UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 8-K

CURRENT REPORT

Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934

Date of Report (Date of earliest event reported): May 12, 2022

Astra Space, Inc.

(Exact name of Registrant as Specified in Its Charter)

Delaware	**001-39426**	**85-1270303**
(State or Other Jurisdiction of Incorporation)	**(Commission File Number)**	**(IRS Employer Identification No.)**
1900 Skyhawk Street **Alameda, California** **(Address of Principal Executive Offices)**		**94501** **(Zip Code)**

Registrant's Telephone Number, Including Area Code: (866) 278-7217

Check the appropriate box below if the Form 8-K filing is intended to simultaneously satisfy the filing obligation of the registrant under any of the following provisions:

☐ Written communications pursuant to Rule 425 under the Securities Act (17 CFR 230.425)

☐ Soliciting material pursuant to Rule 14a-12 under the Exchange Act (17 CFR 240.14a-12)

☐ Pre-commencement communications pursuant to Rule 14d-2(b) under the Exchange Act (17 CFR 240.14d-2(b))

☐ Pre-commencement communications pursuant to Rule 13e-4(c) under the Exchange Act (17 CFR 240.13e-4(c))

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Class A common stock, par value $0.0001 per share	ASTR	NASDAQ Global Select Market

Indicate by check mark whether the registrant is an emerging growth company as defined in Rule 405 of the Securities Act of 1933 (§ 230.405 of this chapter) or Rule 12b-2 of the Securities Exchange Act of 1934 (§ 240.12b-2 of this chapter).

Emerging growth company ☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Item 8.01 Other Events.

On May 12, 2022, we held our inaugural Astra SpaceTech Day at our headquarters. This event was livestreamed through our website, and we are furnishing the transcript of the livestream as Exhibit 99.1. This transcript should be read in conjunction with a viewing of the video of the livestream, which is available on our Twitter account (@astra), our LinkedIn account (linkedin/company/astraspace) and our website at www.astra.com.

This exhibit shall not be deemed filed for purposes of the Securities Exchange Act of 1934, as amended (the "Exchange Act") or incorporated by reference in any filing under the Securities Act of 1933, as amended, or Exchange Act, except as shall be expressly set forth by specific reference in such a filing.

We also wanted to clarify a statement that our chairman, chief executive officer and co-founder Chris Kemp made at approximately 18 minutes and 38 seconds into the livestream. Mr. Kemp's statement, in relevant part, was "put into Earth orbit, satellites four years faster than any other company in history." Mr. Kemp meant the following: "put into Earth orbit, satellites four years faster than any other *privately funded U.S.* company in history." (Clarification added in italics).

In addition, on our earnings call on May 5, 2022, we reported that we had entered into contracts with customers for the sale of 61 units of our Astra Spacecraft Engine. On our livestream, we reported that we had entered into contracts with customers for the sale of an additional 21 units of our Astra Spacecraft Engine, making the total of 82 units of our Astra Spacecraft Engine under contract as of May 12, 2022.

Item 9.01 Financial Statements and Exhibits.

(d) Exhibits

Exhibit No.	Description
99.1	Transcript of livestream of Astra SpaceTech Day on May 12, 2022
104	Cover Page Interactive Data File (embedded with the Inline XBRL document)

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned thereunto duly authorized.

Date: May 17, 2022

Astra Space, Inc.

By: /s/ Kelyn Brannon

Name: Kelyn Brannon

Title: Chief Financial Officer

Intro Video:	00:00:06	Hard problems, attract amazing people And the chance to get to work with a bunch of really great people on really hard problems is something very special.
	00:00:17	Four years ago, Adam London and I quietly founded Astra with a bold mission to improve life on Earth from space. Our
	00:00:25	Goal is to expand access to space so dramatically that we deliver things to orbit every day, but it always starts with one.
	00:00:43	And Astra's LV triple zero seven has successfully reached orbit, there is a new orbital rocket.
	00:00:48	This is an incredibly hard thing to do, uh, continuing to do it is incredibly hard. So we're just getting started.
	00:01:13	5, 4, 3, 2, 1, 0. First motion. First motion. Vehicle has cleared the tower. LV-triple-zero-nine is it's on its way to space. There is faring separation…
	00:01:25	Great news to report the payloads have started to communicate with ground stations. Our customers are calling us and indicating that satellites are alive. They're talking, which means they've been successfully deployed. We're excited to see you back here very soon for our serial number 10 flight.
Kelyn Brannon, CFO:	00:02:02	Good morning, everyone. And welcome to Astra's inaugural Spacetech Day. I'm Kelyn Brannon, and I'm the Chief Financial Officer at Astra. And it was my honor to invite you here today to join me, our leadership and the rest of our Astra team at our Bay Area rocket factory. We're very excited to share more about our mission, vision, and strategy with you. But here comes a little bit of the boring part. Before we get started I want to go over some important reminders for you. Today's event will contain forward-looking statements. These forward-looking statements, refer to future events, including Astra's future plans, product and outlook.

00:02:49	When used today, the words anticipate, could, enable, estimate, intend, expect, believe, potential, will, should, project, and similar expressions as they relate to Astra, are as such a forward-looking statement. These forward-looking statements are subject to a number of risk and uncertainties. And as a result, Astra's actual future results and performance, including our ability to achieve many plans, ideas and goals that we may discuss today may differ materially from those discussed during this event. We encourage you to review our filings with the SEC in which we describe the factors that could cause actual results to differ materially from our current expectations. Today, we'll also referenced Non-GAAP financial measures, which we believe to be useful to investors as our management team uses these Non-GAAP financial measure to plan, monitor and evaluate our financial performance. These Non-GAAP financial measures exclude certain items and should not be considered as a substitute for comparable GAAP financial measures. Astra's methods of computing these Non-GAAP financial measures may differ from similar Non-GAAP financial measures used by other companies. A description of these items, along with the reconciliation of our Non-GAAP financial measures to the most comparable GAAP financial measures can be found in our earnings release, furnished to the SEC on May 5th, 2022.
00:04:23	You're going to have an opportunity to see a ton of our technology today. This is an ITAR facility, and we have limited in-person attendance to US persons only for this reason.
00:04:37	If you were to take a photograph of an object that is ITAR controlled and published it, this is a potential federal offense. For this reason, we're implementing the following rules about cameras: You can take photos of the presentation and stage from your seat only. As we separate into groups for tours, we will ask you to put your phone in the secure bag that your tour guides will provide. And at no point during the tour, may you remove your phone from the bag. If you remove your phone from the bag without permission, or take a photograph outside the permitted seating area, you will be asked to leave the building. If you must take calls, we ask that you do so from the front lobby, your guide will point you there. A little other logistic, restrooms are back by the inventory cage. So that is back that way against the wall, both men's and women. And we would ask you, uh, to use those facilities. We will also take a few questions from the room and online at the end, please submit those to the QR code or the code on the screen. Now I'd like to invite the honorable mayor of Alameda, Marilyn Ezzy Ashcraft up to the stage. Mayor Ashcraft and the city of Alameda have been incredibly supportive to Astra as we have developed and upgraded this facility. And we are so grateful to the mayor and the city for their continued support.

Mayor Marilyn Ezzy Ashcraft: Thank you so much, Kelyn and good morning, everyone. Um, and thank you to Chris Kemp, uh, for inviting me here today and welcome to everyone who's here to watch the inaugural space tech day of Astra. It is great to be here at Astra with you, and as the mayor of Alameda, I'm delighted to learn that 63 members of Astra's workforce call Alameda home. Because Alameda is a great place to live, work and play. I'm also told that over the last year, Astra has grown its employee base by 285%. That is impressive. Astra is located here in the enterprise district at Alameda Point, which is our former Naval Air station from back in the world War II days. Actually, it was built a little before that and our vision, the city's vision for this area, is to transform old airplane hangars and industrial buildings like this that used to be used to overhaul and repair jet engines to transform those into a thriving employment center that promotes research and development, high tech, manufacturing, and sales.

00:07:38 And I am thinking that Chris Kemp and Astra could do for Alameda what Elon Musk and Tesla did for Fremont, but without any controversies. Right, Chris? Right. And so, um, right next door to where we are here is, um, what we call site A — you're right. We need more creative names. But we've been working hard on developing this area into new homes, residential also retail and parks. Those new homes could be homes to more Astra staff, just saying. The city of Alameda is also deeply committed to sustainability and resiliency. So we were proud to open our third ferry terminal. We're an island after all, we need water transport, but last July we opened the new Sea Plane Lagoon ferry terminal, literally walking distance from here and ferries from Sea Plane Lagoon provide 20 minutes service to and from San Francisco, you will not find a pleasanter, more beautiful, stress-free commute.

00:08:45 And the ferry terminal is served by AC transit line 78, which provides cross island, uh, service to meet every ferry, arrival, and departure starting and ending at the Fruitvale Bart station in Oakland. And by providing alternatives to automobile transport, we also help reduce traffic congestion and greenhouse gas emissions that contribute to, uh, global warming and lead to sea-level rise, which is an existential threat, especially to our island community. I understand that Astra's supports sustainability by subsidizing public transportation for its employees and providing onsite bicycle storage and that 27% of Astra's employees bike take public transit, including the ferry and carpool to work. Yay you! Good work. And please keep up that good work. Let's get more of you to join. Um, the, the non-automobile transport way to get to work. Astra is also engaging with the Alameda community in a variety of ways, including preparing a STEM project that will support the Alameda Boys & Girls Club, donating to the Alameda Education Fund, which supports all of our classrooms across the city, and working with the College of Alameda to establish internships and graduate to hire programs, and leading local cleanup efforts for Earth day.

	00:10:13	I'm so pleased to join you for this exciting event. And I'm looking forward to hearing more now from Chris Kemp, but I want to wish Astra every success in all your ventures. Thank you again, everyone for being here. Thank you.
Kelyn Brannon:	00:10:42	Thank you Mayor Ashcraft for joining us. It is now my deep pleasure to bring up Astra's founder, chairman and CEO Chris Kemp.
Chris Kemp:	00:10:56	Thanks Kelyn.
	00:11:02	Yeah, it's such an incredible honor to have you all come and visit us today and for the hundreds of you that we're able to, to tune into our webcast today, uh, we've got an incredible morning setup. Uh, for those of you who are here, we're going to be unveiling some, uh, of the details of our product roadmap, our strategy. For those of you here, we're going to do some tours. We're going to actually see some of the hardware that we're going to talk about in the presentation today. And we're going to be sharing as much of this as we can on the live webcast as well. So, as we get started, I want to underscore why we're all here today. I think that in the last 50 years, I have never seen a more significant opportunity to improve life on Earth then from space. And as we look over the past few months, the impact of space has been clear when this image was taken on February 15th, Vladimir Putin was, was talking about how his troops were retreating from Ukraine.
	00:12:01	This is a picture of the Pripyat River, where on the Russian-Belarus border, a pontoon bridge was built and four hours after Putin said he was retreating this bridge was imaged from a Planet Lab satellite. This is a startup that didn't exist a few years ago that is showing us that the world's most, one of the world's most powerful leaders and most powerful nations was lying to us all. And the images that we're seeing from companies like Planet and Maxar are providing an unprecedented level of honesty, truth, and transparency to world affairs that we've never seen before.

