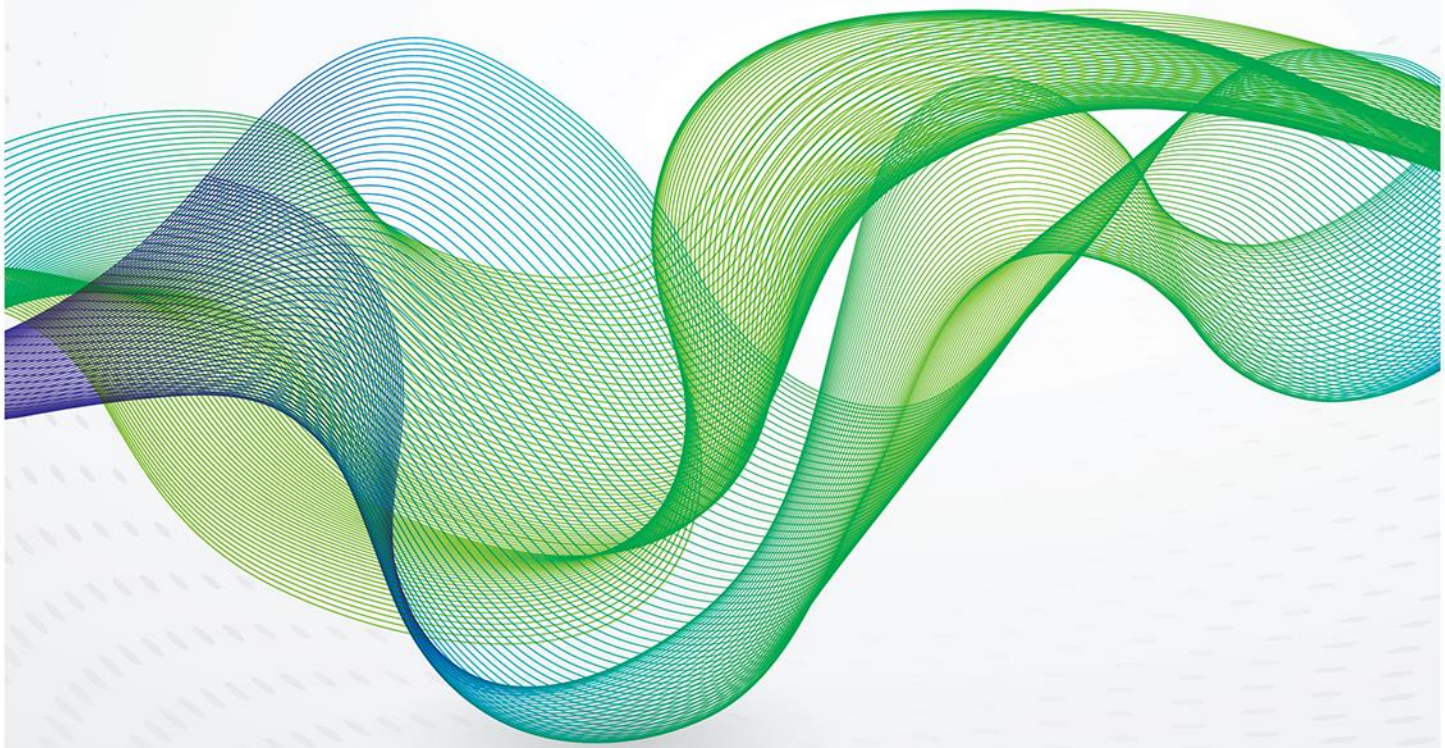
THE OXFORD INSTITUTE FOR ENERGY STUDIES

June 2021

Europe's energy transition trajectory: Is conventional wisdom at risk of becoming inconvenient truth?



OIES ENERGY COMMENT

Laszlo Varro, Chief Economist of the International Energy Agency, and *Christian Zinglersen*, Director of ACER, the EU's Agency for the Cooperation of Energy Regulators

The content of this opinion piece, by Laszlo Varro, Chief Economist of the International Energy Agency, and Christian Zinglersen, Director of ACER, the EU's Agency for the Cooperation of Energy Regulators, expresses the views of the authors, not necessarily those of their respective organisations, and not the views of the Oxford Institute for Energy Studies or any of its Members.

