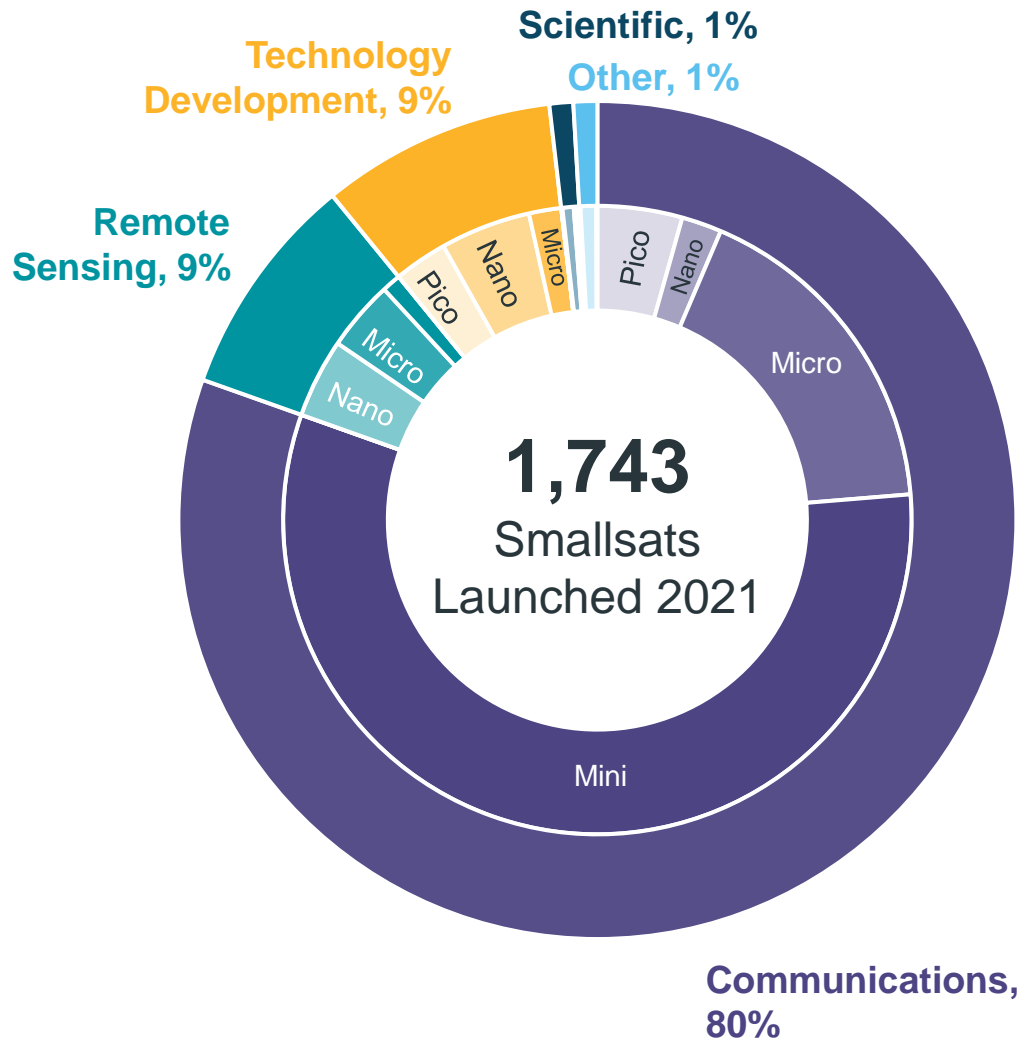


The background features a view of the Earth from space, showing the Americas. A complex network of white lines and dots is overlaid on the globe, representing a satellite network. A bright light source on the right side of the globe creates a lens flare effect.

Smallsats by the Numbers 2022



- 94%** of spacecraft launched in 2021 = smallsats
- 43%** of total 2021 spacecraft upmass = smallsats
- 37%** of all smallsats in last 10 years launched in 2021 (69% 2020+2021)
- 80** launches in 2021 carried smallsats
- 6%** of smallsats launched on small/micro launch vehicles in 2021

- ✓ Smaller satellites have broken records and are transforming in-space architectures
- ✓ Bryce’s *Smallsats by the Numbers* presents historical information on smaller satellites launched 2012 – 2021
 - Definition used here, 600 kg and under, reflects the five smallest mass classes defined by the FAA
 - Report includes all smallsats launched regardless of operational status
 - Due to the large quantity of LEO broadband telecommunications smallsats launched in 2021, 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 and Operator/Mission Type Trends

Smallsat Mass Trends

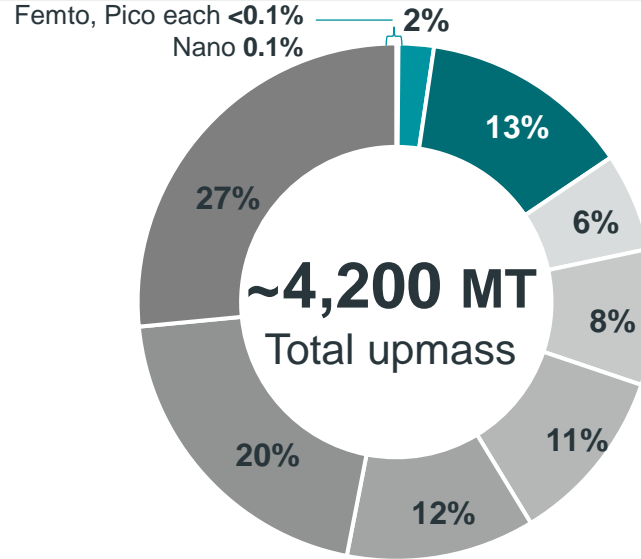
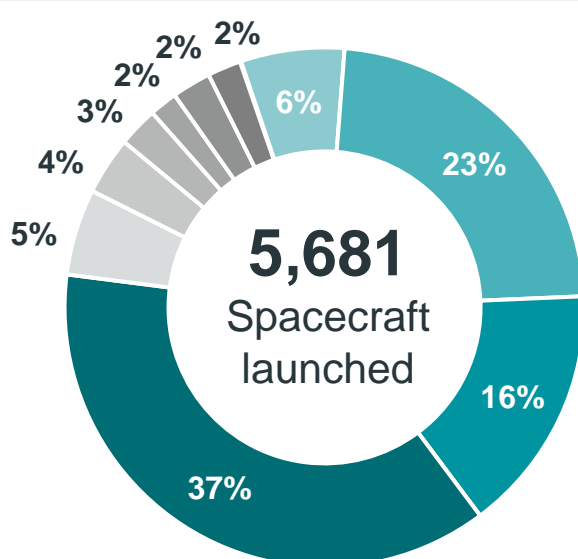
Smallsat Launch Trends

Looking Forward

Smallsats Launched and Total Spacecraft Upmass 2012 – 2021

Smallsats in Context and Operator/Mission Type Trends

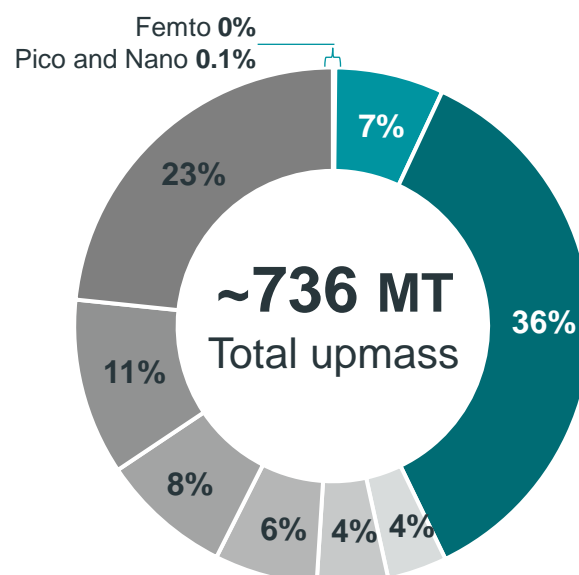
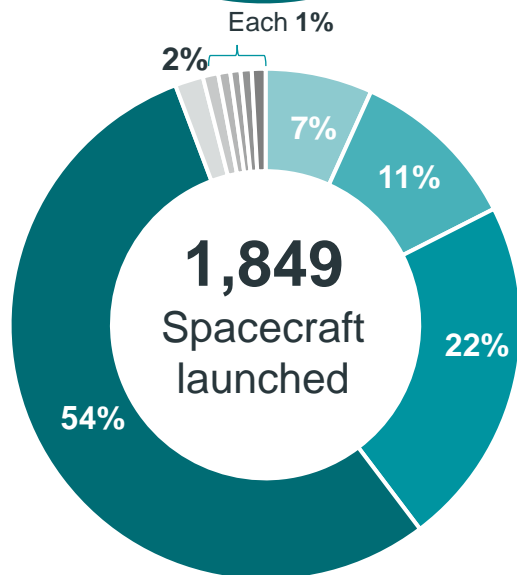
2012 – 2021



Smallsats

	Mass Class Name	Kilograms (kg)
	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

2021

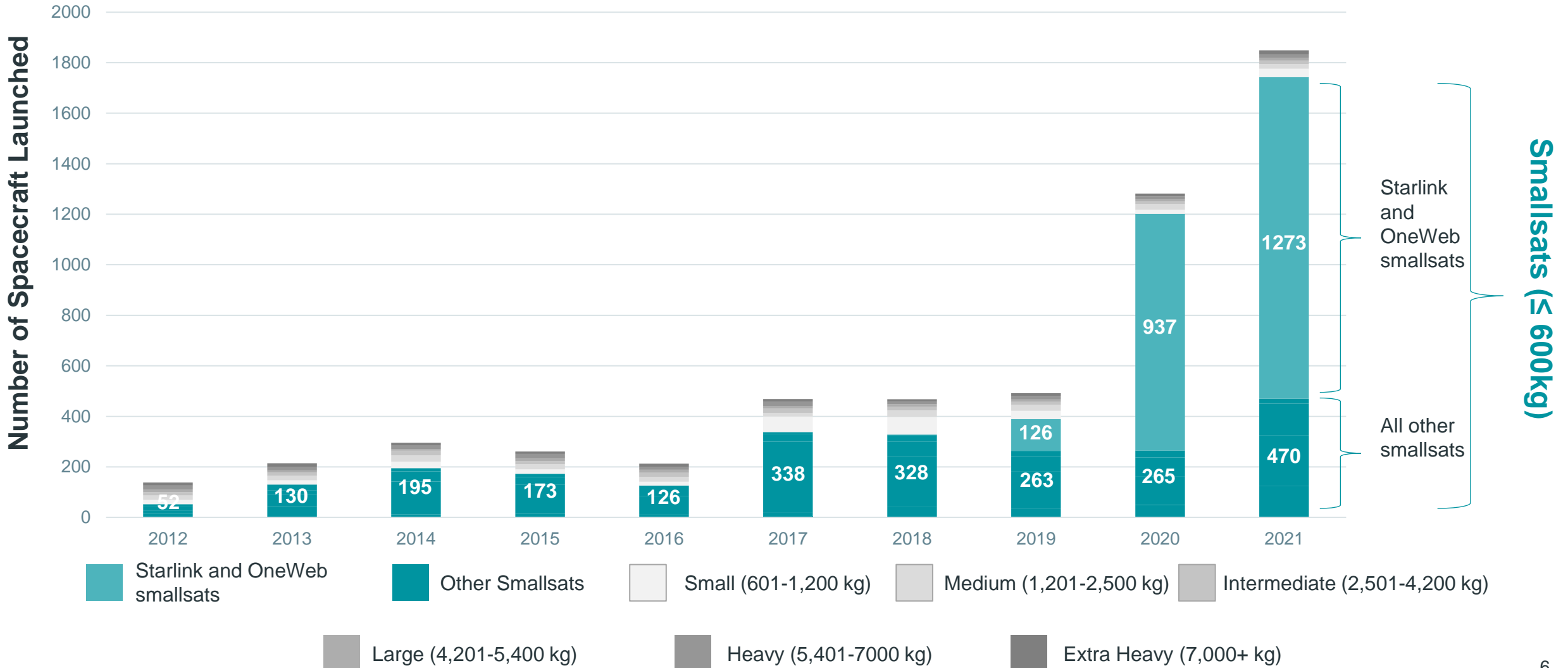


- Smallsats represent 82% of spacecraft launched 2012 – 2021, 16% of total upmass
- Smallsats represent 94% of spacecraft launched in 2021, 43% of total upmass

"Non-smallsat launches" includes Chinese hypersonic missile test on July 27, 2021 due to speculated complete orbit

