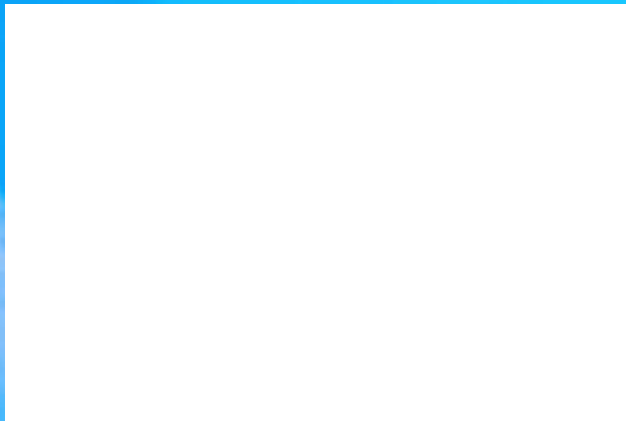


Laura Appolloni

Ground Systems and Operation at ArianeWorks



THEMIS TEST AT ESRANGE SPACE CENTER

SPACE INNOVATION FORUM



1ST DEC 2021

LAURA APPOLLONI



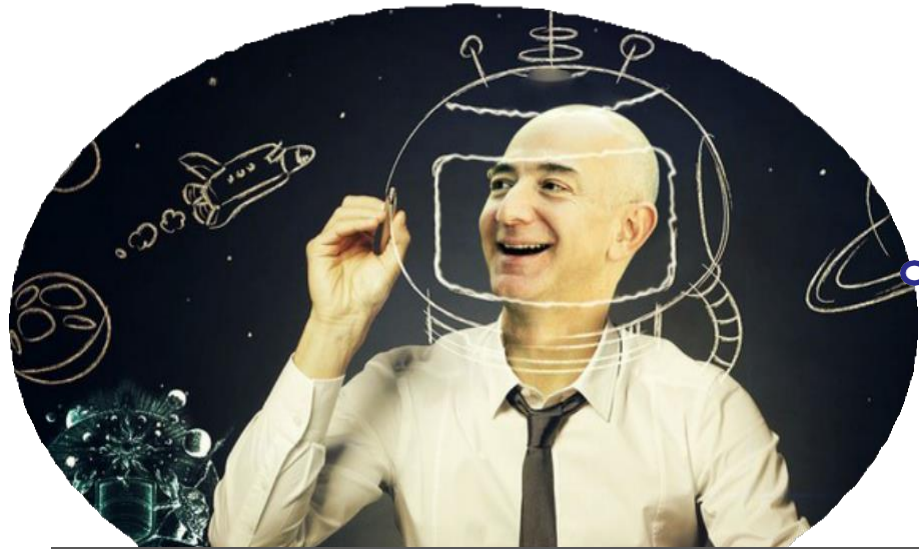


ROCKETRY IN THE 2020_{IES}

FACING AN INNOVATION
WAVE OR A TSUNAMI ?



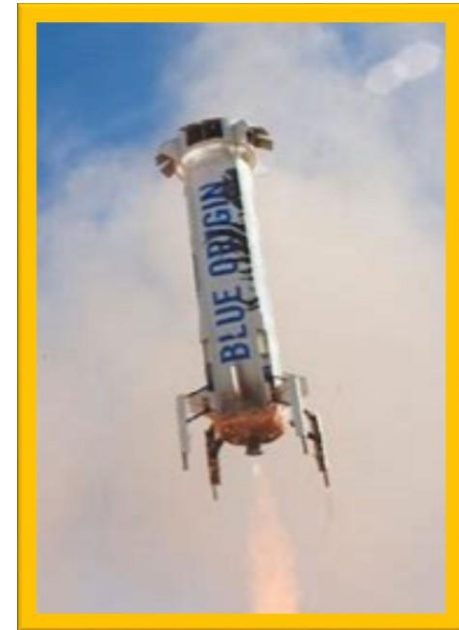
Space is not a Government prerogative anymore



Jeff Bezos

Founder and CEO of Amazon, 3rd richest man on Earth (> 82 B\$) Blue Origin space company founder