Introduction

"*The Master said: When everyone dislikes a man, enquiry is necessary. When everyone likes a man, enquiry is necessary*". Confucius, Analects.

As Europe embarks upon an unprecedented shift in the decarbonisation of its economy, it is timely to consider some of its greatest assets, be they political, economy or geography related, as well as its most enduring challenges often related to those exact same factors.

For Europe as for others, significant dilemmas and trade-offs loom. The objective of this short comment is to combine a global 'policy horizon scan' view from the IEA with perspectives from the 'regulatory engine room' at ACER and offer four perspectives on such dilemmas and trade-offs; some of them curiously absent from much contemporary political discourse in the hope that the political 'command bridge' of Europe, with its diversity of captains and guides, will find these perspectives relevant to navigating increasingly unchartered waters, namely Europe's energy transition trajectory.

"Small may well be beautiful, but it won't cut it alone: The crucial role of large-scale infrastructure."

The revolution in decentralised energy is real. A combination of competitively priced rooftop solar panels, home storage solutions and smart aggregation tools means the future of local networks balancing supply and demand may well reside with localised solutions. This is good news for many, ranging from those concerned with local grid congestion and the (otherwise) massive grid investments needed to solve it, to those who link such developments to local democracy and consumer empowerment.

Enter the prediction then of '*everything becoming decentralised*'. A prediction possibly borne from preference fixation or a romanticised notion that net zero ambition in 2050 will be obtained by reversing economic growth.

Whatever the attractiveness, the more likely reality is that whilst localised solutions will increase in importance, centralised assets will continue to provide a significant share of Europe's bulk power needs at industrial scale. And this even more so in a context of aggressive decarbonisation.

Consider a few numbers: In the IEA's Sustainable Development Scenario (SDS), by 2030 Europe will have to build 140 gigawatts (GW) more renewable capacity than the currently stated renewable policies would deliver. This is 20,000 wind turbines and the equivalent of 100,000 football fields covered by solar panels. Similarly, the EU's hydrogen strategy, announced last year, envisages 10 million tons of green hydrogen produced by 2030; an amount 'absorbing' more than 10% of current electricity generation.

Bulk production at this scale will not primarily be local. Electric vehicles and heat pumps in Europe's suburbs hooking up in innovative virtual power plants will unlock new flexibility options, but they don't produce primary energy.

As such, getting this bulk power to demand centres will be the next challenge. Unless of course one thinks that energy-intensive industry will relocate to sites of energy abundance as opposed to the other way around. Imagine the industrial clusters of the Ruhr or Bavaria relocating to regions where bulk wind and solar production at a multi GW scale is available. Now imagine the relocation costs of such a shift

and the equally significant political economy upheavals at both the recipient and sending end. In short, we find this unlikely.

Enter then the conundrum of power transmission uptake at the thousands-of-kilometres scale – an issue currently not getting the attention it deserves. This we find odd given the interdependency between the two. In the IEA's Sustainable Development Scenarioo (SDS) the achievement of the EU renewables and emission ambitions would see half a trillion Euro more investment in the European electricity network in the 2020s than was observed in the 2010s. Today, significant network congestion exists across Europe. Left unaddressed, it will compound in the coming years significantly raising costs for remedial action and increasing the risk of extensive renewable power curtailment. To add insult to injury, ACER's annual overviews show recurrent delays in transmission project planning, meaning lead times from inception to actual operation are vast, often spanning ten years or more.

Some of the strategic interest around hydrogen seems to suggest that if power lines are not there, the electricity will 'just' be transported via pipe, repurposed or new, after conversion to gaseous form – in effect suggesting that some sort of 'transportation hedging' will be available further down the line. However, conversion losses and additional capital costs may well make this a complementary route rather than a substitute for network upgrades, and its use is most competitive when the final consumption itself would otherwise be in the form of hydrocarbons.

This is not to discount the large interconnected gas infrastructure under Europe as a key strategic asset in and of itself: existing European gas storages can store around 100,000 times more energy than all the power system batteries deployed in the world last year. This infrastructure can make a major security contribution in the net zero age, factoring in a combination of biomethane and hydrogen under a fit-for-purpose regulatory framework (the subject of ACER-CEER recommendations earlier this year).

Nevertheless, when discussing the more headline-grabbing new industrial wonders supplying bulk power for broader parts of Europe, we find policymakers should accord equal attention to associated grid infrastructure needs.

