Memo on the comparison between launch bases costs toward ISS or L2

Delta V (theoretical dV to low circular orbit; dV losses (incidence deflection; drag; Lift; gravity) & dV gain from rotation rate at latitude and azimuth; dV transfer)

Case ISS at LEO (the current one or the next one)

	dV Launch to low orbit	$dV_{losses\&gain}$	dV transfer from low orbit	dV transfer at arrival	
Earth ground to ISS	8 020	≈ 2 100-465 max	77	76	9 808
Moon ground to ISS	1 885	≈ 118- 4.6 max	775	3 165	5 939

- Ratio of the DV shows that from Earth it is **1.65** times higher than from Moon
- Translation in terms of take off mass per payload mass (that can be considered as a cost index) is
  - for Ariane To ISS: 500/20 = 25 kg/kg
  - for a Moon launcher: 90/18= 5 kg/kg
- Hence a cost ratio of **5** in favour of the Moon launch*

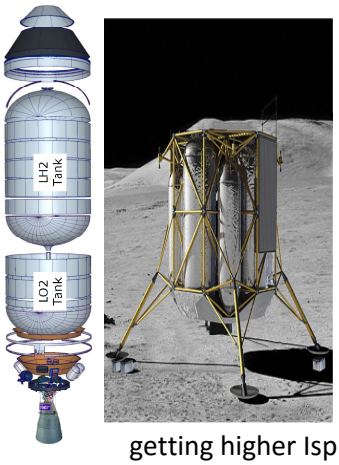
Case ISS at L2 (Space port)

	dV Launch to low orbit	$dV_{losses\&gain}$	dV transfer from low orbit	dV transfer at arrival	
Earth ground to L2	8020	≈ 2 100-465 max	3 165	1 230	14 050
Moon ground to L2	1885	≈ 118-4.6 max	775		2 774

- Ratio of the DV shows that from Earth it is **5** times higher than from Moon.
- This last case show the large advantage for a launch Moon based wrt Earth based.
- Translation in terms of take off mass per payload mass is
  - for Ariane To L2: 800/5* = 160 kg/kg (5 tons into L2 TBC)
  - for a Moon launcher: 90/45= 2 kg/kg
- Hence a cost ratio of **80** in favour of the Moon launch*

* *The cost of the needed things carried from Earth to the Moon is not included.*

Note about the Moon Launcher



A launcher from a Moon base may not look as a Earth launcher because all the advantages coming from Moon (vacuum, gravity) lead to major impacts: it is a major advance for **Single stage to orbit with appendices (SSTO)**

With a minimum of hardware from Earth it is possible to foresee a Moon Launcher, thanks to ALM and Moon robotic.

- Tanks, structure, tubings perform by ALM. And AIT performed by robotics devices (about 6 ton). Probably a nozzle extension for Vinci could be coming from ALM too for getting higher Isp.
- Rocket engine, pyrotechnic , MLI, wiring, sensors, batteries and computer from Earth (less than 1 ton)

Major advantages gained from a Moon launch base: **Vacuum** and **lower gravity** than Earth

- Vacuum condition imply the following consequences:
  - High Isp (highest Isp vacuum) ,
  - no drag (no fairing, no aerodynamic concerns, transonic),
  - no acoustic concern,
  - no thermal convection (tanks only covered by MLI),
  - possible use of solar cells for smaller battery
  - possible use of star tracker at Moon ground for navigation
  - no deltaV losses (no losses due to incidence deflection; drag; Lift)
- lower gravity than Earth imply the following consequences:
  - lower acceleration,
  - lower vibration,
  - lighter structure
  - much lower deltaV gravity losses (term "g.sin (α)", so ratio 1/6)

Rocket engine data: Vinci: 550 kg Thrust 180 kN Isp 465s (HM7: 165 kg Thrust 64.8 kN Isp 446s)

A SSTO launcher of 90 tons from a Moon base could carry a payload of 45 tons to L2 or 18 tons to LEO (ISS orbit)