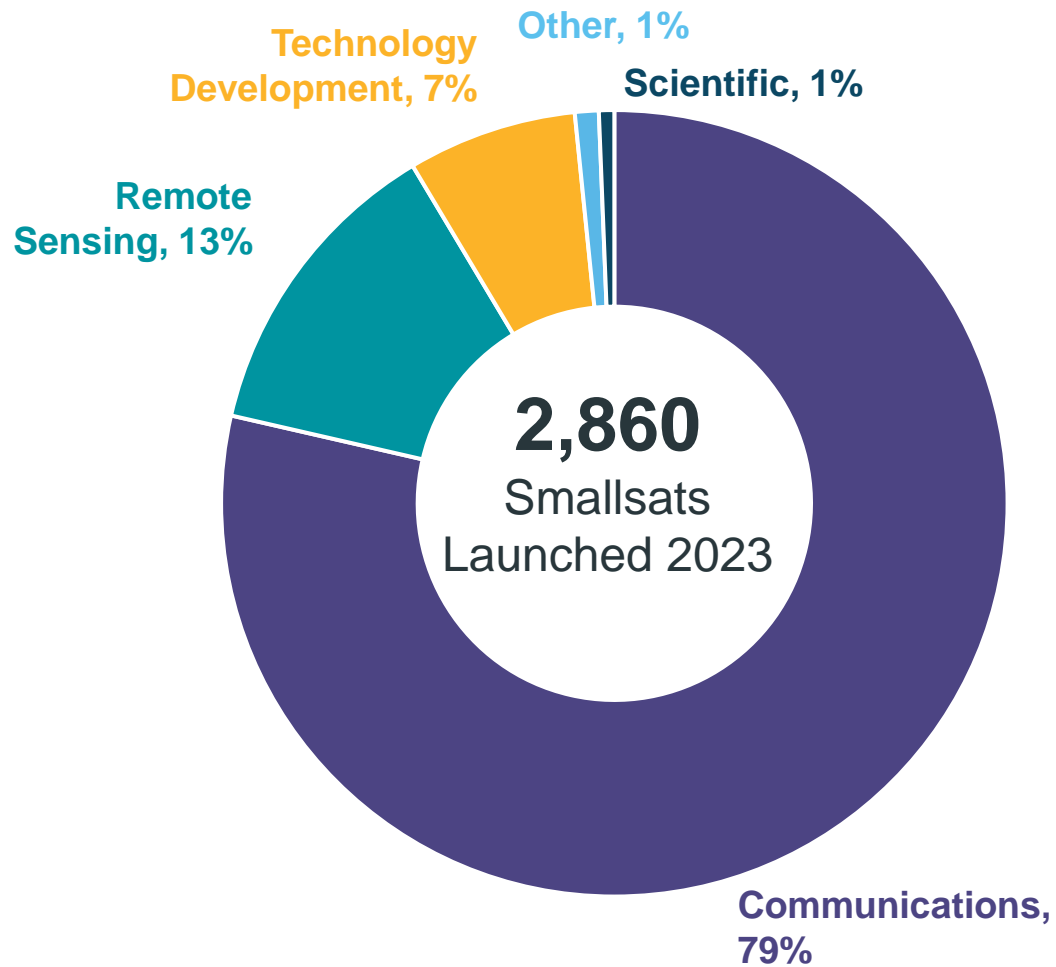


# Smallsats by the Numbers 2024



## Smallsats launched in 2023

**97%** of all spacecraft (2022: 97%)

**63%** of spacecraft upmass (2022: 58%)

**164** of 221 orbital launches (2022: 109)

**267** different operators (2022: 212)

**5%** launched on small or micro launch vehicles (2022: 7%)

Smallsats defined by having mass of  $\leq 1,200$  kgs

- ✓ Smaller satellites have broken records and are transforming in-space architectures
- ✓ Bryce’s *Smallsats by the Numbers* presents historical information on smaller satellites launched 2014 – 2023
  - Definition used here, 1,200 kg and under, reflects the six smallest mass classes defined by the FAA.
  - Updated definition accounts for the greater mass of new Starlink satellites
  - Report includes all smallsats launched regardless of operational status
  - Due to the large quantity of LEO broadband telecommunications smallsats launched in 2023 this report provides data views that both include and exclude these systems; views excluding LEO broadband telecommunications smallsat systems provide insight into trends in other types of systems

|           | Mass Class Name | Kilograms (kg) |
|-----------|-----------------|----------------|
| Smallsats | Femto           | 0.01 – 0.09    |
|           | Pico            | 0.1 – 1        |
|           | Nano            | 1.1 – 10       |
|           | Micro           | 11 – 200       |
|           | Mini            | 201 – 600      |
|           | Small           | 601 – 1,200    |
|           | Medium          | 1,201 – 2,500  |
|           | Intermediate    | 2,501 – 4,200  |
|           | Large           | 4,201 – 5,400  |
|           | Heavy           | 5,401 – 7,000  |
|           | Extra Heavy     | > 7,001        |

From FAA *The Annual Compendium of Commercial Space Transportation: 2018*



## Smallsats in Context

Operator and Mission Type Trends

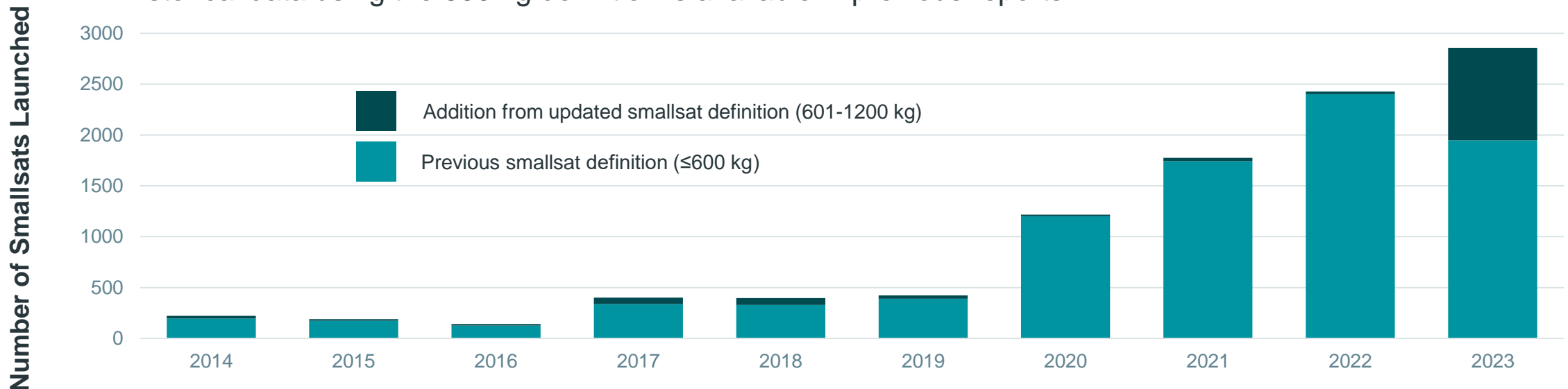
Smallsat Mass Trends

Smallsat Launch Trends

Looking Forward

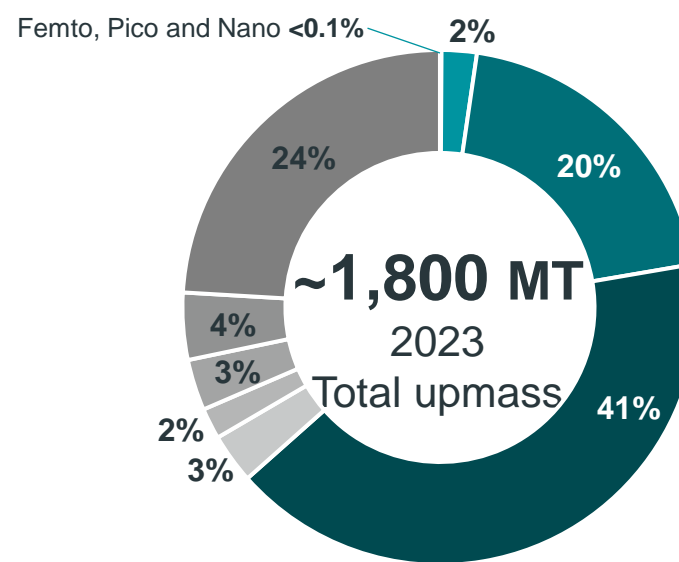
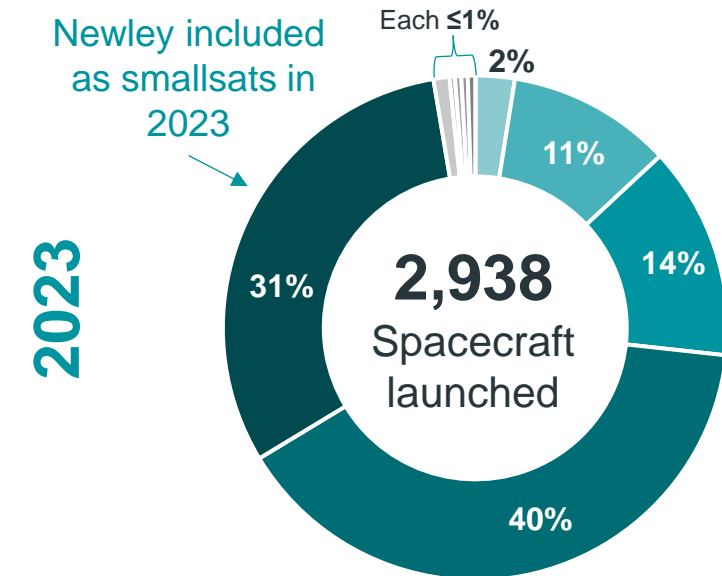
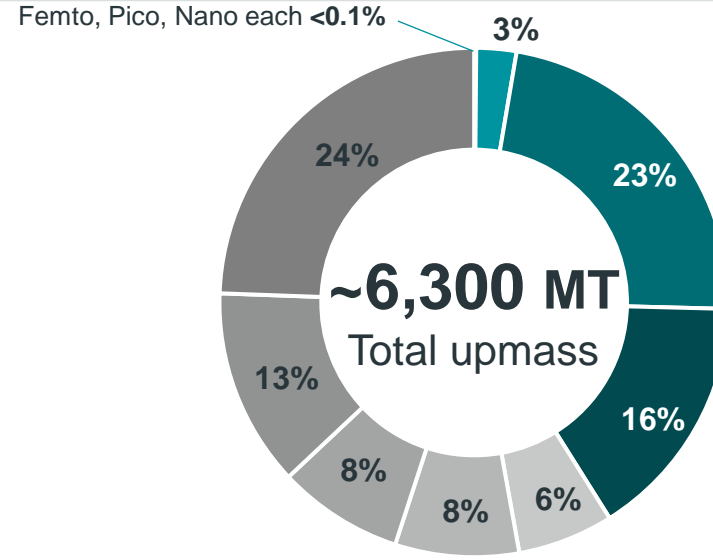
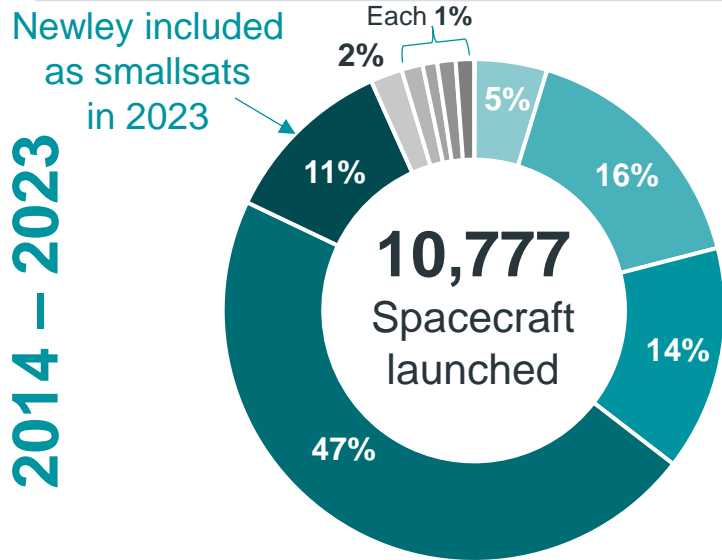
# Smallsats are Getting Bigger

- Next generation satellites in constellations tend to be larger
  - Starlink v1 (~300 kg) vs v2-mini (~800 kg)
  - Planet Skysat (~110 kg) vs Pelican (~150 kg)
  - Capella Whitney (~100 kg) vs Acadia (~165 kg)
  - Iridium (~670 kg) vs Iridium Next (~860 kg)
- This report reflects an increased threshold for smallsats from 600 kg to 1,200 kg
  - Historical data shows 1,200 kg definition, resulting in the inclusion of 298 satellites from systems such as O3b, Galileo, and Iridium NEXT from 2014 – 2022
  - Historical data using the 600 kg definition is available in previous reports