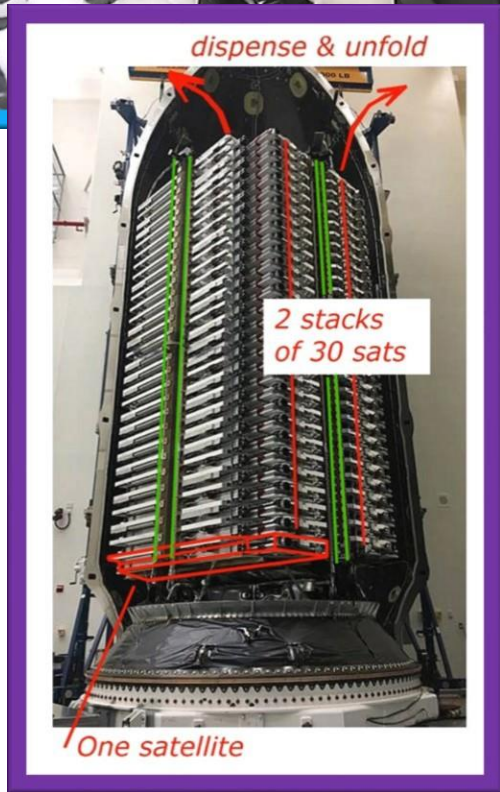
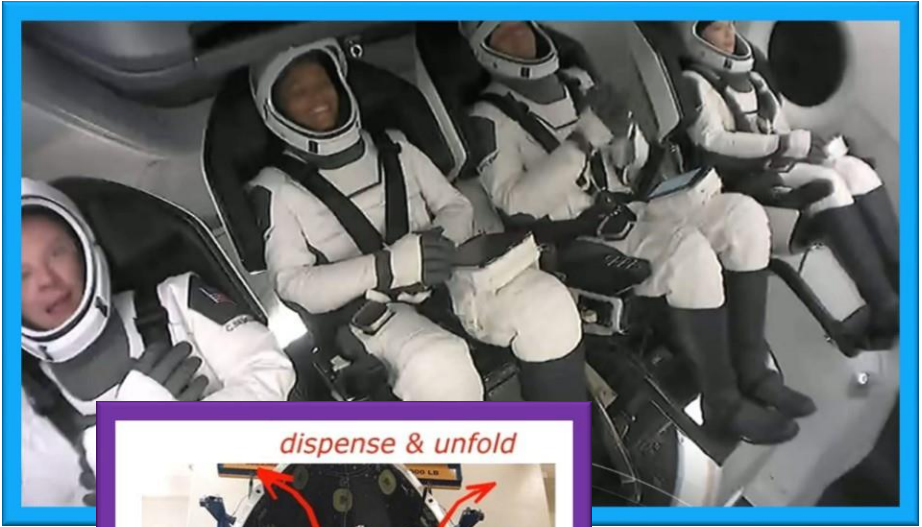
*I believe that this is a new **golden age** of space exploration, I think the first golden age was the 60s. And I think we have been treading water for a long time. And what you're beginning to see now is that some new things are coming out and I'm very, very excited about that.*