Spacecraft Launched 2012 – 2021, by Mass Class

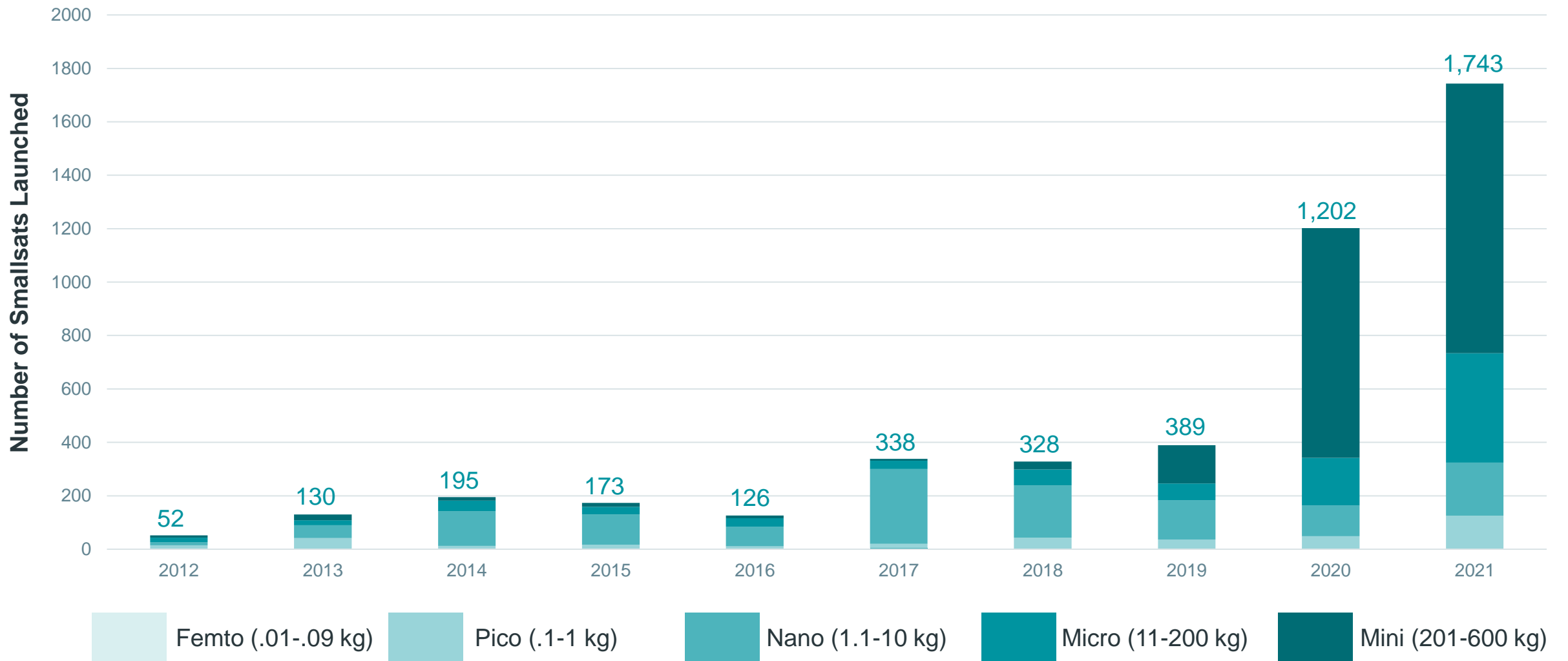
Smallsats in Context and Operator/Mission Type Trends



Smallsats 2012 – 2021, by Mass Class

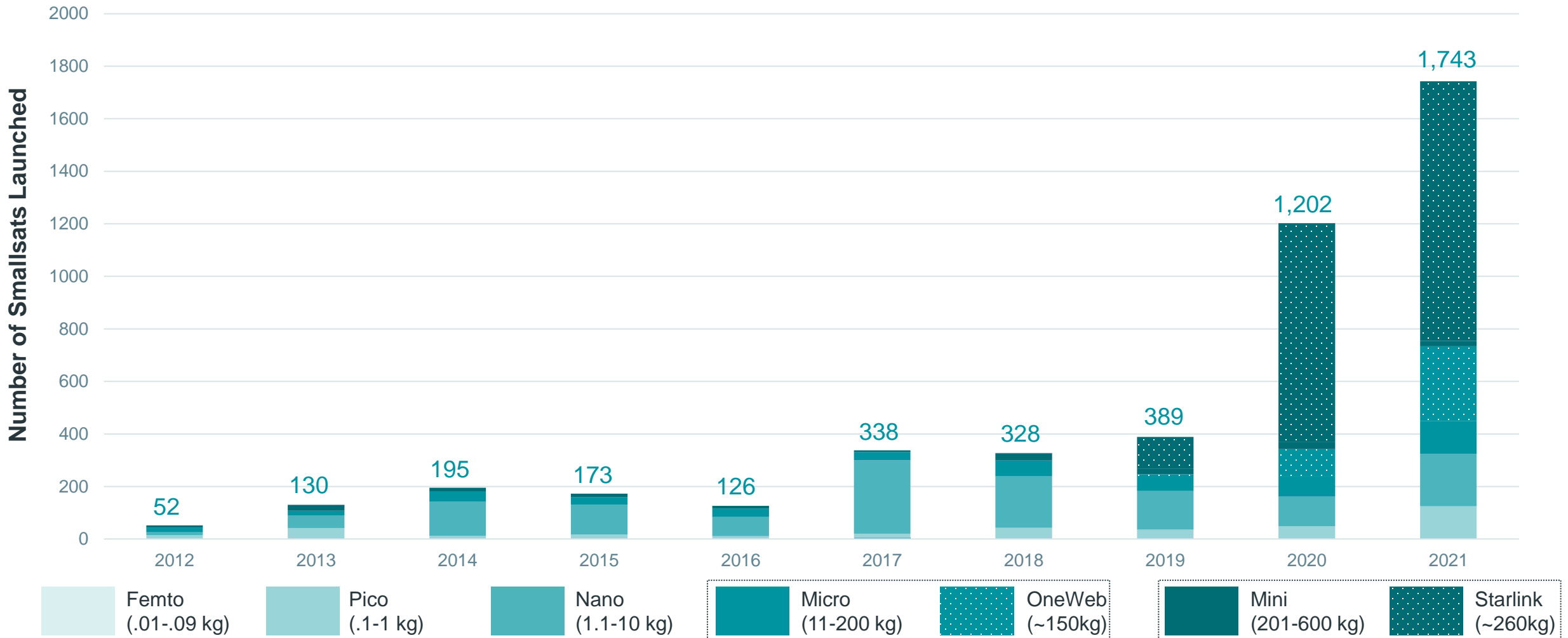


Smallsats in Context and Operator/Mission Type Trends



Smallsats 2012 – 2021, by Mass Class, Starlink and OneWeb Breakout

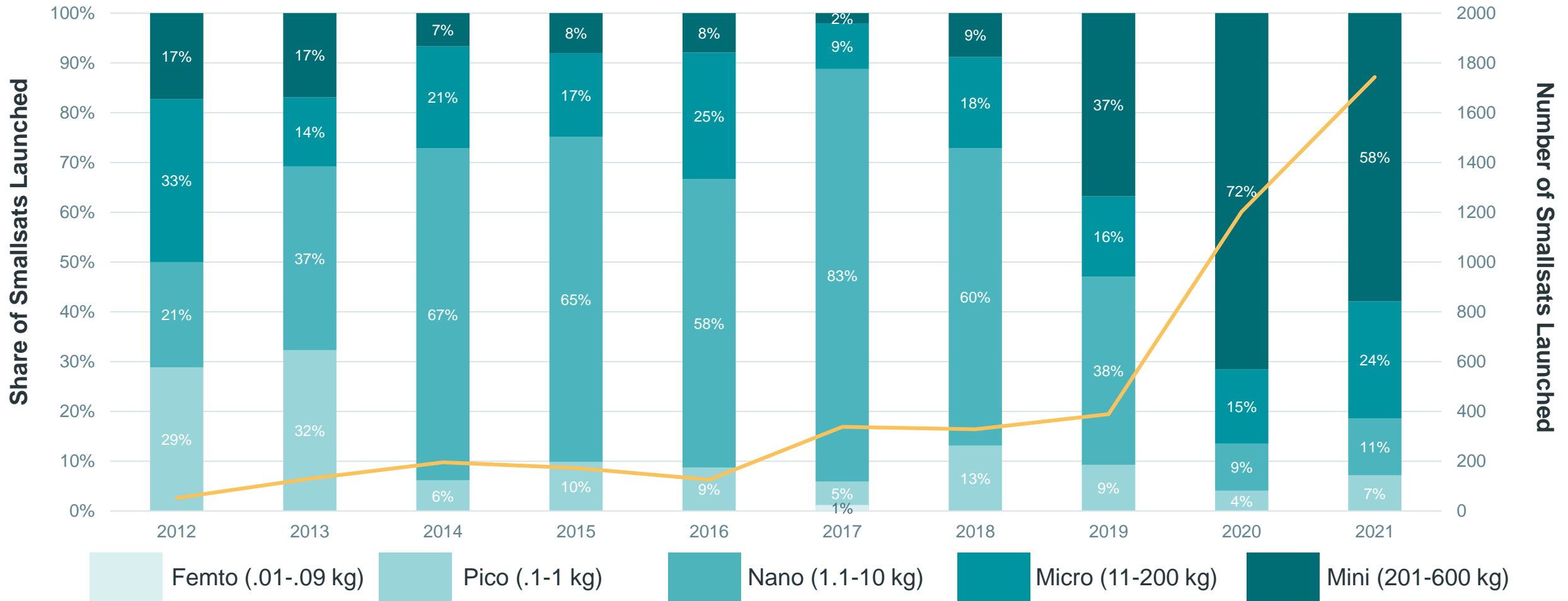
Smallsats in Context and Operator/Mission Type Trends



Share of Smallsats 2012 – 2021, by Mass Class Including Starlink and OneWeb



Smallsats in Context and Operator/Mission Type Trends

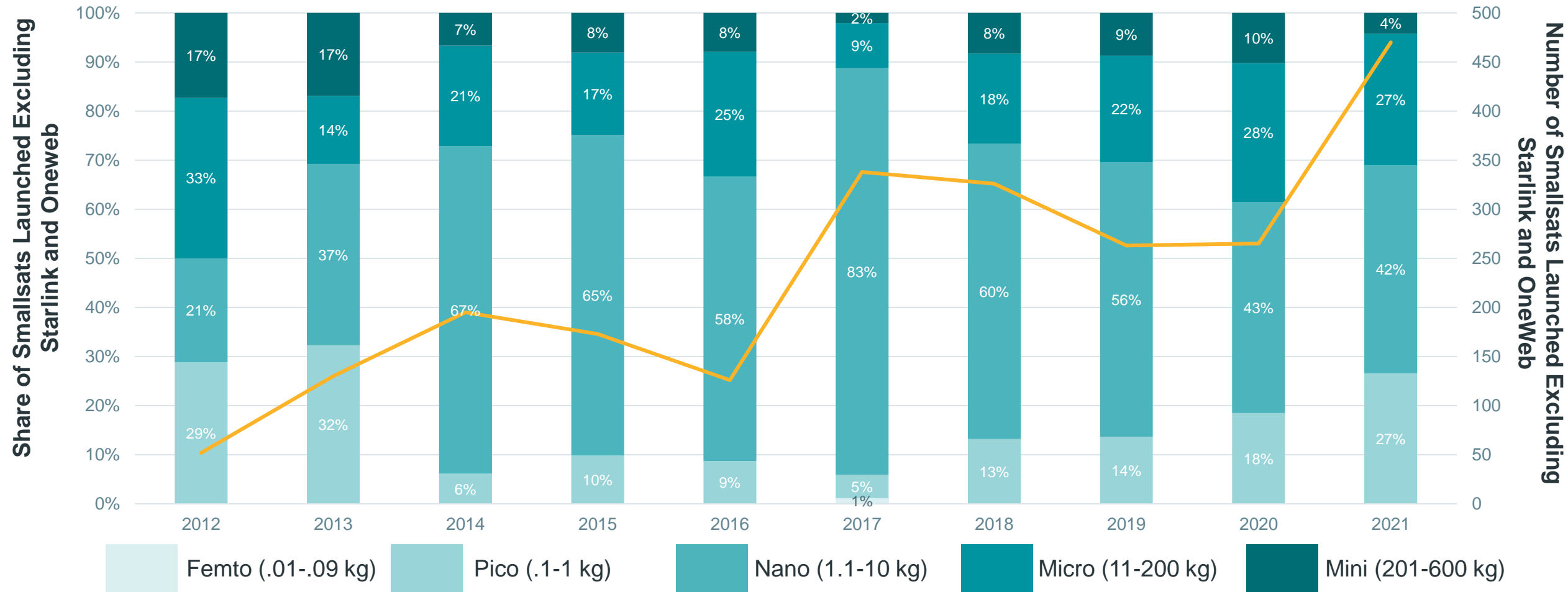


Mini satellite mass class (which includes Starlink LEO broadband constellation smallsats) constitutes the largest share of smallsats in 2021

