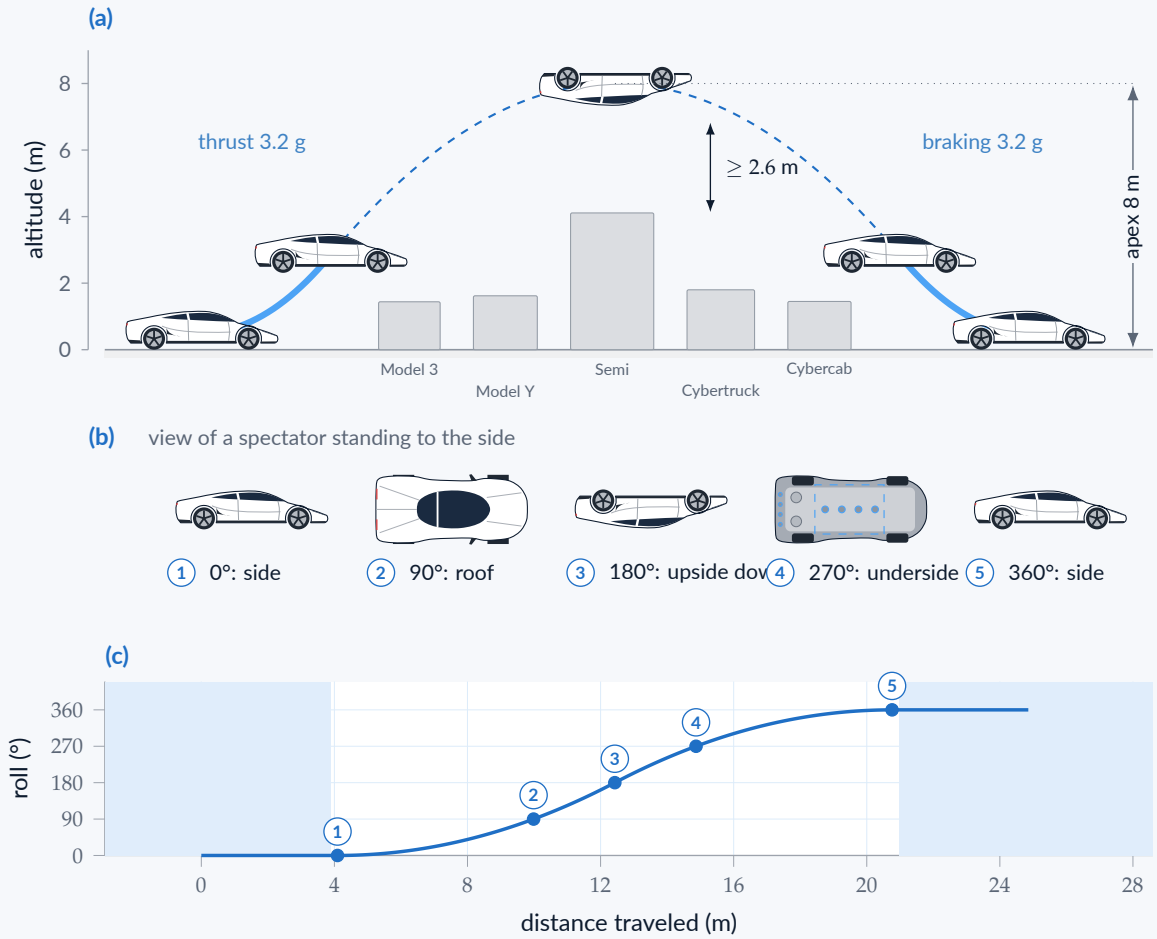

Figure 13. Scene 3 to scale, side view. (a) Trajectory of the center of gravity; the bright blue segments mark the powered phases. The car arrives side-on, is upside down at the top of the jump, then lands back on its wheels. Vehicle dimensions are approximate. (b) Successive orientations of the car during the roll, as seen by a spectator standing to the side. The direction of rotation shown is arbitrary. (c) Roll angle as a function of distance traveled; points 1 to 5 correspond to the views in (b). The rotation takes place entirely during the ballistic flight, between the two powered phases (shaded areas).

