ABU DHABI SUSTAINABILITY WEEK

WORLD FUTURE ENERGY SUMMIT

ADSW ADVISORY COMMITTEE INSIGHTS REPORT

EXPLORING THE GLOBAL ENERGY TRANSITION

Hosted by

MASDAR

Contents

Foreword

While a successive series of COP commitments, falling prices and technological breakthroughs paints the picture that the global transition to clean energy is all but inevitable, what is the reality in 2024 for those trying to make it happen? For government institutions, developers, financiers and technology providers, what are the major concerns, considerations, goals and opportunities that occupy their strategic thinking right now?

Masdar, hosts of Abu Dhabi Sustainability Week (ADSW), understand intrinsically that the transition to a truly sustainable global economy can only occur within a viable timeframe, if we collaborate at every level. Every stakeholder from every major industry has a role to play and perspectives to contribute.

Accordingly, each year Masdar hosts a series of ADSW Advisory committees on a series of sustainability topics. These sessions are designed to gather leaders from the most internationally respected organizations across the business, academic and public service spheres and engage in open, transparent discussion about what they are doing, what they are seeing in their industry, and what they want to see happen next.

This insights report analyzes the first of six ADSW Advisory committee meetings held this year. Over the following pages, you can get a deeper sense of the most relevant trends and changes affecting the world's collective efforts to decarbonize, as told by the people who grapple with this evolving reality every day.

Each section is dedicated to a specific trend that is currently affecting the energy transition, complete with first-hand experience and expert analysis from the advisory committee members. Collectively, these insights serve as a snapshot of where the Middle East region and the wider world are positioned regarding their energy transition efforts.

As you will see, there is no shortage of eagerness among the industry's leaders to not only determine where we are but to boldly forge a path ahead and realize the full potential of a world powered by clean energy.

Grids – There's no Transition without Transmission

Both scalability and stability are essential to realizing the next generation of electricity grids that can absorb the massive influx of renewable energy that is coming as production ramps up across the world. We need to be plugging in clean, renewable energy faster, but currently there's a limit to what grids can consistently manage.

There was a consensus among the advisory committee participants that the limited ability of current-generation grids to absorb the influx of renewable energy is holding up the scalability of projects. This isn't just a problem for emerging economies or areas which have traditionally underinvested in their grids – it's an issue everywhere.

Scalability is key to driving down the costs of renewable energy projects – larger capacity means cheaper financing and greater contributions to creating economies of scale. However, participants agreed that greater cooperation between governments and project developers is needed to get the capacity planning element right from the outset. There needs to be clarity on how any new renewable capacity will fit into the grid in a stable and sustainable manner, without coming up hard against transmission limits. This will only come about through more forward planning; as one contributor put it: "The devil is in the details – it's not just a case of picking a production capacity level and plugging it in."

Financing fears versus fresh thinking

Another concern that continues to dominate stakeholders' thinking when it comes to grids is financing, or more directly: "where is the money going to come from?" In the session, one participant referenced the UK National Grid's recent revelation that it will need to invest £60 billion over the next five years.[1] This is clearly a vast investment and advice from multiple contributors was that governments and state-owned TSOs will need to get more creative in their approach to financing as well as innovating technologically.

Private investment will be needed if grids are to be made fit for purpose quickly, which means they must look like a good bet for investors to make. Incentivisation of TSOs was, accordingly, a key topic of discussion, as various participants called for either easier paths to collaboration or regulatory approaches that will encourage more rapid innovation and efficiency gains.

A specific avenue of interest was the potential for unbundling local utilities, in order to allow greater autonomy and transparency in investment decisions. While many countries bundle together electricity distribution into one entity that is dependent on government funding, a model like Norway's – where separate payments are made for the actual grid connection – there are greater opportunities for cost recovery and greater transparency of when and where efficiency gains can be made.

> **"We always say that there is no transition without transmission. With the growth that we are seeing overall in terms of the generation of renewables, transmission will play a fundamental role. We're seeing a lot more discussion between governments and private entities on how to connect transmission lines and how to be more efficient. From our side, we're working very closely with our partners in the government to support them and proactively address their needs on transmission but also grid stability. If your grid is not stable, you're going to incur major losses and undermine the viability of the clean transition."**

Batteries and storage – Tackling Intermittency

The long-predicted acceleration of falling battery costs is finally happening. They fell by 35% in the past 12 months, and Goldman Sachs predicts that they will fall by 40% overall between 2023-2025.[2] Our advisory committee predicts even bigger drops in the coming years. But what does that mean for companies looking to aid in the energy transition and profit from its acceleration?

