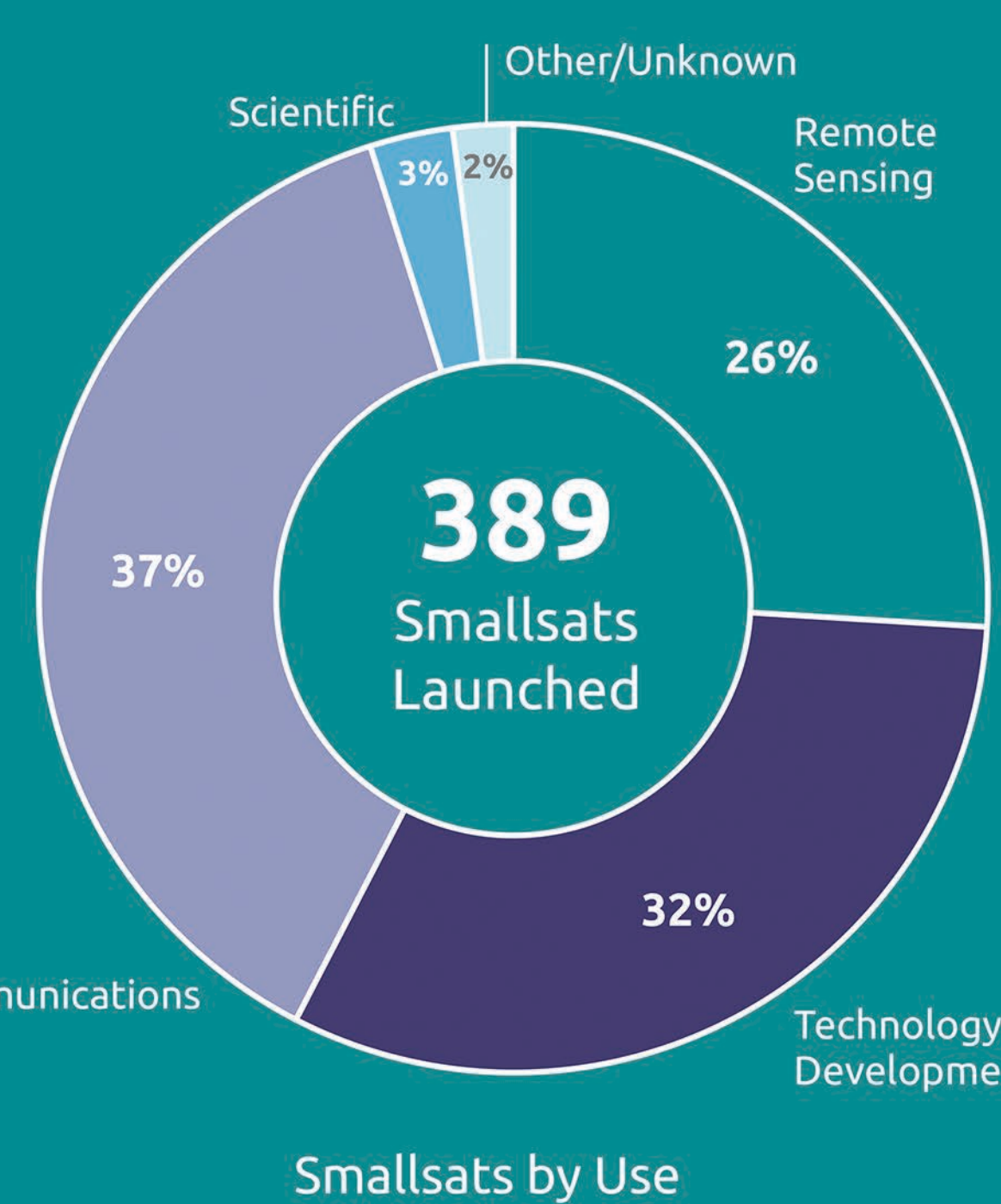


2019 Smallsat Highlights



109 kg

average smallsat mass, nearly 2x increase from 2018, 6x increase from 2017

45%