# Smallsats in Context

## Spacecraft Launched and Total Spacecraft Upmass 2014 – 2023

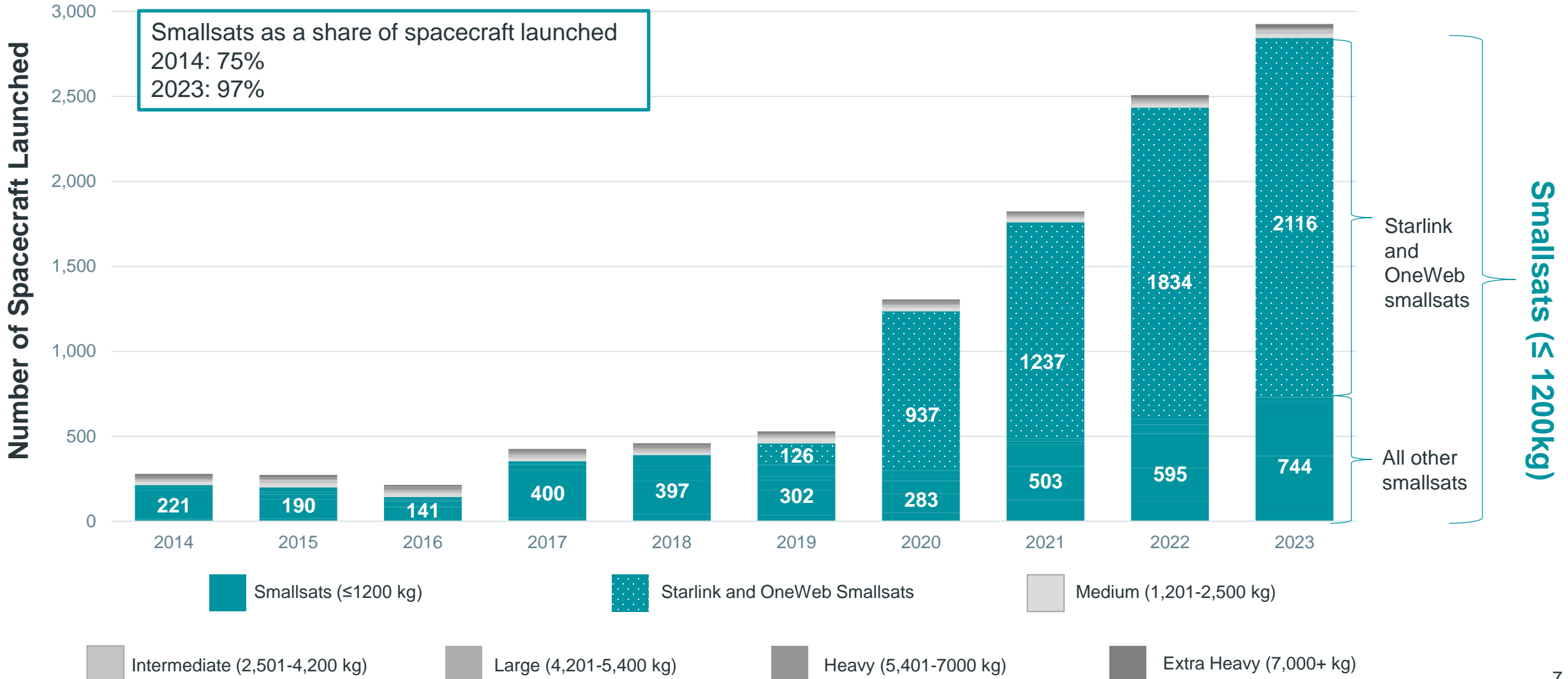


|           | Mass Class Name | Kilograms (kg) |
|-----------|-----------------|----------------|
| Smallsats | Femto           | 0.01 – 0.09    |
|           | Pico            | 0.1 – 1        |
|           | Nano            | 1.1 – 10       |
|           | Micro           | 11 – 200       |
|           | Mini            | 201 – 600      |
|           | Small           | 601 – 1,200    |
|           | Medium          | 1,201 – 2,500  |
|           | Intermediate    | 2,501 – 4,200  |
|           | Large           | 4,201 – 5,400  |
|           | Heavy           | 5,401 – 7,000  |
|           | Extra Heavy     | > 7,001        |

- Smallsats represent 93% of spacecraft launched 2014 – 2023, 41% of total upmass
- Smallsats represent 97% of spacecraft launched in 2023, 63% of total upmass

# Smallsats in Context

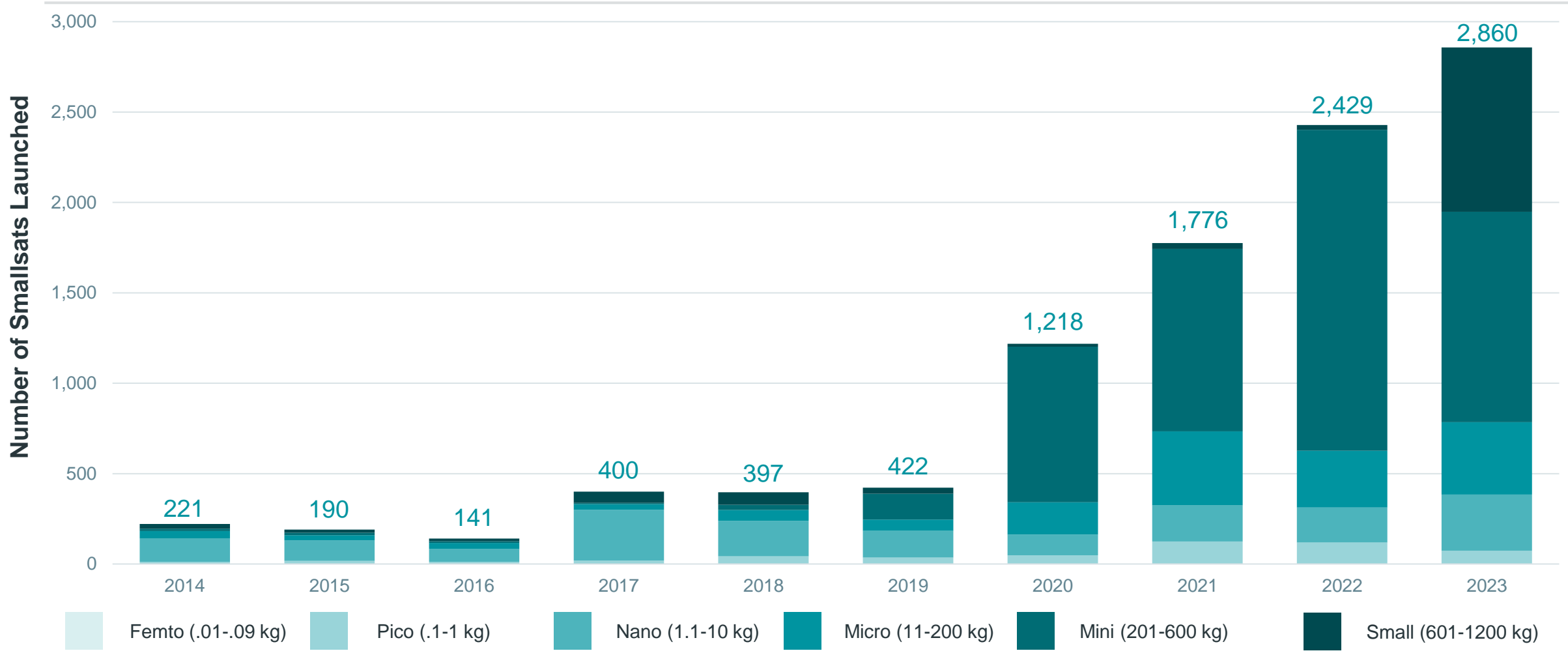
## Spacecraft Launched 2014 – 2023, by Mass Class



# Smallsats in Context



## Smallsats 2014 – 2023, by Mass Class



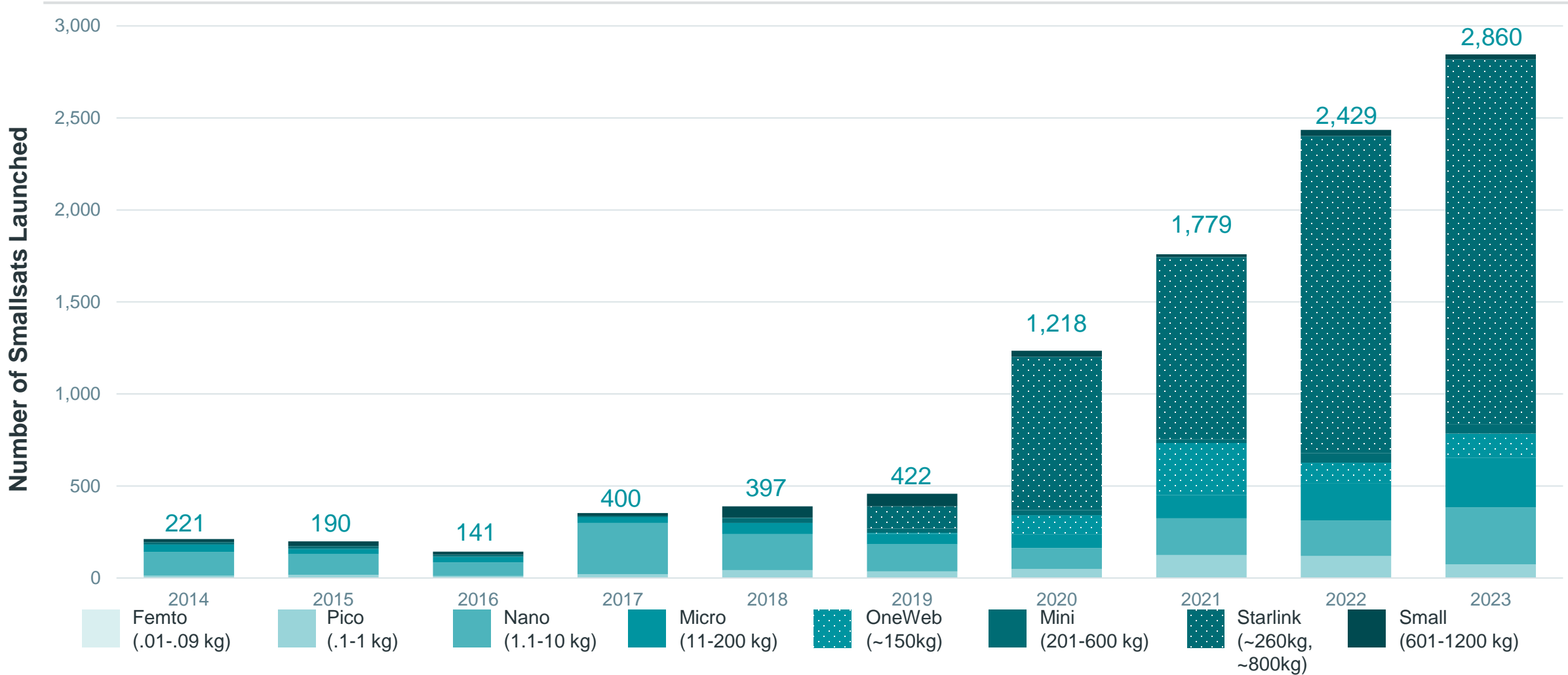
**Increase in mini satellite mass class since 2019 driven by LEO constellations**  
**Increase in small satellite mass class in 2023 due to Starlink shift to larger satellites**



# Smallsats in Context



## Smallsats 2014 – 2023, by Mass Class, Starlink and OneWeb Breakout

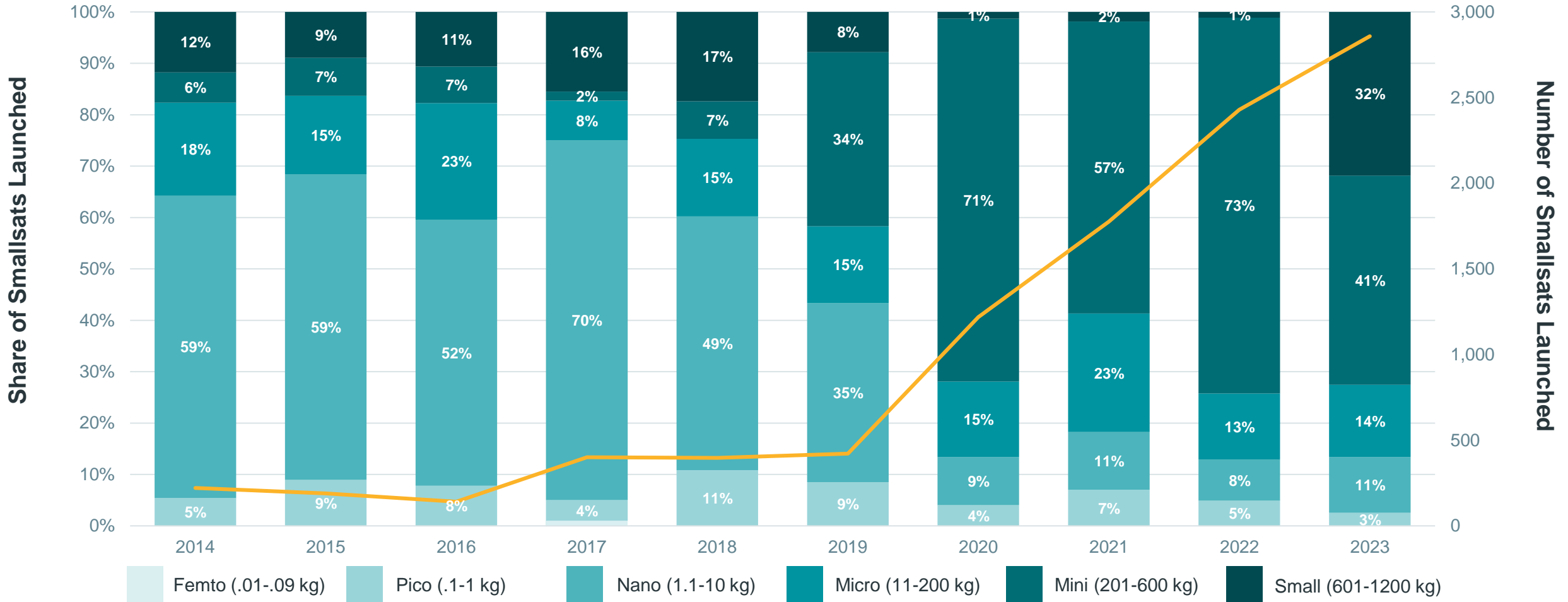


**Most growth in smallsat deployments is attributable to broadband constellations, but deployments of non-broadband constellation spacecraft have increased as well**