B.6

Side-by-side assessment

Figure 14 compares the requirements of the two scenes with the car's resources. The requirements do not depend on mass. The resources do: the heavier the car, the less speed the same mass of air gives it.

Table 4 gives the air used and the share of the usable reserve it represents.

Table 4. Air used per stunt, in kilograms and as a share of the usable reserve (Case A / Case B).

Mass	Scene 2	Scene 3	Δv_{avail} (m/s)	Available/required ratio
1,300 kg	102 (59%) / 88 (40%)	96 (56%) / 84 (38%)	66 / 100	1.75 / 2.66
1,600 kg	125 (73%) / 108 (49%)	119 (69%) / 103 (46%)	53 / 80	1.40 / 2.12
1,900 kg	149 (86%) / 129 (58%)	141 (82%) / 122 (55%)	44 / 66	1.17 / 1.76

No stunt exhausts the reserve, even in the worst case. But at 1.9 t, a single stunt uses between 55% and 86% of the usable reserve. Using a different car for each stunt, as Tesla did, is therefore consistent with these orders of magnitude.

The question of a lightened car is settled by inverting Equation (3). The maximum mass that still allows the most costly stunt is

$$m_{0,\max} = \frac{m_u}{1 - e^{-\Delta v_2 / c}}, \tag{13}$$

which gives 2205 kg in Case A and 3263 kg in Case B. A complete 1.9 t car stays below both limits. Figure 15 shows this boundary as a function of the exhaust velocity.

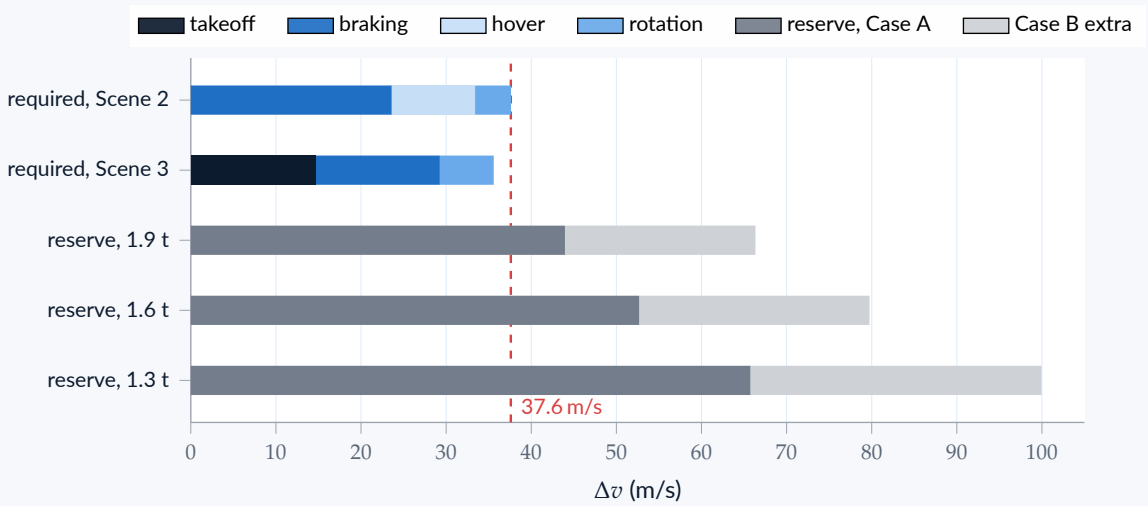

Figure 14. Requirements and resources in Δv. The top two bars break down the cost of each stunt. The bottom three bars give the Δv supplied by the air reserve, depending on the car's mass: dark for Case A, light for the additional amount in Case B. Every reserve exceeds the highest requirement (dashed line).

