

NUCLEAR FUSION: SUMMARY



- ❑ Nuclear fusion¹ has (when compared to renewable energy) the potential to provide almost limitless, zero carbon power, with a capacity factor of over 90%
- ❑ That longstanding promise has, in recent years, come closer than ever to being realised:
 - The push for net zero by 2050 requires that all technology options be pursued
 - Fusion technology continues to progress, with ‘net energy output’ ($Q^2 > 1$) already achieved³
 - Several companies are now constructing proof-of-concept machines
- ❑ Nuclear fusion will only become mainstream once LCOE (driven by system complexity & scale, reliability, ‘plug-to-plug’ $Q \geq 5$...) is competitive
- ❑ Most start-ups target grid-connected fusion power generators by the mid-2030s
- ❑ Governments are becoming more supportive of nuclear fusion (funding, regulation ...) and government-backed consortia (e.g. ITER⁴, NIF⁵) will retain an important role in advancing the technology ...
- ❑ ... however, the proliferation of well-funded private companies and a sharp spike in fusion funding in 2021-2022 should, despite having cooled, ensure that many companies progress steadily on their development roadmaps
- ❑ Challenges remain with respect to all the key fusion building blocks – in particular plasma confinement but also fuel type, reactor design, control systems / algorithms ... – and ultimately start-ups may need to combine (consolidate) to ensure best-in-class solutions
- ❑ US fusion start-ups are the best funded globally, but Europe (incl. the UK) possesses many exciting companies
- ❑ With the fusion investment environment having chilled, it is imperative that start-ups find a way to bridge a possible “valley of death” by broadening the funding pool (corporates, grants ...)

¹ Nuclear fusion, the process where two light atomic nuclei merge to produce a heavier nucleus, releases substantial energy; ² Q = ‘fusion energy gain factor’; ³ laser input to energy output (not ‘plug-to-plug’); ⁴ ITER = International Thermonuclear Experimental Reactor; ⁵ National Ignition Reactor