# Smallsats in Context



Share of Smallsats 2014 – 2023, by Mass Class, Including Starlink and OneWeb

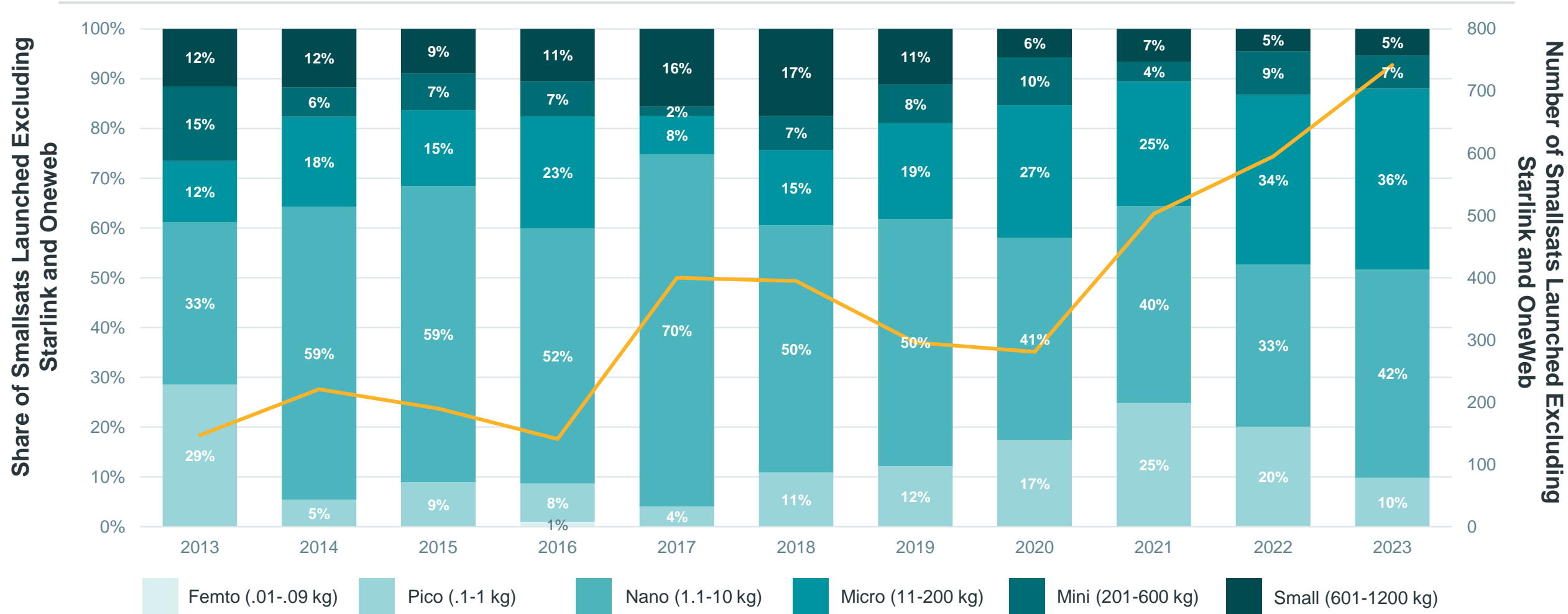


**Mini satellite mass class (which includes Starlink block 1.5) constituted the largest share of smallsats in 2023, SpaceX transition to larger Starlink satellites in mid 2023 drove increase in small satellite mass class**

# Smallsats in Context



Share of Smallsats 2014 – 2023, by Mass Class, Excluding Starlink and OneWeb



**Excluding Starlink and OneWeb, in 2023 nano satellite mass class overtook micro and constituted the largest smallsat mass class, with the largest share since 2019**

Smallsats in Context

**Operator and Mission Type Trends**

Smallsat Mass Trends

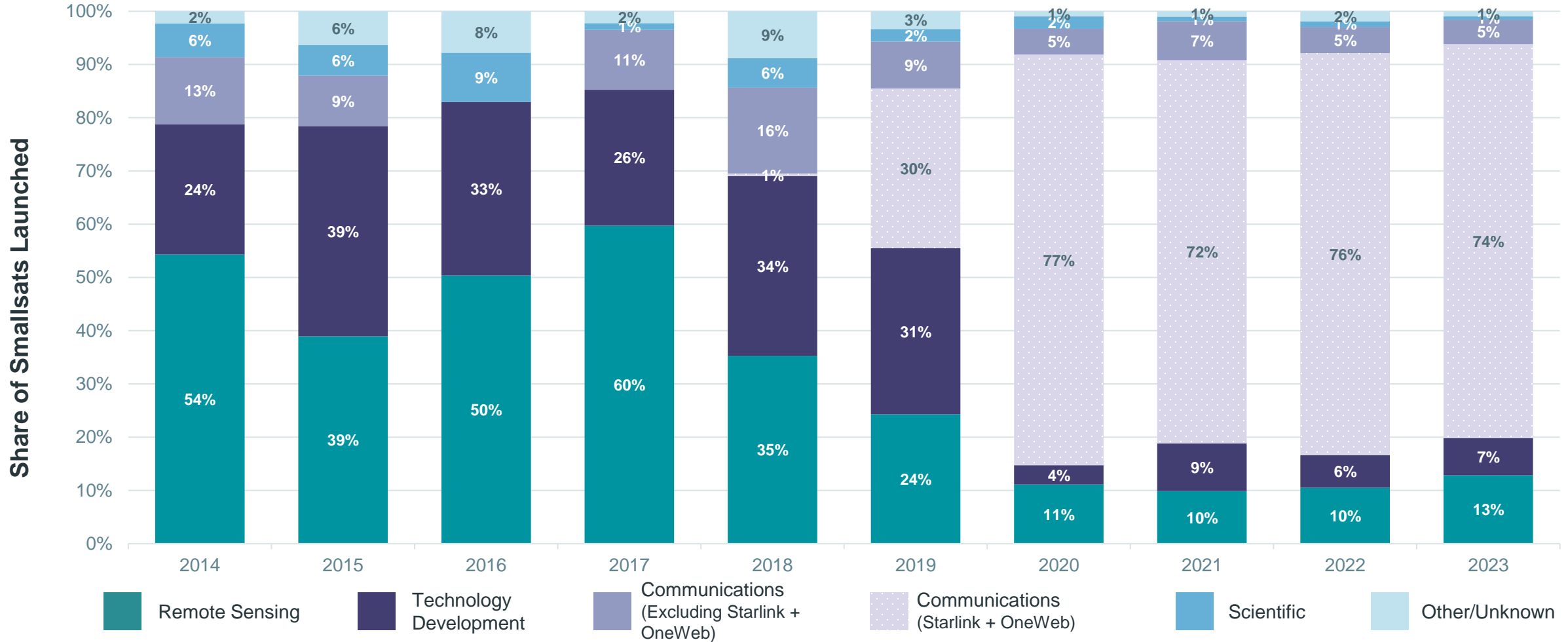
Smallsat Launch Trends

Looking Forward

# Operator and Mission Type Trends



## Smallsats 2014 – 2023, by Application, Including Starlink and OneWeb



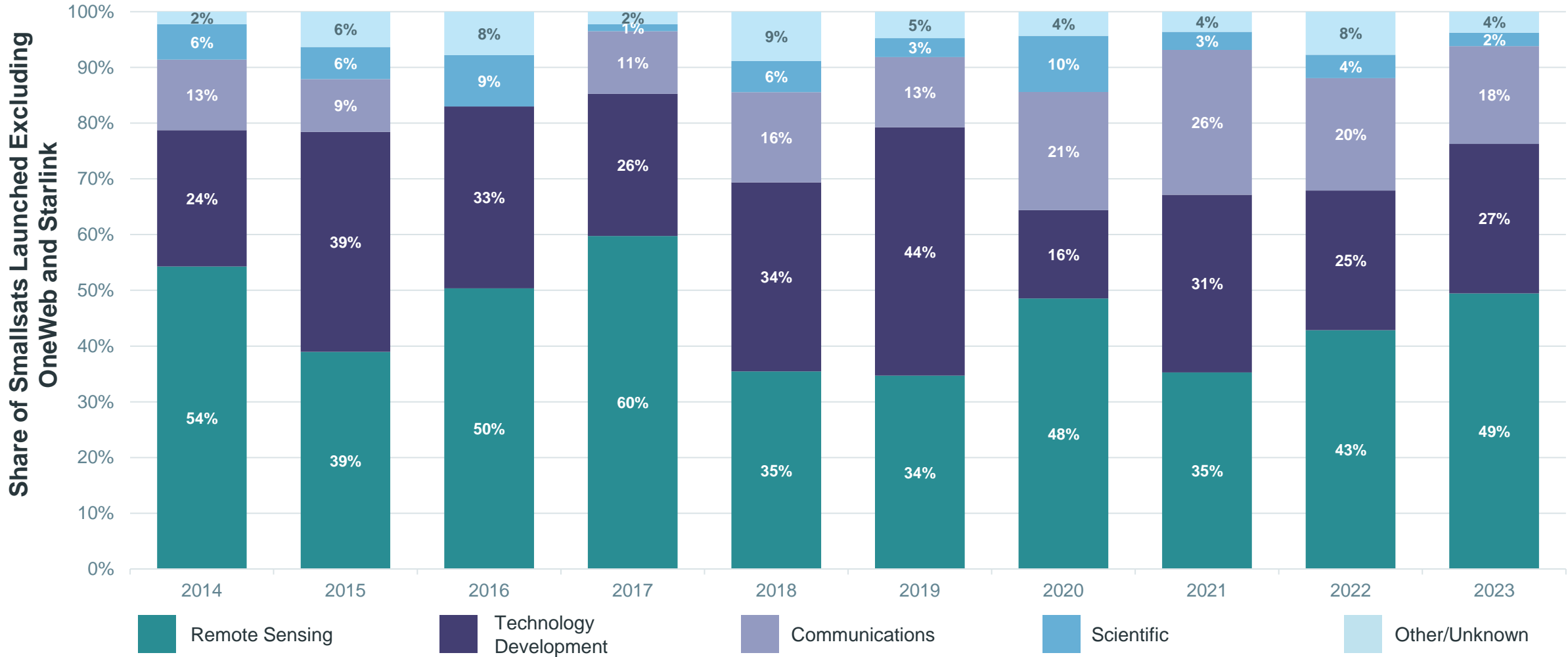
**Communications satellites constitute the largest share of smallsats in 2023. Relative share of remote sensing and technology development smallsats has decreased due to launch of LEO communication smallsats**



# Operator and Mission Type Trends



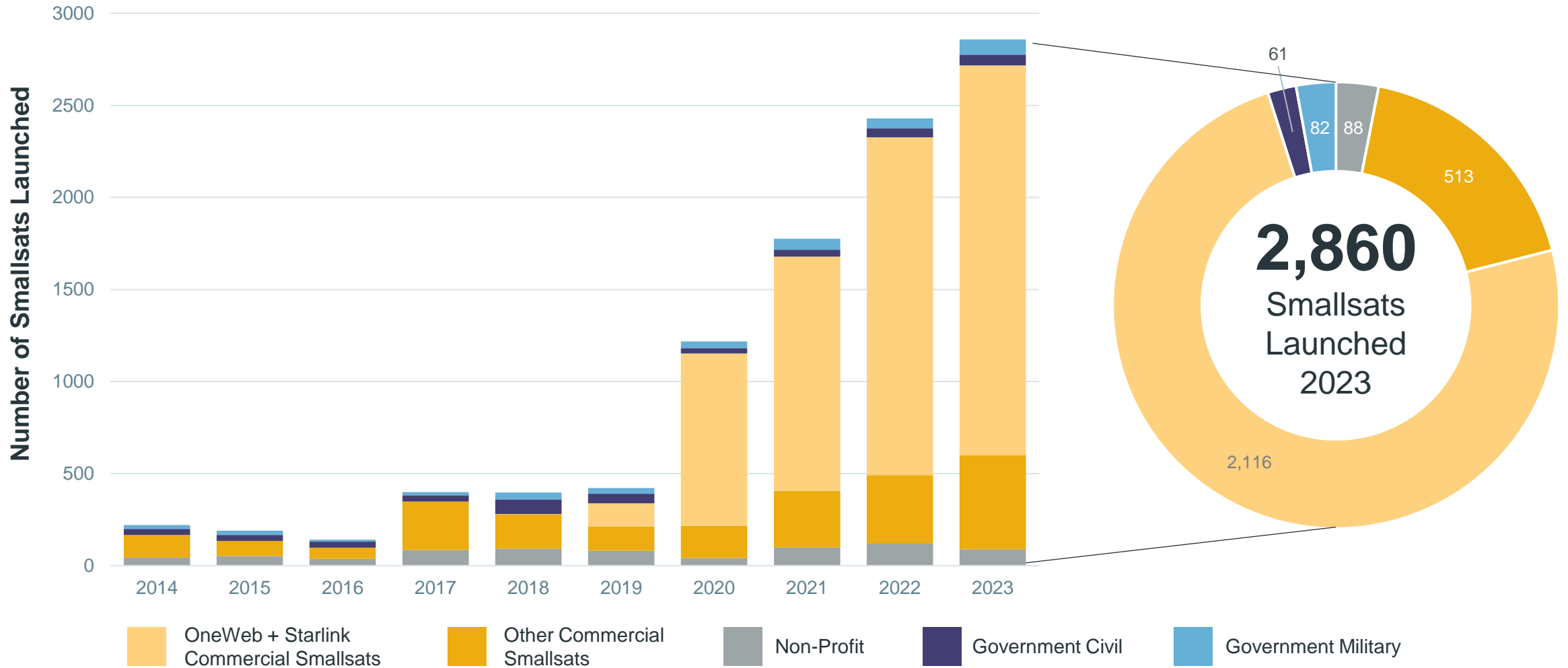
Smallsats 2014 – 2023, by Application, Excluding OneWeb and Starlink



Excluding Starlink and OneWeb, remote sensing and technology demonstration smallsats constitute the largest share of smallsats launched in the last decade

