Dossier de synthèse inversée – Gp 9 : Maxime / Grégoire / Tim

En vous appuyant uniquement sur les documents du dossier thématique qui vous est proposé, vous rédigerez une synthèse répondant à la question suivante

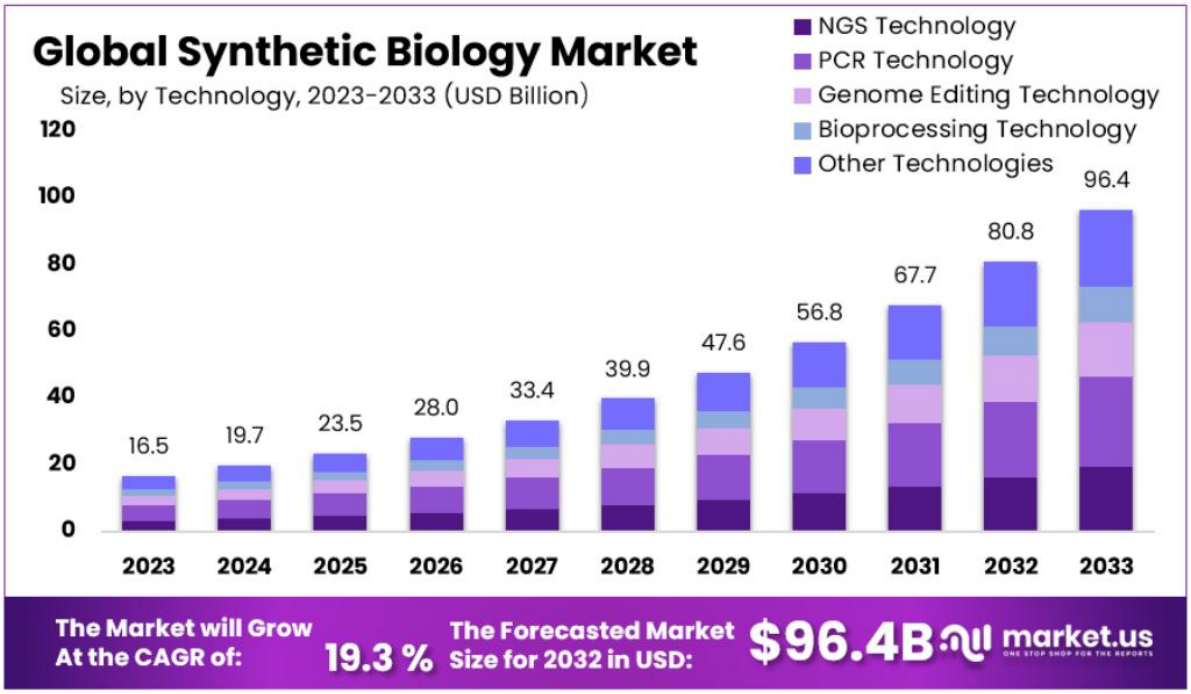
Synthetic biology: boon or bane?

Votre synthèse comportera entre 450 et 500 mots et sera précédée d'un titre. Le nombre de mots rédigés (titre inclus) devra être indiqué à la fin de votre copie.

Document 1

Charlotte Kanzler, 2019

Document 2



Document 3 - The Coming Wave by Mustafa Suleyman review – AI, synthetic biology and a new dawn for humanity, *The Guardian*, August 28, 2023, by John Naughton

What is it with wave metaphors? Technological determinists – people who believe that technology drives history – love them. Think of Alvin Toffler, who saw the history of civilisation as a succession of three such waves (agricultural, industrial and post-industrial). The idea is of immense power, unstoppable, moving inexorably towards us as we cower before its immensity, much as the dinosaurs must have done when they saw the mile-high tsunami heading in their direction.

Mustafa Suleyman says he is not a determinist, but at times he sounds awfully like one. “At its heart,” he writes at one point, “technology emerges to fill human needs. If people have powerful reasons to build and use it, it will get built and used. Yet in most discussions of technology people still get stuck on what it is, forgetting why it was created in the first place. This is not about some innate techno-determinism. This is about what it means to be human.”

The oncoming wave in his title is “defined by two core technologies: artificial intelligence (AI) and synthetic biology”, and it’s the conjunction of the two that makes it intriguing and original. Together, he thinks, these two “will usher in a new dawn for humanity, creating wealth and surplus unlike anything ever seen. And yet their rapid proliferation also threatens to empower a diverse array of bad actors to unleash disruption, instability, and even catastrophe on an unimaginable scale.” Our future, apparently, “both depends on these technologies and is imperilled by them”.