Share of Smallsats 2012 – 2021, by Mass Class Excluding Starlink and OneWeb



Smallsats in Context and Operator/Mission Type Trends

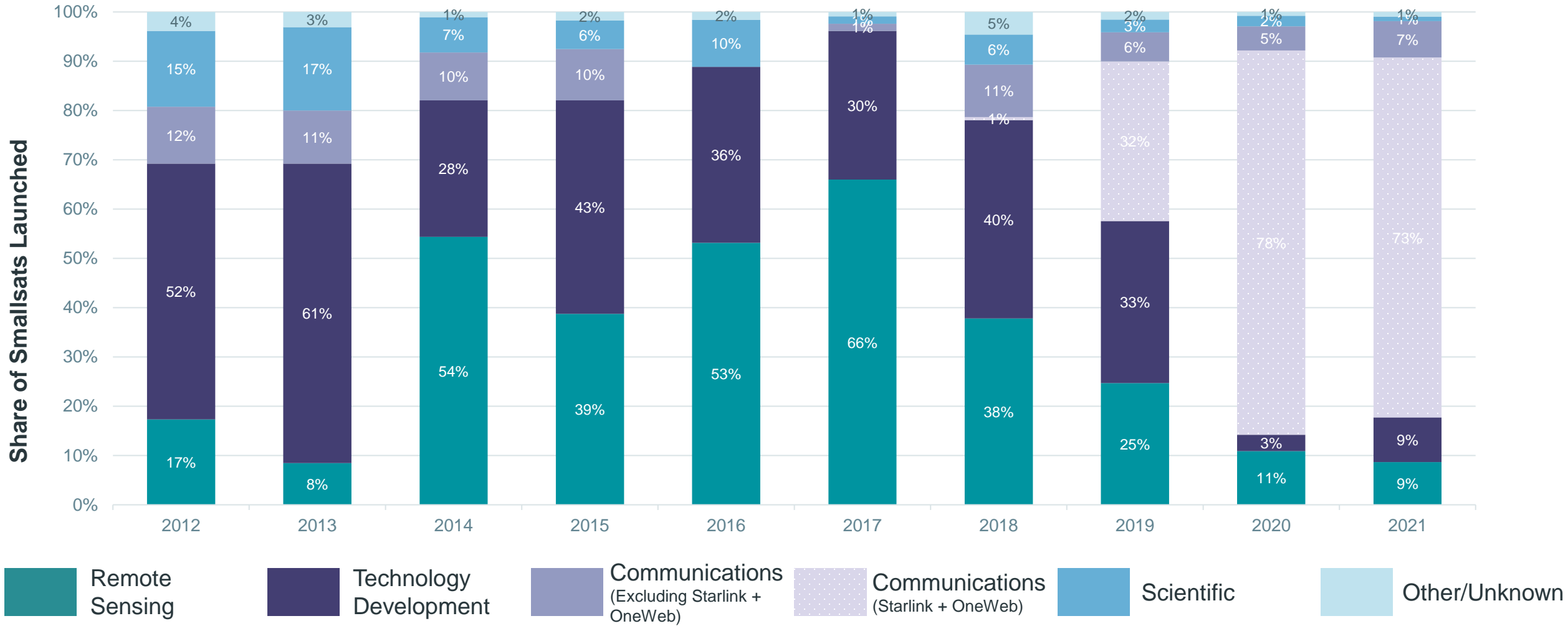


Excluding Starlink and OneWeb (LEO broadband constellation smallsats), the nano satellite mass class has constituted the largest share of smallsats since 2013

Share of Smallsats 2012 – 2021, by Application Including Starlink and OneWeb



Smallsats in Context and Operator/Mission Type Trends

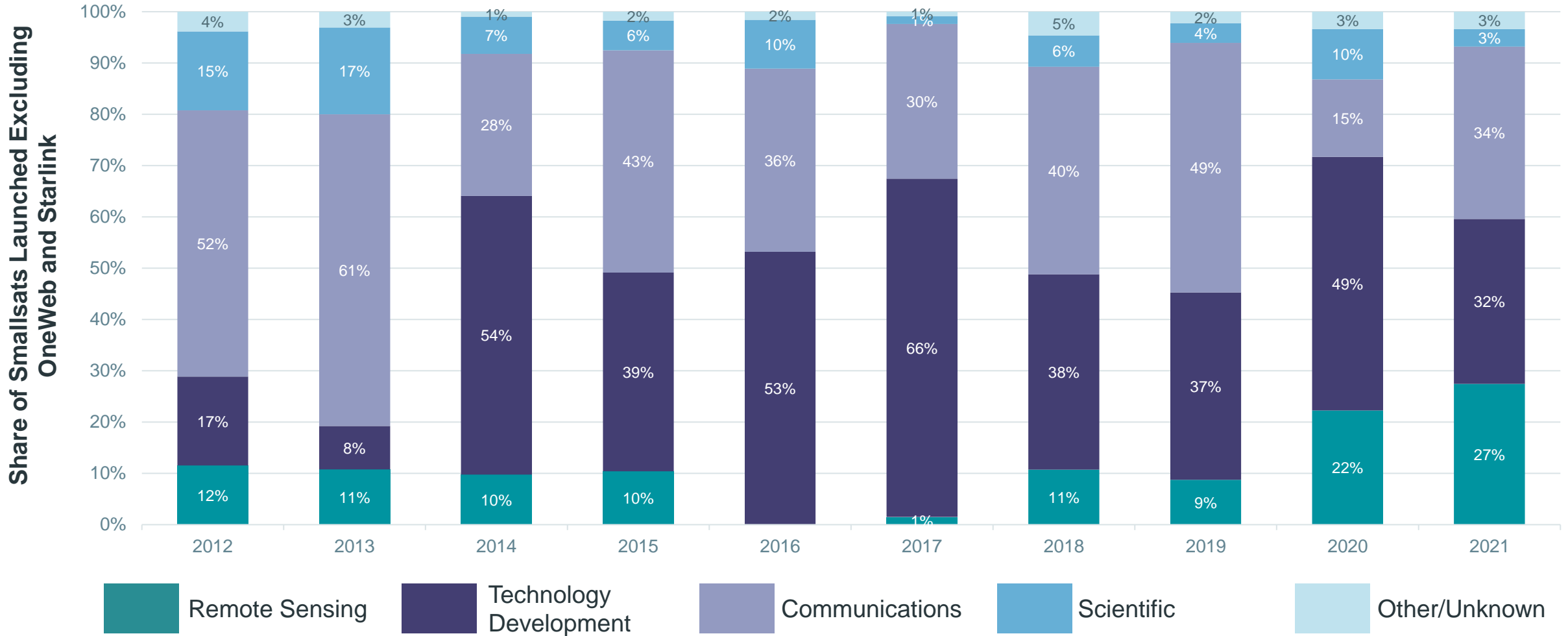


Communications satellites constitute the largest share of smallsats in 2021. Relative share of remote sensing and technology development smallsats has decreased due to launch of LEO communication smallsats

Smallsats 2012 – 2021 by Application Excluding OneWeb and Starlink



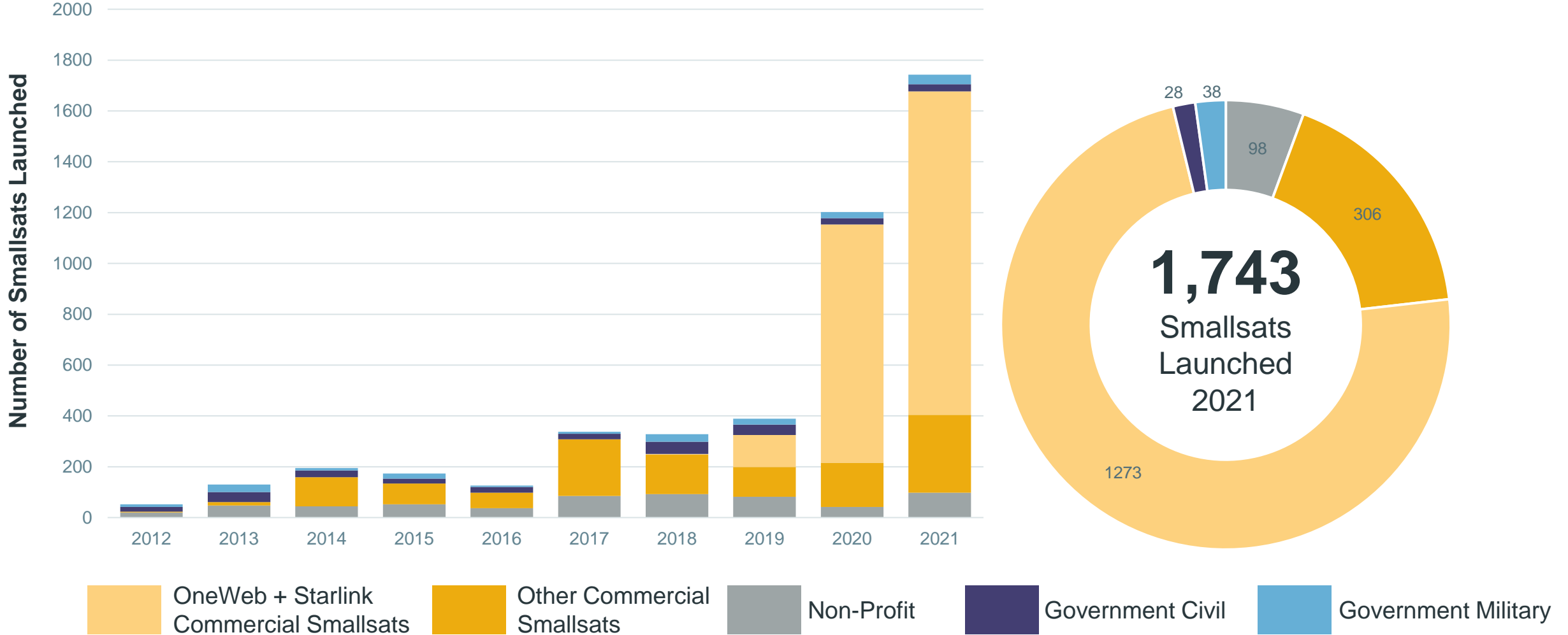
Smallsats in Context and Operator/Mission Type Trends



Excluding Starlink and OneWeb, remote sensing and technology demonstration smallsats historically have constituted the largest share of smallsats

Number of Smallsats 2012 – 2021, by Operator Type

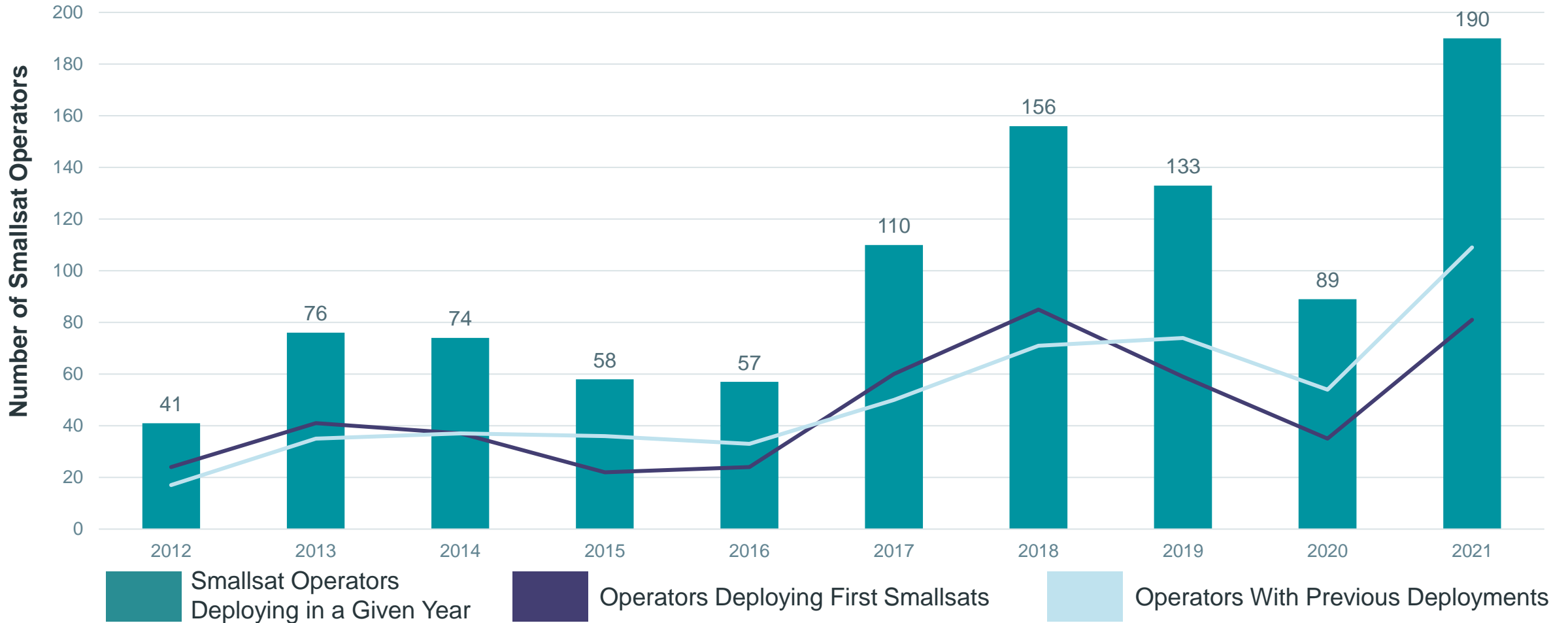
Smallsats in Context and Operator/Mission Type Trends