00:12:41 When the leader of this country needed to communicate with the outside world to reach us. He didn't use CNN. He didn't use the internet. He used TikTok connected through a Starlink terminal, and there's been an effort to try to connect the country, not through infrastructure that we take for granted because that's all been destroyed. But through space. Through a constellation of satellites in low Earth orbit that are providing connectivity to the front lines, to our troops, to our allies in this country, this is a private company that didn't exist again with this service just five years ago. We're about to see and hear from NASA. We're going to hear about how a, a satellite that used to be the size of a car has been shrunken down to a 10 by 10, 10 by 30-centimeter cube. And we're able to see inside hurricanes with unprecedented temporal resolution to understand their trajectories so that we can get people out of harm's way and we can evacuate people before the hurricane strikes. This kind of capability simply didn't exist a few years ago and through a collaboration between MIT and NASA, we're able to deploy an entire constellation of satellites, uh, in, in just a few months.

00:14:00 So the, the precedent here is we, as we see these opportunities to use space to improve life on Earth, you have to be able to get to space. And the problem is with hundreds of new companies, building new applications and new small satellites, they have to wait to get to space. They have to wait until a rideshare mission, a large rocket, uh, is going to the place in the space where they need to go. And until then they can't get their, their satellite into space. And so if you look at this opportunity, it is truly being gated by access to space. If you have a new application, a new sensor that you're trying to develop, and you're, you have a business that you're trying to fund a service that you're trying to provide, and you can't get it into space, you're held back, your revenue streams are held back.

00:14:43 Your fundraising is held back. Your ability to make progress is held back. And so as we see this trillion dollar opportunity unfolding in both public and private companies alike over the next several decades, we see access to space as the key enabler for unlocking the new space economy. And so just in the last year, we've seen almost a dozen companies, I believe go public raising billions of dollars of capital to build new applications across global communications, IOT, Earth observation, national security applications. These are real businesses that are generating real revenue solving real problems here on Earth from space. And this wasn't the case 10 years ago or 20 years ago. Uh, we have customers that have collectively raised billions of dollars to build satellites, to have a huge impact here on Earth. And so, when Adam and I first met, and I can't believe that this was, this picture was taken just over five years ago in a garage in San Francisco, we imagined the potential of space.

00:15:50	We imagined the idea of dramatically increasing access of space. In fact, we coined the phrase “daily space delivery” and literally on day one. And I, I think Scott Stanford is somewhere in the audience. Uh, when we first raised our first money to build this business, the idea was simple. Let's scale, the number of launches. And that's a theme that we're going to be talking and talking about throughout today. And you'll be seeing throughout your tours and throughout the, the conversations we're having, uh, throughout the, throughout the morning. But it is our shared vision of a healthier and more connected planet that truly inspires everyone here in the building. And I think that we might all go to space for other reasons to settle other planets, uh, to spread humanity into the solar system, but for Adam and I, and for the whole team here at Astra, and for, for almost all of our customers, the mission is here on Earth and the, the opportunity to improve life on Earth, through these dimensions of a healthier planet and a more connected planet is truly something that is inspired.
00:16:59	Uh, all of the things that you'll see today, everything that that's here in the building. And so the approach that we took was not to design and create PowerPoints and, and, and do it all of analysis. And then, uh, you know, five or 10 years later finally maybe build a rocket. It was within 18 months of founding the company in that garage, getting a launch license and launching our first rocket, and then doing it again a few months later. And again, and again, and again, and again. This was not the popular way to approach this problem. You know, you typically do not want to iterate with a rocket, but we felt we could learn so much more quickly if we pulled the entire system together. And importantly, also to iterate all the pieces of the rocket, we needed to build a factory that could actually manufacture a lot of the components of the rocket. And so what you'll see today is a factory that's actually manufacturing from raw materials, aluminum tubes, aluminum bricks, aluminum sheets, most of the components of the rocket at that loading dock materials come in — at that loading dock that leaves the building. And throughout the tours today, you'll be able to see how we make most of the components of this rocket, the tanks, the structures, the valves, the engines electronics here in this building.
00:18:20	And of all the images that are on this screen. I'm most proud of this final one.

00:18:25 That's an image that we took from space, when we first put our first satellite in Earth orbit. So this iterative process actually allowed this team, the smallest team ever assembled, to put into Earth orbit, satellites four years faster than any other company in history and maybe eight or 10 years faster than many of our peers in this industry. This learning faster mentality of building, iterating, learning, uh, is deeply baked into our culture here at Astra. And everything that we approach our space products, our space services will benefit from this vertical integration, uh, and this commitment to learning and iterating as quickly as possible.

00:19:15 So now that we've gotten into space and we've deployed satellites into Earth's orbit for our customers, the mission is to scale. The mission is to make more rockets. And so we're scaling our launch services as quickly as possible by taking the company public, by investing capital in the machines that will allow us to remove labor from key components to continue to drive the cost of the launch vehicle down. And in a few minutes, you're going to hear from my co-founder about how essential this is to winning the market in those, in the small launch vehicle, uh, space.

00:19:51 So by ramping up our operations, we're also focused on a mobile launch architecture. So not just having a spaceport that is a fixed fortification, but having a mobile launch system that can truly be deployed anywhere we are licensed to operate in the world in just a few days with just a few people. And this will allow us to fly from more places on Earth, to more places in space, more easily. In fact, we have three of these mobile launch systems that we are deploying and able to deploy anywhere within just a few days. And you'll see them here today. Um, we're really excited to, uh, we are operating now out of two spaceports, Kodiak, Alaska, and the, uh, <laugh> one in Florida, right? Been there a lot, Cape Canaveral of course, SLC <"slick"> 46.

00:20:39 We're also excited to introduce the, uh, a new location in the UK. Uh, this is a location that we're working with, uh, the regional authorities to get licensed to operate. Uh, this is a site that, uh, we'll be able to operate perhaps the first, uh, launch an orbital launch out of Europe. Uh, if you think about what scale allows you to do, if you scale up your rocket, you end up with the lowest cost per kilogram - undeniably. Uh, the rocket equation is clear. The bigger the rocket gets, the less the fraction of the overall mass of the rocket, uh, is the avionics and is the other, the, the, all the mechanisms that control things. So the larger, the payload capacity that you can have. Makes senseA A container ship, uh, set triple seven has a lot of capacity, and it's very inexpensive to operate on a per pound basis.

00:21:30 But what we'll assert today is that if you scale up the factory and you drive the cost of the rocket down through economies of scale. Economies of scale, apply to rockets, just like they apply to everything else in the world, the more of them you make, the lower the cost. And the drivers behind this are not how many times you reuse the rocket, but it's about how many times you reuse the factory to make more rockets. So what inspires us at Astra is the aluminum can. What inspires us is taking the complexity of the rocket, simplifying it so that we can remove the parts. The simpler we make it, the more automated we make, the, the system, the lower, the cost, the lower the unit cost of the rocket is. Textron makes small aircraft - the Cessna. If you're pilots, uh, Textron makes a few hundred Cessnas per year. They cost a few hundred thousand dollars each, and it might not surprise you that, that <pointing to rocket> which is LV11.

00:22:32 One of our TROPICS launches coming up weighs about as much as a Cessna. And so if Textron can make a few hundred Cessnas a year for a few hundred thousand dollars each, why should this cost millions and millions and millions of dollars? It's actually a tube, but with a pointy end, and it has far fewer moving parts. The engines don't don't have pistons. They don't have magnetos. They don't have it's the details really matter with rockets, but it doesn't have to cost more. If you control the cost of the production of all the parts, and you make a lot of them, because then you can amortize this across a larger number of units that are being produced. So from day one, Astra's mission was to focus on simplification and scale. And through simplification and scale, the economics of launch tip in our favor. And so in the end, you can win in this at both ends of the spectrum.

00:23:24 You can either have the largest rocket and you can reuse it more than anyone else, or you can have the largest factory and you can make more rockets. They'll launch more frequently and provide more value by saving your customer’s time. For every large aircraft that takes off from San Francisco airport, how many small ones take off? For every container shipthat pulls up to a port, how many trucks come in and deliver the actual shipping containers? The ratio is typically one to a thousand, right? And rockets are no different. Our ability to responsively launch our customer's payloads exactly where they need to go in space on their exact schedules has real economic value. And when you drive the cost of the system down through mass production, we will make a strong argument that there are winners on both sides of this curve. And Astra intends to be a winner on the right side of that curve.

	00:24:21	So what I'd like to do now is calibrate this with a customer that I'm honored to introduce and, and talk with here, live - NASA. I used to work at NASA and the opportunity to come partner with Adam and this entire team at Astra to build rockets, to launch NASA satellites, is probably one of the most incredible things for me personally. Um, and we are so proud and so inspired as a team to be able to launch NASA's first small satellite Earth science constellation. And so with me today, I would like to introduce the TROPICS mission.
TROPICS intro video	00:25:02	…that matters to focus on number one on the list is to observe the Earth's climate. The TROPICS mission is a mission that Americans really care about because it is directly observing our climate and helping save lives and protect
	00:25:17	property. TROPICS has a very specific need for their overlook configuration. We need to go to a 30-degree inclined orbit and no one else really wants to go there. The ride shares are all going to sun synchronous, orbits, or mid inclinations. So it's very well targeted to, uh, a smaller vehicle with a very targeted, uh, insertion where they can get us exactly where we want to go. And Astra is perfect for
	00:25:35	That. NASA's selected Astra because of our unique ability to get to three different orbital planes in a very short period of time at a low cost. And so being able to launch three different times for $8 million is unprecedented.
	00:25:50	We're excited about this mission because it's, NASA's first constellation built from small satellites. And Astra's platform is really ideal because it allows us to deploy these satellites rapidly and to the precise locations where they're needed in order to make the constellation operational as soon as possible.
	00:26:07	And we have the honor of being the final and most important piece at this moment in time of their mission, which is get that hardware in space exactly where it needs to go. We see that there are increasingly smaller satellites that are smarter, that are doing cool things in orbit, but they need to go to particular destinations at particular times.
	00:26:25	The real end game here is improving our ability to forecast tropical cyclones. What we're trying to do is make measurements in the microwave wavelink region, and those have the advantage of being able to penetrate the cloud tops and see the storm thermodynamics underneath the clouds. We're going to get something we've never had before in the history of weather satellites, which is revisit rates, uh, better than one hour.
	00:26:48	For the team itself, just, this will be a massive culmination of the last three years of work of developing this launch system to be able to do these things that we set out to do from the very beginning.