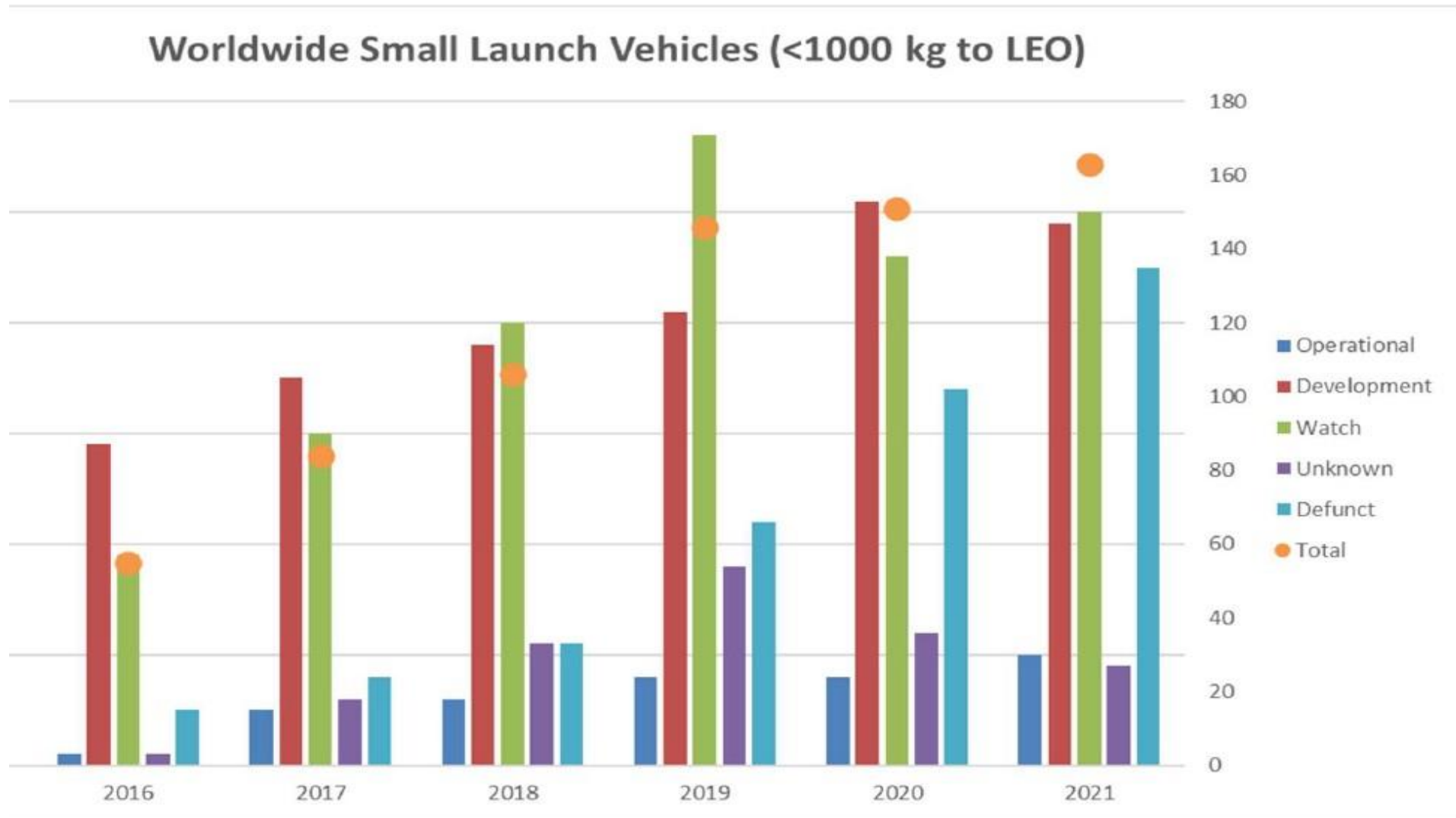
Saturday 4 November 2017 8:49am

Jeff Bezos sells off a million Amazon shares for \$1.1bn to fund Blue Origin space ambitions

SpaceX tempo shaking space standards



Smallspace blossoming : >100 private newcomers



Source: C.G. Niedestrasser-IAC-21, D2, 7, 2, x67121

Figure 5: Growth of the Small Launcher Market 2015-2021

China, India...US is not the only region moving forward

India launches powerful new rocket

Advanced satellite launch vehicle will free India from the need to buy launch slots from other countries in future



THE TIMES OF INDIA
INDIA

News » India News » Plan to largely privatize PSLV operations by 2020: Isro chief

Plan to largely privatize PSLV operations by 2020: Isro chief

Srinivas Laxman TNN | Updated: Feb 15, 2016, 10:46 IST

MUMBAI: In a revolutionary change in India's space scenario, the operation of Isro's workhorse — the four-stage Polar Satellite Launch Vehicle (PSLV) — will be largely privatized in four years.