Number of commercial smallsats launched increased from 3 smallsats in 2012 to 1,578 in 2021

Smallsat Operators Deploying Smallsats, 2012 – 2021

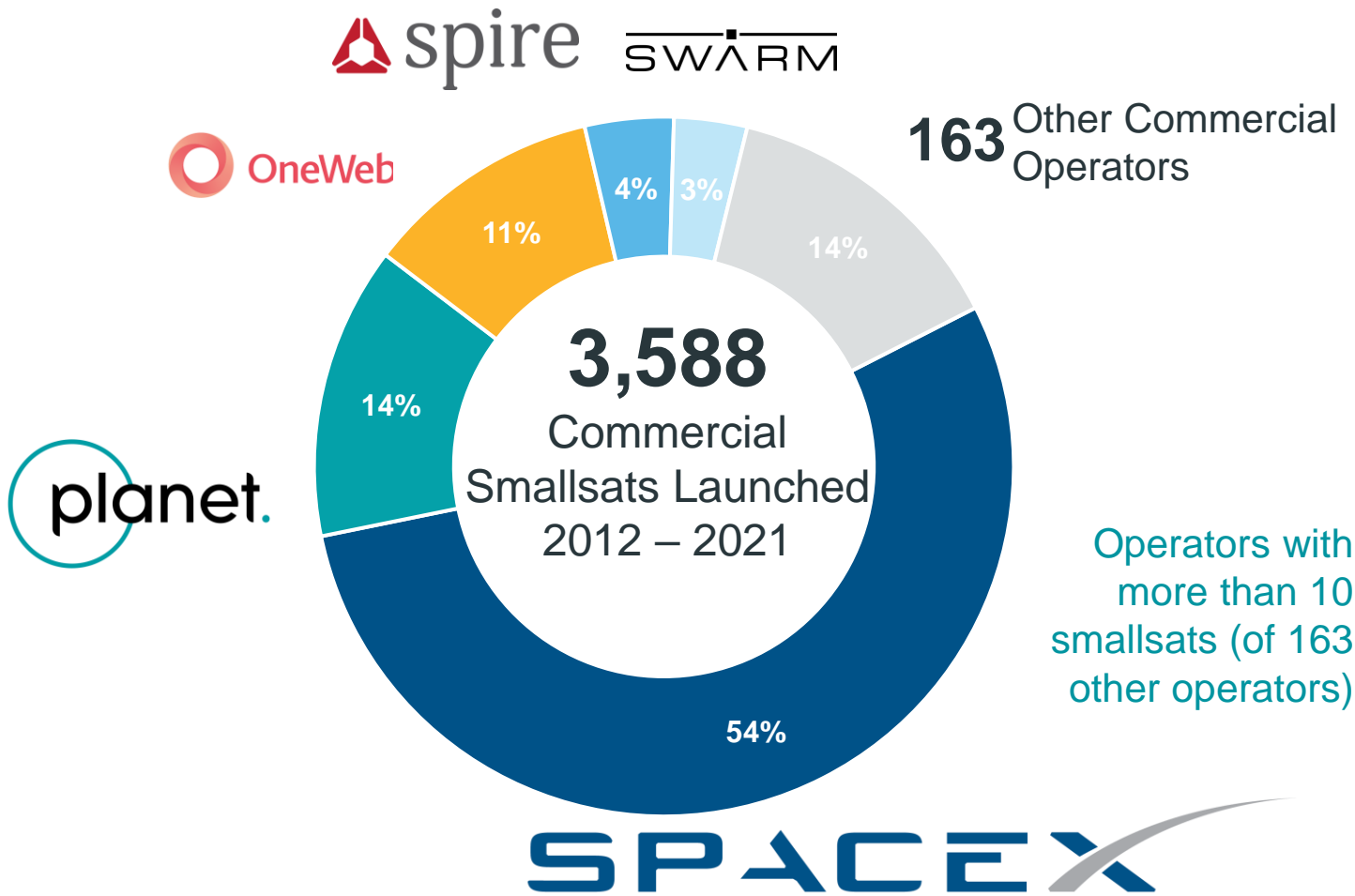
Smallsats in Context and Operator/Mission Type Trends



Commercial Smallsat Operators 2012 – 2021

Smallsats in Context and Operator/Mission Type Trends

86% of smallsats launched 2012 – 2021 are owned by 5 operators

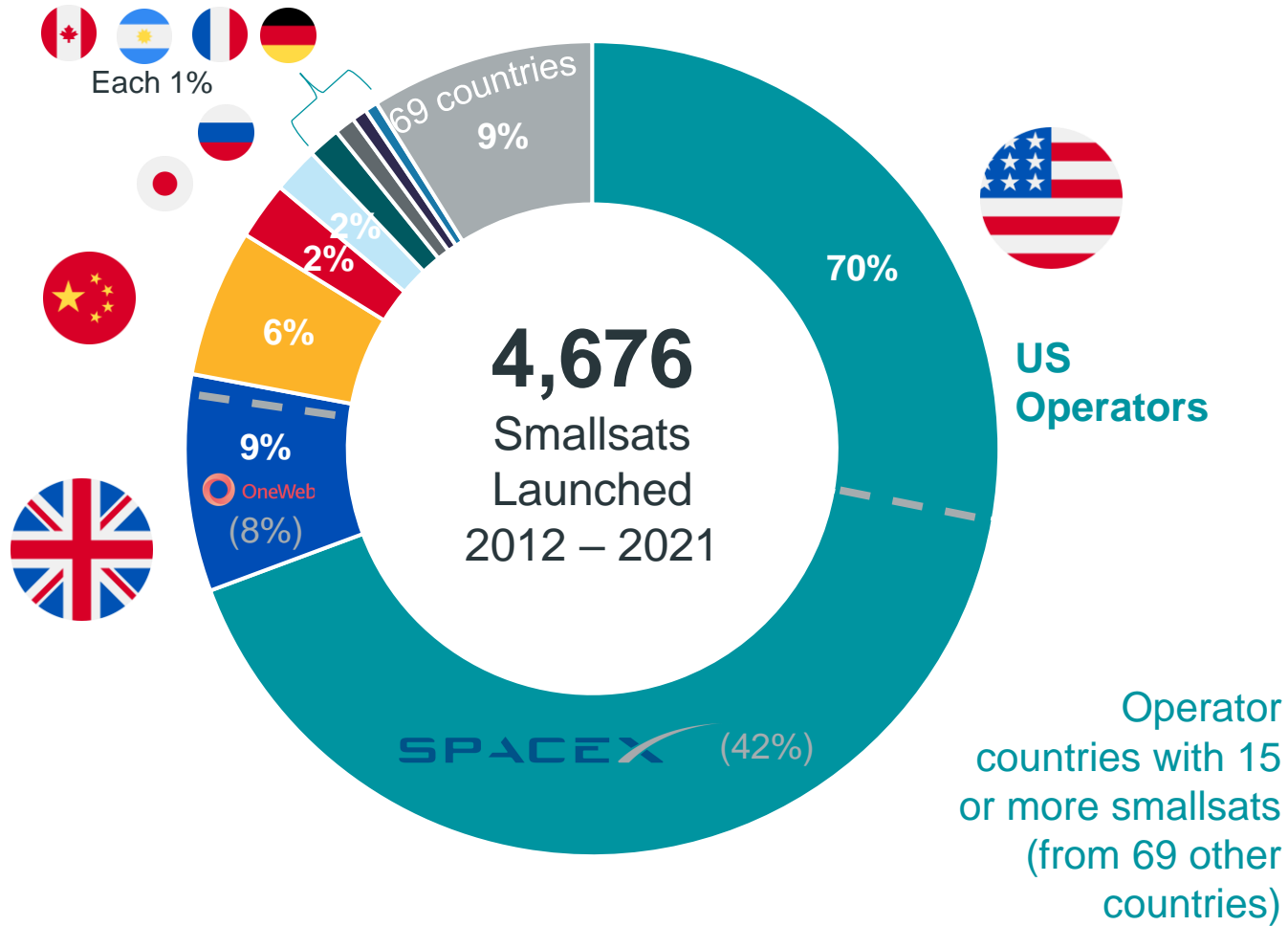


Commercial operators with more than 10 smallsats

Operator	# of Smallsats
SpaceX	1944
Planet	485
OneWeb	394
Spire Global	147
Swarm Technologies	121
CGSTL	33
Satellopic	25
ORBCOMM	19
Spacety	16
Kepler	15
BlackSky	14
Guodian Gaoke	14
Zuhai Orbita	12
Astrocast	12
ICEYE	12
Astro Digital	11

Smallsats 2012 – 2021, by Operator Country

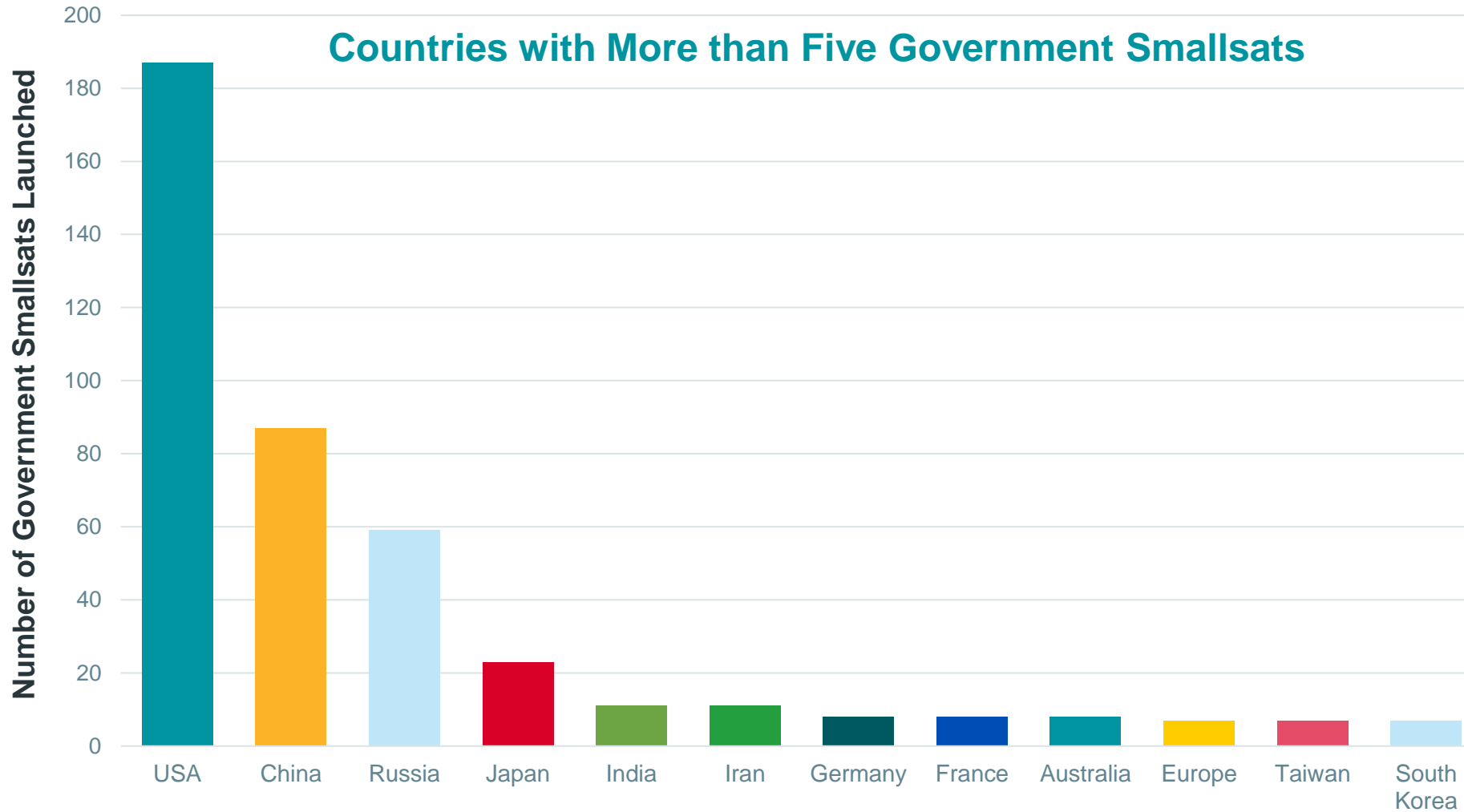
Smallsats in Context and Operator/Mission Type Trends