	00:26:58	From Astra's perspective, it's really important because we believe in space at scale, and to do that, you need to have much more frequent launches and access to space. And so this has been an opportunity for us to really understand how can we further compress the turnaround time between launches both in terms of building the rockets and in conducting the launches.
	00:27:22	What this milestone means for us is delivering a really important mission for our customer, but also demonstrating the capability that others can leverage in the future.
	00:27:31	And so the opportunity to be a part of something like TROPICS, where you get to make a difference and make a really large impact in the lives of people and help humanity as a whole does mean a lot to me. And it really excites me as well, going into this mission, knowing that we can help do something to make the world a better, safer place for people.
Chris Kemp:	00:28:01	Cool.
	00:28:05	All right. So now I am joined by Dr. Will McCarty, the program scientist for NASA, uh, from Washington. Uh, we're going to be talking a little bit about the upcoming TROPICS mission, and he's also going to share a little bit of detail, because he manages the portfolio of small satellite missions at NASA, about his vision for, uh, NASA's use of platforms like Astra. So, Dr. Will McCarty welcome.
Will McCarty:	00:28:27	Hey, hi. How are you doing? Do you hear me all right?
Chris Kemp:	00:28:30	Yeah. Perfectly excellent. Yeah. Thanks for joining.
Will McCarty	00:28:33	Yeah, go ahead.
Chris Kemp:	00:28:36	Oh, just tell us a little bit more about NASA's Earth science program and how this mission, uh, fits into, uh, your, your portfolio.

Will McCarty:	00:28:43	Yeah. So to, to understand what my position is at NASA, I'm a program scientist. I'm a program scientist in the weather and atmospheric dynamics focus area, which is one column of the Earth science division, which falls under the entire umbrella of the science mission directorate. So, um, basically, to understand what I do, you really, it helps to know my background. My background's actually, I am a meteorologist by training. I, uh, come from, um, essentially a weather modeling perspective. And so, um, you know, it's, it's the idea of what can we use NASA satellites, NASA resources for, to basically improve the weather. But, of course, the weather then affects everything because the weather affects the composition, you know, that we have not just that you have extra CO2 or extra pollution, but how that blows around that falls back to weather. Um, and so my cons, my, my portfolio is, um, you know, it's, it's both big and small.
Will McCarty:	00:29:35	I do, uh, the global precipitation measurements mission, which is a large satellite that measures precipitation plus or minus 60 degrees all over the globe. Uh, I do the Aqua mission, which is, um, actually just launched 20 years ago, last week, which, uh, really revolutionized weather forecasting by basically measuring with vertical, vertical, uh, integrity that, that never had been seen before in the infrared. But these are big school bus missions. These are large, right. And then what I'm also have been able to, to adapt to is, is the small world. Um, and so TROPICS is coming up, uh, it's really exciting. It's, you know, shoe boxes that essentially can measure, you know, the vertical profiles of the atmosphere in, in the TROPICS. Um, we have the S mission which actually measures reflected GNSS, uh, signals. So GPS and also other constellations around the world. And you, you can actually measure, uh, wind speed and soil moisture using those signals.
Will McCarty:	00:30:29	And then finally, um, which really connects has been, how I've been in with industry is I was, I've basically been with since the inception, the commercial small set data acquisition programs. So that's, um, the idea there is, is, uh, NASA comes in and basically buys commercial data and, and tries to use it for our scientific objective. So Planet, you mentioned planet earlier, planet's one of our customers, we, we basically buy access to Planet's portfolio. We buy it with a latency because that's how we kind of keep it affordable for science. But, uh, we, you know, there's a lot of this data that's coming out there, Planet, Spire being like two of the big ones that we've kind of been around since the beginning, um, that we want to make sure that their data, if it is useful to us, and we go through an evaluation process with all the new vendors to make sure it is, but if it's useful to us, we want to get it in the hand of our scientists so that our scientists can basically better understand their scientific objectives, whether that be in my focus area or anywhere within the Earth system.

Will McCarty:	00:31:22	Um, so that kind of helps, you know, explain my, my portfolio. I, I'm relatively new to the job four months. So things like TROPICS, I was excited four months ago about TROPICS from a user perspective. Now I'm, I'm at the headquarters level, but, um, you know, this is, this is a big step forward for us, I think. And, and it adds a lot of information.
Chris Kemp:	00:31:41	Now, can you talk a little bit more about how this satellite compares to some of these school bus size or some of these large, uh, you know, automobile size satellites in terms of its capabilities, uh, given how it's being deployed?
Will McCarty:	00:31:54	Yeah. It's, I mean, the engineering of it I'll admit is over my head, I'm just a literally scientist, but you know, the fact that we're building these little three U cube sets, you know, shoe boxes that can literally do what satellites that have been, you know, have been doing for 40 years now. But, you know, they used to be, like you said, the size of, you know, a refrigerator, if not larger. Um, and they would get four channels. This one's going to have like 15 channels, which is what our, like, best have. Now it's measuring at different frequencies. That's how you shrink things down. Um, but it's going to give us the ability to basically measure the vertical profiles of temperature in and around hurricanes, uh, the vertical profiles of the water vapor in and around the hurricane and also image the hurricane itself. So we can kind of do that with existing satellites, but with existing satellites, we get a picture when the satellite goes around and in LEO, they get basically two pictures a day with TROPICS.
Will McCarty:	00:32:46	We're going to get this ability of not just seeing them but seeing them with multiple revisits and quick rapid revisits. So, you know, with adding one, even just adding a second orbit to, to the, to one orbit allows us to then see the time evolution and, and the time evolution is, is really the important part that we're missing here. The time evolution, um, when you feed that to the models that doesn't just the temperature and moisture that you see directly, but it allows the models to understand how the wind fields are adjusting to, because you have to adjust the windfield based on how the storm is evolving over these short time periods. And that then results in, um, you know, basically more accurate predictions. So, um, you know, it's, it's so, and then you can just think of how that scales, right? You could literally launch dozens and dozens of orbits, but, but the reality of it is you can't do it with one orbit because the Earth's always spinning beneath you. So you have to kind of put up complimentary orbits to get that revisit, but that revisit is really what we're missing in the modern observing system.
Chris Kemp:	00:33:40	So the mission's been designed so that the more satellites, the more launches the, the higher, uh, the revisit rate is. Right? So can you talk to me more about, uh, what you consider mission success and how the mission was designed and, and why, how you chose Astra as a provider given how early we are in our program.

Will McCarty:	00:33:58	Right. Yeah. Well, you know, the idea here is this is, this is a fairly new paradigm for, for NASA that, that we would, you know, basically be able to build six, relatively inexpensive satellites through the source venture programs, the source venture, program's a neat program in that. It's basically very experimental, right? The, the, the proposals are written by the PI with both the engineering side of how to build the instrument, but also the scientific objectives that they're trying to reach. And, and so the idea here was, okay, you could build these things and now we could build them and we could put 'em up into space. But if you think of traditional launch services, um, <laugh>, we'd be spending many multiples of, of the instruments themselves to get two orbits out of this. Um, you know, this constellation or plus two, you know? Um, so Astra provides this low cost opportunity and this low cost opportunity, um, really opens up an entire slew of, of different scientific objectives, not just for TROPICS, which is kind of the first example, but it really opens up the whole world as we, we develop these small satellites, but a lot of those scientific objectives can't just ride along with the space station, which is where let's face it, many cube sets up until now we've gone, because we send things routinely to the space station.
Will McCarty:	00:35:10	Um, you get to pick your orbit now. There's no reason to send a communication satellite or, you know, something that commercial entities would likely put up into space into some of the orbits we want to use for Earth science. Um, so you're really able to go places that, um, there's no other reason to go. And that's, that's, what's really exciting to us is, is instead of having to, we, this basically allows the small satellites to be the primary pay lift. And that's, that's kind of unachievable right now in, in the world we're at.
Chris Kemp:	00:35:39	Yeah. So, uh, the mission was designed so that you would have some number of these satellites, uh, successfully deployed in order to have minimum, uh, success criteria for, for the, uh, the overall program. Can you talk more about that?

Will McCarty:	00:35:53	Yeah, so it's, um, you know, basically our, our minimum threshold is two orbits. You, we need two orbits to be able to see that time evolution, right? It's, it's, you know, it's the first two pages of the flip book. Um, we have three and hopefully we get three. That'd be awesome because then you even get that second page in the flip book, but really two is a huge step for us. The only way we get that temporal revisit right now is basically GEOs, stationary orbit and GEOs stationary orbit you're way up higher. So you have lower signal to noise, um, and you only see a disc of the Earth if you don't get to see the whole, the, you know, the whole circumference of the Earth. So, so the idea here is, is that, you know, two times four, um, or two times two, so four satellites that really gives us our baseline. Um, you know, but I look at these things, not just for what we're doing with TROPICS, but you know, where we go in the future. And, and the reality of it is, is, is that this is, this is the first step towards a new paradigm and, and a paradigm that's already existing. I mean, Planet Labs is flying up there with how many satellites and Spire has an entire constellation. Um, the, this is the ability for NASA to build our scientific objective primary payloads to then kind of work in that same space.
Chris Kemp:	00:36:58	It's exciting when you, the cost of the satellite continues to come down, the cost of the launch comes down, what matters is the constellation and the, and service it provides not any one launch or any one satellite. So, I know the team will do everything we can to make sure all three launches and all your satellites are deployed, but it is, it's good to know that, uh, you know, the, the price point of three launches allowed you to enable a mission where even if only two were successful, uh, like the last two of our three launches were successful. So we'd like to, we'd like to do better. Uh, but it is nice to know that even NASA is designing constellations, uh, so that the overall constellation performance is the end goal, not thinking about every single satellite and every single rocket launch.
Will McCarty:	00:37:39	Yeah, that's a really important point is our objectives are really with this new capability at hand, our scientific objectives are really built on the constellation, not the individual instrument. And so that's, and that's something that's very different than what we've done traditionally with these school buses where one instrument exists on one satellite.
Chris Kemp:	00:37:55	So you've already launched one of these satellites on a SpaceX, uh, flight. Can you tell us a bit more about, uh, what the satellite is already able to do, uh, for the program?