Les ambitions orbitales de Zhang Changwu, l'Elon Musk chinois

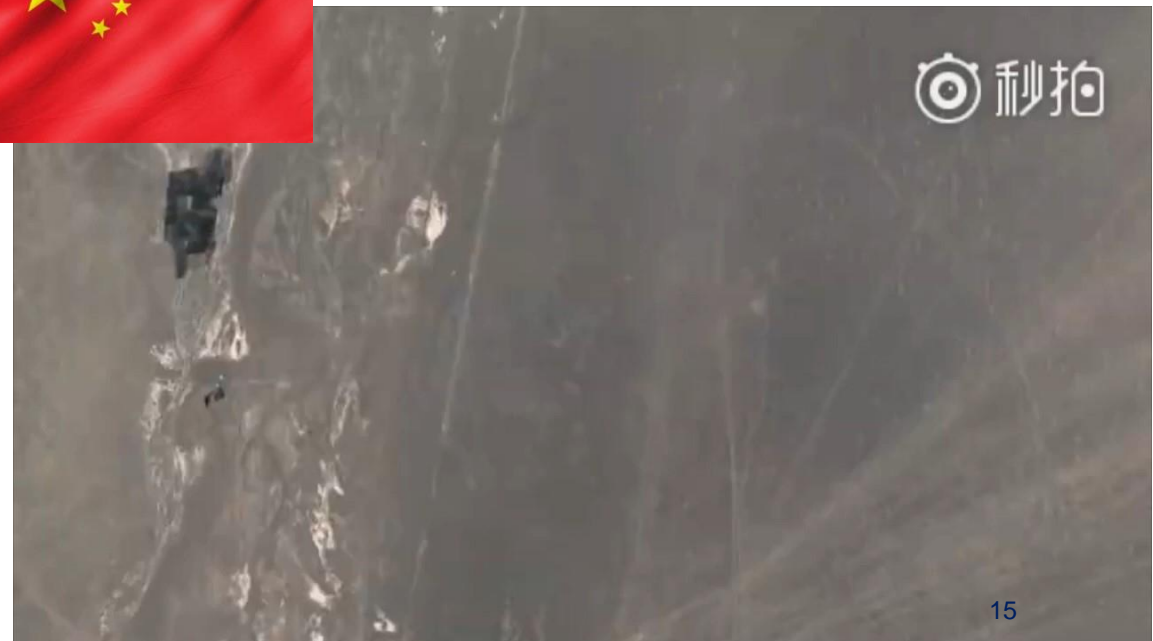
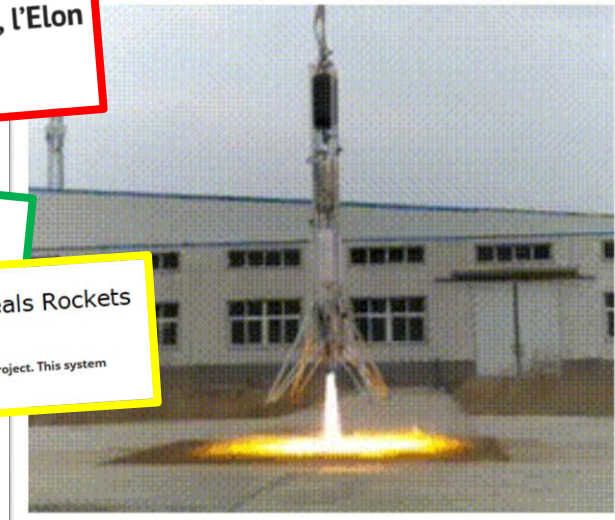
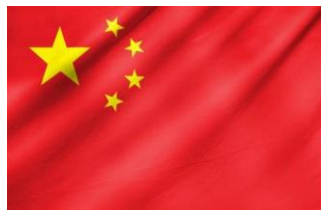
Le Figaro 25 nov. 2017 CYRILLE PLUYETTE @CyrillePluyette CORRESPONDANT À PÉKIN

EXPACER Raises \$182 Million for Small Satellite Launchers

December 20, 2017 Doug Messier News

Breaking SpaceX: China's LinkSpace Reveals Rockets That Are Reusable

Another cost-effective launch system is on its way as LinkSpace unveils its new project. This system development attempts to break the monopoly of SpaceX.





ARIANEWORKS

FAST TRACKER, PATHFINDER, ENABLER



Ariane turning 40 at a pivotal moment



Gwynne Shotwell, SpaceX
(at Centrale Supélec, 2019)