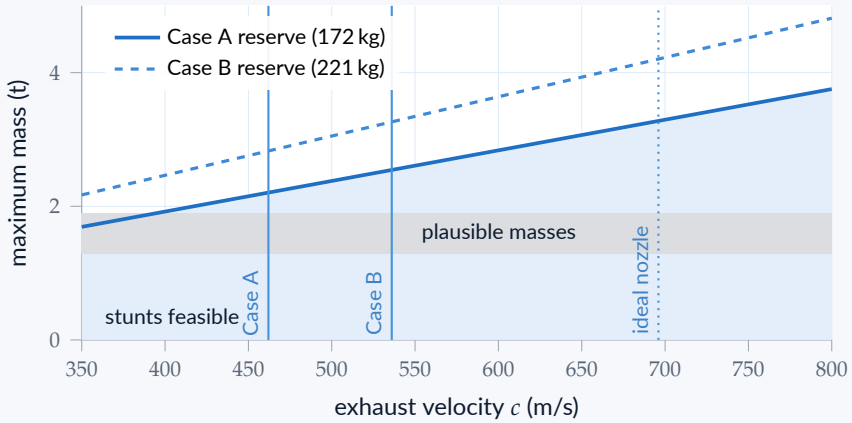

Figure 15. Maximum car mass that still allows the most costly stunt (Scene 2), as a function of the exhaust velocity. The blue area is where the stunts are feasible even with the Case A reserve. The gray band covers the plausible masses.

B.7

Roll speed and mass

After these assessments, only the speed of the rotations could still point to a car lighter than announced. Equation (7) shows that the lateral thrust scales as $1/t_r^2$. Table 5 gives the values for a full roll at 1.9 t.

Table 5. Full roll of a 1.9 t car: lateral thrust and air used as a function of the roll duration (Case A).

Roll duration	2 s	1 s	0.7 s	0.5 s
Lateral thrust	6 kN	24 kN	49 kN	96 kN
Air used	26 kg	51 kg	73 kg	101 kg

Tesla announces a total thrust of more than 80 kN, spread over ten nozzles. The attitude nozzles account for only part of it. If we assume they can deliver half of this total, or 40 kN, a full roll cannot take less than 0.78 s at 1.9 t, nor less than 0.64 s at 1.3 t (Figure 16).

This threshold allows a simple test: time the Scene 3 roll on the video, frame by frame. A duration longer than one second is compatible with a complete car. A duration well below 0.78 s would indicate a car much lighter than a production Roadster, or altered footage.

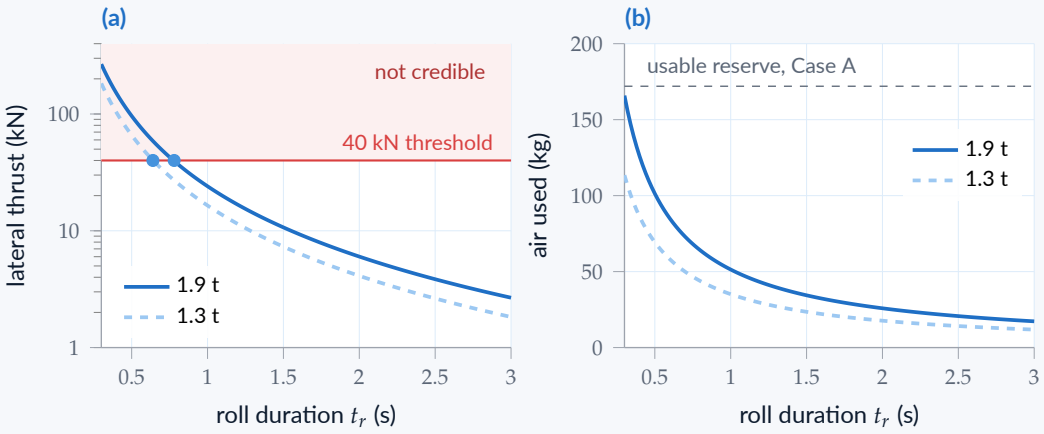

Figure 16. Full roll as a function of its duration: (a) required lateral thrust, on a logarithmic scale; (b) air used. The red area corresponds to an attitude thrust greater than half the announced total thrust.

