1. Compact Satellites, Terran Orbital SmallSat GEO

2. Boeing 702 Small GEO Satellites

Terran Orbital's SmallSat GEO represents a significant step forward in the evolution of geostationary small satellites. A similar past innovation is Boeing's 702 Small GEO satellite series, which was introduced in 2012 to offer more compact and cost-effective GEO satellite solutions. Both innovations share the goal of reducing the size and cost of geostationary satellites while maintaining high performance."

"However, while Boeing's 702 Small GEO was a breakthrough for its time, it was still significantly larger and heavier than Terran Orbital's latest SmallSat GEO. Technological advancements in miniaturization, propulsion, and power efficiency allow Terran Orbital to deliver even smaller, more affordable, and more versatile GEO satellites. This makes space missions more accessible to commercial and governmental entities, further democratizing access to geostationary orbit.

3. https://www.statista.com/statistics/1536861/forecast-satellite-market-value-share/#statisticContainer

The world's six major space powers — the United States, China, Europe, Russia, India, and Japan — are projected to account for more than two-thirds of the satellite manufacturing and launch markets by value in 2033. This is despite the rapid growth of private low Earth orbit (LEO) satellite constellations such as Starlink, which are planning far more frequent launches over the coming decade. The launch of small LEO satellites has proven far more cost-effective than the launch of larger satellites, such as those placed into geostationary (GEO) orbit.

4. Market potential (M) is the maximum number of potential adopters or the total possible market size for Small GEO satellites.

- Based on forecasted market share data from Statista, the total satellite market in 2033 is projected to be approximately $500 billion.
- Small GEO satellites are estimated to capture around 10% of this market.
- Thus, the estimated market potential for Small GEO satellites is:

  $M = 10\% \times 500 \text{ billion} = 50 \text{ billion dollars}$

p (Coefficient of Innovation) represents early adoption due to external factors such as:

- Consumer electronics (e.g., smartphones) → 0.02 - 0.03
- High-tech & industrial innovations → 0.005 - 0.02

Satellites are capital-intensive and slow to adopt, meaning p is expected to be low.
Previous studies on aerospace technology adoption suggest p ≈ 0.01 - 0.02.

Final Coefficient of Innovation (p) = 0.015

q (Coefficient of Imitation) represents adoption due to internal influences, such as:

- Word-of-mouth effect
- Industry adoption trends
- Competitive pressure in telecommunications, defense, and commercial sectors

How We Estimated q
Typical q values in technology adoption:

- Consumer electronics → 0.3 - 0.5
- Aerospace & industrial adoption → 0.4 - 0.6

  The satellite industry follows a trend where organizations wait for early adopters (governments, major telecom companies) to validate the technology before making large-scale investments.
  Similar studies on commercial satellite adoption trends suggest q ≈ 0.4 - 0.5.

  Final Coefficient of Imitation (q) = 0.45

5. To estimate how Terran Orbital's Small GEO satellites will be adopted over time, we applied the Bass Diffusion Model. This model helps predict how new technologies spread in a market, starting with a few early adopters and then accelerating as more people follow.

Based on industry forecasts and market trends, we used the following parameters:

- Market Potential (M) = $50 billion (estimated total market for Small GEO satellites in 2033).
- Coefficient of Innovation (p) = 0.015 (representing slow early adoption due to high costs and regulatory barriers).
- Coefficient of Imitation (q) = 0.45 (indicating strong growth once key players adopt the technology).

Predicted Adoption Curve

The Bass Model forecasted adoption levels from 2024 to 2033, showing a gradual start, followed by accelerated adoption in later years. The adoption pattern follows an S-curve, meaning:

- In the early years, growth is slow because only a few companies or government agencies invest in Small GEO satellites.
- After 2028, adoption picks up as more companies see the benefits and follow the trend.

Below is the estimated market adoption over the next decade:

Year	Cumulative Adoption ($B)
2024	0.0
2025	~0.93
2026	~2.35
2027	~4.45
2028	~7.44
2029	~11.5
2030	~16.8
2031	~23.2
2032	~30.3
2033	~38.2

Key Insights from the Forecast

1. Slow Adoption Phase (2024-2027):
    - In the early years, adoption remains low because of high costs, regulatory approvals, and a limited number of industry pioneers.
    - Most early adopters are expected to be government agencies, defense organizations, and large telecom companies.
2. Acceleration Phase (2028-2033):
    - After 2028, adoption increases rapidly as more companies realize the benefits of Small GEO satellites.
    - Word-of-mouth and successful use cases encourage more commercial players to enter the market.
3. Market Potential by 2033:
    - By 2033, cumulative adoption is expected to reach ~$38 billion, approaching the estimated market potential of $50 billion.
    - This suggests that Small GEO satellites will be widely integrated into global telecommunications, defense, and commercial space operations.

Conclusion

This forecast supports the idea that Small GEO satellites will experience slow adoption at first, but once early adopters prove their value, growth will accelerate rapidly. The pattern aligns with previous trends in the satellite industry, where high-tech investments often take time to gain traction but eventually lead to widespread market adoption. If government space programs and major private sector players continue to invest in Small GEO satellites, we can expect substantial market growth within the next decade.

6. For this analysis, I have decided to examine the global diffusion of Terran Orbital's Small GEO satellites, rather than focusing on a single country. The satellite industry is highly interconnected, involving multiple countries, organizations, and private companies working together. Given the international nature of satellite development and the data available, a global approach provides a more realistic and meaningful analysis.