# Operator and Mission Type Trends

## Number of Smallsats 2014 – 2023, by Operator Type

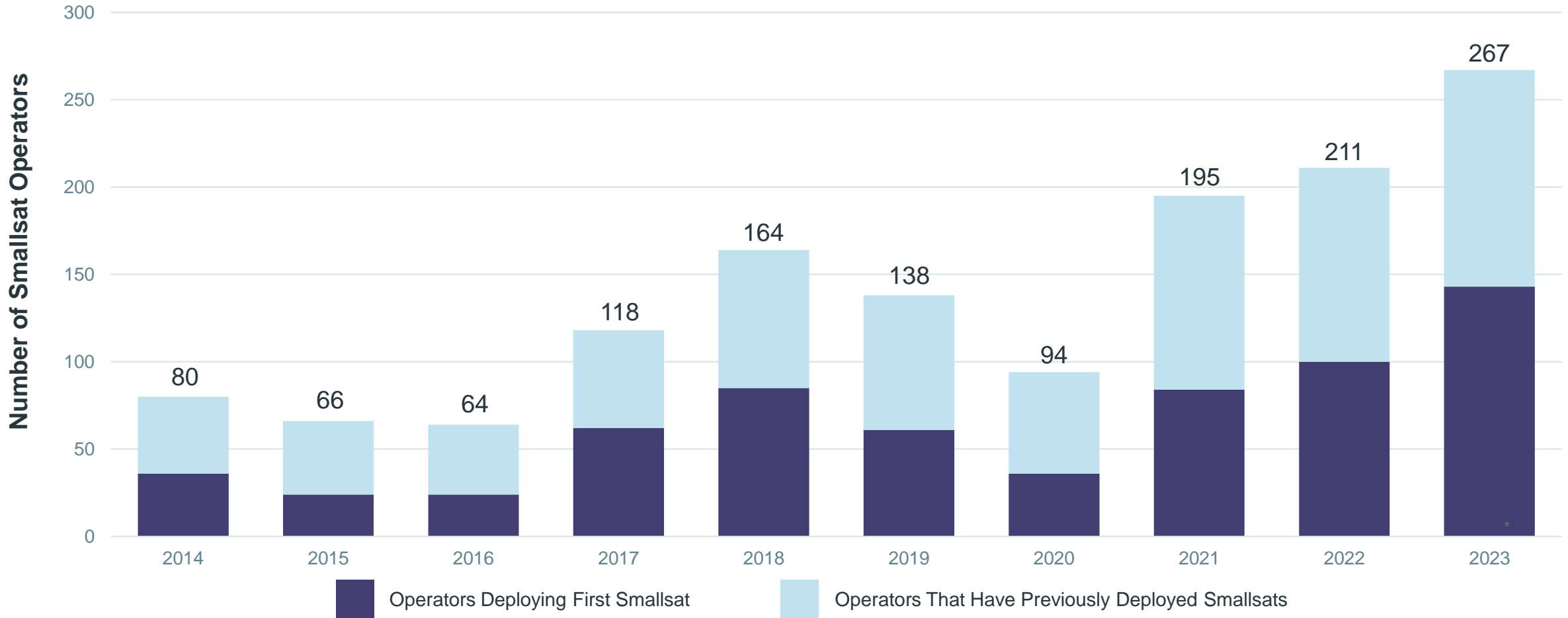


Number of commercial smallsats launched increased from 115 smallsats in 2014 to 2,629 in 2023

# Operator and Mission Type Trends



## Operators Deploying Smallsats 2014 – 2023



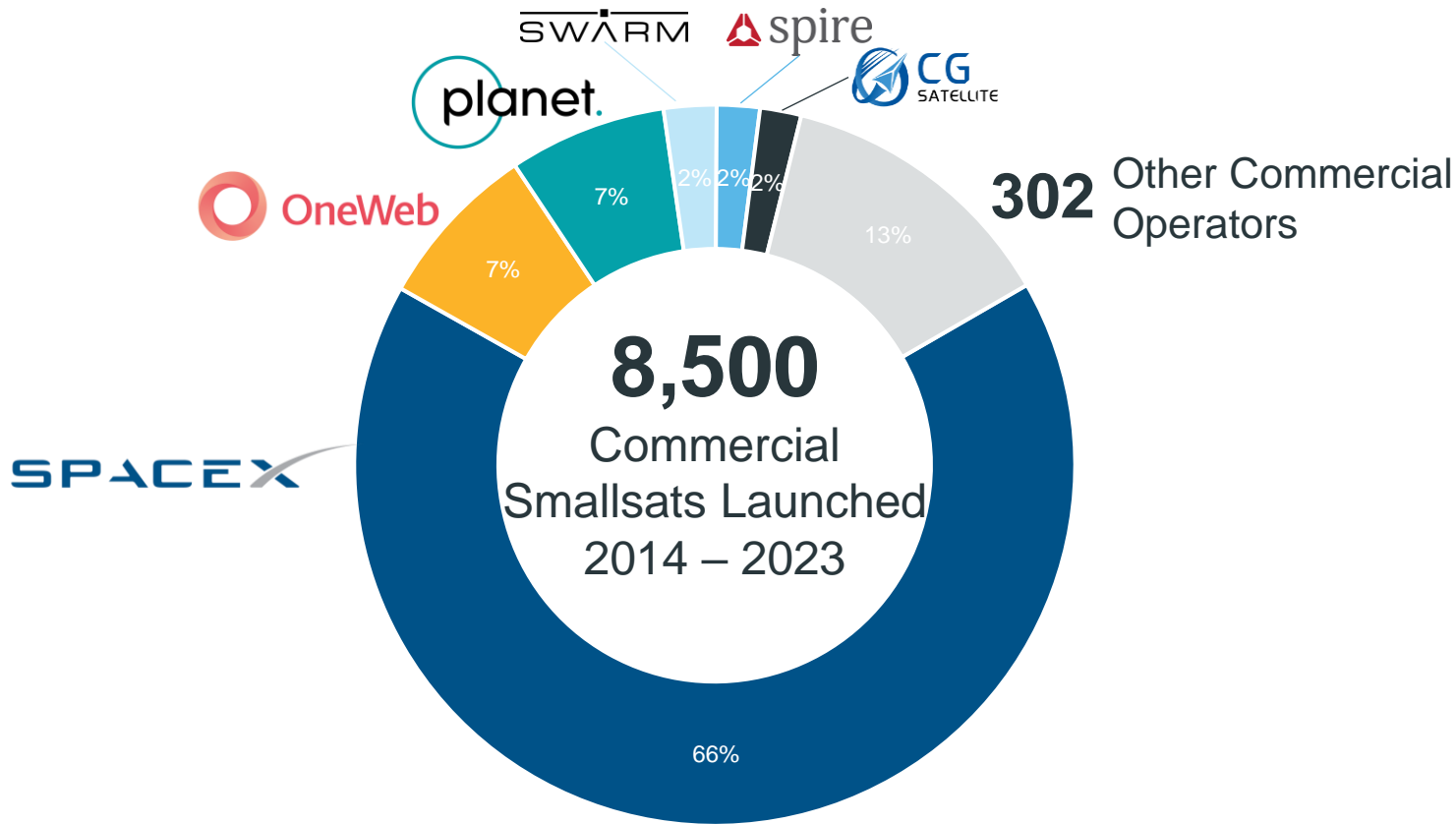
Includes government and commercial operators

**2023 was the first year since 2018 where the number of first-time satellite operators deploying smallsats exceeded the number of operators with previous deployments**

# Operator and Mission Type Trends

## Commercial Smallsat Operators 2014 – 2023

**87% of smallsats launched 2014 – 2023 are owned by 6 operators**

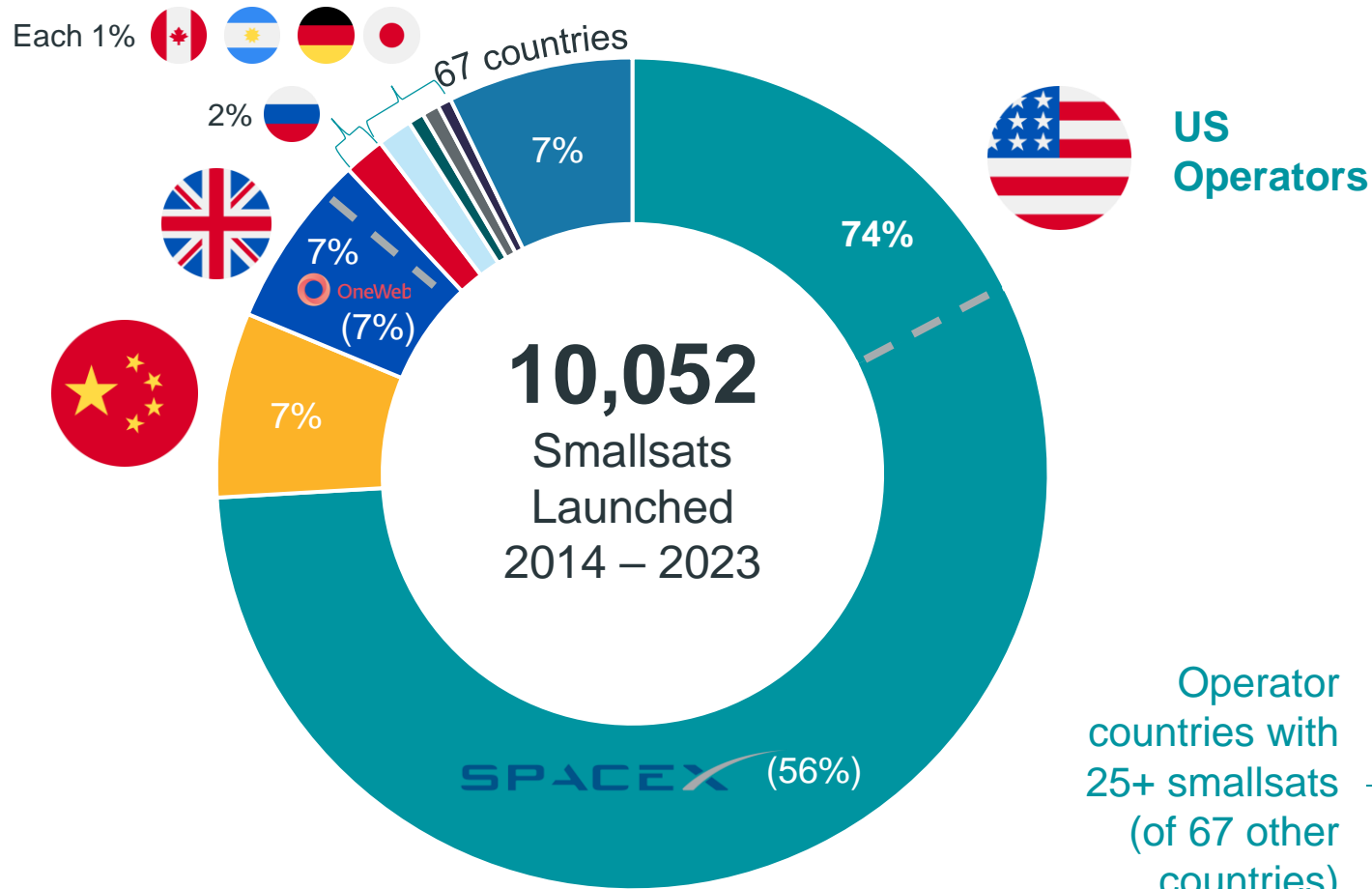


### Operators with >15 smallsats

| Operator                      | # of Smallsats |
|-------------------------------|----------------|
| Satelloptic                   | 44             |
| ICEYE                         | 30             |
| Kepler                        | 23             |
| Guodian Gaoke                 | 21             |
| Astrocast                     | 20             |
| Spacety                       | 19             |
| BlackSky                      | 18             |
| HawkEye 360                   | 18             |
| Xioyong Microelectronics Park | 18             |
| ORBCOMM                       | 17             |
| Fossa Systems                 | 17             |
| BlackSky Global               | 16             |
| Kleos Space                   | 16             |
| Abla Orbital                  | 15             |