Will McCarty:	00:38:05	Yeah, it's, it's actually been, so just as you know, these are experimental untried technologies, right? So, so the, that, that what they did was basically there was a seventh TROPIC satellite and was their engineering bench model. And, um, after completing everything, it was realized, wow, the bench model, um, could basically be thrown up as a secondary payload and, and go up into space and give us basically some early look data to, to understand how, how it's going to function. Um, so, you know, every satellite that goes up in space has its nuances in Earth science. We, we think very much at the lowest level calibration level, everything has to be completely understood. That's how you get climate. You need, you need climate quality data to, to get to that point. Um, so, so the Pathfinder is what we're calling it, that's the first satellite. Um, the Pathfinder is in a sun synchronous orbit, and what that'll allow us, what that's basically has allowed us to do is refine and test our calibration methodologies in, on real data versus, you know, what we think we, we we're going to have coming out of the lab.
Will McCarty:	00:39:06	Um, but the other thing that's really cool about that is that we've actually hopefully extended through the beginning of the mission where then we'll actually overlap the ones going this way with this way, and we'll get better overlap. So you get a lot more simultaneous measurements from the Pathfinder, which we understand pretty well by now, but that also allows us to cross calibrate the, the prime constellation, uh, with each other. So that, um, one of the great mysteries of these constellations is how well are we going to be able to get them to match each other, um, that you know, that we, one thing you lose by shrinking down generally is calibration stability. That's one of the, the arguments. Um, but by having the Pathfinder up there, we've already demonstrated end to end the, the observation itself. And now we're going to be able to use that really to make the constellation in better agreement with each other across the board.
Chris Kemp:	00:39:50	Well, uh, Dr. Will McCarty, I appreciate you joining us today. Uh, if you were here, you'd see, uh, we have LV10, uh, about to leave the building, LV11 here next to the stage, uh, and on the production line, LV12 and other things. So, uh, we'll, we'll shoot some video of it and send it to you. Uh, thank you for inspiring me, everyone here at Astra. This mission is really important to us and, uh, we're going to do everything we can to deliver for you and your team.
Will McCarty:	00:40:14	We appreciate it. Thank you. Fun stuff. So good.
Chris Kemp:	00:40:19	All right. I'd like, and I'd like to dig a little bit more into this idea of scaling the number of launch vehicles, the economics, and the rocket science behind it. And there is no better person to do that than my co-founder, our Chief Technology Officer, Dr. Adam London. So with that, Adam,

Adam London:	00:40:39	Thank you, Chris. Welcome to the rocket factory. Thank you all for coming. I'm excited to get up here and spend a few minutes talking about the question that we get asked a lot, which is why small rockets. Fundamentally, there are three reasons that I'll highlight. First, orbital complexity, similar to what, um, Chris and Will were just speaking about, uh, make small rockets, very useful, versatile, and valuable to our customers like NASA and others. Second, the economies of scale make small rockets cost effective. And third, small rockets are frankly, easier to make than big rockets, and so that is actually capital efficient to do that, um, as a company that's new and growing. So, let's get into it with a bit of Astradynamics.
Adam London:	00:41:32	I like to say that are many addresses in space. On your home, you have your street number, your street, and your zip code. In space, there are actually six things that define an orbit, but three are most important, as well. The altitude, sothat's how high above the Earth you're circling, the inclination, which is the plane that your orbit is in, how far is that above the equatorial plane of the Earth, and then the rotation of that plane, which is basically, where as you clock it around the Earth, does your satellite cross the equator? And that's called the Local Time of the Ascending Node for asynchronous orbit or the Right Ascension of the Ascending Node for sort of a more generic orbit. And fundamentally, constellations are built up of many planes. So, we just heard about the TROPICS mission, that's three planes, two orbits per plane.
Adam London:	00:42:25	All of them have the same altitude and inclination, but the three orbits are clocked in rotation, um, 120 degrees so that they are evenly distributed around the Earth. And the thing that you need to know from the sort of rocket science set of things is that it's really expensive from a time and energy perspective to change planes in particular, but even any of your space addresses once you're in space. And so that's one of the reasons why TROPICS is so much easier to do with three launches than trying to do it with one bigger launch and waiting for a very long time to get the things to the right locations.

Adam London:	00:43:06	Um, as you look at other bigger constellations, there's some that have been proposed with thousands of satellites in hundreds of planes. Um, and this gets very, very complicated. But fundamentally, it's important if at all possible, to launch directly into the correct orbit, go direct delivery to the right space address. And that is fundamentally what our dedicated launch service is designed to do. So, what do our customers need as they're building and deploying these constellations? Initially they need deployment to all of their orbital addresses. Then over the life of a mission, they'll need to add spares or move spares or replacement during operations, which go to specific individual addresses. And then at the end of life they will want to replenish the, the constellation. And that means all addresses have to be touched, but if satellites last different amounts of time, you don't want to go to them all in the same order. So, you want to be able to very precisely, replenish potentially one satellite at a time, maximizing the value of that very expensive asset. And perhaps most importantly, our customers want to do this quickly, because time is money, particularly in space. When you're launching a satellite that costs a lot of money, you need it to generate the revenue to bring that back. And this typically means that a month of a satellite's time is worth 10 to hundreds of thousands of dollars.
Adam London:	00:44:40	And that actually can really help benefit the idea of responsive, uh, quick launch. So, Astra is out to solve all of these problems. Whenever, you need to get something to space quickly, we would love to help. And our responsive capability and scale, we believe will enable that. When you're deploying low density, constellations like TROPICS, which is six satellites, but spread all the way around the Earth, a small system like Astra is often the best andn the fastest option to make that happen. In higher density constellations, where you can benefit from the bulk deployment of very large rockets, Astra still has the role to play. We think we can complement them by delivering those last few satellites required to finish out each of your orbital planes, or by supplementing the bulk capacity for a small subset of your total thing to accelerate deployment and make the whole constellation operational faster at a really fairly small, incremental, um, cost to the average delivery cost. In terms of the on orbit and during operations phases, we think we shine as well.

Adam London:	00:45:47	If a satellite fails or needs to be quickly replaced, we can help do that. And then as satellite's near the end of their useful lives, we think that it's quite unlikely a whole plane is going to get to end of life at the same time. And so, we aim to enable a more focused replenishment, that might otherwise be possible. Economies of scale, we talk about scale a lot, are so core to our strategy, and so I wanted to talk about the concept briefly. What this is, which is one of my favorite charts, is if you buy a rocket or an airplane or a car and you put it on a scale, how much does it weigh and how many dollars did you pay for each of those dry kilograms? When you step back and think about rockets, airplanes, cars, you think, well, those are totally different, but in fact, they're fairly similar.
Adam London:	00:46:47	They're mostly metal, although more and more are being made from carbon fiber, they're run by pretty complicated engines and they have a growing amount of avionics and software that makes it all work. But you produce them at tremendously different rates. The demand is very different and, um, and that is the thing that fundamentally drives the cost that you can buy a car for tens of dollars for kilogram, but rockets are thousands today. And so, ultimately because these physical devices, they start with the same stuff like aluminum cost, a few dollars a pound, no matter more or less what, so the commodities that make them up is sort of at the bottom or even below this chart. And as you think about each of these charts, is how much time and energy, um, capital go into converting those fairly inexpensive, although recently trending upwards commodities, um, into a unit of something useful, this amazing device that we then go use.
Adam London:	00:47:51	And, uh, and so our objective, and I think the fundamental reason why this comes down, is that you can invest more in the automation, in the manufacturing, in the efficiency of production. And so, our objective is to move our small rockets down around to the bottom level of airplanes. As Chris said earlier, if, as Cessna can be that much, can’t a rocket of similar size? So, what does this mean for small launch economics and why did we choose and do we continue to choose to develop a small rocket instead of a very large one? I like numbers and I like charts. So, um, try to avoid to much of a lecture. The sort of traditional view is that small launch is much more expensive on a per satellite basis or a per kilogram basis than big launch. And that's born out when you look at today's pricing on a price dollars for kilogram basis.

Adam London:	00:48:46	But if you think about what is possible, if you reduce the cost through scale of small launch, it gets quite a bit better. And if you, account for the value or in the inverse, the cost of losing time of big launch, they start to become much more similar on a per cost basis. And then there's something that many of you in the audience and we care deeply about, which is capital efficiency and the return on capital? The amount of time and money and effort to develop a program that can build a 10 to 20 times larger rocket costs quite a bit more than that, of a small rocket. And so, when you amortize those costs over a fixed amount of time, the sort of true economic cost of these bigger programs on a per mass launch basis increases, and they start to become even more similar.
Adam London:	00:49:40	So in short, we believe that over time on a per kilogram basis, large rockets will probably continue to be more cost effective, but we think that delta is going to get smaller and be much smaller than what you experienced today. Of course, on a per launch basis, which is to think that drives many of these higher value things of quick access and responsive must. It's not even close, um, because we're able to produce a smaller thing. And so at a high level, I'd summarize our strategy as we're using scale to dramatically, to obtain dramatically better cost for launch, but at a very reasonable cost for kilogram.
Adam London:	00:50:21	And that is what we think fundamentally enables us to deliver for our customers and provide these high value consolation, deployment maintenance, um, and replenishment services. Before I hand it back to Chris, there's one other thing I wanted to cover, um, way back in my management consulting days. We like to talk about what are going to be the frequently raised objections to this idea. So, let's cover one of those. Um, as you might imagine, I get a lot of questions about reusability. Why aren't you reusing your rockets? Um, and so let me say this first reusability and reusable rockets are incredibly cool. One of the most amazing and impressive things that I've ever had the pleasure to witness was those two Falcon heavy boosters landing in unison in 2018. What an accomplishment. I suspect that I have a better appreciation than many on sort of how challenging and impressive that was.

