

**Statement of
Carissa Bryce Christensen
Co-Founder and Managing Partner
The Tauri Group**

**Before the Subcommittee on Space and Aeronautics
Committee on Science, Space, and Technology
United States House of Representatives
August 1, 2012**

Chairman Palazzo, Ranking Member Costello, Members of the Subcommittee, thank you for the opportunity to testify on emerging markets for suborbital reusable launch vehicles. On a personal note, it is an honor to be testifying—I have spent my entire career in commercial space, and I am pleased Congress is interested in this important subject.

My partners and I founded The Tauri Group based on the belief that objectivity and rigor are critical to effective decision-making. Our business model is to provide independent analysis to government and industry. I lead our space and technology practice, which focuses on the space industry, advanced technologies, and related emerging markets.

The Tauri Group recently completed a 6-month study to forecast 10-year demand for suborbital reusable vehicles, or SRVs. The Federal Aviation Administration Office of Commercial Space Transportation and Space Florida jointly funded the study.

Our purpose was to develop an objective and rigorous forecast of SRV demand and market dynamics. Equally important, we sought to identify the ways current realities could change, positively or negatively, in order to help decision makers understand and manage future outcomes. Our research and analysis-focused process included interviewing 120 potential users and providers; polling 60 researchers; and assessing budgets, market studies, and other data. We also conducted a structured survey of more than 200 high net-worth individuals.

My testimony describes results of that study.

Emerging Markets

Our study concluded that demand for SRV flights at current prices is genuine, sustained, and appears sufficient to support multiple providers. We estimate baseline demand—reflecting predictable trends that exist today—at between 400 and 500 seat equivalents each year, for people and cargo. Our growth scenario sees that number nearly triple; our constrained scenario sees it halved. Additional potential demand is possible from unknowns such as research discoveries, commercial applications, or a viral consumer response. Price reductions would also increase demand.

The largest market by far is commercial human spaceflight for individuals—we estimate it is more than 80 percent of the total. Given current prices, most of these individuals will be wealthy. Many will be from outside the United States.

These individual consumers enable a new SRV industry with capabilities that can benefit researchers, educators, and others.

Specifically, we identified five additional markets active in our 10-year forecast period: Basic and Applied Research, Aerospace Technology Test and Demonstration, Satellite Deployment, Education, and

Media and Public Relations. Our baseline for these markets shows initial demand for about 30 seat equivalents that grows to 130 annually, while our constrained scenario grows more slowly. Our growth scenario increases to nearly 400 seat equivalents each year, representing thousands of payloads.

As of this moment, purchases of SRV services in most of these markets have already begun.

It is important to recognize that this forecast predicts outcomes related to experiences that, for the most part, do not yet exist. If SRV services vary from today's expectations, demand could increase or decrease from forecasted levels. Our forecast also identifies and includes assumptions about uncertainties such as consumer behavior, researcher interest and institutional response, and media and public opinion influences. We used research and analytic judgment to calibrate assumptions, and we explain our analysis fully. Understanding uncertainties is a critical aspect of framing discussion about how the market will ultimately unfold.

Unique Benefits for Research and Education

SRVs have unique capabilities for basic and applied research. We interviewed researchers and analyzed program activity and grants from organizations like NASA, NOAA, NSF, NIH, non-U.S. space agencies, non-profits, universities, and commercial firms. We identified currently funded research areas that are better served by SRVs than by existing alternatives; we predicted some of the funding in these areas would shift to SRVs. These areas are:

- Atmospheric research of the poorly understood upper reaches of the atmosphere that affect weather and climate
- Suborbital astronomy to get access to infrared (IR) and ultraviolet (UV) observations from above the atmosphere
- Longitudinal human research on space travelers to understand things like vascular and immune responses to microgravity and acceleration
- Microgravity research where the unique combination of SRV capabilities may energize the research community and attract new organizations

SRVs can also be used for test and demonstration of certain types of technology, including vehicle components, life support systems, and mechanical parts like pumps and valves. Some SRVs may also serve as launchers for small satellites, which are increasingly used for research.

Finally, our analysis suggests that SRVs may be widely used for science, technology, engineering and math (STEM) education. Student-built projects can fly to space and return, frequent launches allow alignment with academic calendars, and schools can afford likely SRV prices. Based on analogous hands-on STEM programs, we estimate that after 10 years as many as 600 schools (K-12) and more than 100 universities could be flying small student payloads.

Regulatory Challenges

SRVs will create a different kind of space transportation industry than we have seen before. This will be a commercial marketplace heavily influenced by individual consumers, with, based on our estimate, the government at less than 10% of total demand. There is a lack of precedent for regulating consumer-driven space transportation. An important regulatory challenge is developing an effective approach given these new dynamics.

Thank you for the opportunity to speak today. I look forward to your questions.

MAJOR POINTS FROM
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- Tauri Group study of 10-year demand for suborbital reusable vehicles (SRVs)
 - Funded by the FAA AST and Space Florida
 - Purpose was to describe industry dynamics and estimate demand

What are the emerging launch markets for suborbital RLVs? When do you anticipate they will begin to purchase commercial launches from the companies?

- Demand for SRV flights at current prices is genuine, sustained, and appears sufficient to support multiple providers
- Largest market is Commercial Human Spaceflight, more than 80% of total
- Five additional markets
 - Basic and Applied Research
 - Aerospace Technology Test and Demonstration
 - Satellite Deployment
 - Education
 - Media and Public Relations
- Purchases have begun
- Forecast includes important uncertainties
 - SRV experience does not yet exist
 - Other assumptions

What are the unique benefits that suborbital RLVs offer the scientific community for research? How can these new vehicles be applied to STEM education?

- Basic and Applied Research
 - Atmospheric research
 - Suborbital astronomy
 - Longitudinal human research
 - Microgravity research
- Aerospace Technology Test and Demonstration
- Small Satellite Deployment
- STEM Education
 - Students build payloads that return from space
 - Frequent launches align projects with academic calendars

What are the regulatory uncertainties or challenges that have the most impact on the suborbital researchers that intend to fly experiments on future RLVs?

- SRVs will create a different kind of space transportation industry
 - Government is less than 10% of total demand
 - Commercial marketplace heavily influenced by individual consumers
- Lack of precedent for regulating consumer-driven space transportation
- Regulatory challenge is developing an effective approach given these new dynamic