You 'd better disrupt your own business before someone else does it for you

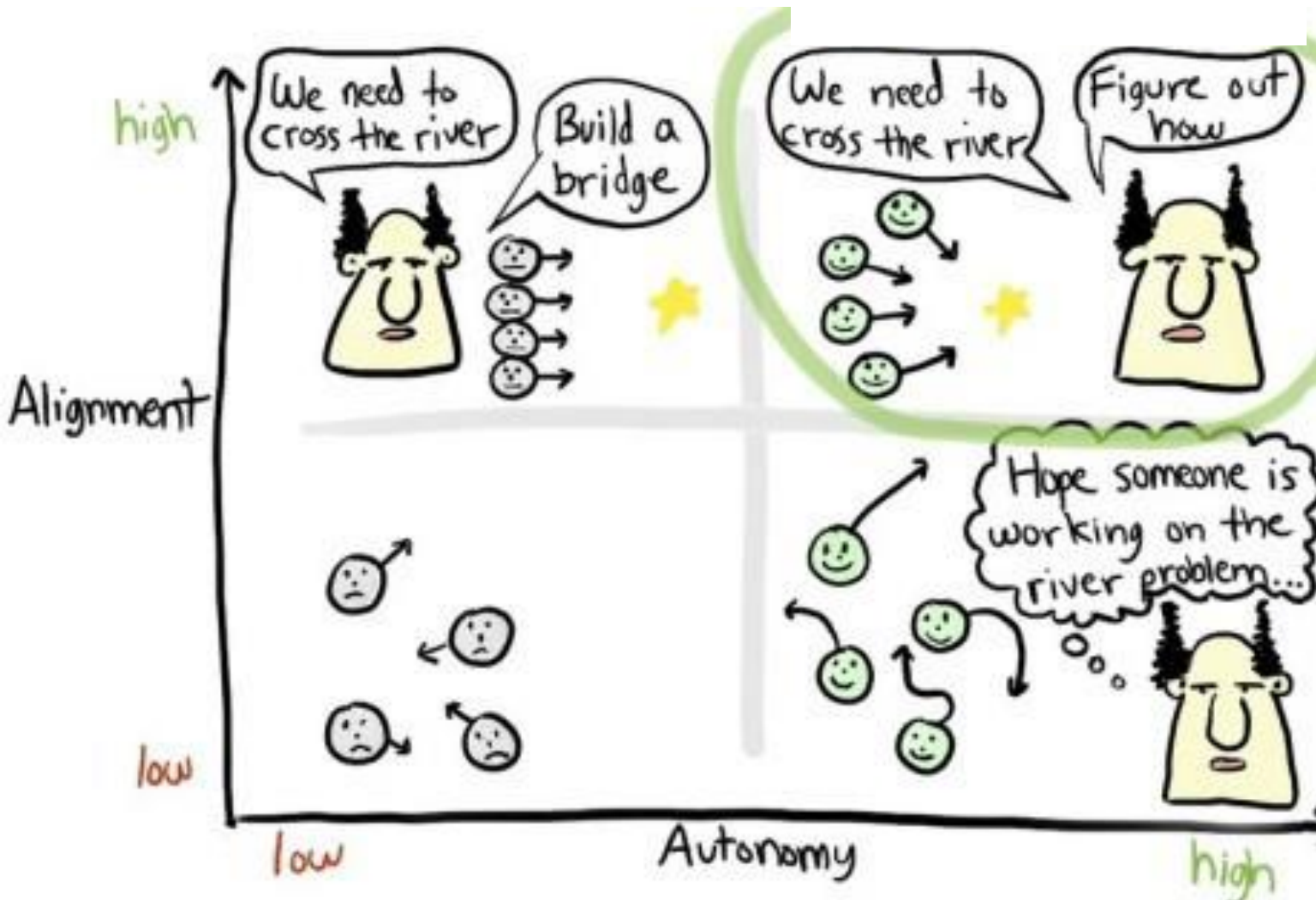


We're entering an era where there will be only two kinds of space companies : the quick and the dead



Pr. Jacques Blamont, CNES
(at CNES prospective circle, 2014)

We're a pathfinder innovation unit



- ✓ Strategic alignment to Europe space strategy
- ✓ Sponsored/supported by real enabling players
- ✓ Highly autonomous
- ✓ Bold and dary
- ✓ Happy & smiling !

Intra-preneur, operation «as if» an SME



ENABLING & SUPPORT

ESA plans demonstration of a reusable rocket stage

15/12/2020 22264 VIEWS 148 LIKES

ESA / Enabling & Support / Space Transportation

ESA is taking the first steps towards the in-flight demonstration of a prototype reusable rocket first stage called Themis from 2023.

Ressources from CNES & ArianeGroup seed funding + a first contract from the European Space Agency + opportunities we're hunting by ourself