of launches included smallsats, nearly doubling from 24% in 2012

28

dedicated smallsat launches, almost half by China

57%

of smallsats launched by U.S. launch providers

Commercial Smallsats

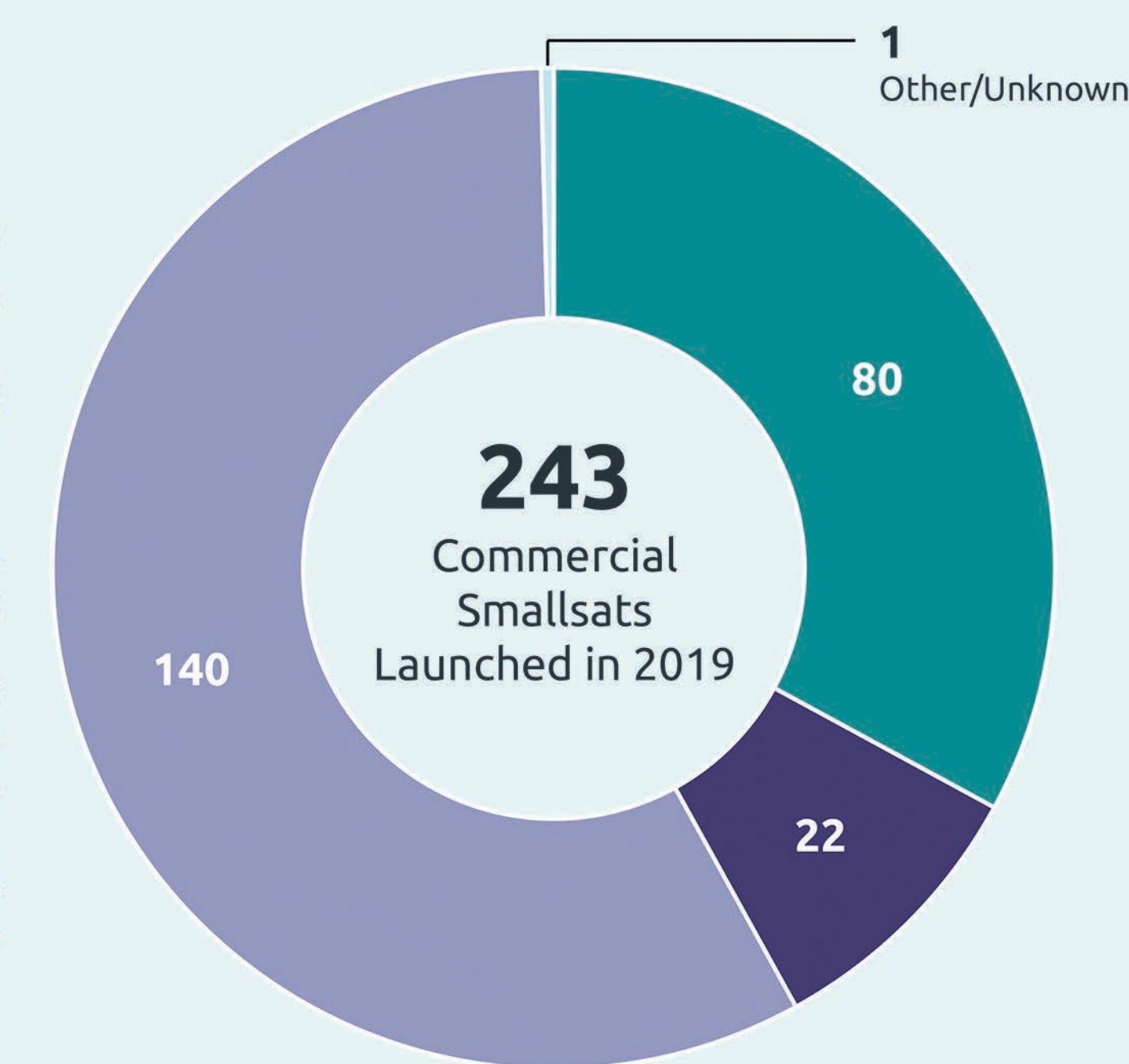
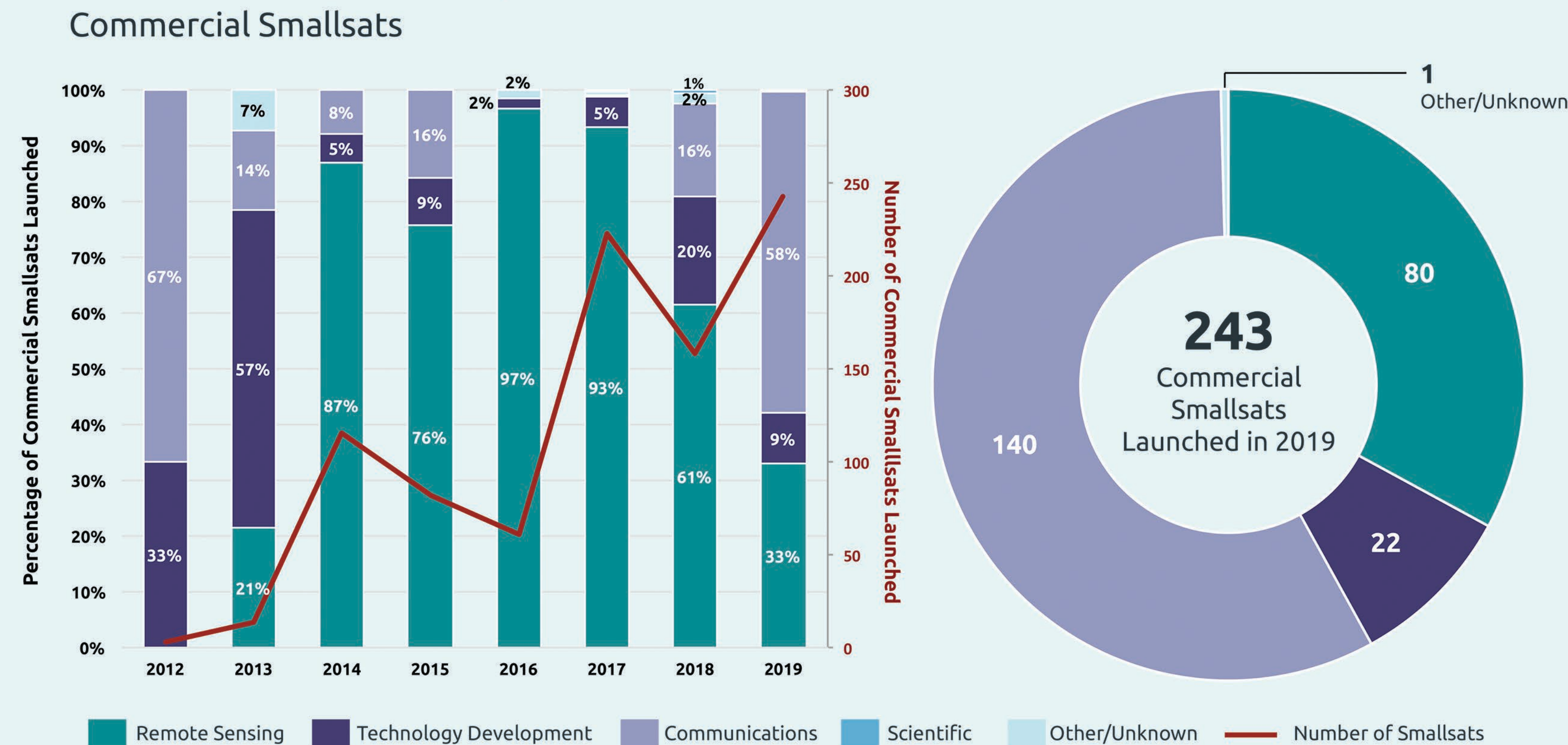
899 commercial smallsats launched, 2012 – 2019