B.8

Flight time and the use of the stunts

To find out whether the car can fly, it is enough to compute how long its air reserve can hold it up. By rule (5), this maximum flight time, with no maneuver at all, is $\Delta v_{\text{avail}}/g$. For a 1.9 t car, it lies between 4.5 and 6.8 s depending on the blowdown case. For a 1.3 t car, it reaches 6.7 to 10.2 s (Figure 17).

These durations are of the same order as those of the stunts. The car can jump and land gently, but its air reserve does not allow it to fly like an aircraft, and the FAA does not consider it one[126]. With compressed air, each second in the air costs about 40 kg of air at 1.9 t in Case A.

On the road, these stunts serve no purpose. As Electrek points out, a jump or a roll improves neither acceleration nor handling. Only the rear and side nozzles could help in corners or when pulling away. Tesla also states that the "Rocket" version, the only one equipped for these stunts, is reserved for invited customers and is not street-legal.

A car that nearly empties its tank in one stunt and is not allowed on the road is not a step toward any product. Its function is the one described in Part A: feeding Musk's narrative.

[126] *Fortune*, October 17, 2026, citing CBS News and *Politico*.

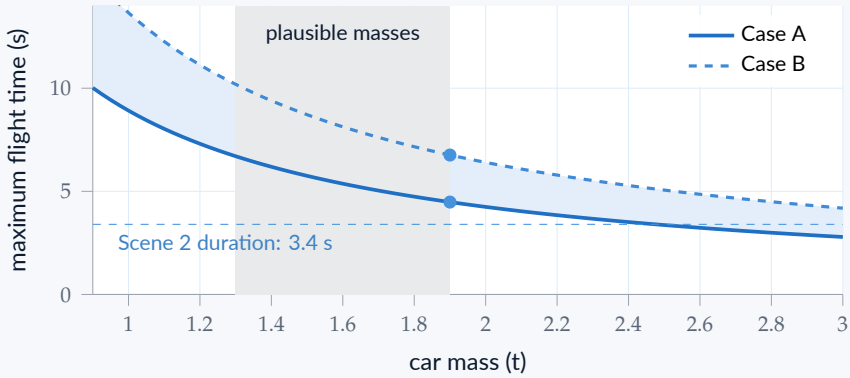

Figure 17. Maximum time the air reserve can hold the car up, with no other maneuver. A 1.9 t car cannot stay in the air for more than a few seconds.

B.9

Flow rate and nozzle size

Braking a 1.9 t car at $n = 3.2$ requires a thrust of 60 kN. With $c = 462$ m/s, the air mass flow rate is $F/c = 129$ kg/s. For a sonic nozzle, the mass flow per unit throat area is

$$\frac{\dot{m}}{A^*} = p_0 \sqrt{\frac{\gamma}{R T_0}} \left(\frac{2}{\gamma + 1} \right)^{\frac{\gamma+1}{2(\gamma-1)}} . \tag{14}$$

At 437 bar, the total throat area is 12.5 cm^2, which means a diameter of 2.0 cm for each of four nozzles. At 100 bar, after a partial blowdown or downstream of a pressure regulator, 55 cm^2 is needed. These dimensions are modest and compatible with fast-acting valves, which Tesla describes as capable of adjustments within a fraction of a second. The technical difficulty lies rather in keeping the thrust stable while the tank pressure drops by a factor of ten.

B.10

Limits of the model

- The mass and the mass distribution are unknown. The moment of inertia of a uniform box gives an order of magnitude. A battery placed in the floor would change κ by a few tens of percent, which does not change the conclusions.
- The telemetry is interpreted. The 3.2 g could correspond to an impact peak at touchdown rather than to the braking thrust-to-weight ratio. The check in Section B.5.2 makes our reading plausible without proving it.
- The blowdown is idealized. Pressure losses, regulators and valve opening time reduce the effective exhaust velocity. Case A partly accounts for this by assuming a very low gas temperature.
- Aerodynamics is neglected. At 16 m/s, a car falling flat experiences a drag on the order of 1.5 kN, or 2 to 3% of the braking thrust. This drag slows the fall, so neglecting it makes the calculation conservative.
- Rotations other than roll, nozzle misalignment and trajectory corrections are not counted. They add a cost that can be estimated at a few meters per second.
- The standing start from 0 to 60 mph in 0.81 s is not studied.