COMMUNIQUÉS

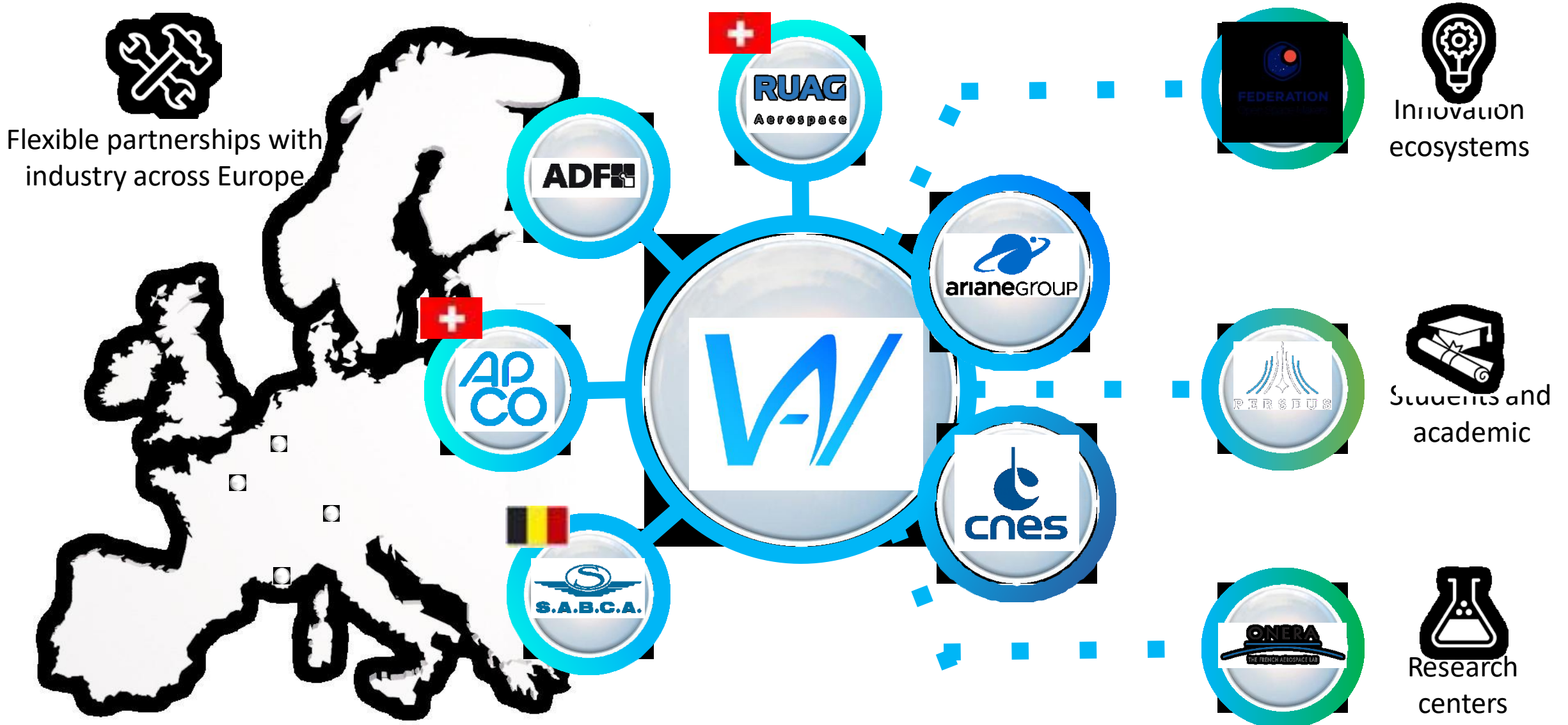
12 OCTOBRE 2020

La Région Nouvelle-Aquitaine soutient ArianeWorks



Small & experienced team (15) supported by CNES & ArianeGroup backoffices when it comes to hardcore engineering, knowledge base or facilities

ArianeWorks : plateforme open innovation



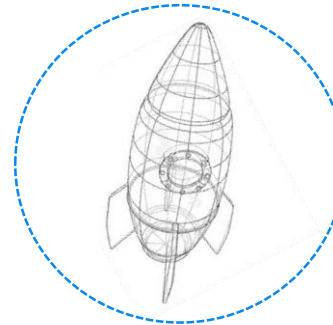
Our added value in the Ariane ecosystem



Innovation LAB



Accelerating high values ideas for the Ariane community, mainly through hardware demo



rocket science engineering on projects we have been tasked to boost

Prototyping WORKSHOP



Space ecosystem CATALYST

Exploring new opportunities or business around our skills





THEMIS

HIGHLIGHTS SINCE 2019



Inspiring European vision for the 2030ies




Up and running great!




-40%
improvement



Upper stage de-orbit,
Spaceport smart energy



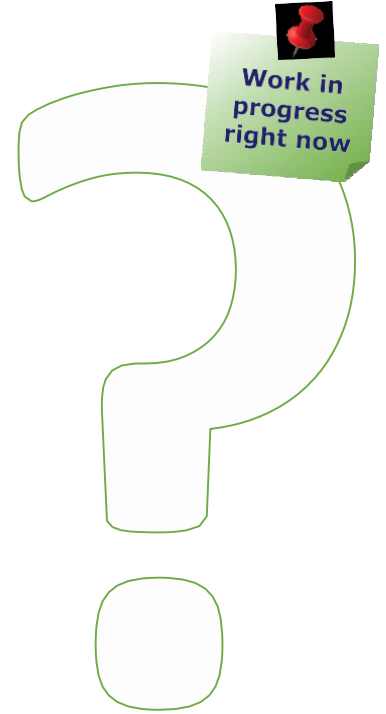

Coming soon



-50%
improvement



-40%
CO₂ impact




Work in progress right now

Ariane 5 / Vega / Soyuz
1996 → 2023

Ariane 6 / Vega-C
2020 → ?