Once you get past this hyperbolic prologue, the book settles down into a serious exploration of what the future might hold for us all. Suleyman’s credentials for the task are good: he was co-founder of DeepMind, arguably the smartest AI company around, but he has also worked in the charitable sector, in British local government, and at Google – where he worked on the company’s large language models (LLMs) and the thankless task of trying to persuade the search behemoth to take ethics seriously. Although he hasn’t worked in molecular biology, his account of DNA sequencing, gene editing and the design and manufacture of new genetic products seems well-informed and supports his case that AI and computational biology are the twin challenges that will soon confront societies.

So what’s needed? The conventional answer is regulation, which he regards as inadequate

Translated into terms of technological waves, Suleyman’s evolutionary sequence looks like this: humans first used technology to operate on the physical world – the world of atoms; then they worked on bits, the units of information; and now they are working on creating new forms of biological life. Or, to put it more crudely: first we invented mechanical muscles; now we are messing with our brains; and soon we will be doing this with our biology. However you portray it, though, the reality is that we are in the process of creating monsters that we have no idea how to manage. [...]

He’s right. So what’s needed? The conventional answer is regulation, which Suleyman rightly regards as woefully inadequate for the scale of the challenge. Regulation is the last refuge of an exhausted mind: something that kind-of worked in the past, and so will hopefully work again – in an entirely transformed context. [...]

“Containing technology,” Suleyman writes, “needs to be a much more fundamental programme, a balance of power not between competing actors but between humans and our tools. It’s a necessary prerequisite for the survival of our species over the next century. Containment encompasses regulation, better technical safety, new

governance and ownership models, new modes of accountability and transparency, all as necessary (but not sufficient) precursors to safer technology. It's an overarching lock uniting cutting-edge engineering, ethical values, and government regulation." [...]

Document 4 - The nuclear and biological weapons threat, *Financial Times*, by Gideon Rachman, September 7, 2023

[...] we also have new risks that are emerging from new technologies. I had started worrying about synthetic biology starting in around 2002. I had been working for several years as an epidemiologist on infectious diseases like malaria, tuberculosis, HIV. But in 2002, the first virus was synthesised from scratch, just to show that it could be done. And some of the people I worked with had been veterans of the smallpox eradication effort. So the reason that most of us now no longer need to get vaccinated for smallpox is because thousands of public health workers around the world succeeded in eradicating it. But when a virus was synthesised from scratch from 2002, the reaction of that community of veterans was "crap". You know, we spent decades eradicating smallpox and now somebody could, you know, recreate the virus if they had millions of dollars and sufficient technical skills. Unfortunately, the costs have dropped significantly. Several years ago, a couple of people synthesised a pox virus for $100,000. That could probably be done for less today. So that's quite worrying. I mean, as Covid demonstrated, the world remains highly vulnerable to even moderate pandemics, and an especially severe pandemic that's caused by an engineered pathogen could combine, say, high lethality, high transmissibility along incubation period. That could be a true existential risk. [...]

Gideon Rachman
Just back to synthetic biology, before I ask you kind of a general question to close us out. It's obviously something you've been following for decades now, but the pandemic has really made everybody focus on those kinds of risks. Do you think post-pandemic, we've made any advances sort of intellectually or in policy terms in preventing people be able to, you know, whether it's a terror group or a nation, to just manufacture a virus to manufacture the next pandemic?

Jason Matheny
I think we've made surprisingly little progress. I think this is one of the more sobering observations after the peak of the pandemic was really how little defence we have built up in response to it. We haven't built up the kinds of bio defences that we would need against the next pandemic. We don't have the sort of bio-surveillance diagnostics, breakthroughs and medical countermeasures. We have great ideas on how to scale up things like wastewater surveillance and advanced PPE or improving infection

control in the built environment. But we haven't built this at the scale that we would need to in order to prevent the next pandemic. And we haven't done much at all to address the security risks inside of commercial synthetic biology or synthetic biology that's within research labs. And I think part of that is just a challenge that biology is still sort of catching up to some of the risks that are emergent. The fact that somebody could buy a DNA synthesiser commercially off of eBay and use it to create a pox virus or something worse is something that we're slow to react to. Policy moves much slower than technology.

Gideon Rachman
So to finish, I mean, you were working on the National Security Council, which was set up, I think in the 1940s at the dawn of the nuclear age. And as is clear, I mean, nuclear weapons are still absolutely central to national security risks. But do you think the rise of these new technologies, AI, synthetic biology, mean that we really need to rethink quite profoundly, particularly, say, post-pandemic, what national security means?