Adam London:	00:51:17	And I remain profoundly in awe of that. But I think it's important to talk a bit about the economics and sort of how we think about this question. Conventional reasoning looks sort of like this. Um, the cost of a launch of conducting a launch is pretty much the same, whether it's reusable or not. And if you can reuse the rocket four times, that means each launch is a quarter of the cost of the rocket and 20 times a 20th. And so, it's a no brainer you should reuse rockets. But my view that things are a little more complicated, particularly we can, when you consider the economies of scale,. First, recovery and refurbishment does add additional per launch operational costs. So those costs are not constant second and perhaps most fundamentally producing four or 20 times fewer rockets, each of which frankly is more complicated, likely larger, likely needs
Adam London:	00:52:12	higher margins, often is sort of somewhat lower performing for these reasons means that the per launch production cost is actually quite a bit more than this quarter or one 20th kind of factor that one would just apply.. And third, reusing rockets is hard, reusing a rocket or building design rocket, i think, we reuse 20 or 50 times is really hard. And so, you have to think about the programming capital costs that need to be amortized over all of those launches. And so, we actually believe that as you introduce reusability, the costs go up, initially and then eventually will come down and our modeling and our analysis suggests that that payoff is somewhere in the range of 20 to 50 reuses. It's highly dependent on the specifics, but pretty sure it's not two to four.
Adam London:	00:53:00	And so fundamentally when you think about this, like, do I want to invest more capital to potentially get a benefit after the end of things, I'm very, very happy to focus on making rockets simple. That's hard enough. And so, we remain intensely focused on scaling, dedicated launch. I will acknowledge it's certainly possible that we're wrong about this. There are lots of people who believe we are, but our model so far, and our understanding leads us to move in this direction as we scale and as we learn more, we'll keep evaluating the economics and if we win, we believe it makes sense to reuse. We'll absolutely consider investing. But for now — simple rockets made at scale. That's what we're about. That's what I'm very excited to do here. And I think that's what ultimately will enable us to really meet and help our customers and provide great value. It's important to acknowledge one thing about that though, to achieve that scale and to solve these future launch challenges for all of our constellation customers, we need a scalable launch system that is capable of launching almost every single satellite produced, even if it's only one or two at a time. And that means that our launch system needs to get a little bit bigger. And so I'd like to turn it over to Chris to talk about the next step we're taking on that front. Thank you all.
Chris Kemp:	00:54:29	Thanks, Adam.

	00:54:34	Awesome. So I'm about to share with you some really exciting work. Uh, the team has been iterating since day one, launch system, 1.0 rocket 1.0, rocket 2.0, rocket 3.0, 3.1, 3.2, that's version 3.3 of a system that over a five-year period of time has gotten better and better and better. And so as we talk about Astra's strategy, we talk about our launch services because you can't improve life on Earth from space if you can't get to space. We talk about the space services themselves and our progress, uh, towards building that, that platform in space. And we talk about the core technologies and the products that we need to power that platform. And so what I'm going to dive into, uh, is each of those three areas in a bit more depth. But first we're going to start with launch system 2.0. We called this one, 1.0, because it's the first one that worked.
Chris Kemp:	00:55:26	It's the first one that delivered our customers satellites into Earth orbit. But this is a system that's now been operated and developed over the last couple of years, about 18 to 24 months. And so over this year, uh, the team has been working to build the next version of the rocket 4.0, a new version of the launcher, a new version of the software that powers the entire system. And a new version of the factory to make it all. And so what we're going to dive into today, and we're going to hear from Benjamin, uh, a really deep, deep, deep dive into everything happening here in the building. And what I'm going to talk about is the design goals for launch system 2.0. We focus primarily on three areas, cadence, capacity, and cost. And so if you think about this, this is the north star for every product team working on every single component of this system. And if you think about the overall launch system — we're talking about rocket engines, we're talking about stages, we're talking about the overall launcher, we're talking about all the ground support equipment. All the stuff has to work together. So having clarity and focus and purpose is critical to bringing it all together, time and time again.
Chris Kemp:	00:56:38	But before we get into cadence, I just want to underscore how infrequent launches actually are. In Q1, it might surprise you that Astra followed SpaceX, Russia, and China as tied for the second most frequent orbital launch on Earth. We tied with ULA that also had two launches last quarter. And in a way we're not really proud of this, this, this just shows you how few launches occur on Earth <laugh> every quarter. And by doing three more launches for NASA, if Russia's not launching anymore, how quickly we move up that list and how infrequent launches truly are available to all these customers that are building all these small satellites, these innovative applications that need to be as Adam explained, launched to a particular address in space as fast as possible. And so this new launch system is designed for weekly launch. And what we mean by that is the factory was designed and scaled for weekly production.

Chris Kemp:	00:57:39	We mean that the software and the systems are designed to be operated by teams so that we can support a weekly cadence of launches and so it informs a lot of the details in the design of the system. This unlocks more launch availability, more scheduling flexibility, and a shorter time from book to orbit for our customers. And these are the things that we hear from customers are the most critical things to them. So how do we do this? Well, first of all, uh, software, we, we automate as much as we can in the factory so that we can make more rockets more quickly with less people. But we also are driving the mission control and the onsite launch operations experience down from around 21 people to eight people. And so again, a design point means that the mission control, which you can kind of see behind the rocket here, that's a pod and the old one's right there.
Chris Kemp:	00:58:34	So there's iteration actually, even in the concept of mission control the number of seats, the number of screens, the CONOPS is being evolved to use a fewer number of people which translates into lower cost. And in this new model, the idea is a pilot and a co-pilot. If hundreds of passengers can get on a jet and fly across the ocean with a pilot and a co-pilot, why can't a couple of people fly a rocket that doesn't have any people on it with a satellite that's, you know, largely most of them have to work for the customers to be happy? There's no reason. So as we think about innovating, we think about driving efficiencies in every area of the operation, including the recycle time at the pad. So the new launcher is designed to have a one day recycle time, which means we could ship a rocket, launch it, and then the following day do another launch from the same launcher. This means that we're going to have lower cost in operations, lower cost in, uh, any, anything that has to happen that's expendable at the pad so that we can continue to launch, uh, from a particular spaceport more and more frequently. Truly potentially, if we accomplish this objective

Chris Kemp:	00:59:45	operating a daily space delivery service from a single spaceport. The problem is, that'll never happen because of weather, because of regulatory issues, constraints at the ranges, licenses — and so that's why we need more spaceports. And so you've seen the announcement last week. Uh, we're working with SaxaVord in Scotland, and we have an entire team here looking across the entire world, looking at regions and areas where we can operate spaceports, because if you can truly take a mobile launch system and deploy it in anywhere that is happy to have us do a launch, uh, then we truly allow the, the company to unlock the potential of launching from anywhere on Earth to anywhere in space. But the key is the system has to be mobile. You have to reduce the number of skilled, uh, you know, onsite personnel that have to fly in so that the fewer, the people that are out there, the safer it is for the team. Um, and basically, we're be we're, we're, we're driving efficiencies and economies of scale, not just in production, but in operations as well. The second, the second key design point is capacity. Um, while many of our customers have very small satellites, an increasing number of large mega constellations have larger satellites that they're beginning to launch and deploy. So as we look out over the next 10 years or so, the average weight of a satellite, the mass of a satellite is about 180 kilograms. Some are larger, some are smaller. But as Adam said, our objective is to address the majority of the market for mega constellation customers. And so with launch system 2.0,
Chris Kemp:	01:01:25	our design point is 300 kilograms of payload to LEO. And you might ask how, how we do that. Well, first of all, it's a slightly larger rocket with more powerful engines. So we're actually moving to a larger faring that has more volume for our customers to support the ESPA Grande standard so that we can take a lot of common satellites that are being designed for other rockets and launch them on our rocket without having to be designed for our faring. We're moving from five engines to two, this reduces the cost, it reduces the number of engines we have to manufacture, uh, and these new engines, which you'll see here on the tour today — I think I have a video too, one running — um, it's a really cool engine, has fewer parts. Um, doesn't have big batteries, uses turbo pumps, so it's a lot more efficient. And actually I do have a video! So we're going to play a video of the engine that you're about to see on the tour, running through its its qualification acceptance test. This engine produces 35,000 pounds of thrust — so two of them will produce a total of 70,000 pounds of thrust. This replaces the current engines that produce about 7,000 pounds of thrust — so five engines that collectively produce 35,000 pounds of thrust are being replaced by two engines that collectively produce twice as much thrust. So two fifths as many engines with twice the thrust.

Chris Kemp:	01:02:54	Um, we have several of these engines, our we're setting up a production line of these engines, which you'll see, uh, so that we can reduce the number of total engines we have to produce. As we continue to increase the production rate of rockets.
Chris Kemp:	01:03:07	It goes for a while, which is what you want them to do. Um, while we continue to focus on capacity, uh, we are continuing to, to drive costs down. And what this means is our base launch price will be only $3.95 million, uh, which is a lot less than many of our competitors. And as Adam showed you while the dollars per kilogram might be more, that dollars per launch remains low. And by continuing to offer what we hope to be the lowest price per launch, we'll continue to attract customers., uh, especially as capital is more expensive for our customers. As, especially as we go into times of economic uncertainty, we believe that our customers are going to choose the lowest price per launch. And so it remains our focus to, to own that right side of the curve by continuing to drive cost down. And so, as we look ahead, we're never done. Uh, the teams that work at Astra to make better engines, better stages, better rockets, better software will have a 3.0 right behind it.
Chris Kemp:	01:04:10	And with 3.0, we'll continue to focus on what our customers tell us they need. And every indication is that the capacity will need to continue to ever so slightly increase. How much? We don't know. But our customers are telling us now, and as, as constellations, like the hyper constellation fine tune and, and finalize the mass of their satellites, we can make adjustments because 1.0 is flying 2.0 will be, uh, tested and flying for a while. And then there'll be a 3.0 and a 4.0 and a 5.0. And so this idea around continuous innovation, continuous development, and continuously listening to our customers and incorporating their needs into our products is what drive drives Astra. This might be the first product-led, customer-obsessed aerospace company. We can't hire product managers from this industry, right? Because products have generational life cycles. Typically when you're, uh, an aerospace company, the product management is done by NASA. They tell you what they need and that it's a cost plus contract. There's not this continuous cycle of listening, iterating, incorporating that feedback loop into your products. And you won't see it here on your tour, but it's deeply embedded in the, in the values and the culture of every single team member at Astra. And it's really special.