Here, the current regulatory toolbox seems ill-suited to deal with non-market factors like local opposition, permitting restrictions and the like. Whilst already significant today, let us imagine for a moment such opposition in the future. If the outlook for Europe lies in vast generation centres in key resource-endowed areas servicing multi-country demand, there will be an increased role for transit-destined transmission projects.

Consider the example of a new four-lane highway being proposed to cross the territory of country A, primarily for the purpose of heavy-duty trucking bringing goods from country B to country C. Now consider if those trucks rarely stop in country A for fuel, let alone deliver goods for that country; might such a scenario for future power transmission projects lower or perhaps rather increase levels of local opposition? We think the latter.

At first glance, a modernised regulatory toolkit might point to a different distribution of costs for such networks, looking less to the territory on where construction costs fall and more towards the benefits gained from transit infrastructure for neighbouring countries (the B and C countries in the example above). However, such incremental advancement is unlikely to do the trick on its own. Looking at the inhibiting factors here – local opposition, the perceived lack of community benefits, the related political economy challenges etc. – it may well be that solutions need to lie outside the normal energy sphere.

Consider for example the ambitious coal phase-out processes developed in parts of Europe. These integrate social policy, pursue active stakeholder dialogue and imply monetary transfer at a scale benefitting both community and region, ie. measures and approaches much beyond that of the normal regulatory toolkit.

Such processes are inherently political, reinforcing the need in our view to expand current discussions on the infrastructure challenge facing Europe.

"Pricing emissions vs. targeted regulation – are we relegating a thoroughbred just as it gets going?"

The past decade witnessed outages in Belgian nuclear plants, a winter cold wave pushing French peak power demand to almost double its usual level and sudden storms pushing North Sea wind production to the maximum and then to almost zero as the automatic safety mechanisms shut down the turbines. The gas industry first redirected large volumes of LNG from Europe to Asia to replace Japanese nuclear after Fukushima and then absorbed the upswing of American production.

The best feature of these episodes? That they are thankfully completely unknown outside the community of energy geeks. The lights stayed on, homes stayed warm and the European energy system continued to function with clockwork precision. They share another, unfortunately underappreciated aspect as well: they represented situations which would have been completely impossible to manage on a nation-state by nation-state basis with segmented infrastructure.

It was a resounding success of the visible and the invisible hand: Especially in the case of gas but to some extent in electricity as well, interconnectivity improved, and in both cases the regulatory environment achieved a step change: through better access to infrastructure, improved transparency and market based allocation of capacity, Europe made impressive progress towards a genuinely integrated single market in energy.

With a better infrastructure platform and appropriate regulation, the invisible hand delivered. Market participants flexibly reacted to fluctuations, supplies flew where demand was higher, smoothing out shocks that in the old days would have been a severe energy security crisis. Even a military conflict between the biggest gas exporter and the biggest transit provider was managed flexibly as was last year's unprecedented drop in energy demand, thus showing the resilience of the system.

Better functioning integrated markets played a positive role in fostering the energy transition as well: Europe integrated a larger share of renewable production faster than was envisaged to be possible a decade ago. While Europe lost some ground in clean energy 'hardware', its experience in system integration still positions it to be a global leader of the 'software' for the clean energy system. Smart energy systems aggregating demand response from consumers is one of the few areas of the digital economy where innovative European companies are expanding in the United States rather than the US tech giants conquering territory in Europe.

In the meantime, clean energy investment continues to be dominated by non-market policies – Europe has several hundred different prices for renewables per country, per technology, per vintage. These would correspond to genuine system value only through random luck. This did not matter when renewables were an infant industry representing a small part of the system. In those days wind and solar were called 'alternative energy'. Soon some may start to call oil and gas the 'alternative energy' – the system itself will be based on wind and solar-driven electrification, with declining hydrocarbon use in sectors where electrification is difficult or expensive. Given the dominant role of renewables in new investment, there is no European energy market without market-based renewables.

This does not have to mean pushing renewables to an energy-only wholesale market when this is deemed too risky by decision-makers. There is a compromise to be made between the efficiency of market signals and the need to reduce investment risks. Capacity auctions can be keenly competitive and they have already driven impressive cost reductions. Nevertheless, where preferred, their design should be adjusted to reflect the value of location and the different production profiles. In short, national renewable policies could be better harmonised for the next stage of Europe's energy transition.