According to participants, it's not just about having good storage capacity at an increasingly lower cost; it's about managing the intermittency of renewables. The interruptive, "stop-start" nature of solar and wind continue to cause major issues for grids trying to utilize them effectively, leading to a wide range of confidence issues in financing and the general business models of renewable projects trying to remain economically viable, not just ecologically beneficial.

Hybrid systems – storage solves intermittency while boosting profits

Without exception, the participants agreed that projects featuring hybrid systems (multiple types of energy generation and/or storage) will become increasingly popular in the coming years. Not only are they more effective in terms of supporting grid stability, they also present the project's owners with greater flexibility for energy arbitrage – buying/storing energy when the price is low and selling when the price is high.

One contributor pointed out that the improvement of the storage duration of utility-scale batteries – where the standard is moving up from 1-2 hours to 2-4 or even higher – significantly improves the capability of said battery systems to enable energy arbitrage, and that this will quickly become their primary source of revenue.

Pumped hydro continues to excite interest

Despite these recent improvements in both duration and cost, our advisory committee still worries about the fact that no truly large-scale battery solution has been achieved, leaving pumped hydro storage (PHS) as the best viable option currently available. Given the current expense of PHS, this an issue that leads back to the greater problem of overall scalability of renewables.

Despite the current problems, pumped hydro is still a topic of significant interest across the industry, as its scaled-up use asv a long-duration storage medium could ultimately provide renewable projects with the flexibility they need to fully overcome their intermittency issues while improving their energy trading capabilities as they could wait longer for the optimal time to sell

> **"Batteries are going to become a lot more profitable, not just because of lower costs but because they will help solve the intermittency issue. If we solve that, it will allow for the much quicker penetration of renewables overall. Batteries are one of the key elements to get us there, but only one. Pumped hydro is another, and it's a trend that's developing very quickly."**

AI For Energy – Energy for AI

The potential of artificial intelligence (AI) to enhance energy systems and the technology's impact on energy demand were key topics of discussion. AI can optimize energy consumption, forecast demand more accurately and improve the efficiency of energy production and distribution. Challenges such as ensuring data transparency and effectively integrating AI into existing energy infrastructures were also noted. Addressing these issues is crucial for maximizing AI's benefits and advancing the transition to a more efficient and sustainable energy system.

However, participants also acknowledged that the development of AI is expected to significantly increase energy demand. To reconcile AI's high electricity consumption with its potential to reduce emissions, technology and energy companies must collaborate in innovative and creative ways. This cooperation is essential to harness AI's capabilities while mitigating its energy footprint.

The consensus was that discussion around the AI energy nexus will remain a crucial issue for many years to come.

The Future of Green Hydrogen – Bringing Cost Down

Despite green hydrogen's massive potential, the consensus around the table was that the market for itis still some way from maturity. Green hydrogen still suffers from a mismatch on the demand and supply sides' expectations, from a lack of off-takers when it comes to attracting investment, and from a slower pace of technological breakthroughs.

Above all though, it's still just too expensive. None the less, the discussion emphasized the critical role of hydrogen in decarbonizing heavy industries. Participants highlighted the necessity of regulatory support and financial incentives to make green hydrogen economically viable.

Lower costs + broader cooperation = a viable green hydrogen future

If the cost of production of green hydrogen is simply too high, then what can be done to lower it? Our participants believe that costs will come down but green hydrogen will not follow the same development path of other clean energy sources. Unlike solar, we are unlikely to see rapid technological improvements that make the actual process of producing green hydrogen cheaper. Instead, the group believes that the main lever for reducing hydrogen production costs will be reducing the cost of the energy used in the process of producing it, which represents around 60-70% of the actual cost of the hydrogen.

This presents some hope for a quicker scale-up of green hydrogen (particularly in the Middle East), as it potentially becomes more viable when coupled with increasingly cheaper solar and wind energy. Equally key, accordingly to our advisory committee, would be broader and deeper cooperation between the public and private spheres on hydrogen. They believe that currently, governments around the world rely too heavily on subsidies to promote hydrogen production, the cost of which falls on a taxpaying public that's already overburdened due to global inflation.

In short, overreliance on subsidies will not secure green hydrogen's viability in the long term. Instead, governments are going to have to get more creative with their incentivization plans.

Regulations can reinforce areas of early adoption

Cost reduction is only part of the solution for scaling up green hydrogen. The regulatory piece is of equal, if not greater, interest to many of our participants. One contributor pointed specifically to the case of global shipping, where green ammonia is poised to provide a pathway to net zero by decarbonizing 60% of the industry.[3] In December last year, Maersk ordered four of the world's biggest ammonia carriers from Hyundai to ship hydrogen worldwide,[4] a move that signifies the kind of investment confidence in green hydrogen that can't easily be found in other industries.