# Operator and Mission Type Trends

## Smallsats 2014 – 2023, by Operator Country



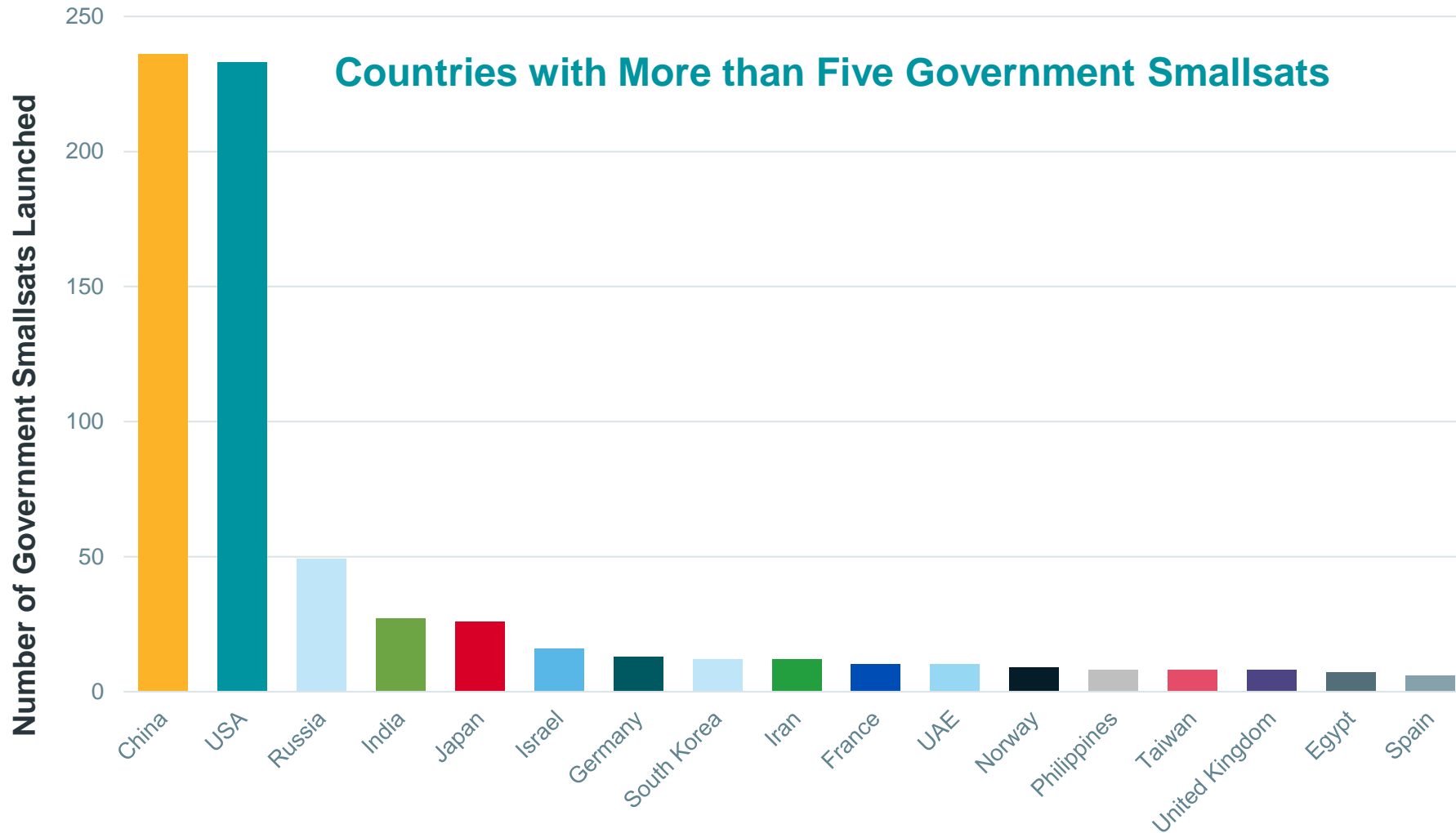
**U.S. operators dominate smallsats, accounting for ¾ of those launched since 2014**

| Operator Country | # of Smallsats         |
|------------------|------------------------|
| USA              | 7,420 (5,652 Starlink) |
| China            | 719                    |
| UK               | 679 (636 OneWeb)       |
| Russia           | 159                    |
| Japan            | 135                    |
| Canada           | 66                     |
| Germany          | 62                     |
| Argentina        | 54                     |
| Italy            | 49                     |
| France           | 47                     |
| Spain            | 47                     |
| India            | 45                     |
| Finland          | 38                     |
| South Korea      | 37                     |
| Israel           | 33                     |
| Australia        | 32                     |
| Netherlands      | 31                     |



# Operator and Mission Type Trends

## Number of Government Smallsats 2014 – 2023, by Country



| Five or Fewer Government Smallsats |            |
|------------------------------------|------------|
| Italy                              | Australia  |
| North Korea                        | Singapore  |
| Turkey                             | Algeria    |
| Thailand                           | Brazil     |
| Canada                             | Vietnam    |
| Indonesia                          | Kazakhstan |
| Ethiopia                           | Colombia   |
| Sweden                             | Mexico     |
| Morocco                            | Poland     |
| Belgium                            | Ukraine    |
| Netherlands                        | Kenya      |
| Peru                               | Pakistan   |
| Rwanda                             | Malaysia   |
| Venezuela                          |            |

**Between 2014 and 2023, China has deployed 3 more government smallsats than the United States**

# Operator and Mission Type Trends

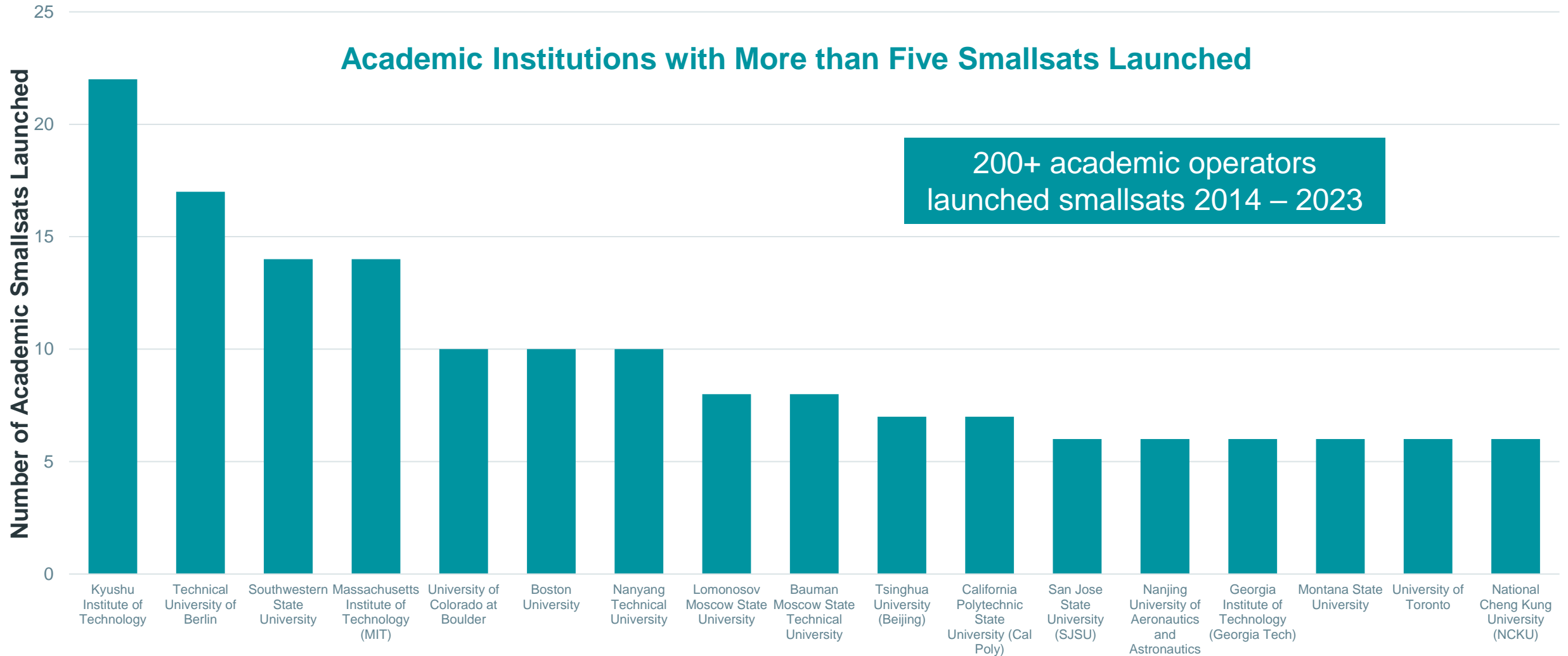


## Largest Government Smallsat Operators 2014 – 2023

| Type              | Largest Government Operators<br>Open-Source Data               | Country       | # of Smallsats<br>Launched |
|-------------------|--|---------------|----------------------------|
| Civil             | National Aeronautics and Astronautics and Space Administration | USA           | 51                         |
|                   | Chinese Academy of Aerospace Navigation Technology             | China         | 30                         |
|                   | Indian Space Research Organisation (ISRO)                      | India         | 24                         |
|                   | Japan Aerospace Exploration Agency (JAXA)                      | Japan         | 16                         |
|                   | Los Alamos National Laboratory (LANL)                          | USA           | 13                         |
|                   | Roscosmos  | Russia        | 13                         |
|                   | Chinese Academy of Sciences                                    | China         | 11                         |
|                   | Jet Propulsion Laboratory (JPL)                                | USA           | 10                         |
|                   | European Space Agency (ESA)                                    | Multinational | 9                          |
|                   | Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)           | Germany       | 8                          |
|                   | China National Space Administration (CNSA)                     | China         | 8                          |
| National Security | People’s Liberation Army                                       | China         | 129                        |
|                   | Russia MoD/Aerospace Forces                                    | Russia        | 31                         |
|                   | Space Development Agency (SDA)                                 | USA           | 22                         |
|                   | Defense Advanced Research Projects Agency (DARPA)              | USA           | 20                         |
|                   | United States Air Force  | USA           | 16                         |

# Operator and Mission Type Trends

## Number of Academic Smallsats 2014 – 2023, by Institution



Smallsats in Context

Operator and Mission Type Trends

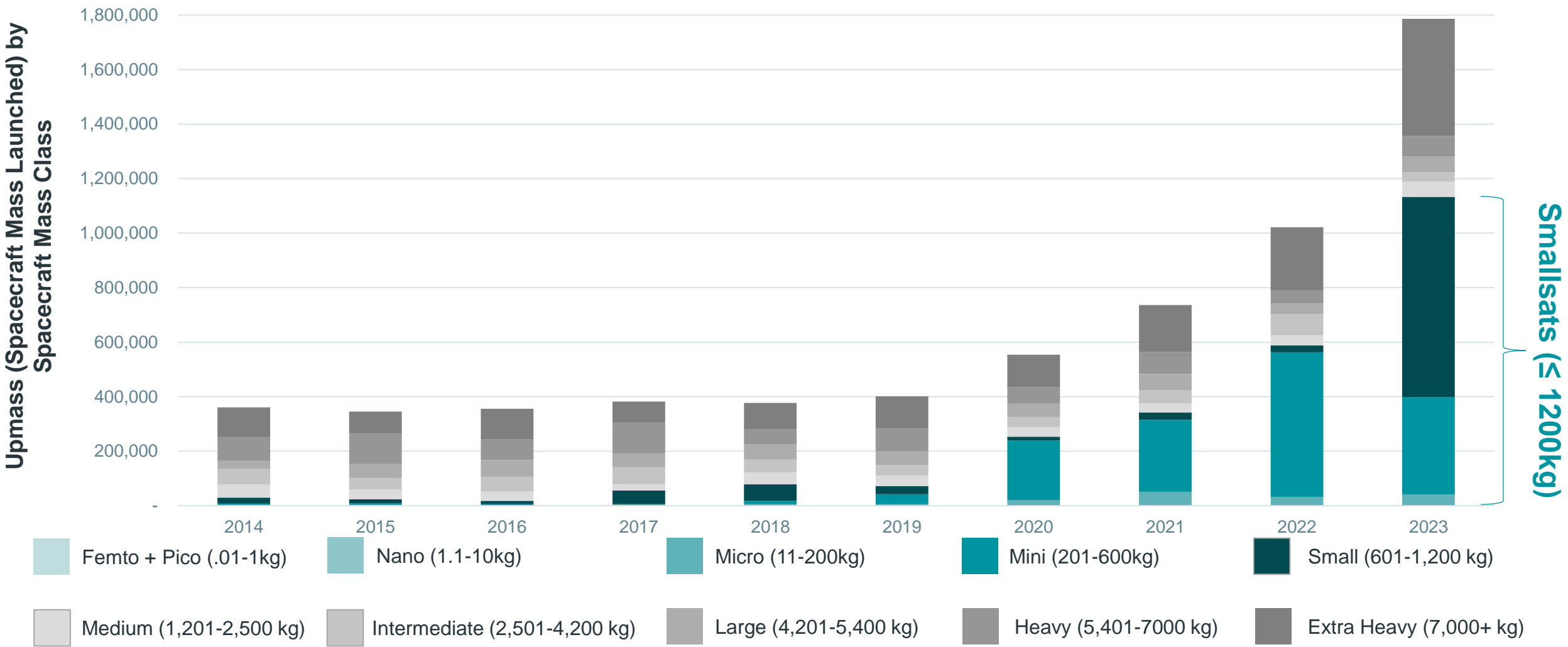
**Smallsat Mass Trends**

Smallsat Launch Trends

Looking Forward

# Smallsat Mass Trends

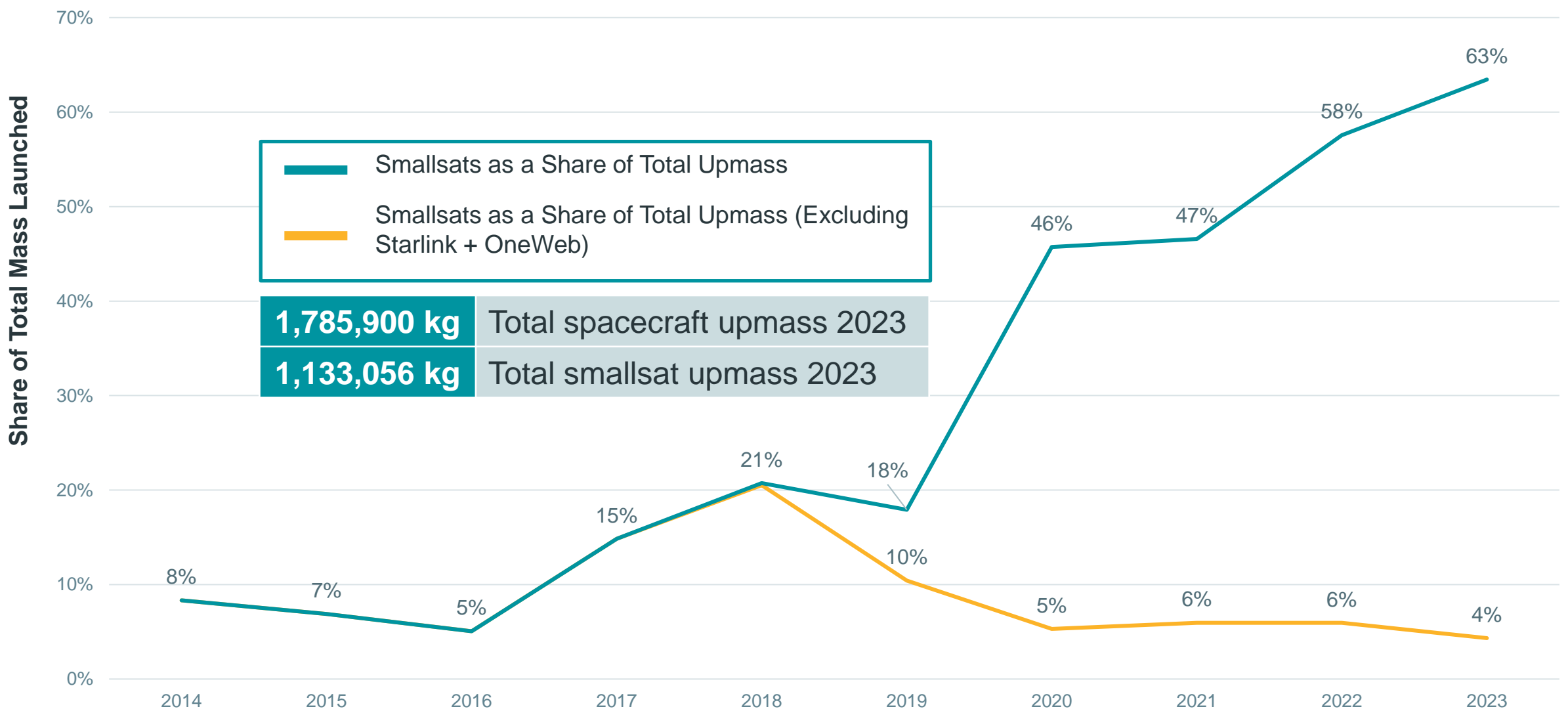
## Spacecraft Upmass 2014 – 2023, by Spacecraft Mass Class