Europe is a global laboratory in which the challenges and opportunities of carbon pricing are being tested. Its Emissions Trading System (ETS) has certainly had a rough decade, but some of the bad press is undeserved. It is not the fault of an emission trading system that after the start of a longer term trading period, a once-in-a-century macroeconomic shock hit the European economy (in 2008) and brought down energy demand and the need for carbon quotas.

Even with several years of depressed prices the ETS has played a historic role in increasing the awareness of the European corporate sector concerning CO_2 emissions. It was a big nail in the coffin

of coal and it has encouraged energy efficiency improvements in industry. With the recent reforms and expectations of further tightening carbon budgets, by 2021 it reached a level where significant major new low carbon investments are possible on a market basis. The ETS has grown up, it can serve as a powerful decarbonisation driver and Europe should trust and expand it.

In one very important case, this does not seem to be the case: for hydrogen, Europe seems to be going down the route of a complex, highly administrative approach of applying different color codes and different regulatory treatments to a commodity based on production technology. It is clear that the existing European hydrogen production should be decarbonised. It is also very likely that in the European context renewable electricity will end up as the main technology (the fabled 'green hydrogen'), with other alternatives like natural gas equipped with carbon capture playing an interesting but secondary role.

The point is that the ETS would seem the perfect vehicle to drive this shift. Steam methane reformers are under the ETS, and so in tightening the carbon budget, unabated reforming will be increasingly uneconomical. The same tightening budget, together with successful renewable investment policies, will rapidly cut the carbon intensity of electricity supply so the difference between a dedicated 100% renewable supply and simply plugging in wherever it is suitable for the network will narrow over time.

Some companies will retrofit their reformers with carbon capture, others will shift to electrolysis and others to pyrolysis. Some will invest in a new dedicated 100% renewable supply, others will value the already existing infrastructure and locate the electrolysers in their existing facilities paying for the remaining electricity emissions through the ETS. Others still will make investment choices in expectation of a significant demand-pull for low-carbon products, facilitated perhaps by credible guarantees of origin. This is called market capitalism and it is the most successful economic system in history.

Of course, other aspects of the transition besides the long-term trajectory itself will require strategic decisions from governments, most importantly major infrastructure. There is a very strong government role, too, in both R&D and scaling up early adoption. Plus, a number of energy efficiency challenges in Europe will likely depend on bread-and-butter regulatory interventions, not relying on carbon pricing as a panacea.

However, having invested two decades in making the ETS work, Europe should harness its potential, putting that particular asset to work where it makes strong sense, thereby reaping the benefits of the market as much as possible. After all, why discard or relegate a thoroughbred just as it enters its prime?

"Security of supply is a priority - and demand holds most keys to solve it. But can we get the keys out in time?"

As Europe is one of the largest oil and gas importers in the global economy, the security impact of the energy transition has tended to be discussed in a geopolitical framework: renewables and energy efficiency reduce fossil fuel imports and thus improve energy security. While this is certainly true, Europe should not underestimate the new energy security challenges associated with the rapid transformation of its energy system.

Even in the age of conventional energy, the most powerful public image of an energy security crisis is a major city in the dark. Electricity plays a unique role in a modern society and its importance will increase further: with wind and solar-based electrification emerging as the most likely credible pathway to decarbonise applications like light transport and heating, electricity will be even more essential.

In the last decade European utilities and system operators exceeded expectations in integrating larger shares of renewables in a more secure and cost effective manner than previously expected. This is to be appreciated, but the positive performance was also due to historical luck: Europe had a major investment wave into gas turbines just before the Eurozone crisis put electricity demand onto a lower trajectory. As a result, there was plenty of underused flexible capacity in the system. Moreover, in the last decade the European nuclear fleet was still holding its own.

Neither appears to be sustainable, however. This excess gas capacity was not the result of a strategic decision and was financially painful for the owners, and Europe is unlikely to have a nuclear renaissance. In the meantime, renewable energy deployment will have to accelerate further. Given that a single blackout can shape social and political attitudes for a decade, robust electricity security is a key precondition for a viable transition.