Operator Country	# of Smallsats
USA	3,241 (1,944 Starlink)
UK	421 (394 OneWeb)
China	274
Japan	107
Russia	85
Germany	60
Canada	38
Argentina	28
France	23
Australia	24
Italy	23
South Korea	21
India	21
Spain	19
Finland	18
Israel	17
Switzerland	15

Number of Government Smallsats 2012 – 2021, by Country

Smallsats in Context and Operator/Mission Type Trends



Five or Fewer Government Smallsats	
Norway	Canada
Israel	United Kingdom
Saudi Arabia	Algeria
UAE	Italy
North Korea	Ecuador
Poland	Sweden
Ethiopia	Turkey
Indonesia	Rwanda
Egypt	Netherlands
Spain	Slovenia
Belarus	Colombia
Malaysia	Kazakhstan
Brazil	Thailand
Mexico	Pakistan
Peru	Belgium
Vietnam	Argentina
Singapore	Philippines

Largest Government Smallsat Operators 2012 – 2021



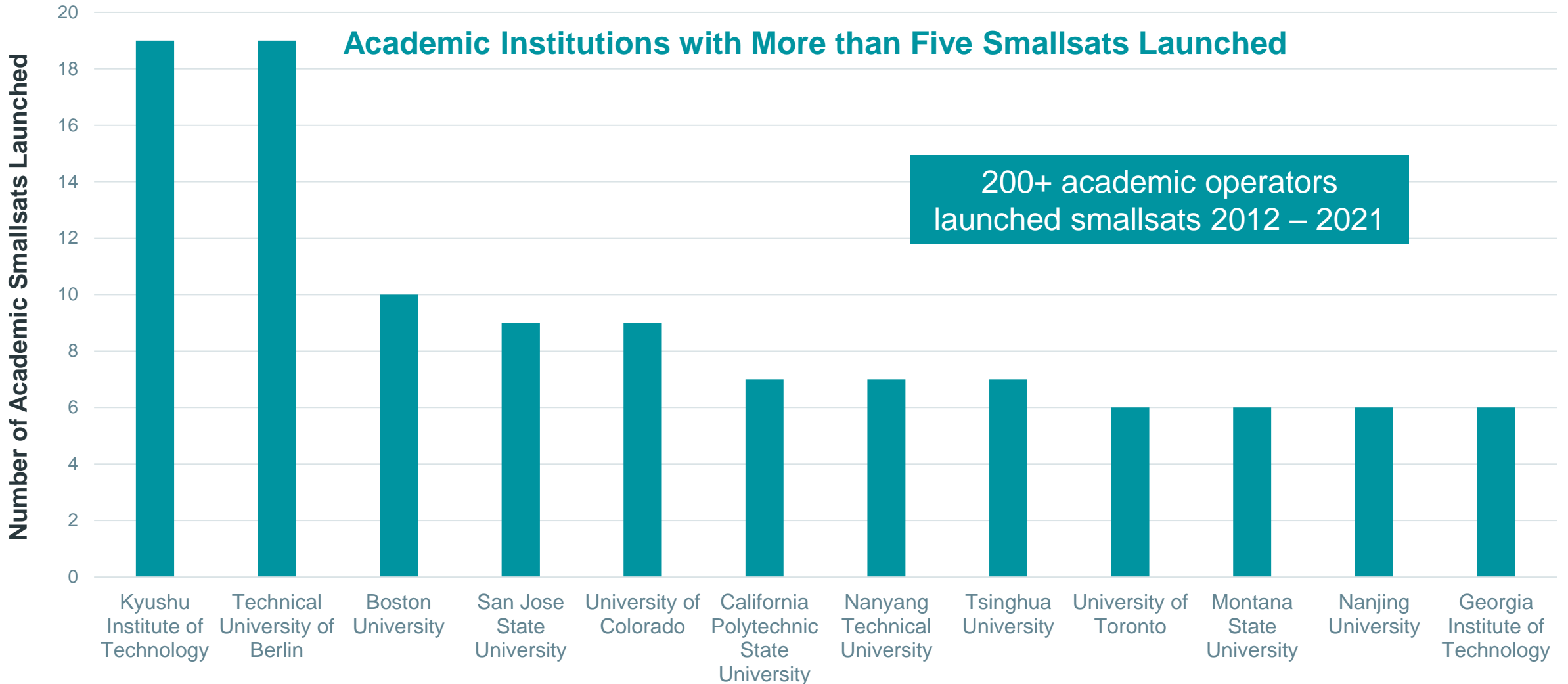
Smallsats in Context and Operator/Mission Type Trends

Type	15 Largest Government Operators <small>Open-Source Data</small>	Country	# of Smallsats Launched
Civil	National Aeronautics and Astronautics and Space Administration	USA	61
	Los Alamos National Laboratory (LANL)	USA	19
	Roscosmos	Russia	14
	Japan Aerospace Exploration Agency (JAXA)	Japan	12
	Gonets Satcom	Russia	12
	China National Space Administration (CNSA)	China	9
	Indian Space Research Organisation (ISRO)	India	9
	China Academy of Space Technology (CAST)	China	9
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	Germany	8
	Iranian Space Agency	Iran	8*
Military	US Department of Defense	USA	88
	Russia MoD/Aerospace Forces	Russia	23
	People's Liberation Army	China	20
	National University of Defence Technology (NUDT)	China	13
	National Reconnaissance Office	USA	11

*No successful deployments. BryceTech includes launched smallsats regardless of operational status