Chris Kemp:	01:05:28	So now I'm going to turn to space products briefly. In order to build space services, you've gotta have the best space products you, your, your satellites have to have fantastic propulsion systems. They have to have power. They have to have radio systems and payload performance that's market leading. And the challenge is no suppliers exist to supply a mega constellation because there's really only one mega constellation right now operating and it's SpaceX. And so we have to take every single one of these space based technologies and figure out as a company, how do we scale this? How do we take what we've done with rockets and launchers and apply it to these other key critical space technologies? Take this factory that we've built, take the vertical integration capability, the ability to do the test facilities that you're going to see on your tours today and apply them to every critical core space technology.
Chris Kemp:	01:06:20	Our first space technology we acquired last summer with the acquisition of Apollo Fusion. I'm proud of this team. I'm proud of the work they've done because we've already sold 82 of these engines. And if you listen to, to my earnings call last week, we'd sold 61. And so this product is working in space. It's, it's being adopted by customers. And the more these we make, just like the rockets, the more the cost comes down, which means the more we're going to have market leading space services potential. And again, we're just getting started on identifying, uh, the strategies that we're going to use to introduce new space products that are going to power the space services. So on to space services. Uh, the team here as we continue to make progress on our launch system, um, is making very strategic investments in building the first prototypes of the Astra spacecraft for our constellation. And all I'm going to do is tease you with it here today. This is going to be something that we will apply the same values, the same culture, and the same approach to, but we're not going to build it by integrating a bunch of parts. Ultimately, what we have to do is we have to bring the best space products to bear,
Chris Kemp:	01:07:43	so that we have the best capabilities on orbit. And the great thing about that is that creates revenue potential for Astra there's potential in taking the best technology, productizing it and selling it to our competitors, just like a popular electric car company said, if we want to electrify the auto industry, we need batteries and sold batteries to many other automakers. We see an opportunity in building revenue streams for Astra around taking our ability to get to space fast, develop our own space products, space qualify them faster, and create opportunities for Astra and our customers to have the best space technologies in their constellations. And the fact that we've sold 82 of these spacecraft engines is an early indicator of the value of this, uh, opportunity.

Chris Kemp:	01:08:38	So with that, we're going to show you the exciting stuff. Uh, you've had to listen to me and Kelyn, but uh, but I'm going to introduce Benjamin Lyon after 23 years at Apple, uh, where Benjamin led a lot of the core technology development in the iPhone, uh, is, uh, own, uh, issue, uh, robotics programs. Uh, he, after many, many months of, of coming in visiting and hearing what we were doing and hearing about what we were trying to do for Earth, he left Apple to join Astra. He leads engineering, launch operations. Uh, he leads manufacturing and today I hope you get the opportunity to tour with him because he's, he's going to take you to all the places. He's going to show you a lot more detail into how we're pulling launch system 2.0 together, and some of the other core space technologies. So with that, Benjamin Lyon.
Benjamin Lyon:	01:09:21	All right. Yes, sir. Nicely done. Thank you, Chris. And thank you everyone joining us here today, as well as online. Um, it's super, super exciting to welcome you, uh, here to Astra. Um, you know, to me, uh, small cross functional and diverse, uh, teams that are largely independent, um, are like part of our secret sauce and what it's, what enables us to, uh, move so quickly and also will enable us to adapt as we learn more and more about the market as the market evolves. And so when you get these really small, um, teams, it really makes the magic happen. And rather than kind of tell you about it, I'd like to just show you. Um, if you think about the factory that you see today, this is what most of it looked like less than a year ago. And we have this amazing real estate team, um, that took this and this, and turned it into this and then this, and now this,
Benjamin Lyon:	01:10:27	And for us, once you have an incredible space, then you can start to facilitize it, um, with all of the capital equipment needed really for scale. And when we think about what equipment to bring in, we think about automation and we think about particularly what automation, uh, makes sense for what we're doing here. On one hand, we want to do scale. Um, on the other hand, we know that the market is evolving. And so we're very, very tasteful about where we bring in automation in order to drive app, uh, tak time, but also have the flexibility in order to adapt as we learn. And so in general, where we see activities that are highly repetitive, we bring automation, we bring robotics in, in order to speed those things up. And you'll be able to see some of that today. In addition, we've been deeply investing in people.

Benjamin Lyon:	01:11:21	Our team is an incredible team. It's incredibly diverse. They come from all over the industry and all walks of life. It's one of the most exciting things for me personally, about working at Astra is that I get to work with people from all various different backgrounds. This is Felix here. He's one of our, uh, lead, uh, weld, uh, engineers. We have Susan and Tim here. Um, also they do welding and they do assembly and test. Um, we also have a great intern program at Astra. And one of the great things about interns is that they don't know what can't be done, and they ask the most incredible questions. And those questions often cause us to go, oh, you know what? That's not the way we did it in aerospace. It's also not the way we did it in tech, but guess what? That's a brilliant idea.
Benjamin Lyon:	01:12:08	And because we're nimble, we're able to like turn and make changes based off of those ideas. Um, you know, here, we've got Emily and Nick, uh, working with Kyle on the assembly, uh, of our faring. The other thing that we thought deeply about at Astra is all the challenges that we already see the world is seeing in the supply chain. And we think hard about vertical integration, but we also look deeply into where can we have great partnerships with the supply base? And so Will, uh, Drewery actually joined us, um, from the automotive industry and it's built out this incredible supply chain team that is working deeply with the, uh, supply base in order to get ahead of a lot of these supply chain challenges. And it's, what's enabled us to have multiple rockets and build, um, that you see here today at the factory.
Benjamin Lyon:	01:12:59	And of course that comes together to this, um, launch system. And one thing that you may not note in this picture is actually that strongback, which you'll also see next to the stage over here is not only the thing that supports the rocket before a launch, but it's also the packaging that we ship the rocket with. And so this mobile system has parts that actually have multiple purposes to them. And for example, we can drive it down the road, uh, in Alameda in order to take it to the airport. And we can put our mobile system on an airplane and fly it to the spaceport, or we can put it on a boat and we can ship it out to a spaceport somewhere else. And it's not just the vehicle, which is the kind of the, the thing that everybody sees, but it's also the rest of the launch mount and the, uh, support system, uh, that's needed in order to make a launch really happen.

Benjamin Lyon:	01:13:48	And so this is for example, what we call the cube, which is, uh, the launch mount, which we can literally stick it on a truck. We can ship it, um, in a ISO container and, uh, send it off to the spaceport. So as we think about mobility, we think about adaptability, we think about scale. Um, we're not building one at a time in an artisanal way. We're really looking at building parts in volume, and that allows us to drive costs down. It allows us to drive quality up and reliability up. And so, uh, that leads us to have multiple rockets out on the floor today. And we think that this ability to rapidly produce, but also be flexible, is the critical, critical, secret sauce to being responsive and providing responsive access to space. Um, and of course when it all comes together, it's really magical.
Benjamin Lyon:	01:14:39	Um, but we're just getting started and we've been getting to work on the next generation. And so thinking about the next generation, you know, Chris showed this picture of a, of an aluminum can and from the outside, it really looks like an aluminum can. Um, but there's a lot of complexity actually on the inside. Um, some of which we really can't show you, um, and that complexity drives cost. And, uh, when we think about that, we think about everything that goes on the inside as a feature and some of the very best features are the features that don't exist at all. And so we've been thinking very hard about how do we simplify, how do we drive out complexity? Because the simpler the system is the more we can scale it, the lower cost it's going to be, and the more reliable it's going to be. Um, and so this, this is like a hard problem.
Benjamin Lyon:	01:15:28	Rocket science is hard. Um, but one of the things we can leverage is the fact that our system is sending payloads to space, um, as opposed to people to space. And because we're sending payloads to space, we can think hard about a system that is reliable, um, but is not the 99.999999999% reliable because we're not worrying about, um, a human-rated system. And so that's one of the aspects we can use to optimize. So as we move forward in our roadmap, Chris talked about how we are moving, um, from multiple smaller engines to just a couple larger engines. And we have a facility today, that's actually just across the street where we test, uh, first stage engines, upper stage engines and upper stages. Um, and that's great, but this is another one of those things where we realize, oh, shoot, we've gotta build, uh, a facility that can test these much bigger engines.

Benjamin Lyon:	01:16:23	And, uh, we've gotta do that quickly. And so once again, one of these very, very small, uh, cross-functional independent teams got together. And over the course of just a few months started with this, went to this poured, a bunch of concrete, mowed the lawn dropped in tanks, put up a thrust structure. And now we have a facility that is commissioned for testing, much larger engines. And to me, this again, like it's just mind blowing how small cross-functional groups of folks can move so quickly and do such incredible work in a short period of time. We're also thinking about this from the perspective of, uh, mission control. When I first got to Astra, this was mission control. And even just over the course of the rocket launches that we've been doing over the last year, we've gotten mission control down to just a few people, and you've seen this in the livestream, um, and what's going to happen next is we're going to design a system that takes advantage of automation, um, has a great user experience, um, and allows us to drive down the size of mission control to just a few people.
Benjamin Lyon:	01:17:34	And that's really important because our goal is to operate at scale. And so we need a system that is instead of being designed for people to, um, operate largely manually, where then you add in elements of automation to kind of solve individual pain points. We're flipping it upside down and we're designing a system that eventually we intend to operate largely autonomously with humans in the loop, just to check the system along the way to make sure it's doing the right things. Also in space, um, Chris talked about the acquisition, um, of Apollo Fusion, and this is an incredible photograph of one of the, uh, Astra Space Engine thrusters is operating in a test chamber in a vacuum chamber. And, uh, for me, this was on my bucket list of things that I wanted to see in my life was, uh, you know, a hall effect thruster, they actually operating, um, but what was even cooler than that was to see it operating in space.
Benjamin Lyon:	01:18:31	Um, and this has generated, uh, a kind of a perfect, perfect match that has allowed us to think about, okay, there's great, a great kind of product market match. Now we need to go and we need to mass produce Astra space engines at scale. And so that is a project that is already ongoing today. And you can see, we are producing, um, Astra space engines already at this point. And that will be something that we continue to, uh, build out over time. And not only do you build it, but you've gotta test it and produce it. And so this concept of scale is, is fundamental to what makes innovation really matter. We iterate really, really quickly. We innovate really, really quickly, but we have to be able to do that in a way that is at scale and that is impactful. And we believe that if we do those things and we do those well and with competence, um, that will create access to space and will create, uh, great business opportunities. And so what I'd like to do is I'd like you to, uh, meet, uh, Martin Attiq. Who's our chief business officer. And he's going to talk with you a little bit more about that. Martin, come on down.