For a century, dispatchable power plants were the workhorses of electricity security. They are not going out of fashion anytime yet. Hydropower, nuclear in some countries and even gas turbines (running, say, on hydrogen or with carbon capture) are likely to remain essential to keep the lights on. However, given the geographical and cost constraints on all of them, new solutions will also have to step in, primarily in the shape of electricity storage and more flexible demand.

The lines between the two will be increasingly blurred with the deployment of electric cars and behind the meter storage. An increasing proportion of demand-response will come from parking cars and stationary batteries. How will they interact and compete with utility scale storage facilities? Well, the honest answer is that no one really knows and this is precisely why we need robustly competitive retail markets which will unleash innovation not only in technology but in business models and consumer solutions as well.

It is revealing that technology is much more ready than either regulation or business models. The overwhelming majority of the more than one million electric cars that hit the roads in Europe last year don't participate in any smart optimization. Rather, they charge from a normal outlet in the owner's garage and they use plain vanilla, fixed-price public chargers that charge baseload. Both the cars themselves as well as the smartphones of the owners easily have the IT capacity for smart charging but comparatively small, yet crucial, pieces of the puzzle are still missing at the intersection of regulation and business development. With a million electric cars this is annoying, with a hundred million it becomes a major problem.

Hence, overcoming the institutional barriers of demand-response is one of the most important regulatory tasks to ensure electricity security. Indeed, one of the key new areas for ACER in the coming years is to monitor barriers to market entry for new and especially smaller market players, as well as assessing tweaks to the current arsenal of EU guidelines and network codes in order to facilitate more flexible demand.

There are near-term links here, too, with Europe's economic recovery. Not all demand-response is 'created equal' - teenagers are highly unlikely to stop playing videogames in reaction to fluctuations in renewable production. However, targeting e.g. electric bus fleets as well as electric delivery trucks, not least in urban and suburban environments, would seem to be the equivalent of digitally enabled 'gold on the street'. They offer large aggregation potential, predictable scheduling, locational proximity to usage, and often correlated demand and supply needs.

Here, however, Europe is close to a proverbial 'backwater'. The Chinese city of Shenzen, already having phased out diesel buses, has more electric buses than the EU Member States combined, with dedicated night charging facilities located next to transmission substations. A combination of extensive public transport systems and cash-strapped municipalities make electric buses a priority target for green recovery efforts.

For the sake of completeness, the energy system will not become a pure digital platform, notwithstanding the multiple business opportunities and system benefits. Policymakers will also need to reflect on the limits of electrification. Electricity networks are difficult to build and they are much more vulnerable to both extreme weather events and cyber incidents than pipelines. In addition, buildings-electrification should be coupled with aggressive energy efficiency policies to avoid difficult-to-manage winter peak demand. As ever, a whole-of-energy system view is needed.

History was not over when the Berlin Wall came down and energy security policies will not become redundant when we emit the last ton of CO_2. Energy will remain an essential public good subject to intense social and political attention. The system will need to achieve an unprecedentedly rapid transformation to new technologies and respond to new risks. The main principles remain unchanged, however: efficient markets, robust infrastructure and diversification of sources.

In addition, we would venture that in an increasingly digital age setting the right regulatory and institutional framework enabling market participation 'for the masses' becomes more crucial than ever. Command-and-control rarely proved efficient in the past; in the future, it will prove impossible.

"Europe's energy future is one of increased interdependence. Will political discourse in capitals catch up?"

The first months of this year provided two remarkable power events in highly developed parts of the world. First, in January, the largest and most integrated power system on the planet (Europe) experienced a system split for roughly an hour due to failures originating in a subsystem in a small area of Croatia. Second, in February, facing an unprecedented cold spell and a number of further aggravating circumstances, significant parts of Texas, a territory similar in size to Germany, Poland and Belgium combined, experienced the most serious blackouts in recent memory.

Whilst the situation in Europe was handled swiftly, avoiding massive system disruption, it was serious and had the potential to cause significant damage. The situation in Texas by comparison proved catastrophic, with the consequences for human life, the economic fallout and its political implications still reverberating across the US.

Here is not the place to argue the differences between the European power system and the one in Texas. As one of us has argued elsewhere, being a massively integrated power system significantly enhances security of supply, provided a number of mechanisms, rules and governance practices are in place and vigilantly maintained.