Number of Academic Smallsats 2012 – 2021, by Institution

Smallsats in Context and Operator/Mission Type Trends



Smallsats in Context and Operator/Mission Type Trends

Smallsat Mass Trends

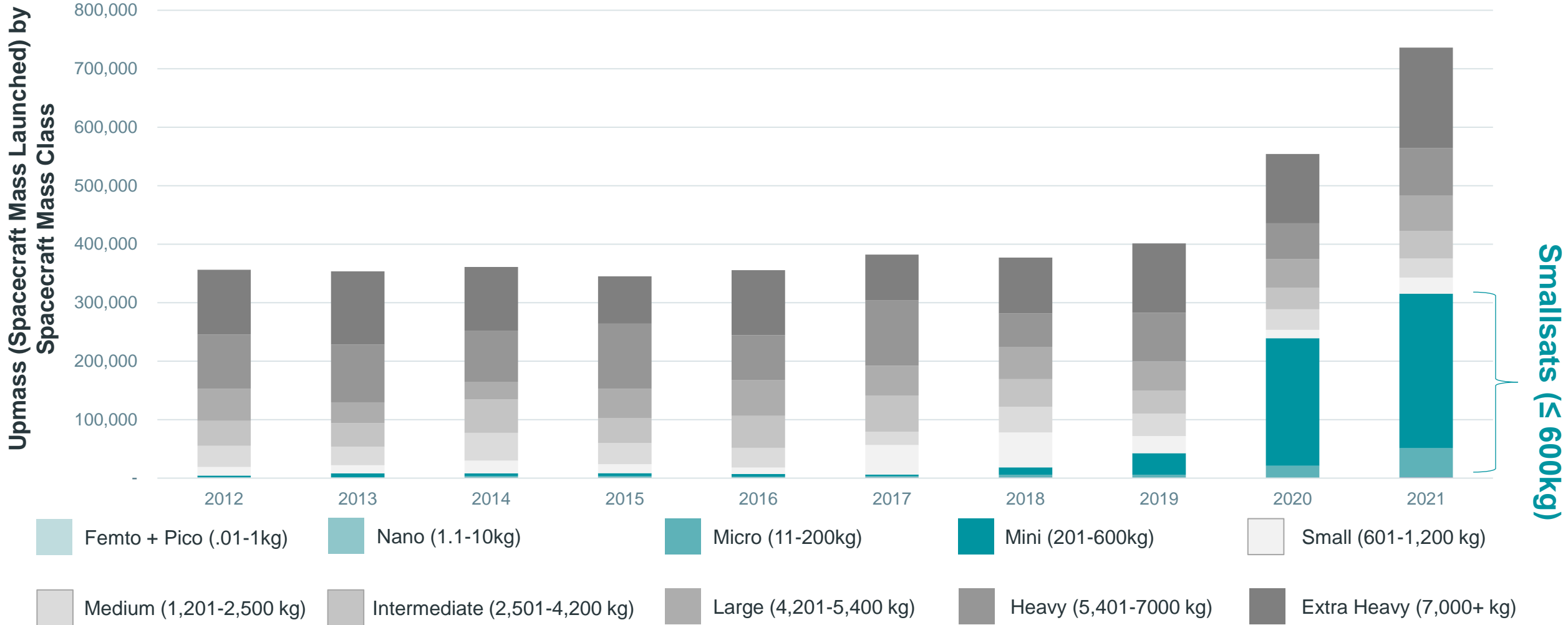
Smallsat Launch Trends

Looking Forward

Spacecraft Upmass by Spacecraft Mass Class, 2012 – 2021



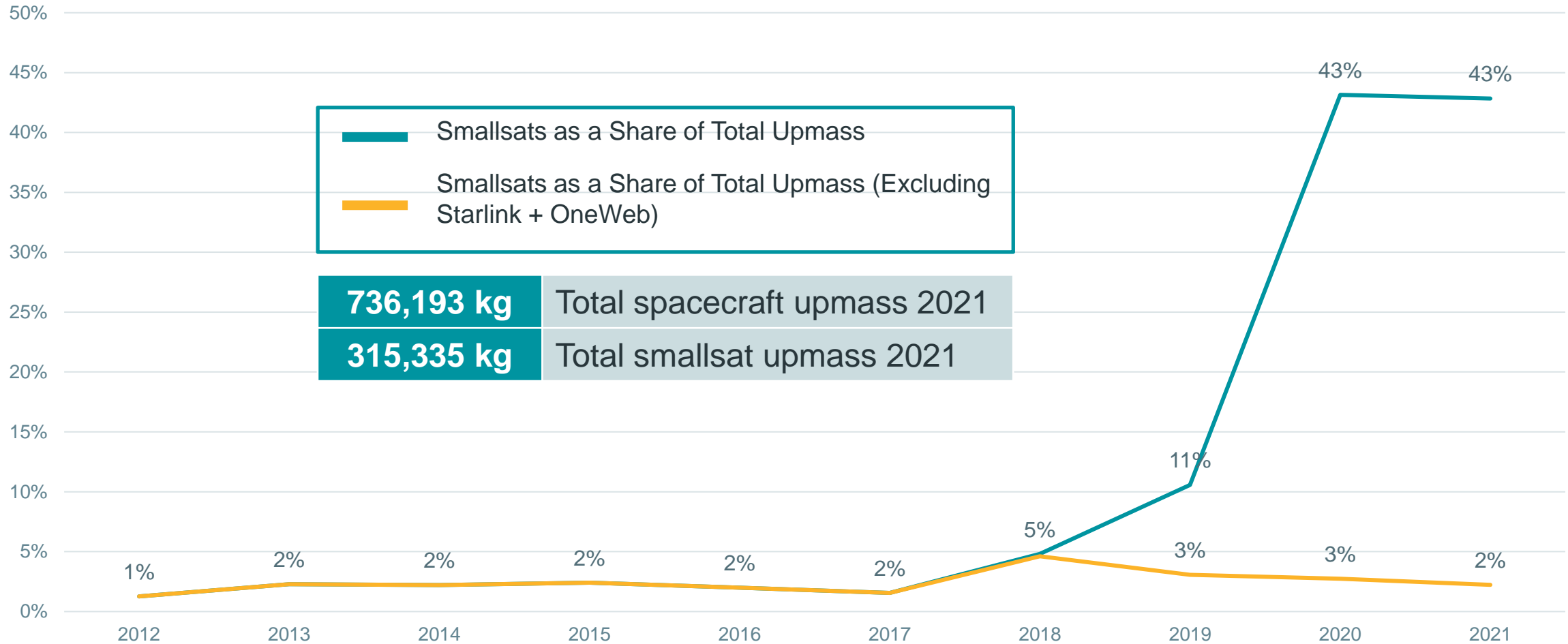
Smallsat Mass Trends



Smallsats as a Share of Total Upmass 2012 – 2021

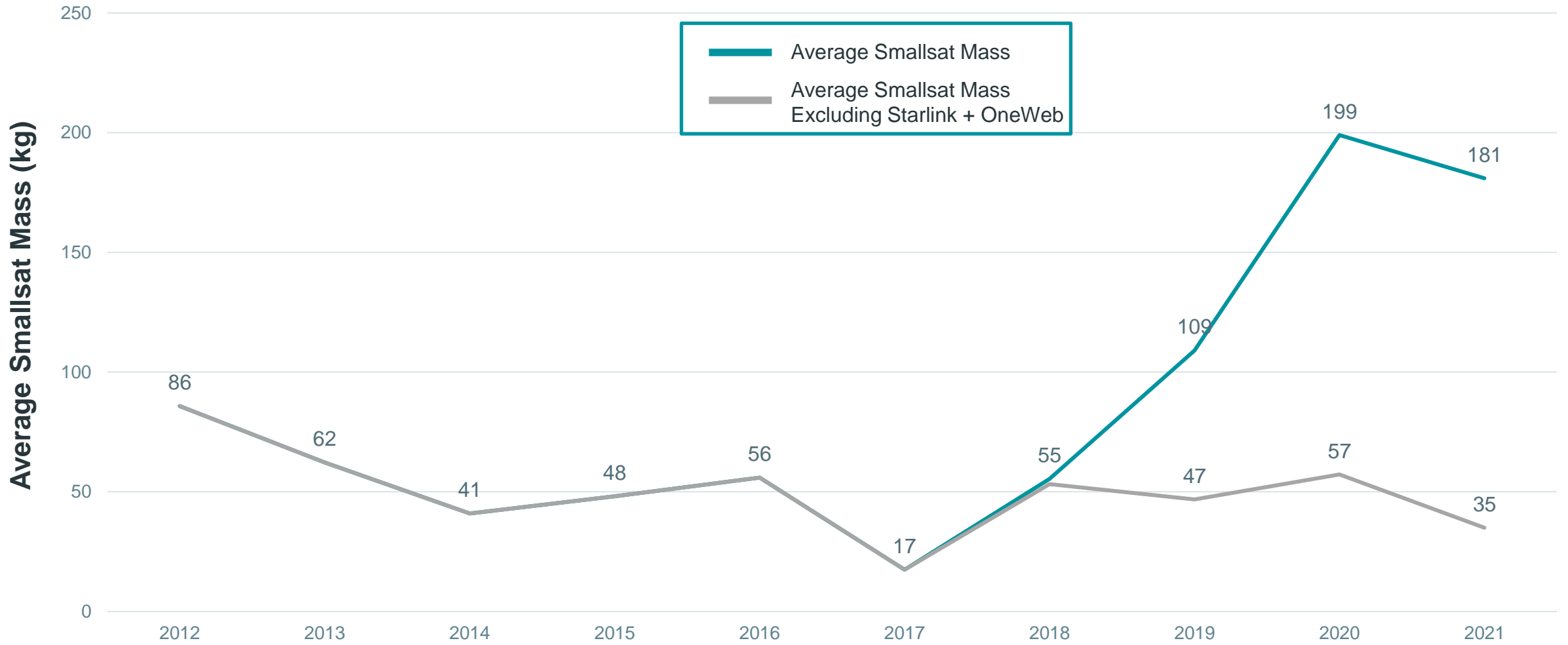
Smallsat Mass Trends

Share of Total Mass Launched



Average Mass, Smallsats 2012 – 2021

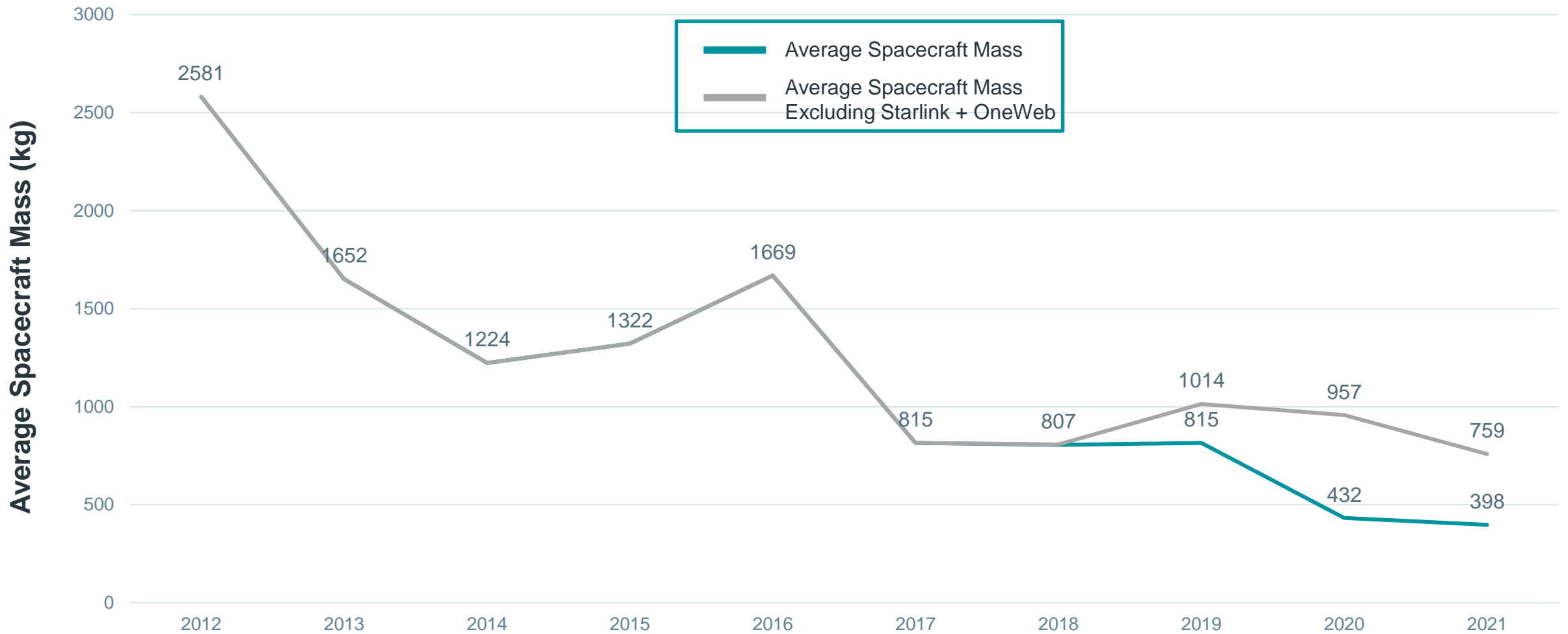
Smallsat Mass Trends



Average Mass, All Spacecraft 2012 – 2021



Smallsat Mass Trends



Deployment of large numbers of smallsats reduces the average of spacecraft mass

Smallsats in Context and Operator/Mission Type Trends

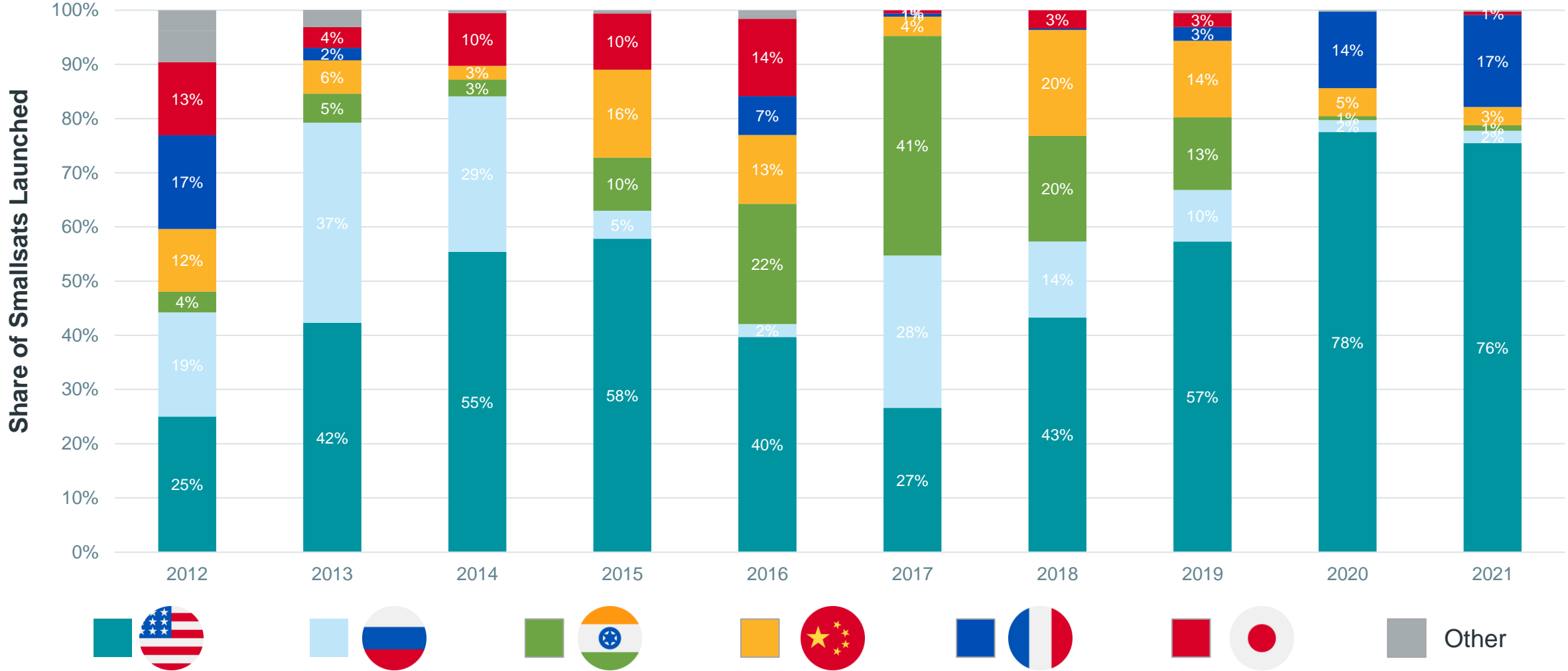
Smallsat Mass Trends

Smallsat Launch Trends

Looking Forward

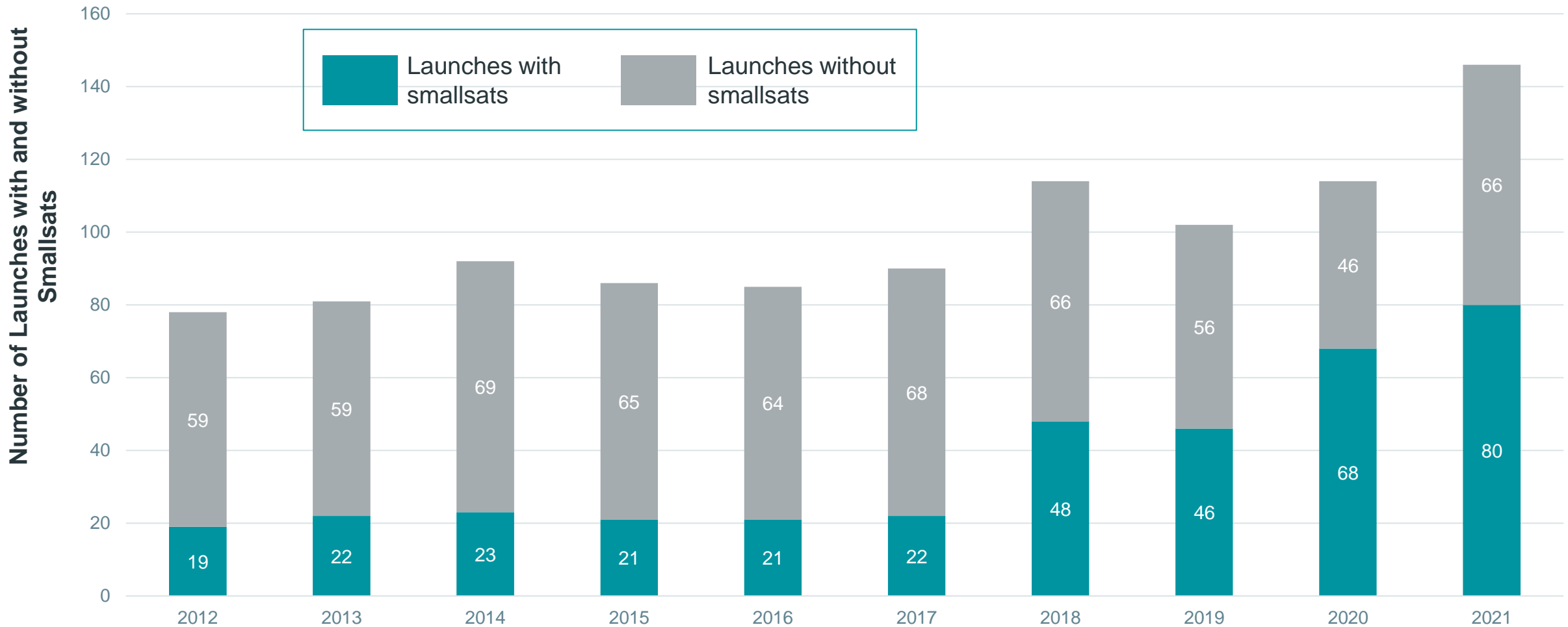
Smallsats 2012 – 2021, by Country of Launch Provider