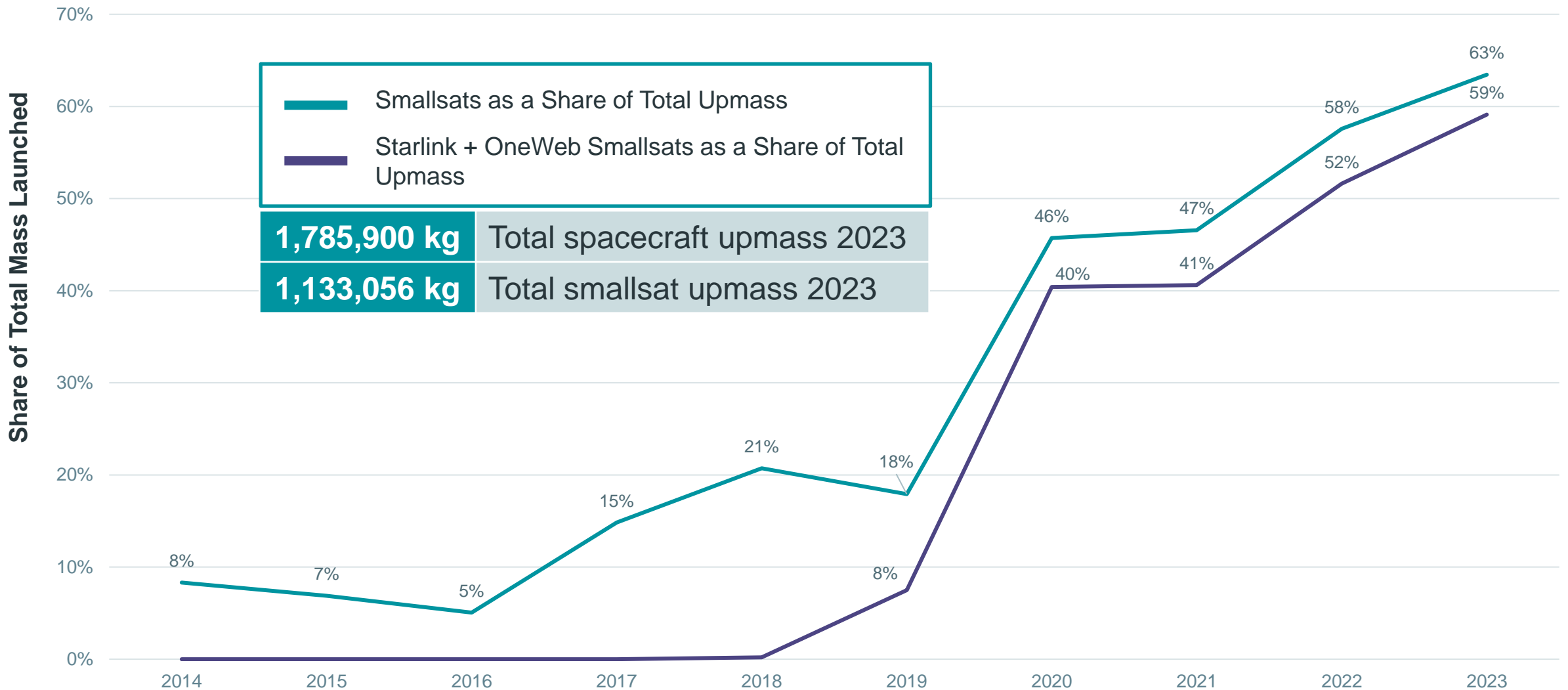
# Smallsat Mass Trends

## Smallsats as a Share of Total Upmass 2014 – 2023



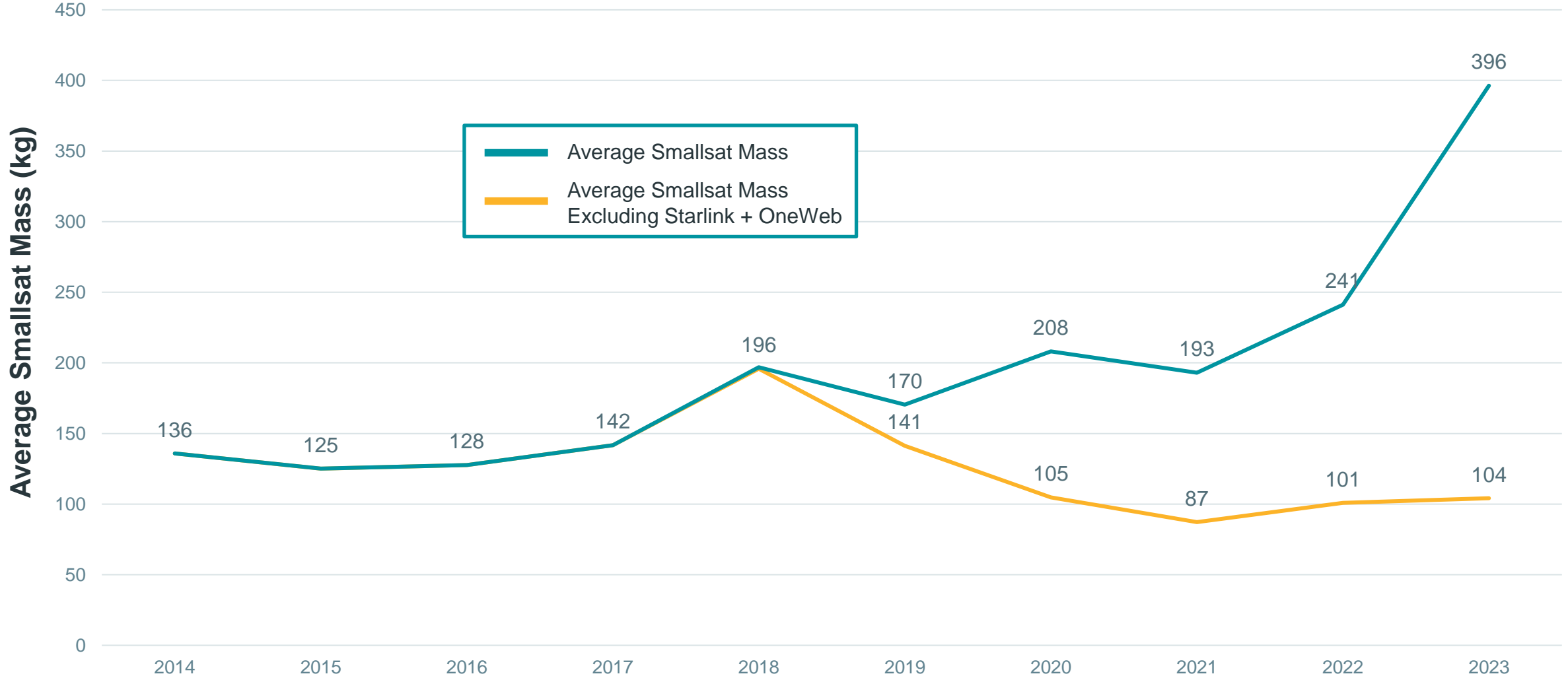
# Smallsat Mass Trends

## Smallsats as a Share of Total Upmass 2014 – 2023



# Smallsat Mass Trends

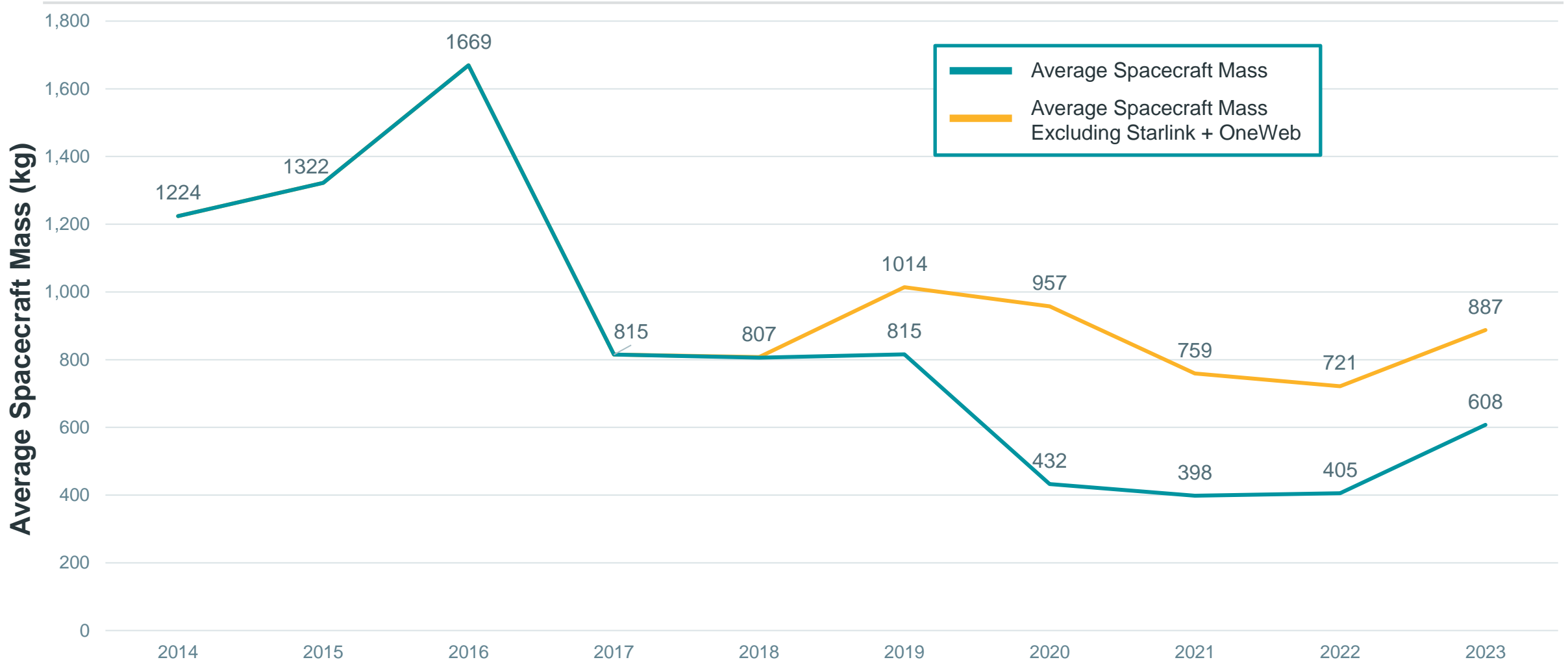
## Average Smallsat Mass 2014 – 2023



# Smallsat Mass Trends



## Average Spacecraft Mass (of Spacecraft Launched) 2014 – 2023



**Overall smallsats have reduced average spacecraft mass. An increase in Starlink satellites mass and deployments of several larger GEO satellites led to an increase in 2023 compared to 2022**