68% for remote sensing

81% manufactured by U.S. companies

70% owned by Planet, SpaceX, Spire Global (largest smallsat operators)

Commercial Smallsats by Use



Smaller satellites are of increasing interest; more widely used in recent years

Bryce's Smallsats by the Numbers presents historical information on smaller satellites launched 2012-2019 (regardless of operational status)

Definition used here, 600 kg and under, reflects the five smallest mass classes defined by the FAA

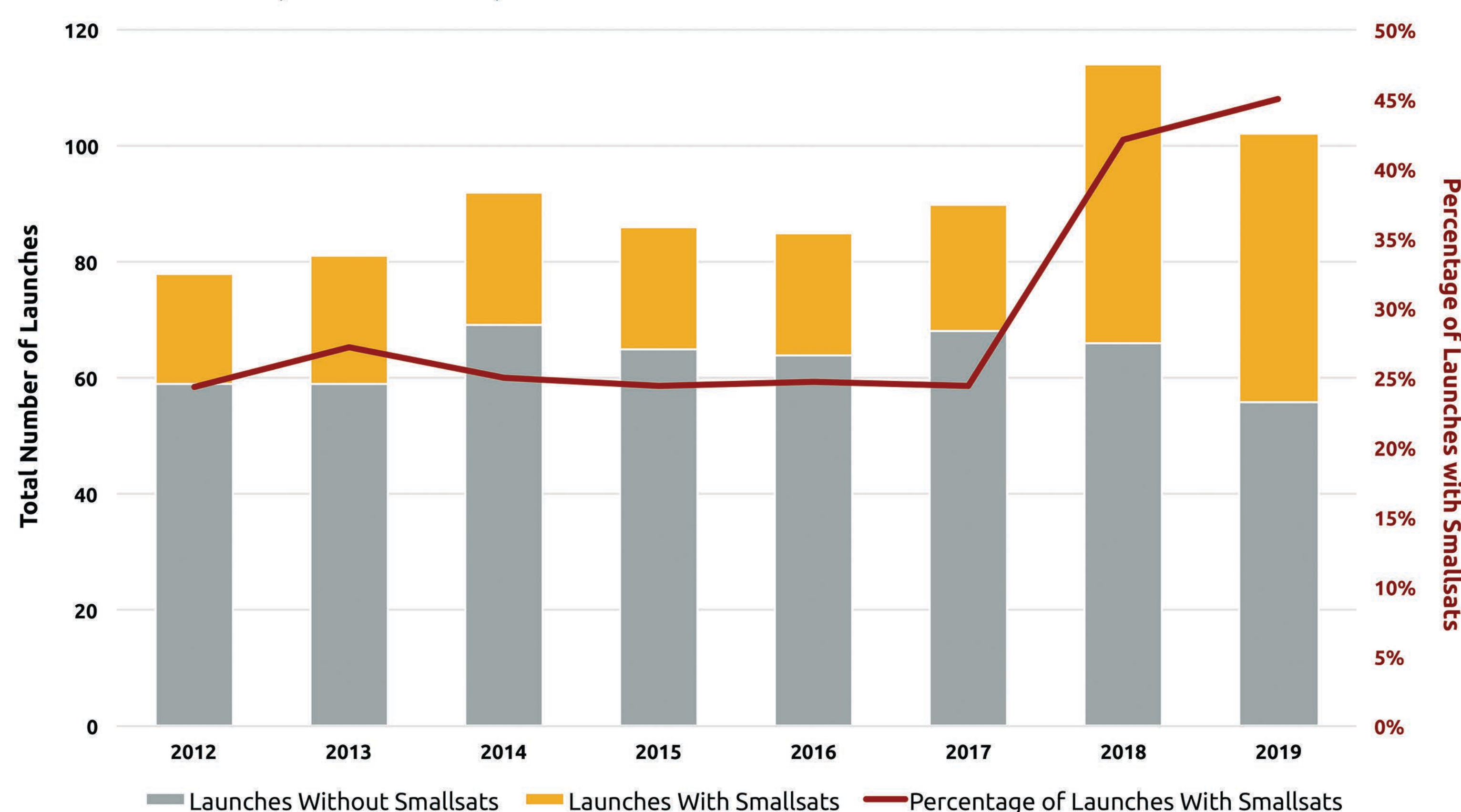
'Smallsat' or 'very small satellite' are often used to refer to smaller satellites

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

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

Percentage of Launches With Smallsats

Smallsat Trends (2012 – 2019)