1. Why a Global Approach Makes Sense

1.1 The Satellite Industry is International

Unlike many industries where products are introduced and adopted country by country, satellites operate in a truly global market. Satellites are launched and managed by various nations and multinational companies, meaning their adoption is not limited to any single country.

According to Statista (2024), the projected market share for satellites in 2033 will be distributed among:

- 67% controlled by the Six Space Powers (U.S., China, Russia, Europe, India, and Japan).
- 14% represented by Four Mega Constellations.
- 12% made up of other commercial operators.

This distribution highlights that no single country dominates the satellite market, making a global diffusion model the most appropriate choice.

1.2 The Market Potential is based on Global Data

- The total estimated market size (M) for Small GEO satellites is $50 billion by 2033.
- This figure is based on global satellite industry forecasts rather than country-specific estimates.
- Since satellite development, launches, and services involve multiple regions, analyzing just one country would provide an incomplete picture of adoption trends.

1.3 Satellite Launches Involve International Collaboration

Unlike consumer technology, where adoption often happens within national borders, satellite launches are a joint effort involving multiple countries. The organizations responsible for satellite development and deployment include:

- NASA (United States)
- ESA (European Space Agency)
- CNSA (China National Space Administration)
- Roscosmos (Russia)
- ISRO (Indian Space Research Organization)
- Arianespace (Europe)
- Private companies like SpaceX, Blue Origin, Lockheed Martin, Boeing, and Terran Orbital

Since several countries play a role in the adoption of Small GEO satellites, analyzing diffusion on a global scale provides a more accurate and meaningful forecast.

After reviewing the international nature of satellite launches, market forecasts, and multinational involvement, I believe the best way to analyze the diffusion of Small GEO satellites is through a global perspective.

A worldwide analysis allows me to:

Use a total market size of $50 billion, based on Statista's (2024) industry forecast.

Account for adoption trends across multiple countries, rather than limiting the study to a single market.

Provide a more accurate prediction, since satellite adoption is influenced by international policies, collaborations, and business investments.

For these reasons, I will apply the Bass Diffusion Model at a global level, forecasting worldwide adoption trends for Small GEO satellites over the next decade.

7. To predict how Terran Orbital's Small GEO satellites will be adopted over the next decade, I applied the Bass Diffusion Model. This model helps estimate how new technologies spread in the market by considering two key factors. The first is early adoption, which is influenced by external factors like government investments, regulations, and marketing. The second is later adoption, which happens as more companies follow the lead of early adopters after seeing the technology's success.

For my analysis, I estimated the Bass Model parameters based on industry trends and historical adoption patterns in the satellite sector.

The parameters I used are:

Market Potential (M) = $50 billion – This represents the total expected market size for Small GEO satellites by 2033.

Coefficient of Innovation (p) = 0.015 – This reflects slow early adoption, as satellites are expensive, highly regulated, and require government funding.

Coefficient of Imitation (q) = 0.45 – This represents strong imitation, meaning adoption will accelerate as early adopters demonstrate success.

Using these parameters, I was able to estimate the number of new adopters per year, as well as the cumulative adoption over time.

Predicted Adoption of Small GEO Satellites (2024-2033)

The Bass Model predicts that Small GEO satellite adoption will follow an S-curve, meaning that in the early years (2024-2027), adoption will be slow as only a few government agencies and corporations invest. However, after 2028, adoption will accelerate, as companies begin to see the benefits and the industry gains momentum.

By 2033, the market adoption is projected to reach approximately $38 billion, meaning that Small GEO satellites will be widely used across telecommunications, defense, and commercial space operations. Since the total market potential is estimated at $50 billion, this suggests that adoption will be approaching saturation by 2033, with further growth likely to continue but at a slower rate.

Interpreting the Forecast Results:

This forecast highlights how initial adoption will be limited due to the high costs and challenges of regulatory approvals. Early adopters will likely be government agencies, defense organizations, and major telecom providers, since these entities have the necessary funding and long-term strategic interests in using Small GEO satellites.

As more deployments that are successful take place between 2028 and 2033, commercial companies will begin adopting the technology at a much faster rate. This pattern has been observed in previous satellite adoption trends— where new technologies begin with limited use cases before experiencing rapid industry-wide growth once their benefits are proven.

By 2033, the cumulative adoption is expected to be around $38 billion, bringing it close to the total estimated market potential of $50 billion. This suggests that Small GEO satellites will be an essential part of the satellite industry by the early 2030s.

Applying Fermi's Logic to Estimate Adoption:

Since precise year-by-year adoption data may not be available, I used Fermi's logic to make reasonable assumptions based on industry projections. Given that the total global satellite market is expected to reach $500 billion by 2033, it is reasonable to estimate that Small GEO satellites will make up about 10% of this market.

Another important consideration is the historical trend of satellite adoption. Typically, when government agencies begin deploying a new satellite technology, private sector adoption follows within 5-7 years. Given that major space agencies like NASA, ESA, CNSA, and Roscosmos are expected to be early adopters, it makes sense to assume that commercial companies will scale up their investments in Small GEO satellites between 2028 and 2033.

Conclusion:

Based on my analysis, the adoption of Small GEO satellites will likely start slowly but accelerate significantly after 2028. If early adopters, such as government space agencies and telecom companies, successfully integrate the technology, it will pave the way for widespread commercial adoption. By 2033, the market is expected to be near saturation, with cumulative adoption reaching around $38 billion, close to the total estimated potential of $50 billion.

This forecast follows a pattern observed in the satellite industry, where new technologies take time to gain traction but eventually experience rapid growth once operational benefits are demonstrated.