IN SHORT

1. Nothing requires us to assume a fake. Both stunts obey the laws of mechanics with the published figures. They require 37.6 and 35.6 m/s of Δv, and a complete 1.9 t car has 44 to 66 m/s available.
2. A lightened car is not necessary. The maximum mass compatible with both stunts lies between 2.2 t and 3.3 t.
3. A single stunt nearly exhausts the air reserve. At 1.9 t, one stunt uses up to 86% of the usable air, which explains the use of a different car for each stunt.
4. The published data are consistent with one another. The 3.2 g load recorded in Scene 2 and the 3 s duration reported for Scene 3 describe the same thrust-to-weight ratio.
5. Only one clue could still contradict the demonstration: the rotation speed. A full roll in less than 0.78 s would be incompatible with a 1.9 t car.
6. These stunts have no use on the road. The air reserve holds the car up for a few seconds at most, and the equipped version is not street-legal.

General conclusions

The direction of the empire

Musk's companies remain legally separate, but they converge on Musk, who runs them and lends them his image. SpaceX absorbed xAI and X, then went public at a valuation of more than $2 trillion. Tesla is tied to it through capital, batteries, software, chips and a shared factory. The group as a whole is shifting from electric cars toward artificial intelligence and defense, on Earth and in orbit, and since September 2026 Musk has co-led a Pentagon mission on future warfare (Part A).

For Tesla, this direction answers a need. Investors value the company far above what its cars earn, while its sales are falling and its robotaxis and robots are arriving late. A merger with SpaceX would back that value with businesses that already make money, and Musk's pay package would make the deal advantageous for him. This merger remains a hypothesis.

The role of October 15

The Roadster demonstration fits this direction. It staged Musk's power before a thousand witnesses, at a SpaceX site, with thrusters designed by SpaceX, and the financial press read it as a signal of a merger. It produced an image that went around the world in a few hours, and that fascinates because no one can judge it in the moment.

The calculations in Part B show that the stunts are real and that nothing requires assuming they were faked. Yet a single one of them uses up to 86% of the air supply, the car stays airborne for no more than a few seconds, and the version fitted with nozzles is not allowed on public roads. October 15 therefore serves the image of an empire that brings together Tesla's cars and SpaceX's rockets.

Endless growth

Musk's pay package requires Tesla's value to increase sixfold, each missed promise is replaced by a larger one, and Musk himself says he could not stop the AI race if he wanted to. The company that was supposed to accelerate the move away from fossil fuels has removed the word "sustainable" from its mission, and SpaceX is buying gas turbines to power xAI's data centers, while seven of the nine planetary boundaries have been crossed.

The stunt as a method

Other stunts accompany the October 15 jump. Tesla is stopping production of cars that exist in order to install a line for robots that do not exist yet. xAI rents out to its competitors most of the GPUs it amassed for Grok. By promising orbital data centers, SpaceX raised more than $85 billion, even though its own prospectus says they rely on technologies that do not exist. With its brand-new shares, it then paid $60 billion for Cursor, a customer of its competitors' models. At each step, the show comes before the product and supports a value that the product does not yet justify. The stunt has become Musk's modus operandi. The Greeks called this excess

hubris, and Nemesis eventually caught up with those who indulged in it. Today the planetary boundaries play that role, for all of humanity.

Room for uncertainty

Whether one likes him or not, Musk is one of the forces shaping the planetary age, and this judgment remains dated 2026. He has already tipped the car industry toward electric, and SpaceX revolutionized space transport with its reusable rockets. Starlink could become an essential service, right down to phones. Other projects of the empire may outlive their promises, even if orbital computing looks like the weakest of them. The more essential these services become, the more their dependence on a single man weighs. Ukraine saw this in October 2026, when its drones lost their Starshield link and it is still unknown who made the decision.