Smallsat Launch Trends



Number of Launches With Smallsats 2012 – 2021

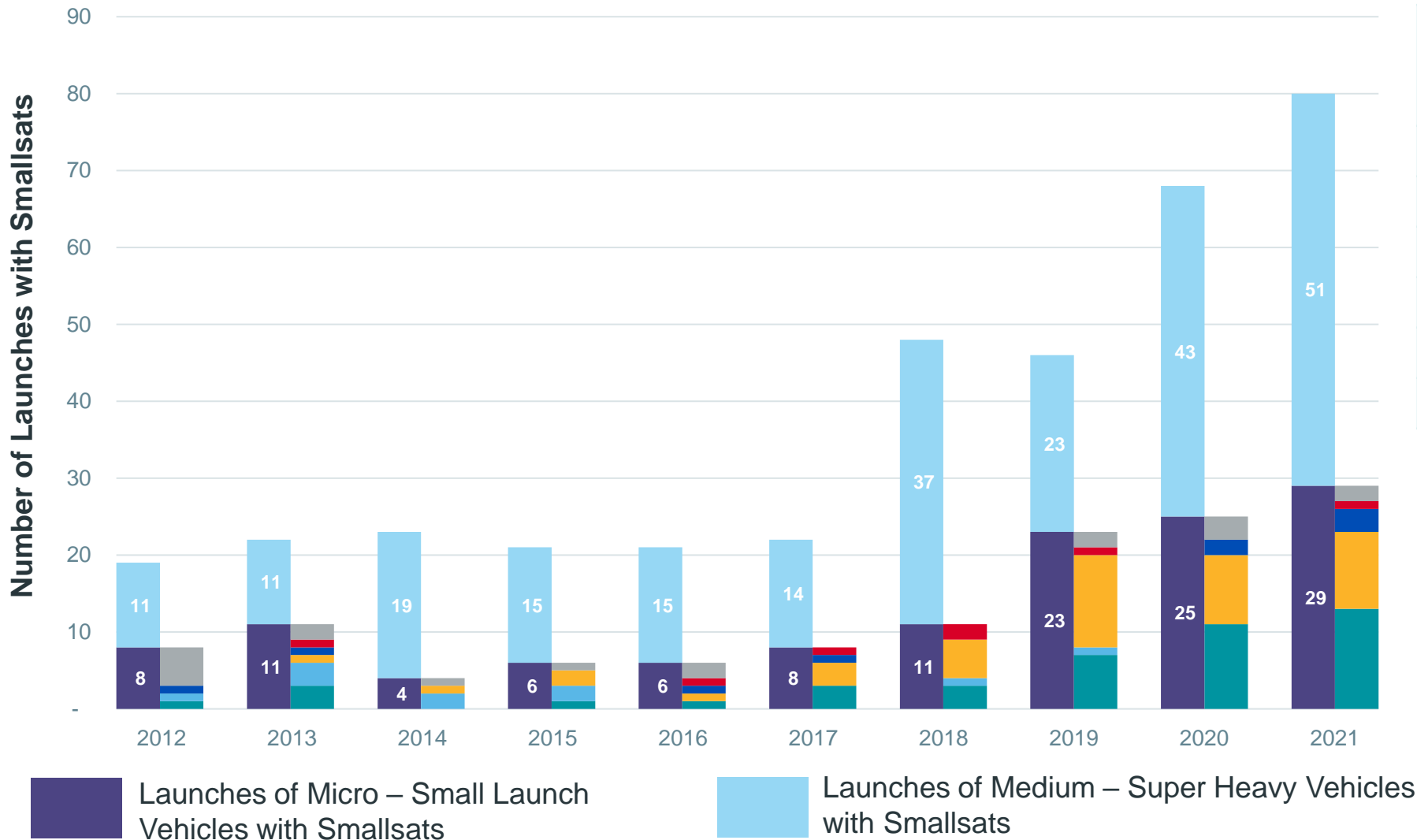
Smallsat Launch Trends



Number of launches that carry smallsats has generally increased over the 10-year period

Number of Launches with Smallsats 2012 – 2021, by Launch Vehicle Category

Smallsat Launch Trends

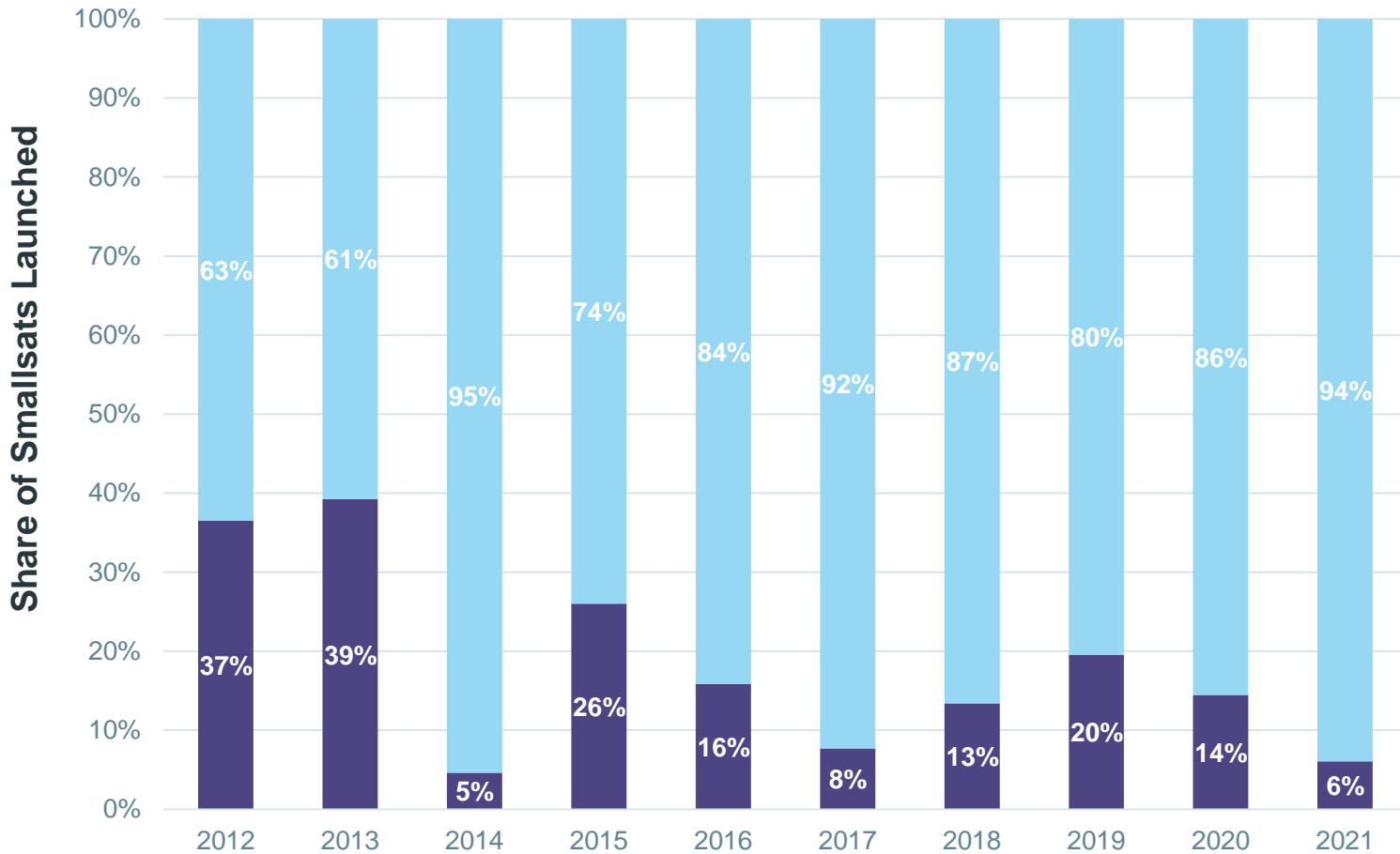


Launch Vehicle Category	Capacity (kg) to LEO
Micro	≤500
Small	500 – 2,268
Medium	2,269 – 5,443
Intermediate	5,444 – 11,340
Heavy	11,341 – 30,000
Super Heavy	>30,000



Share of Smallsats 2012 – 2021, by Launch Vehicle Category

Smallsat Launch Trends

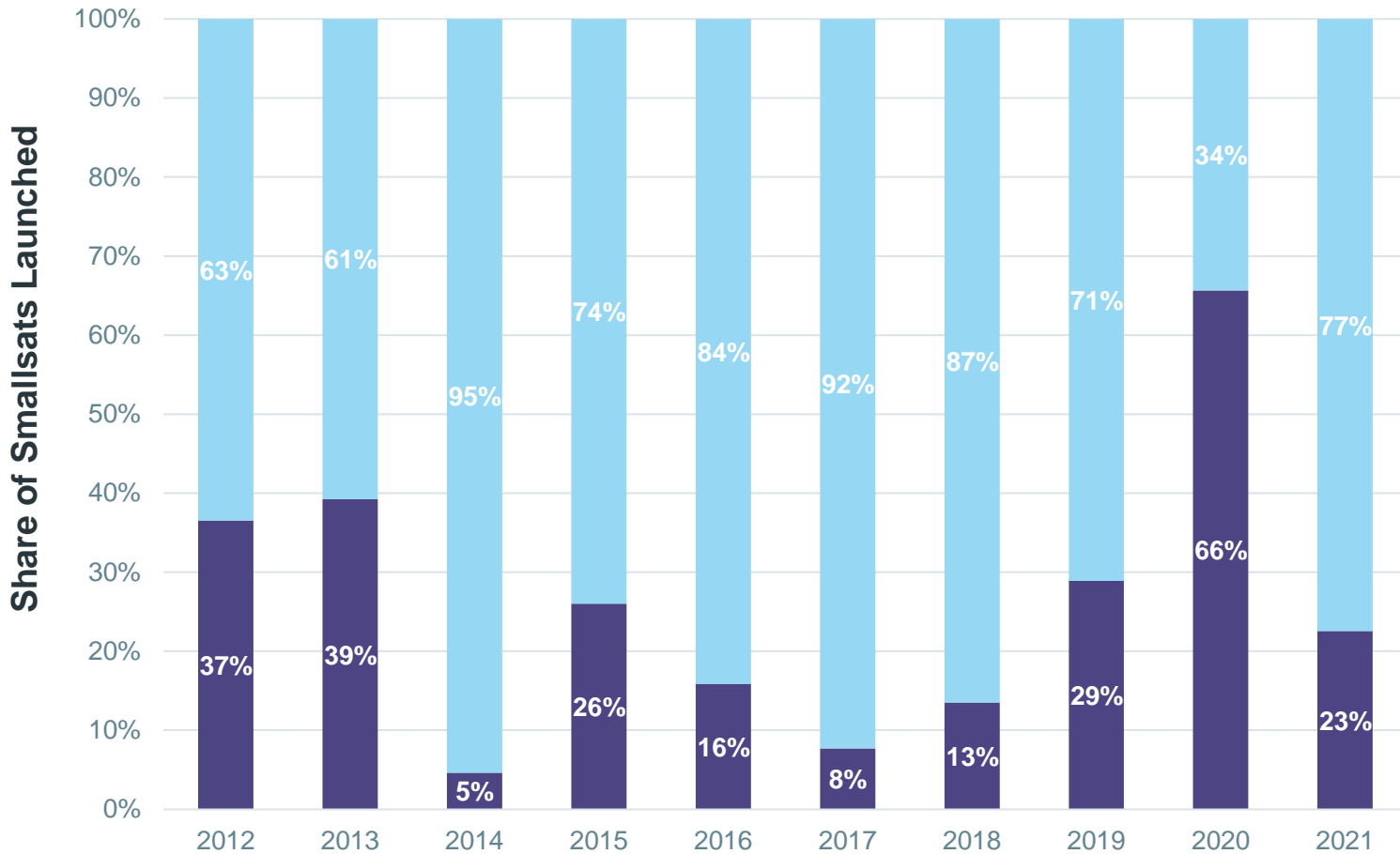


Launch Vehicle Category	Capacity (kg) to LEO
Micro	≤500
Small	500 – 2,268
Medium	2,269 – 5,443
Intermediate	5,444 – 11,340
Heavy	11,341 – 30,000
Super Heavy	>30,000