At the same time, being heavily integrated also exposes parts of the system to risks that originate far away. Put simply, once you are '*in it together*', it is for better - and for worse. Adding to this, Europe's energy transition trajectory will likely rely on *increased* market integration rather than less, given the cost-efficient opportunities such integration provides going forward.

Consider here two examples. First, resource adequacy assessment which answers, at its core, the question of how to 'keep the lights on' over the coming decade. In Europe, such assessment draws increasingly on cross-border perspectives, allowing significant efficiency gains. Last year ACER, in close collaboration with ENTSO-E, took the first steps in developing and adopting methodologies underpinning future European-wide resource adequacy assessments, informing assessments done nationally.

This is a potentially contentious area given it poses limits on one country's discretion and manoeuvrability in light of measures undertaken in neighbouring countries. The political implications of this approach are significant, too; it implies energy policy is becoming increasingly shared or coordinated amongst countries, and less strictly national.

Second, the EU's offshore wind strategy is in essence an embodiment of a similar vision, namely of sharing and using resources across the continent commensurate with respective renewable energy endowments; a vision of course given extra impetus by Europe's decarbonisation objectives.

Here, the notion that particular areas of Europe, whether it is the North Sea, the Baltic Sea or the Black Sea, can supply other parts of Europe with vast bulk power suggests a particular long-term relationship for some EU Member States going forward. Namely, that some will become structural 'exporters' most of the time, whilst others will become structural 'importers'.

At first glance, this is not much of an insight - it is inherently difficult for everyone to be an energy exporter all of the time, and indeed, structural import dependence as regards oil and gas has been commonplace for decades for most parts of Europe. Up until now, however, electricity has been more commonly associated with notions of national self-sufficiency, give or take a bit at the margins. As a result, such a shift is very significant in political terms for Europe.

Just as geographical diversity can be a strength in reaping the benefits of different resource endowments, this same diversity might become a challenge unless the political prerequisites underpinning further interdependence are carefully managed. This implies working on respective 'levels

of comfort' with such developments, tackling governance arrangements, the degree of influence necessary to relinquish control and so forth.

Here, listening to national political debate can be instructive. In many quarters, this remains surprisingly national. Sometimes current levels of interdependence are not acknowledged, thus risking policy detours; even less prevalent is the proactive tackling of the various pros and cons of further energy market integration. Herein lies a risk, in our view, of disconnect.

Such risks are probably most pronounced in times of system duress. If investments are not made in countries' 'comfort levels' towards further interdependence, what happens if a major emergency hits? Might blackouts across Europe for instance (the risk of which would seem reckless to rule out) swing the pendulum back towards greater self-sufficiency - notwithstanding this would likely raise costs and challenges to decarbonising Europe's energy sector?

To be clear, there are certainly some examples where national policy debate seeks to leverage increased European energy market integration for those trajectories which are favoured. For example, the German, Dutch and Portuguese national hydrogen strategies foresee a significant role for hydrogen trade across Europe and beyond, acknowledging different structural exporter and importer roles going forward; Belgium recently took strategic decisions to rely more on new electricity interconnection projects from vast offshore renewable sites outside Belgium for its future power supply, thereby tackling concerns due to its shift away from nuclear; the Netherlands opted for a vast hydrogen project on Danish soil to more effectively fulfil its near-term EU renewable target; and so forth.

It is not for us to suggest whether such approaches are inherently 'right' whilst others are inherently 'wrong'. Rather, our point is that much has been put in place in Europe underpinning a particular model of shared resources, and that more is being set in motion to further strengthen this model. By comparison, much contemporary political discourse in European capitals seems out of step and not fully synchronised.

Viewed from a broader perspective, this discrepancy would seem difficult to sustain in times of strategic shifts.

Conclusion

At first glance, Europe seems uniquely positioned to lead the energy transitions effort. Drawing on its integrated energy system, its policy and regulatory advances over the last decade, its leverage of market dynamics for highly efficient, innovation-prone outcomes; one might assume Europe is in 'pole position' as it charts its course for the next phase.

Alas, this may not necessarily be the case. At stake is more than efficiency and least-cost 'bang for the buck'. Achieving net zero emissions is not tinkering at the edges of conventional energy policy. Rather, it is the trajectory of the most challenging and aggressive industrial transformation of the modern era, requiring a comprehensive interplay of technical regulation, policy design and high-level decisions on strategic infrastructure. Game on.