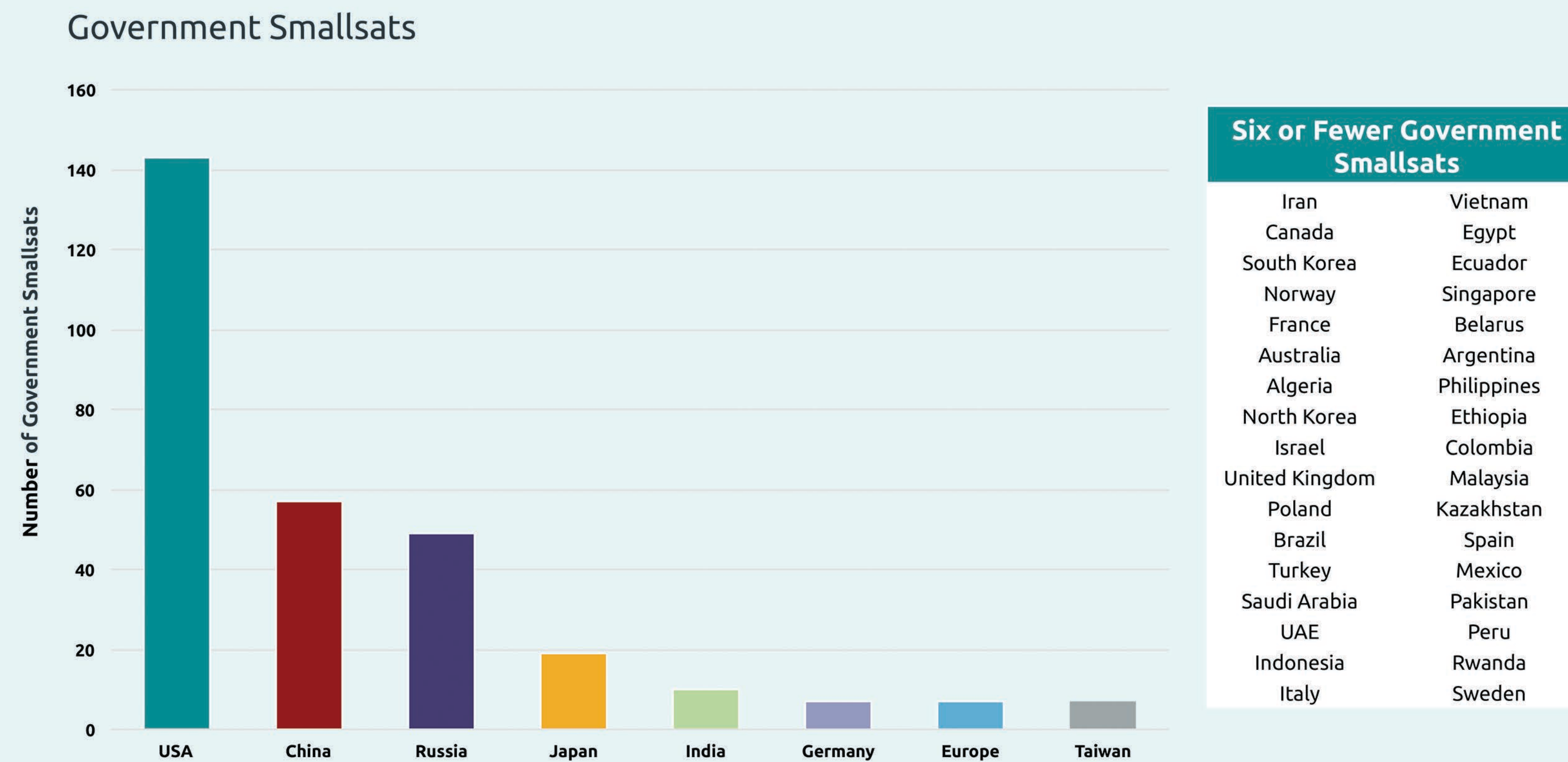
Government Smallsats

353 government smallsats launched, 2012 – 2019

38% owned by U.S. government (about 1/3 NASA)

42 governments (including Europe) own smallsats

Total Number of Government Smallsats (2012 – 2019)



Six or Fewer Government Smallsats	
Iran	Vietnam
Canada	Egypt
South Korea	Ecuador
Norway	Singapore
France	Belarus
Australia	Argentina
Algeria	Philippines
North Korea	Ethiopia
Israel	Colombia
United Kingdom	Malaysia
Poland	Kazakhstan
Brazil	Spain
Turkey	Mexico
Saudi Arabia	Pakistan
UAE	Peru
Indonesia	Rwanda
Italy	Sweden