Martin Attiq:	01:19:44	Thank you, Benjamin. And thank you all. And welcome to Astra. I'm Martin Attiq. I'm Astra's Chief Business Officer. Our mission is to improve life and DPH and space. The way we do that is by providing access to space. And we believe that the potential for space is tremendous. It's already large. Chris talked about the current space economy is about 337 billion. We believe that that there's a tremendous amount of unlocked potential, and the key to unlocking that potential is access. So what I want to tell you today is share with you what I hear every day from our customers and industry partners about the pain they feel in getting space access and where we believe the future of space access will be.
Martin Attiq:	01:20:38	And I'm going to start with an example, imagine that you're an entrepreneur or an executive at a large company, and you want to build connectivity for autonomous vehicles. Autonomous vehicles require level five driving. What level five driving means is that you need to be connected to a network or a high availability network that is reliable to achieve that, um, you need connectivity, uh, that you can, you know, rely on. With a terrestrial network that's extremely difficult. You can't rely on a terrestrial network to always be connected. However, with space, it's very possible to be connected with a high reliable network, but then you say, okay, I have to go build this network. So how do you do that? Well, you have to design a constellation. You have to design, build, test space, qualify satellites, and the, and the components ensure that their radiation hardened so that they can work in space.
Martin Attiq:	01:21:40	You have to acquire spectrum rights so you can connect from space to the Earth. You have to build an entire ground network. You have to build a service model for customers. You have to, uh, hire a launch company to go and launch them into space, and then you gotta maintain it all — forever. That's exhausting. And what it also means is, is a tremendous amount of capital, hundreds of millions, perhaps even billions of dollars to go build this constellation. It also means you have to spend a tremendous amount of, um, time and money to build the technology, all the R and D that's required. And thirdly, it could take many, many years. And so this combination of capital, technology development, and time are, um, resulting in hindering the ability for the space economy to really be unlocked. So now imagine that you're that same entrepreneur or that you're that executive, who's trying to build connectivity for autonomous vehicles. And I told you that instead of spending hundreds of millions or billions of dollars spending many, many years, and doing all this technology development that you can instead just plug into a platform that already exists in space. That is our vision for the future of space access.

Martin Attiq:	01:23:11	This is not new. These transformations have occurred in other industries. This happened with cloud compute. For those of you that are old enough to remember a decade ago or two decades ago, if you wanted to build a company or a product that's based on compute, you would have to go to a data center, buy a bunch of servers, get insurance, hire DevOps people. Have 24 by seven coverage, spend tens of millions or hundreds of millions of dollars to go build it out. And then you have to go maintain it all and make sure that you're up to date all the new technology and all, all the new security and that experience sucked. And it led to, uh, it inhibited the ability for startups to grow and for enterprises to grow. And this is the same transformation that we believe will happen in space and at a high level uh, this transformation is not only new to compute and, and to space, these transformations have occurred throughout history where you simply take something that is really cumbersome and has a high capital expenditure, and you turn it into a recurring revenue, um, over the long term.
Martin Attiq:	01:24:27	So this opportunity is massive. Morgan Stanley estimates that it's a trillion-dollar opportunity by 2040. And I want to walk you through how we're going to solve the pain points of our customers in each of the phases, you know, before we unlock it, you know, with space services in phase three. So with phase one, we have launch services that we discussed today that are low cost, and they can provide ready access to space. With phase two, we're developing core technologies and space qualifying them and producing them at scale so we can support the space economy with those critical components. And then phase three is where we deliver a plug and play, where we leverage the idea that we have this incredible launch system and space qualified hardware to go deliver that plug and play solution. And we believe Astra is uniquely positioned to deliver that. Why, because of this factory, that we've built, the launch system that we've demonstrated, and the space products that we're qualifying, and ultimately that's where we see the future. And with that, I wanted to turn it back over to Kelyn Brannon, to talk to us about the financials.

Kelyn Brannon:	01:26:03	Again, welcome to Astra. As Chris noted, we are operating in a very dynamic and ever-changing environment. And we are just beginning, as we discussed earlier, the space economy is estimated to be 1 trillion or more by 2040. And this includes satellite services, ground equipment, satellite manufacturing, and of course, launch. That means the space industry today is at an inflection point. And we believe Astra is well positioned to take advantage of this opportunity. The current market environment continues to make capital more precious and scarce, not only for Astra, but for our customers. With this in mind, and from Astra's chair, we have efficiently deployed capital in the following areas, expansion of our production facility, which drives scale by increasing our production capacity. The acquisition of automation equipment, which will reduce cost and time our test infrastructure, which ensures we deliver the highest quality product and service to our customers.
	01:27:13	And lastly, continuous development of our product and services, which allows us to address our customers need. When you look around and when you go on the tour, you will see these investments are focused on making Astra, the low-cost dedicated launch provider, which is important to our customers as they deployed their capital. As some of you know, I was an executive with Amazon early on. I recall when Amazon began, their sole focus was on books and unleashing the distribution of books at a very large scale by investing in many phases of the growth Amazon has become a dominant marketplace that serves the world. Having said that, the Amazon we know today is much broader than simply selling and delivering books. For example, the AWS platform has enabled tech companies to build new applications without investing upfront capital in buying servers or leasing data systems with operating networks. Like Amazon, the Astra space platform will allow our customers to focus on their application instead of securing launches, building custom satellites, and operating their own constellations. This will allow our customers to accelerate concept commercial deployment of their products and services. We are laser focused on working with our customers to understand their needs and developing solutions that support their growth.

	01:28:45	As we look at our maturity curve for our different products and services, we expect there will be continuous development in our roadmap. Having said that, as you can see from the curve, we are extremely early in the development cycle for space services. Our early investments in achievement and operational milestones have led us further along the growth curve for launch services. As we drive forward launch system 2.0. Our initial investment in space products through our acquisition of Apollo Fusion in 2021, we acquired the Astra Spacecraft Engine. This product has already achieved commercial success in 2022, the Astra Spacecraft Engine is already providing positive non-GAAP, gross margin, and we have experienced customer growth illustrated by our orders for 82 engines as of today. As we think about funding to commercialization of our products, we intend to explore financial arrangements that is customary to larger capital-intensive initiatives to support the anticipated growth of our business.
	01:29:57	As we look forward and towards our long-term model at a steady state, which we have defined as the commercialization of products and services, we expect non-GAAP, gross margin to be between 50 and 60%. On a non-GAAP basis as a percent of revenue, we expect sales and marketing expensive to represent approximately 6% research and development around 18% and general administration around 6% and adjusted net income of approximately 25%. Please refer to our prior earnings press releases for an explanation of non-GAAP, financial measures and their reconciliation to the comparable GAAP financial measures. And with that, uh, let's begin a Q&A session with all of today's presenters.
Kati Dahm:	01:31:21	Alright. We are heading to Q&A, um, I'm Kati Dahm. Uh, we'll be taking a few questions from online and we will also be taking questions from the room. So we do ask that you enter your questions in Slido. If you'd like to ask it live, a member of our team will run a mic over to you. Um, so find some of these wonderful people. Our first question comes from online and the question is, uh, from Jason Nevada, why go to rocket 4.0 versus sticking with rocket three? Uh, sending this to the stage, uh, management team, take it away.

Chris Kemp:	01:31:55	There's always a new version because we're always learning. Uh, the market's constantly evolving. We're always making more of them, right? So, uh, if you take the feedback from the production team, the feedback from the operations teams, the feedback from the customers, uh, there's a huge list of things that you want to do to make it better, to make it safer, to make it more efficient, to produce. And it's, it's almost a question of, uh, you have to, you have to almost limit what you, what you do because you want to ship the next version. So you can learn more so that you can serve customers so that you can get that next feedback loop. And so it's really a question of, of, you know, how long is the appropriate feedback loop with the product of this level of system complexity. And I think, you know, what we've experienced so far is in the five and a half years of our existence, uh, we've done three major releases of the rocket, two major versions of the launch system, um, or, or the launcher. And so I think we, we, we feel that that 18 months or so, uh, product cycle gives us that right balance between capturing enough enhancements to the various, uh, products, uh, and, and getting that customer feedback loop incorporated back into the products. Uh, we're not going to make rocket three and four at the same time. It's, it's a, it's kind of like, you know, iPhone twelve, thirteen, fourteen. <laugh>
Kati Dahm:	01:33:08	Great. Awesome. Next question is from online, Anu B. has asked what are some specific examples in Astra's vision for a more diverse space economy? What new products or markets do you envision being created?
Martin Attiq:	01:33:24	That's a great question. Um, like I mentioned earlier, the space economy is already large. There's a ton of application, whether that's connecting, um, every human on Earth with high-speed internet, whether that's monitoring the Earth's climate. Um, and we believe that there's a lot of potential that is, that is, that is, that has not been unlocked yet. And, and that is because in the same way that for other industries, once you provide access, once you say, okay, we've driven down the cost of these things, and we've driven down the complexity, new applications get created. And what we're really excited about is we don't want to create every new application, we want to provide access to space so that all the great entrepreneurs and product people around the world can create new products and space. And that's what fundamentally we're focused on.
Kati Dahm:	01:34:14	Wonderful. I'd like to remind everyone, we will be taking questions from the room. So please raise your hand and we'll come to you with a mic. If you would like to ask a question, um, we'll have one more from online, but don't be shy. Um, how does Astra plan on competing with SpaceX and other existing satellite constellations? And why does this set Astra apart from the competition? This was from Flavio.

Chris Kemp:	01:34:38	I think, I think does FedEx compete with Maersk? You know, to some degree. I think if you look at our mission of focusing on improving life on Earth, and you look at SpaceX's mission of creating a multi-planetary species, and settling the solar system, uh, spreading the light of consciousness, the different missions and their different purposes, and they're going to drive at the end of the day, different engineering optimizations, and the products that we build and our products will serve a lot of customers that theirs will not, and their products will serve a lot of customers that ours will not. And so I truly believe that in that curve that we shared, uh, there will be winners at both ends of that curve. And we could not be more, uh, focused on a different set of objectives. You know, we're, we're focused on the number of rockets you can make in the factory, not the number of times that one rocket can fly as an example.
Chris Kemp:	01:35:30	And when you have a system to this complexity, it truly drives a lot of, uh, engineering decisions that are, that are deeply, uh, that deeply affect your products and frankly, segment the market. Uh, so maybe I'll hand the market aspect of that. And then maybe the rocket aspect of that just down here for a second, because I think this is a, a truly important point. You know, I think that the market does have room and in fact, critically requires, uh, companies like SpaceX to be successful on that side of the market and actually has critically requires Astra to be successful, to kind of seed all these new ideas and all these new applications and all these new startups that need that low cost frequent access to space that will, that will create this, uh, this, this revolution and this innovation, uh, and this catalyst for, uh, new applications to be built that will ultimately then need the larger rockets as well.
Martin Attiq:	01:36:20	Yeah. What I hear from customers every day is, you know, I want to get my satellite to the right place and space as efficiently, as affordably as possible. And today, um, you know, you can choose a large rocket, but it may not go to where you want to be. I think Adam said it perfectly when he talked about space has an address. You know, there's an inclination, there's an altitude, there's an LTAN. And going to an address that you don't want to go to is not very useful for, you know, providing services. And so at the end of the day, when customers think about their business models, they think about how can I drive my revenue and how can I deliver for my customers and for them, they want to build global constellations or broad constellations, um, and us precisely delivering to those specific orbits allows them to drive revenue.