Jason Matheny
I think that's right. I think that our institutions around national security were set up around the risks that we had experienced with. The risks from relatively slow-moving technologies, the risks for making bad decisions, the risks from bad intelligence and the institutional responses to those risks are the ones that we have embedded within organisations and the US government and the Russian government and the Chinese government. Things that are focussed on better intelligence, better crisis management, better communication across different parts of government checks on bad intelligence. What's newer and less familiar is the severity of risks from emerging technologies that are advancing much faster than our governance of them. That advanced much faster than our deliberation about them. Richard Danzig has an excellent report on this topic called Technology Roulette. And the core thesis is that we might find that the greatest risks are ones that we're developing ourselves that we don't know how to effectively control. And because technology moves so much faster than policy, I think we're going to need to make much greater investments in things like technology forecasts, stronger forms of risk assessment, a rejection of, you know, the sort of Silicon Valley ethos of moving fast and breaking things. We can't afford to move fast and break things and synthetic biology or an AI. We need a much greater emphasis on public safety because the consequences of screwing up could be catastrophic.

Document 5 - SynbiTech 2023: Unveiling the future of synthetic biology, *www.verdict.co.uk*, December 11, 2023

SynbiTech 2023: Unveiling the future of synthetic biology

After decades of cultivation within the academic sphere, synthetic biology is poised to make a breakthrough into the commercial world.

SynbiTech 2023, a two-day conference on December 5 and 6, at the Kelvin Lecture Theatre at the Institute of Engineering Technology, London, unified researchers, venture capitalists, entrepreneurs, and government representatives, and set the stage for a thorough exploration of the burgeoning field of synthetic biology. [...]

Here are the key takeaways from the event.

What is synthetic biology?

Synthetic biology, commonly abbreviated to synbio, involves changing the genetic material of existing biological systems by copying, cutting, or moving segments of DNA to give them new functions and characteristics.

After decades of cultivation within the academic sphere, synthetic biology is poised to make a breakthrough into the commercial world. In fact, the commercialization of synthetic biology has already begun within the food and healthcare sectors. Companies like Impossible Foods and Perfect Day are using synthetic biology to create vegan alternatives to meat and dairy products. In healthcare, synthetic biology is used in vaccine development and groundbreaking cancer therapies.

Synthetic biology in the UK faces an investment problem

On the second day of SynbiTech, an informative discussion took place among a panel of entrepreneurs and venture capitalists. Facilitated by the chair, Richard Kitney, professor at Imperial College and co-director of SynbiCITE, as well as questions from inquisitive audience members, it became clear that access to growth-stage capital is limited in the UK. This is particularly true for hardware-based tech companies that are riskier endeavors than their software counterparts and typically see returns on investment much later.

The UK fosters strong research at the university level and provides investment support for pre-seed funding and angel investments (typically a few hundred thousand GBP). However, it fails to galvanize investment for series A and beyond financing where tens of millions stand to be gained. In contrast, countries like the US and Singapore have a stronger start-up culture that is more amenable to synthetic biology. By not enabling growth-stage capital, startups that could be UK success stories will instead establish themselves abroad, where it is simpler to acquire adequate funding.

SynbiTech biosecurity panel: Threats facing biosecurity are likely to increase

Synthetic biology will transform many industries for the better through, for example, novel healthcare treatments or sustainable alternatives to petroleum-based products. However, the threat of accidental biocontamination must not be overlooked, nor the risk of intentional misappropriation of the technology by individual bad actors or indeed governments.

To address these issues, the conference hosted a dedicated biosecurity panel populated by professors, policymakers, government ministry members, and professors. In addition to the need for clearly stated gene editing regulations, accountability also formed a key part of the discussion. Once a biosynthetic contaminant has been released, the destruction of natural ecosystems and the mutations that might occur risk being irreversible and have the potential to spread worldwide. Whether this occurs accidentally or through intentional bioterrorism, measures need to be proactively enforced.

The US has bold ambitions to develop its bioeconomy

Enabling a thriving bioeconomy has become a bipartisan objective within the US. A report published in 2020 by the National Academies valued the US bioeconomy in 2016 to be between $402.5bn and $959.2bn. Synthetic biology is expected to play a key role going forward. In fact, as early as 2012, the economic and societal benefits of synthetic biology were highlighted in the US National Bioeconomy Blueprint.

More recently, in September 2022, the Biden administration published the Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy. The executive order contains ambitions to expand R&D, train the next generation of skilled workforces, streamline regulations, prioritize biosecurity, and contribute to a global bioeconomy via international partnerships.