Smallsats in Context

Operator and Mission Type Trends

Smallsat Mass Trends

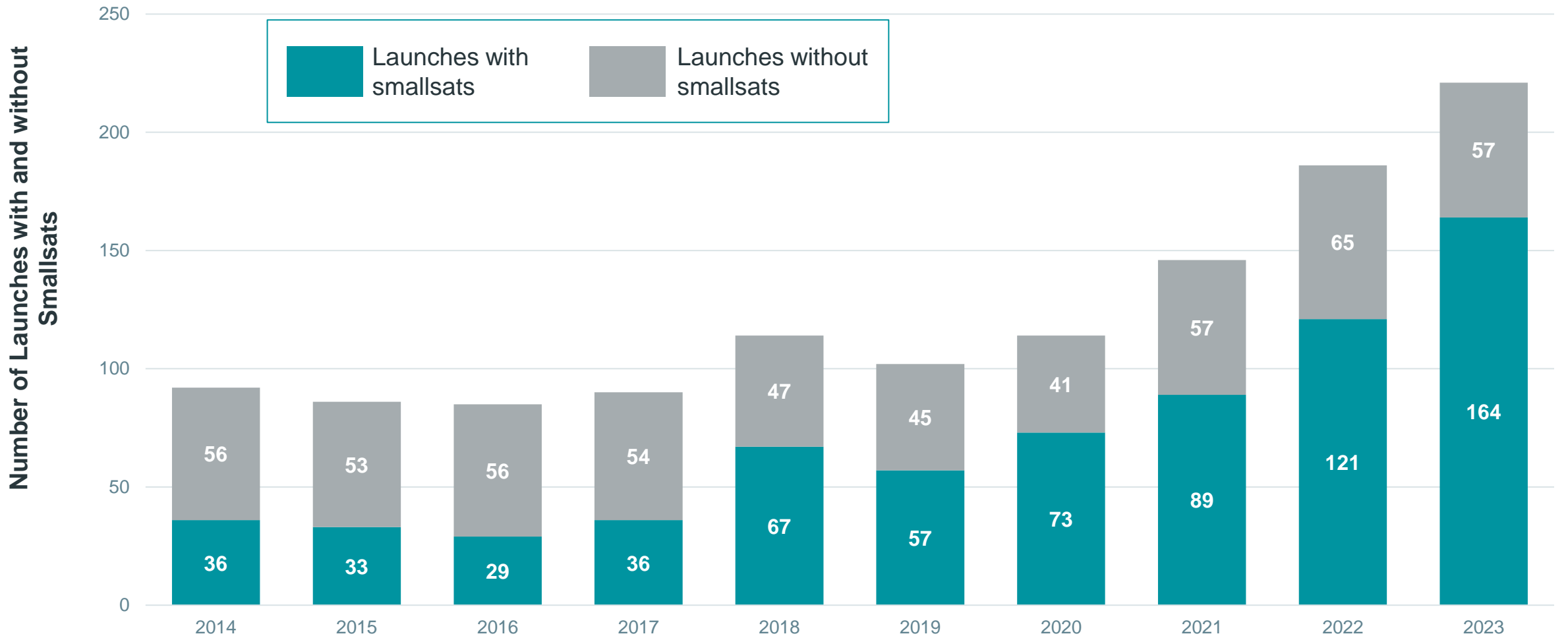
**Smallsat Launch Trends**

Looking Forward

# Smallsat Launch Trends



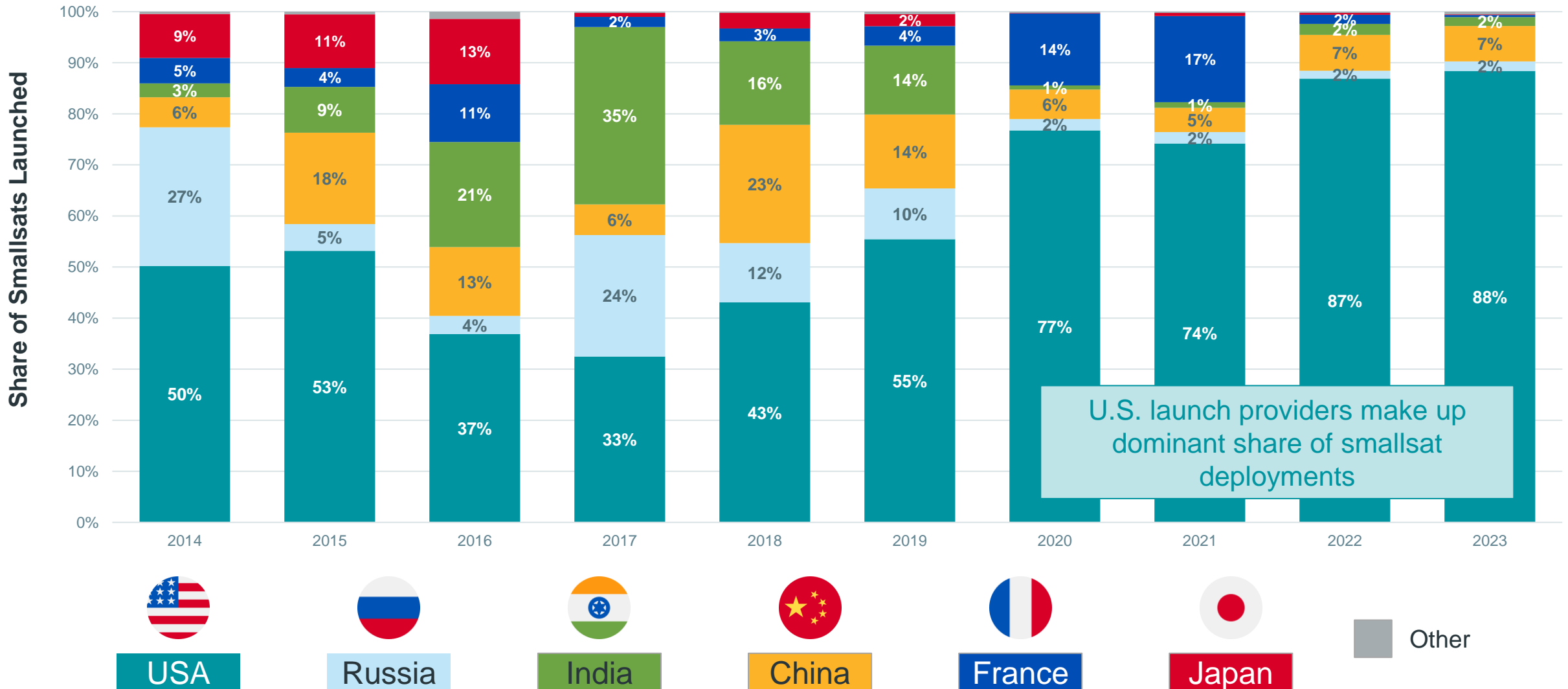
## Number of Launches with Smallsats 2014 – 2023



**Number of launches carrying smallsats has generally increased over time. Since 2020, more than half of orbital launches have carried smallsats**

# Smallsat Launch Trends

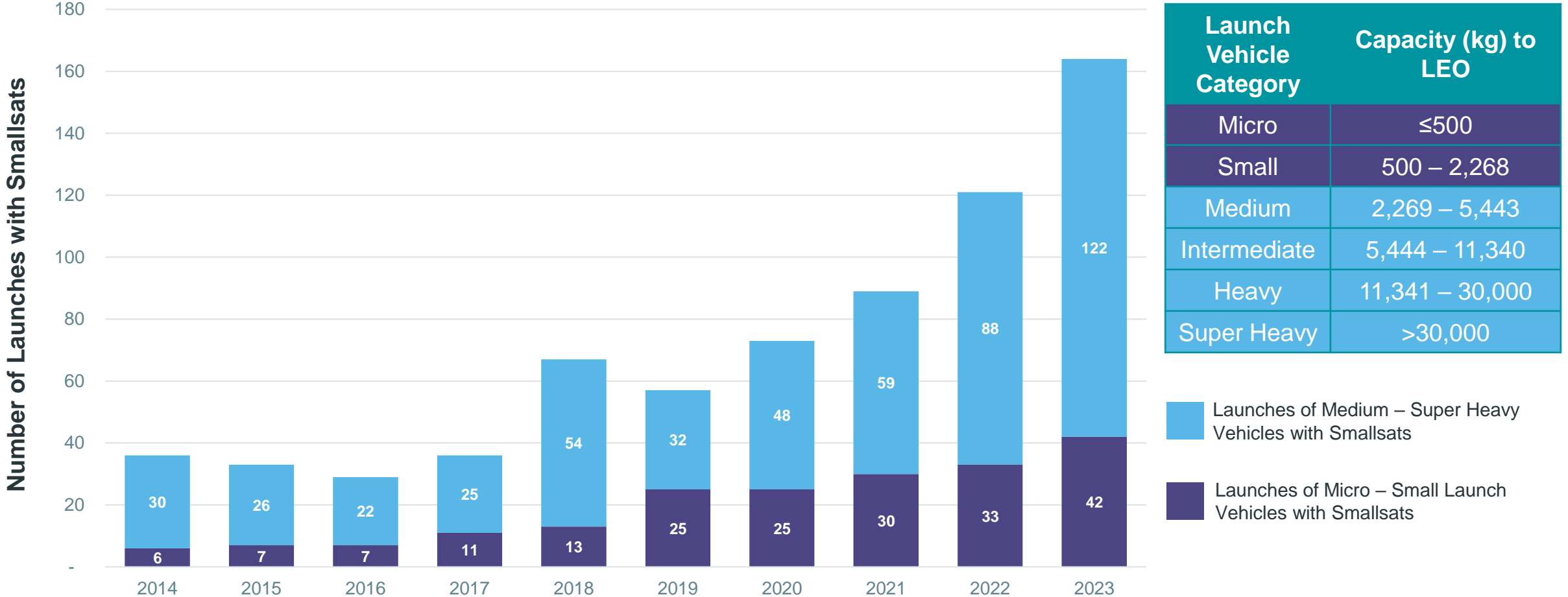
## Smallsats 2014 – 2023, by Country of Launch Provider



# Smallsat Launch Trends



Number of Launches with Smallsats 2014 – 2023, by Launch Vehicle Category

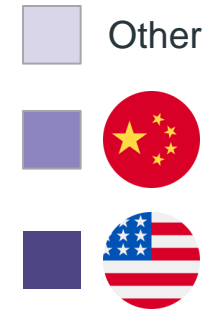
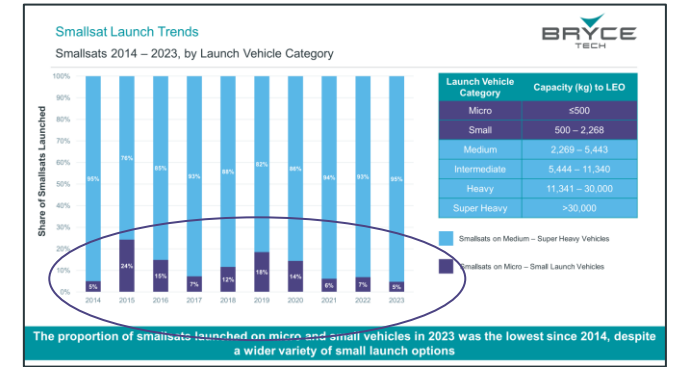
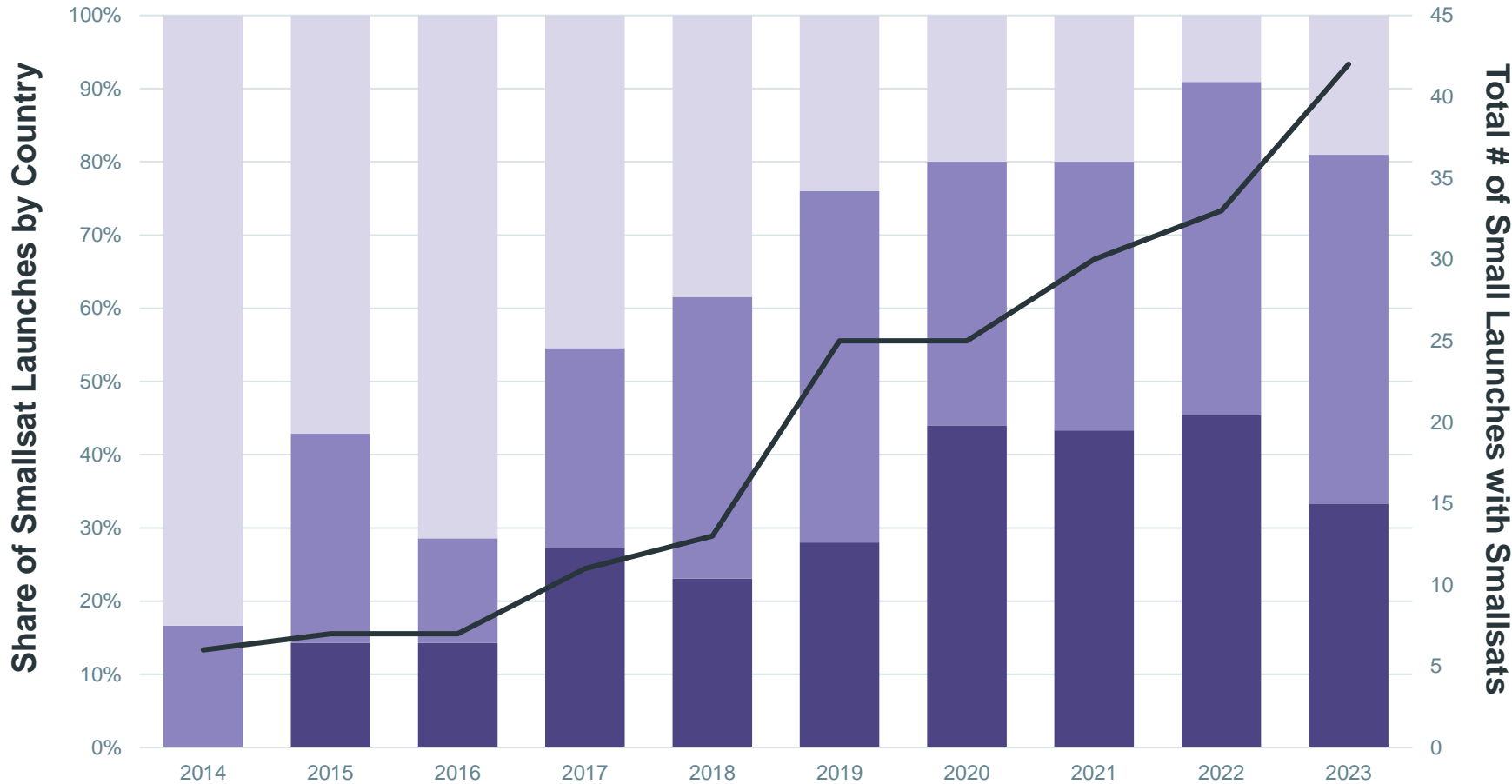


The number of small launch vehicles carrying smallsats in 2023 increased 27% compared to 2022, while the number of medium to superheavy vehicles launching with smallsats increased 39%