Martin Attiq:	01:37:16	And so when they look at the value of if I can get a satellite to a specific address, and that will drive hundreds of thousand dollars of revenue per month, the launch cost or launch cost, you know, difference is kind of immaterial to that equation. And so what we're trying to do is we're trying to be the best in the world at driving down, um, launch cost. So we can deliver satellites precisely where they should be. And we think there is a world where someone like SpaceX can exist by large, by launching really, really big rockets, um, and going to a generic place in space. And we think there's a lot of room for companies to, um, who want to drive down the cost per launch. Um, but there isn't a lot of room we don't believe in between. And why would you want to pay more either on a per kilogram basis for a large launch or on a per launch basis for a small launch, you wouldn't, and fundamentally the products we're building is focused on driving down the per launch cost. And to Adam's point we're less focused on building really cool technology that's not useful in driving down the cost.
Benjamin Lyon:	01:38:30	I think that pretty much covers it. I'll just make one other point, which is, you know, if we are one of many, many customers on a container ship, you know, your individual importance to that container ship company is significantly less. Um, we love working with our customers and being very, very responsive to them. And so for us, this is kind of a perfect match to our DNA.
Kati Dahm:	01:38:52	Thanks Benjamin. And so now we'll take a question from in the room. We have a question from Tim Dodd, um, in the front row right there. So Elliot will come up to you with a mic.
Tim Dodd:	01:39:02	Hi everybody. Thank you, uh, for taking questions. Uh, could we just get some more details on the actual new rocket itself on rocket four? Uh, it appears to have like six times the performance, but double the thrust, so are you still using, uh, pressure fed, um, upper stages? Are you going to pump fed upper stages? Uh, is it all, uh, kero-LOX? Can you give us just kind of all the, the run down the detail on the, on the new vehicle?
Speaker 18:	01:39:24	Yes.
Chris Kemp:	01:39:25	I mean, I can share that it's, uh, pressure-fed upper stage, kero-LOX. Uh, we are moving to a turbo pumped first stage engines from an electric, uh, pump fed engines, uh, larger diameter. Uh, it'll be slightly longer. It'll still be critically, uh, a mobile launch system. So the rocket will still be transportable in shipping containers. And, uh, that's, that's kind of a key design point that we think is important because it, it really differentiates us from the large rockets, uh, when you can really pack the entire thing up, put it in a plane, a truck, a train, a container ship, move it anywhere around the world, discreetly, uh, and move it to all these spaceports that we're working really hard to open up across the world. Hopefully that's enough.

Kati Dahm:	01:40:07	We can follow up on that too more later. Um, we're, we'll take another question from online from Hasim A. Uh, why did Astra decide to acquire Apollo Fusion rather than building similar technology in house?
Chris Kemp:	01:40:21	Maybe give that one to Adam.
Adam London:	01:40:25	I think the, the short answer is capital efficiency, um, to, from scratch, go do and develop something as complicated as a hall thruster, um, is a big undertaking. Uh, the Apollo Fusion team spent years really, really working on it, iterating it, improving it, figuring out how to make it mass manufacturer, et cetera. And it was a great product that we're excited to incorporate into, um, our common platform. And so I think in general, as we look at space products, some it will make sense for us to develop internally others. It will make sense for us to partner with folks, others. It will make sense for us to license or even acquire.
Martin Attiq:	01:41:02	And I'll just add, you know, one of the big pain points in space is you have to space qualify things, and it's really complicated technology. Um, and we found a team that had worked on thousands of satellites that are currently working in space. So we found this phenomenal team, world class team, and we tested other technology and, uh, they space qualified it, you know, you know, last year. So that endeavor of getting from initial concept all the way to space qualifying a really critical component and propulsion satellite propulsion is one of the most critical components, you know, um, in space. Um, to find a team like that, that had made that much technology advancement, um, as efficiently as they did, we thought was phenomenal. And we could not have been more pleased by the market reaction. Uh, customers are in love with this product. Chris mentioned that we just added 20 more spacecraft engines, um, you know, this past week. And, uh, the, the demand continues to be really strong because this stuff is really hard and that's fundamentally what a, what Astra's about is, um, improving access to space. And if we can mass produce a product like that to help people get access, that's what we're all about.
Kati Dahm:	01:42:20	Wonderful. And we have time for a few more questions. I think gentlemen in the blue had one question here, Elliot.
Audience member 2:	01:42:30	Good morning. Uh, I, I certainly appreciate the vision of trying to, um, move things quickly, right? From a customer perspective, getting access to space is important. And I'm excited that you guys are looking at foreign launches because certainly there's going to be opportunities, uh, to, to put constellations up that will require, uh, efficiency in that launch profile and accessing that is, is going to be important. I'm wondering if the Astra team has considered, uh, acting as an integrator for things that involve either EAR or ITAR and doing a single license application that would include the payloads that may be restricted for that foreign launch as well.

Chris Kemp:	01:43:12	Yeah. When you look, when you look at these issues around ITAR and EAR these are primarily US export issues. And so by operating a system that can be totally containerized, deployed, launched, packed up and go, uh, while the US, um, maintains and US citizens maintain control of the entire system, I think is a unique opportunity, uh, for Astra just given the mobile nature of the system that we've developed. It also allows foreign countries to effectively offer sovereign space launch capabilities. So there's over 70 space agencies and it might be, uh, it, it's interesting to note that seven of them have access to space. And so we see that as over 60 sovereign national space agencies that we could potentially partner with, certainly our allies and certainly ones that have already kind of cleared some of these, uh, these export issues, uh, through, uh, TSAs with the State department.
Chris Kemp:	01:44:05	And so we're going to basically start with our closest allies, um, and partners that have already gone through this clearance process. And then, you know, as this allows us to, to continue to, uh, operate, uh, more, uh, more freely, uh, we'll hopefully have more partners that want to partner with Astra. This is about democratizing American, uh, space technology, um, and not, you know, taking some of our best satellite technology and exporting it to countries for foreign launch. Uh, and one thing that geopolitically did evolve, uh, in the Ukraine is all the Soyuz launches stopped. So about a third of the global supply of launch was taken off the map in the last couple months, uh, constellations like One Web were left without a ride to space and scrambled to partner, uh, with companies, uh, that were in some cases, competitors to fly their satellites. And so I think, uh, this is, this is a really, uh, interesting and dynamic geopolitical environment, uh, where access to launch has never been more constrained.
Kati Dahm:	01:45:04	Wonderful. We have one more question. We are running out of time and we want to get you on tours to lunch. We will address your question. So make sure you just ask your host or the person who is on or one of your tour guides, um, and we'll make sure that we are able to address those things. Uh, last question is can we have more insight on Astra's plans to build the AWS for space services? Um, and then it's followed by one other question, which I think is great. It is how is the rocket four development progress going and will it launch in 2022?
Benjamin Lyon:	01:45:39	So we're making good progress. Um, and we don't announce our launch dates, uh, well ahead of time, as we've discussed many, many times before that there are many, many things that can affect when we launch and how we launch. Um, but we've got a great team as you walk around today, you'll be able to see for yourselves much of the progress that we are making along that path. Um, one of the most critical pieces, uh, to, uh, a successful launch is the propulsion system is in the engine system. And you saw the video today. Um, so lots of good work going on there, and then I'll leave the other half of the question, uh, to Chris.

Martin Attiq:	01:46:18	Um, well, we're not ready to announce something, uh, you know, specific on space services, but the thing we are doing is we're talking to customers today about being customers of our space service, um, because they see the value of that. And the engagement we have from customers today is more strategic than it's ever been, because we're talking about immediate concerns around just getting simple access to space. So that's launch, uh, future concerns around being ahead of the game in technology. So that's building core technologies and space products, and then thinking longer term, why am I even doing any of this stuff? Why am I building all these satellites and, um, managing these constellations and putting up with all this capital and maintenance, why this plug into a service? Now, there will always be, we believe, um, customers that will want to launch their own satellites for very, you know, for a variety of reasons, but we believe that portfolio mix of launch services, space products, and space services is an interesting mix to basically, uh, democratize access to space.
Kati Dahm:	01:47:29	Wonderful. That's the time we have, we are excited to get you onto tours. Chris, do you want to close things out for us quickly?
Chris Kemp:	01:47:36	I want to thank all of you for coming from New York, from, uh, from LA, from all over the country, uh, here in person and for the hundreds of people that are joining us on our live, uh, webcast. Thanks for tuning in, uh, we're going to package all this stuff up and, and put as much content out there as we can. Uh, and transcripts are being made. We're going to be making the presentations available publicly. And, uh, this is the, the first Space-tech Day. Uh, we're excited to make this an annual event given the incredible response, and, uh, we're going to be putting a lot more thought into how we can expand and, uh, provide, uh, an even an even greater opportunity for all of our shareholders, uh, customers, partners, uh, to kind of see what we're up to. And, uh, just kind of allow you to keep checking in if you were to be here a month ago, uh, basically nothing here, uh, behind you was even there, right?

Chris Kemp:	01:48:23	If you were to come here six months ago, uh, the construction wasn't even done over here. If you were to come here a year ago, uh, the, the sample rate of velocity for Astra, uh, is high. And if there are people on your tour, uh, that have been here before, just ask them, <laugh>, you know, how fast we're going. We truly were in a garage, uh, just over five and a half years ago in San Francisco with just a few people. So, uh, what you're experiencing here is as much about culture and values and commitment to a mission and customers as it is about any hardware or anything else that you'll see. Uh, and that's why I know that there'll be a rocket 4.0 because there was a three and a two and a 1.0, that all happened in the last five years. And so the teams, uh, could not be more, we we've never had more people, uh, working more, uh, passionately for, for, for customers that are depending on us, uh, than we've had literally right this moment. And tomorrow there'll be more people. And, and as we continue to build this team out, uh, you're going to see more velocity, more commitment, uh, and, and more products. So, uh, thank you so much for coming. Uh, look forward to seeing you all on the tours. We have, I think, five or six tours, uh, that'll be starting right now.