A figure tempted by his dark side

For a long time, Musk put his engineering genius, and a harshness his biographer Walter Isaacson describes without varnish[127], at the service of challenges that were also the planet's. The growth his market value demands now pulls him toward war and political power: in 2025 he led the Trump administration's DOGE, backed several far-right movements in Europe, including the AfD, and called empathy "the fundamental weakness of Western civilization"[128]. Anakin Skywalker becomes Darth Vader by putting his power at the service of the Empire, then returns to the light when he sees his son in danger. A shock, planetary or personal, could likewise turn the innovative power Musk has gathered back toward the planet's challenges.

So where is Musk taking his empire? Toward excess, and no one yet knows whether it will serve the dark or the light. A figure of the planetary age, Musk carries within him the contradictions of humanity: a power able to meet its greatest challenges, and a growth that crosses its limits. The choice of his direction foreshadows the one humanity must make, and that no individual can make alone.

[127] Walter Isaacson, *Elon Musk*, Simon & Schuster, 2023; not read for this note, cited from press reviews.

[128] DOGE: the Department of Government Efficiency; Musk stepped down from it at the end of May 2025. Support for the AfD: op-ed in *Welt am Sonntag*, December 28, 2024, and an address to a party rally, January 25, 2025. Empathy: interview with Joe Rogan, February 2025.

WHERE TO LAND?

In 2017, the philosopher Bruno Latour asked where we should land, in *Où atterrir ?*, published in English as *Down to Earth: Politics in the New Climatic Regime*. According to a review of the essay, he describes elites who would have concluded that there was no longer enough room on Earth for themselves and for everyone else, and who would have given up on sharing a common world. He calls this direction "Out-of-This-World"[129]. Musk's Mars project is its literal version, and orbital computing is becoming its industrial version. Musk is looking beyond Earth for the room that the growth of his companies demands.

The question also applies to humanity. The October 15 Roadster brought together top engineers, tanks at 437 bar and rocket nozzles to make a car jump for three seconds. Musk pushes to the extreme an economy that finances the present with promises of growth and no longer knows how to slow down. For Latour, landing begins with taking stock of what we depend on. This forces us to decide what we want to grow, and what the technical power at our disposal should be used for. In the face of planetary boundaries, humanity needs more coordination and planning, and less magical thinking. A stunt promises to clear the obstacle in a single leap, whereas getting out of the trap we are in requires measuring, deciding together and organizing the transition. The Planetary Lab works on this question: how to put technology in the service of humanity and the biosphere.

[129] Bruno Latour, *Où atterrir ? Comment s'orienter en politique*, La Découverte, 2017, according to a review published in *Cadernos EBAPE.BR* in 2021; the book itself was not reread for this note.

Appendix: formulas

Quantity	Expression
Air consumed (Tsiolkovsky)	$m_{\text{air}} = m_0 \left(1 - e^{-\Delta v / c}\right)$
Available Δv	$\Delta v_{\text{avail}} = c \ln \dfrac{m_0}{m_0 - m_u}$
Exhaust velocity, sonic nozzle	$c \simeq \sqrt{2(\gamma+1) R T_0 / \gamma}$
Vertical cost of a flight phase	$\Delta v_{\text{vertical}} = g\,T$
Optimal braking of a fall from height h	$\Delta v = \sqrt{2gh}\,\sqrt{n/(n-1)}$
Torque for a rotation $\Delta\theta$ in t_r	$M = 4I\Delta\theta / t_r^2$
Cost of a rotation	$\Delta v_{\text{rot}} = 4\kappa\Delta\theta / (d\,t_r)$
Duration of a jump of height Δz	$T = \dfrac{2v_b}{g}\,\dfrac{n}{n-1}, \quad v_b = \sqrt{2g\Delta z\,(n-1)/n}$
Holding on a vertical wall	$\sigma \geq 1/\mu - v^2/(gR)$

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