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

Share of Smallsats 2012 – 2021, by Launch Vehicle Category Excluding Starlink and OneWeb

Smallsat Launch Trends

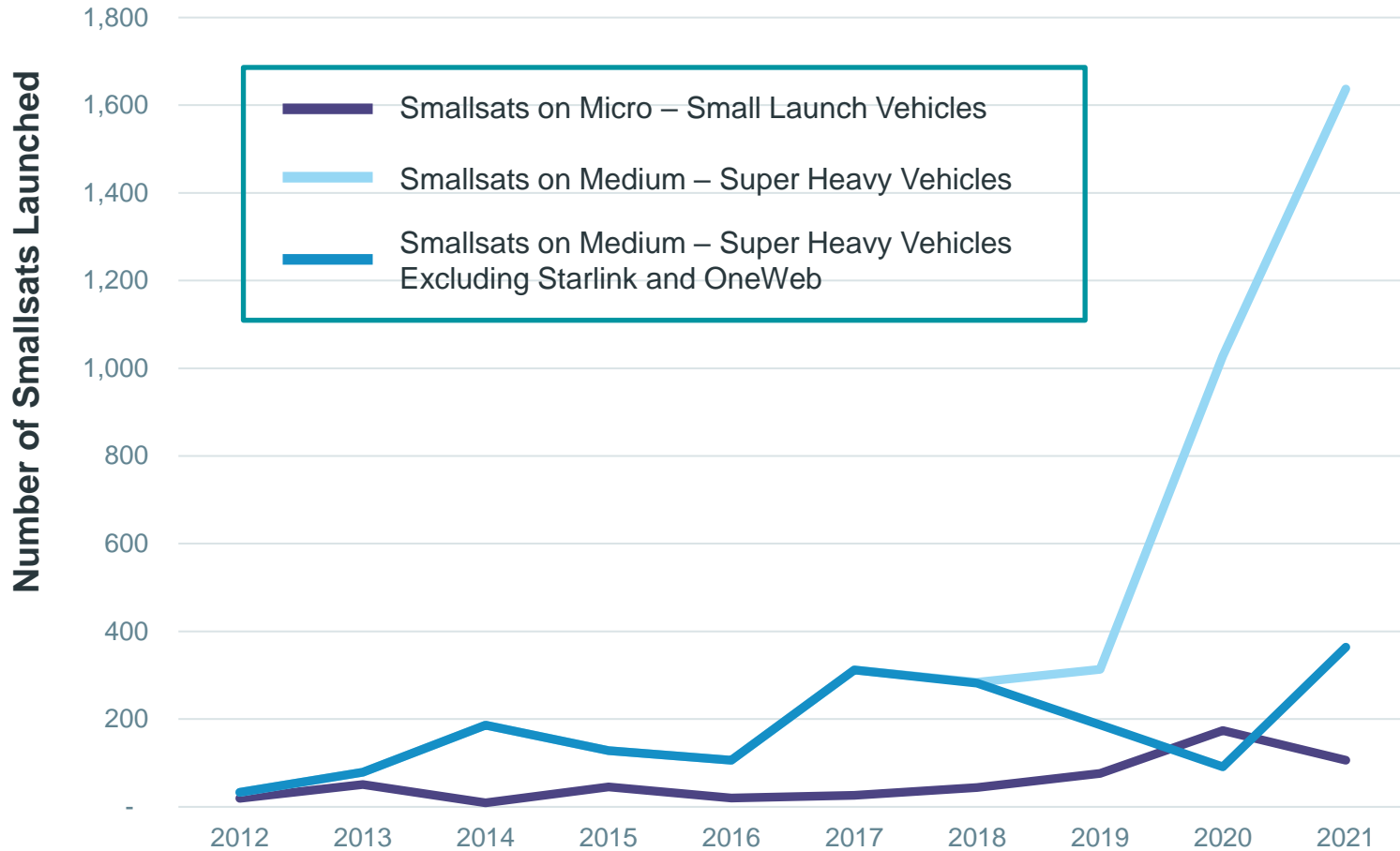


Launch Vehicle Category	Capacity (kg) to LEO
Micro	≤500
Small	500 – 2,268
Medium	2,269 – 5,443
Intermediate	5,444 – 11,340
Heavy	11,341 – 30,000
Super Heavy	>30,000

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

Number of Smallsats 2012 – 2021, by Launch Vehicle Category

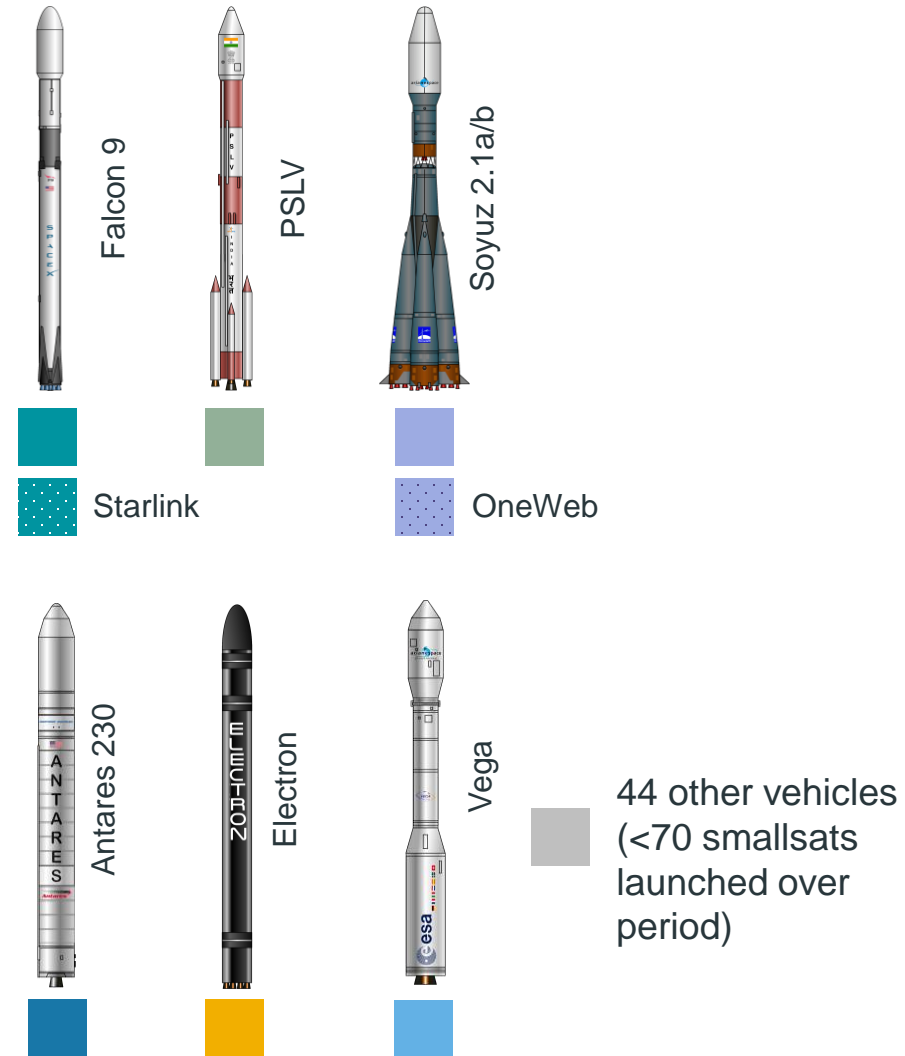
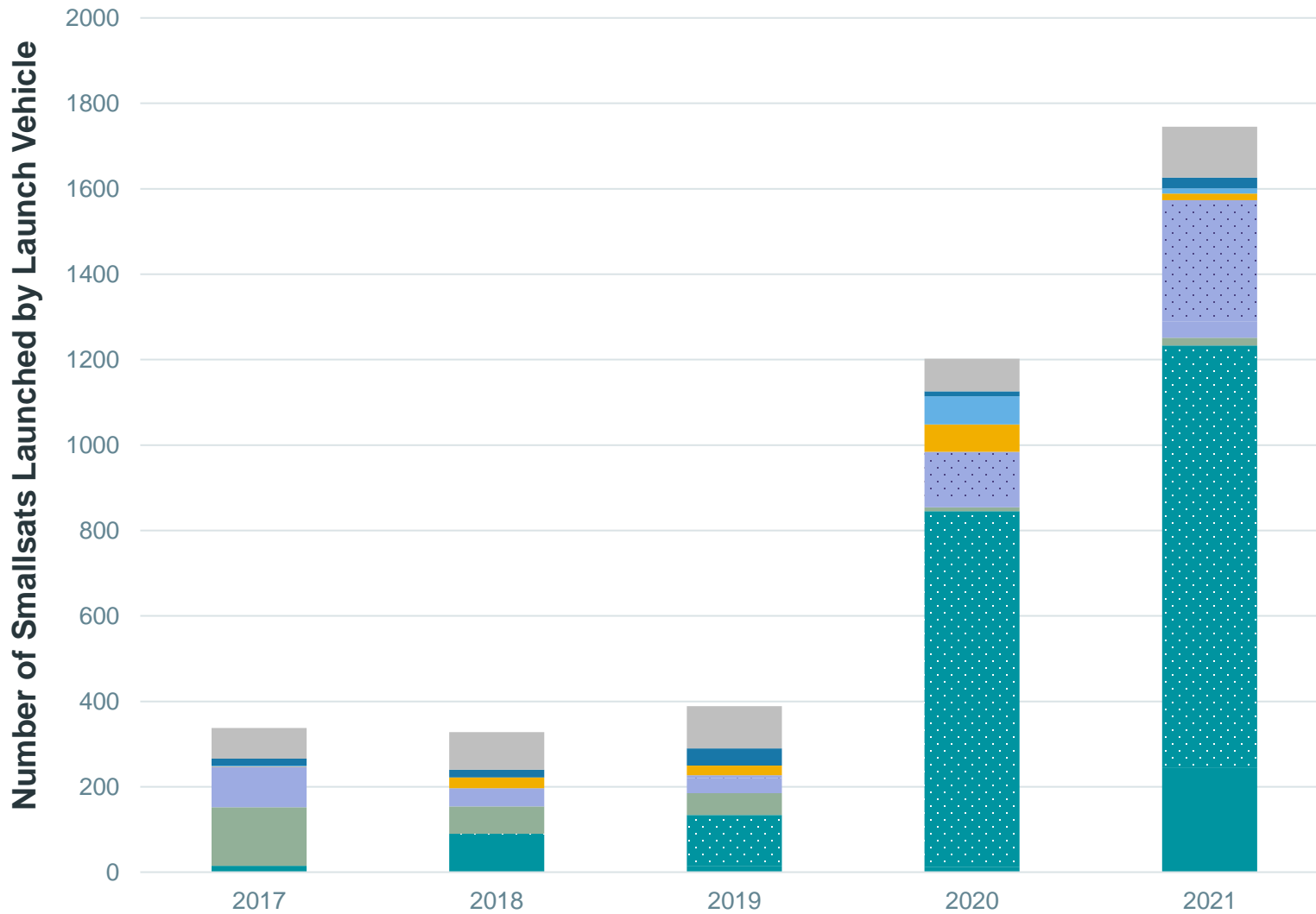
Smallsat Launch Trends



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 2017 – 2021, by Launch Vehicle

Smallsat Launch Trends



Smallsats in Context and Operator/Mission Type Trends

Smallsat Mass Trends

Smallsat Launch Trends

Looking Forward

Business Outcomes

Smallsat business ventures of all types continue efforts to prove both their business models and their ability to generate significant revenue. Financial outcomes of today's smallsat companies will impact the long-term smallsat market

Communications Megaconstellations

Smallsat telecommunications operators dominated smallsat activity in 2021 and are continuing deployments in 2022. Launch of these large constellations will influence smallsat activity in the next few years

Smallsat Launch Options

Smallsat operators have an increasing number of launch options including small launch and rideshare. Dozens of new small launch vehicles (many <500kg capacity) are in development to launch smallsats. Launch providers, especially medium – super heavy are increasing rideshare opportunities/initiatives to capture demand from smallsat customers

Government Use of Smallsats

Governments are increasingly seeking to leverage smallsats/including in architecture planning to augment existing capabilities

Smallsat Driven GEO/NGSO Integration

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