Upgraded EU Fleet
~ 2030

THEMIS as key enabler along this vision




Critical step in the European roadmap



FROG
Early sandbox approach

2019-2021



PROMETHEUS
Low cost reusable 100T rocket engine



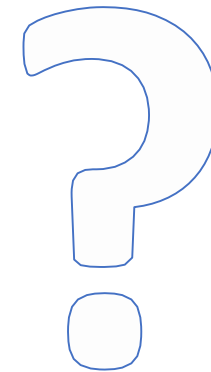
CALLISTO
First reusable testbed

2021-23



THEMIS
Low cost stage / large reusable demonstrator

2020-2025



ARIANE NEXT
Future European space fleet

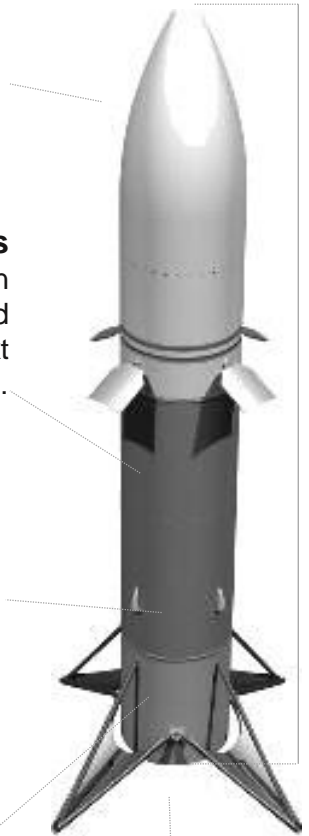
2030+

Avionics
Modular avionics, Wireless communication, autonomous safety, flight algorithms...

Tanks
Standardized structures, common bulkhead, crossing line, no cold thermal protections, low cost next gen fluid equipment...

Recovery systems
Aero devices, landing systems, health monitoring systems...

3 x Prometheus
1 000kN Oxygen / Methane, low cost, reusable, deep throttling...



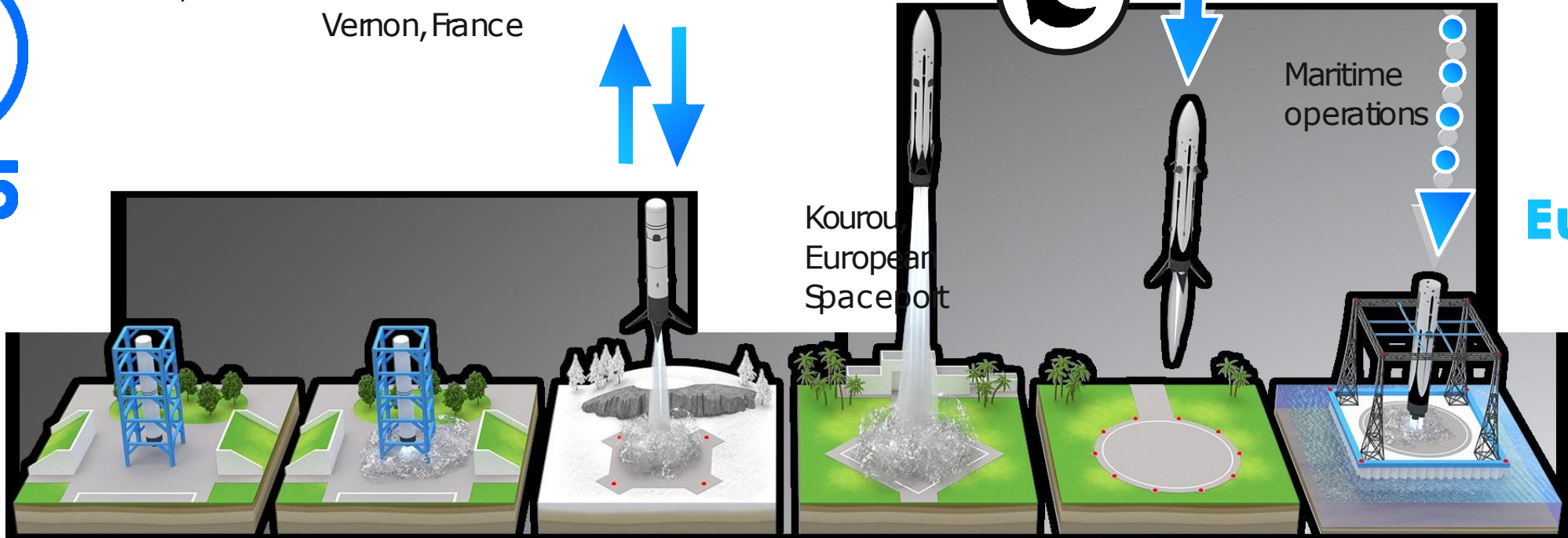
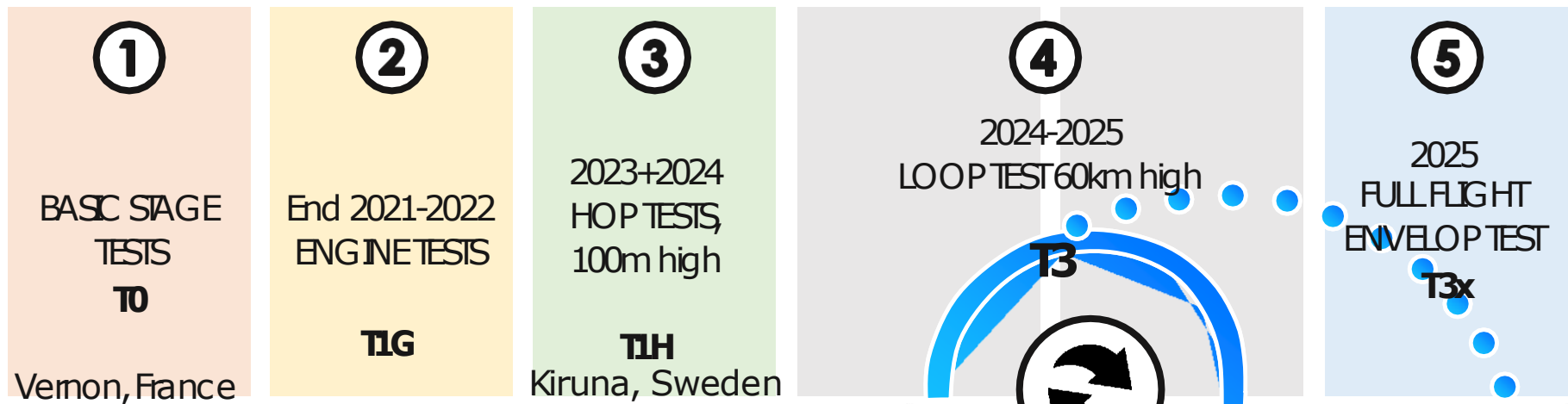
30m tall
3.5m wide