# Smallsat Launch Trends

## Share of Small Launches with Smallsats 2014 – 2023

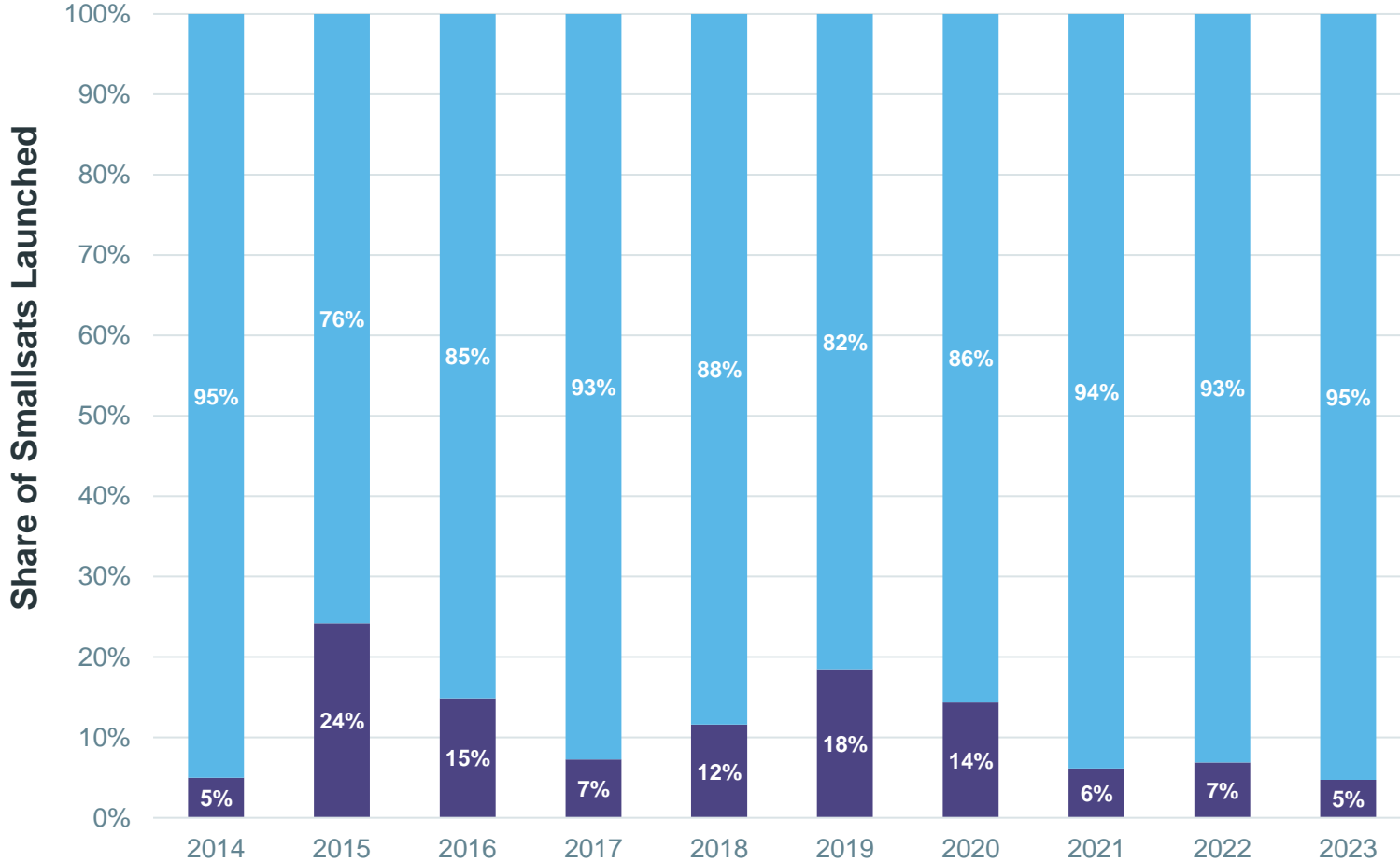


Chinese launch providers had the largest share of micro/small launch vehicles carrying Smallsats in 2023

# Smallsat Launch Trends



## Smallsats 2014 – 2023, by Launch Vehicle Category



| Launch Vehicle Category | Capacity (kg) to LEO |
|-------------------------|----------------------|
| Micro                   | ≤500                 |
| Small                   | 500 – 2,268          |
| Medium                  | 2,269 – 5,443        |
| Intermediate            | 5,444 – 11,340       |
| Heavy                   | 11,341 – 30,000      |
| Super Heavy             | >30,000              |

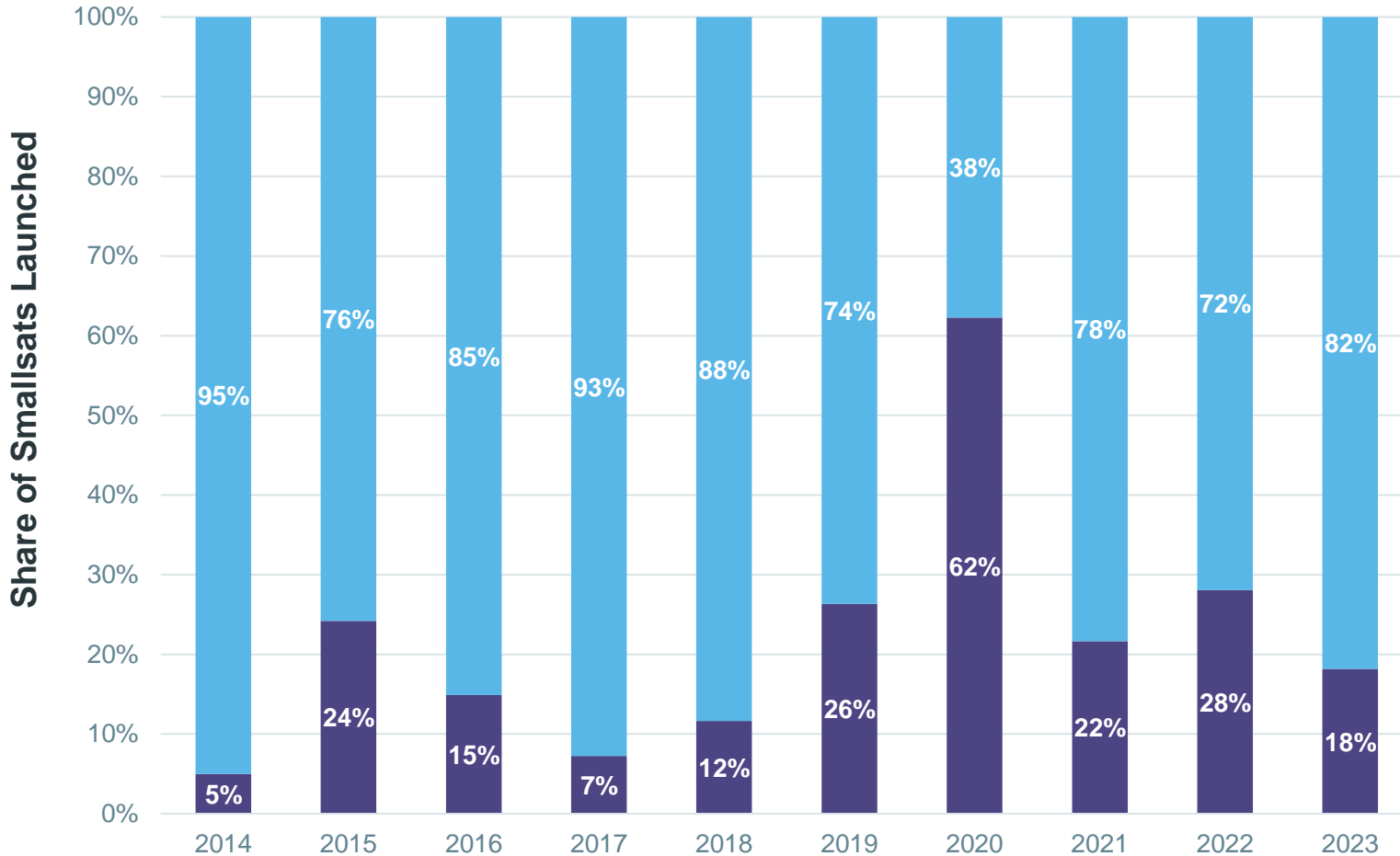
- Smallsats on Medium – Super Heavy Vehicles
- Smallsats on Micro – Small Launch Vehicles

**The proportion of smallsats launched on micro and small vehicles in 2023 was the lowest since 2014, despite a wider variety of small launch options**

# Smallsat Launch Trends



Smallsats 2014 – 2023, by Launch Vehicle Category, Excluding Starlink and OneWeb



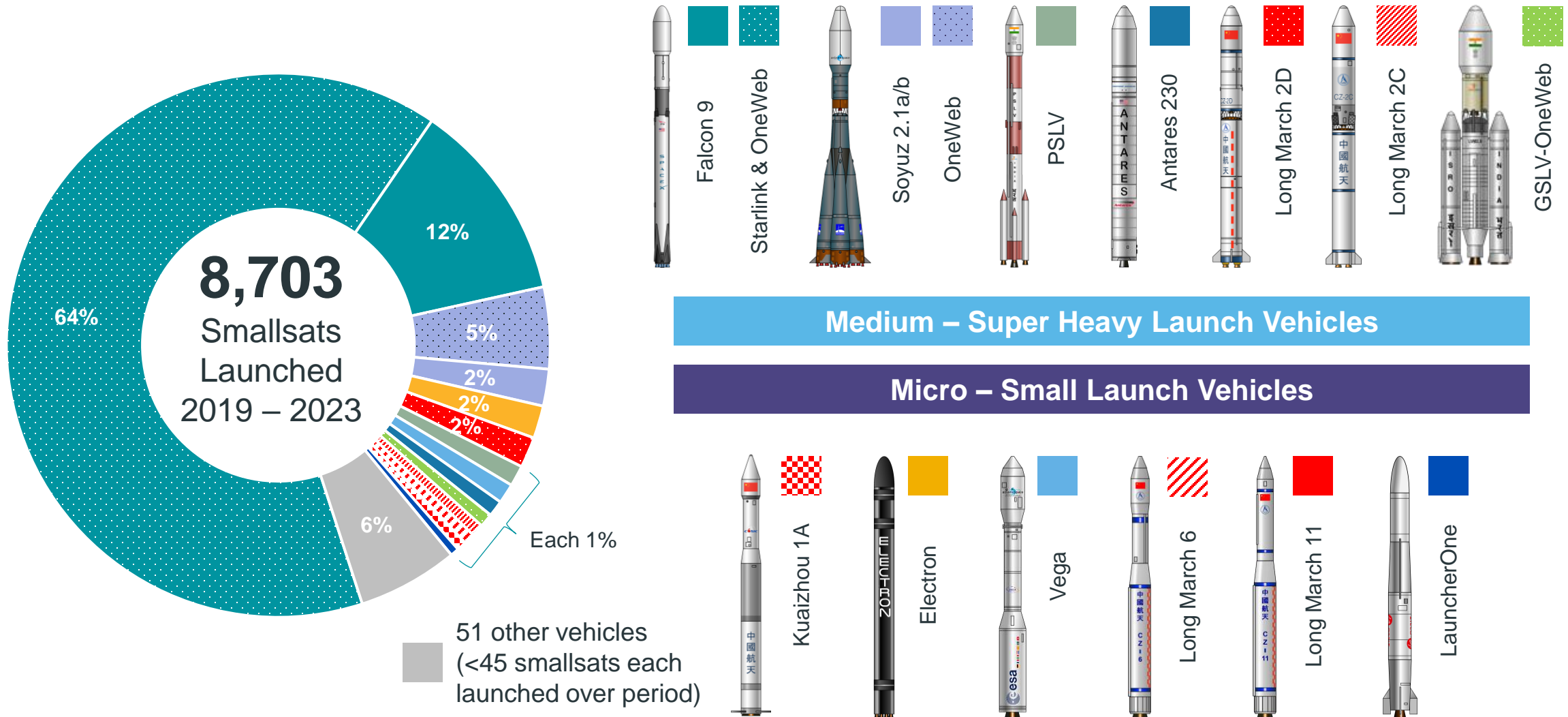
| Launch Vehicle Category | Capacity (kg) to LEO |
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| Intermediate            | 5,444 – 11,340       |
| Heavy                   | 11,341 – 30,000      |
| Super Heavy             | >30,000              |

- Smallsats on Medium – Super Heavy Vehicles (Starlink and OneWeb excluded)
- Smallsats on Micro – Small Launch Vehicles

**Excluding LEO broadband constellations, small launch vehicles still launched the lowest share of smallsats since 2019**

# Smallsat Launch Trends

## Smallsats 2019 – 2023, by Launch Vehicle



Smallsats in Context

Operator and Mission Type Trends

Smallsat Mass Trends

Smallsat Launch Trends

**Looking Forward**

## Business Outcomes

Smallsat ventures continue efforts to prove their business models and generate revenue, with increasing attention on communications megaconstellations. Macroeconomic factors may have outsized impact on early-stage ventures and influence long-term smallsat market

## Communications Megaconstellations

Smallsat telecommunications operators dominated smallsat activity in 2023 and are continuing deployments in 2024. Launch of these large constellations will influence smallsat activity in the next few years as initial deployments finish and expanded constellations are authorized

## Smallsat Launch Options

Smallsats continue to primarily deploy on medium to heavy launch vehicles. Smallsat operators have other launch options including small launch and rideshare. In addition, dozens of companies continue to develop new small launch vehicles (many <500kg capacity)

## Government Use of Smallsats

In 2023, the United States conducted the first deployments of national security proliferated architectures. Governments are increasingly seeking to leverage smallsats or include them in architecture planning to augment existing capabilities

## Smallsat Driven GEO/NGSO Integration

Organizations are likely to continue and expand GEO/NGSO integration, possibly through additional merger and acquisition activity, for optimal routing of traffic based on consumer speed, coverage needs, and unique remote sensing observations/data fusion