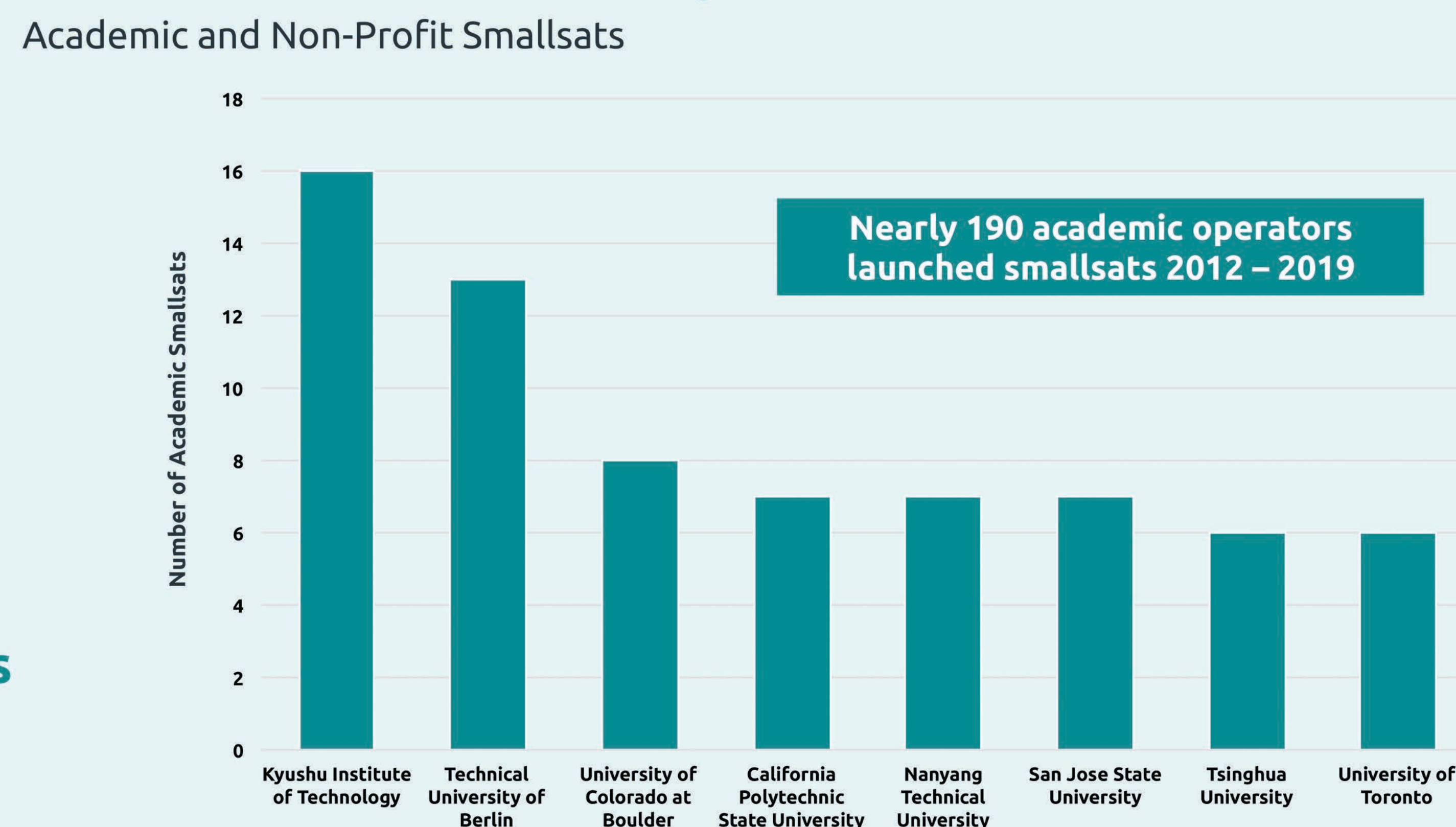
Academic and Non-Profit Smallsats

459 smallsats launched by academic (348) and non-profit (111) organizations 2012 – 2019

~80% for technology development

242 academic (189) and non-profit (53) organizations own smallsats (often only one or two)

Number of Academic Smallsats by Institution



LOOKING FORWARD: WHAT TO WATCH

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 Constellations

Smallsat telecommunications operators have said they plan to launch tens of thousands of smallsats. Initial deployment of these large constellations will dominate smallsat activity in the next few years

Small Launch Vehicles

Dozens of new small launch vehicles (many <500kg capacity) are in development to launch smallsats. Governments are increasingly interested in small launch vehicles. Among commercial customers, competition from larger vehicles and uncertainty in smallsat business cases will shape the market

Orbital Debris

Large smallsat constellations raise concerns about orbital debris. How businesses and policy makers respond to debris risk will be a trend to watch in 2020