Unit cost
Secret 😊

Ground segment
3 different test sites feat. remote launch ops, bioCH4 propellant, robotic critical ops...

Agile approach : hardware driven roadmap

2020
2025



Building block

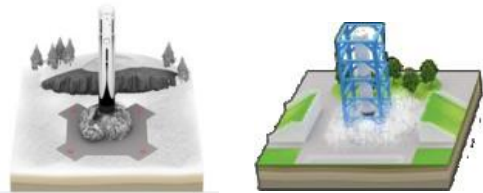
2030 European Space Fleet



3 months / 4 tests

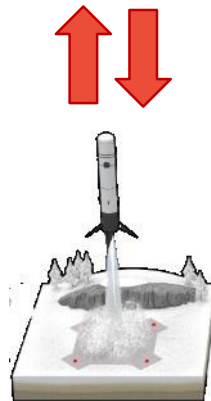
Techno maturation up to subsystem prototyping

~ 20 individual techs, combined in a consistent system approach



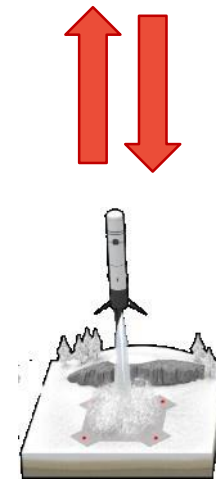
#1

Static Firing Acceptance (<5s)
@ESC during the campaign



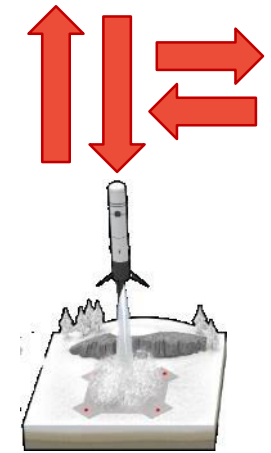
#2

30-100m vertical hop
soft landing



#3

100m vertical hop
hard landing 1.2g



#4

100m vertical hop
Lateral move but
landing at same spot
hard landing 1.3g

Enabling a «test-rich» engineering path



Vernon Test Site : April 2021



Preparing our next playgrounds 1/2



Kiruna test site
(hop test)



Kourou test site
(loop test)



ARIANEWORKS
Esrange Site - LC-3

Removing flight control bay (FCB) tarpaulin

ARIANEWORKS
Esrange Space Center

CH4 and LOx vehicle connection

Preparing our next playgrounds 2/2



Kiruna test site (hop test) : status as of January 2021



Courtesy by SSC

Kourou Diamant test site (loop test)
End 2020



LOOKING AHEAD

ANY QUESTIONS?