The same contributor emphasized the point that to reinforce this confidence and bolster the development of green hydrogen overall, international regulators must ensure a level playing field for shipping industry players. If there's no competitive disadvantage (beyond the initial investment in purchasing/outfitting the vessels) in running ships on green ammonia, then the contributor predicts a much faster rollout. An exemplar industry, like shipping, would be exactly what green hydrogen needs to encourage more widespread adoption.

> **It's a big opportunity that's being missed. The whole Middle East region is like a void where there isn't a great deal of support for hydrogen production, but it supposedly has some of the best conditions in the world for wind and solar. This should really be an easy match to make, but it isn't. If we look at Oman, which had superb aspirations to make green hydrogen part of its new economy, it's pretty much ground to a halt for the moment because it's just too expensive.**

Pricing and Incentives – Efficient Pricing Breeds Energy Efficiency

Too frequently, discussions on the global energy transition revolve around the technological side of things. There is a laser-sharp focus on solving technical problems to do with production, distribution, transportation and the overall efficiency of these processes. Our advisory committee believes that there is too little attention being paid to the other side of the coin: pricing.
One contributor briefly outlined an experiment that was conducted at the MASDAR Institute, where a smart electricity grid was created with a blockchain-based internal currency solution that allowed for different consumers to pay for electricity within a closed system. The entities with the highest productivity were able to pay the highest price for their electricity, while other less productive entities would then disengage from consumption.
This reinforces the point that pricing is a fundamental determinant of both production and consumption behaviors. Our participants would like to see more acceptance of this reality, particularly when it comes to government-based subsidies and incentive schemes. For everyday consumers, much more work needs to be done in tying education regarding energy consumption to incentivization. Gamification apps, neighborhood competitions, school visits and more were mooted as specific examples, but the overall principle is perhaps more important – pricing matters more than we currently give it credit for.

> **Price is the bearer of all information, it's one of the key fundamentals for efficiency, but it's often overlooked. If you want people or companies to show energy-efficient behaviors, then you need to price that energy properly. This is why the regulatory element is so important – it's how you incentivize stakeholders to act in a way that will benefit their wallets.**

O&G Perspective – Building the Bridge to a Clean Energy Future

As we transition to the clean energy system of the future, it is imperative that we also focus on decarbonizing the current energy system. Some of this infrastructure will remain in place for decades, even as we implement new solutions.

Natural gas remains an enabler of renewable energy adoption

Much of the discussion on natural gas centered around the industry's long-term need for it as a feedstock for blue products, a "least-worst-case" hydrocarbon source of supply, but also as a vehicle for the rapid adoption of renewables in areas with underdeveloped grids.

One contributor spoke of the potential in West African nations to use their natural gas resources to take on massive amounts of renewable energy quickly, since it's much cheaper to use gas to stabilize the grid than it is to use batteries. Masdar has prior experience in Senegal, where the IMF asked for its assistance in developing the country's renewable energy program.[5] Due to their practice of burning heavy fuel oil for electricity, Senegal experiences extremely high generation costs of above $300 per megawatt hour. By relying more on its gas resources, Senegal is in the process of unlocking its renewable energy potential, driving down electricity costs alongside its carbon footprint.

> **Decarbonized natural gas is going to remain in the global energy mix for decades to come. If you build an ammonia plant today, it's going to be online for 30 years, and it will need natural gas as a feedstock. It's the bridge between a blue economy and a green one; we simply cannot do without it.**

Key Takeaways

Despite the wide-ranging nature of the experiences and insights shared throughout this advisory committee, there are a number of considerations that consistently crop up in the way stakeholders across the global energy industry think about the biggest issues they currently face.

Scalability breeds speed, and vice versa: Scalability cuts right to the heart of so many concerns and opportunities in the industry today. Our participants routinely referenced their anxiety that major opportunities are being missed due to the slow scaling up of emerging clean energy sources, particularly green hydrogen. While the choice of precisely which levers to pull remains tricky (incentivization, regulatory measures, dynamic pricing) there was a consensus that more speed is needed to harness renewables, deploy them at scale and build on the momentum already established. It is not enough to rely on falling production costs to automatically translate into faster adoption of renewables.

There's not enough forward planning: A persistent concern is that both government and private companies are too often reacting to events (technological breakthroughs, rapid drops in prices, etc.) rather than mapping out the best ways to integrate renewable projects into grids effectively. Participants spoke of a "mad dash to secure things," to secure financing, storage solutions, resources, talent, bids for projects, but without enough thought on how to put these elements into place efficiently.

Cooperation is key: With the forward planning concern in mind, the advisory committee strongly emphasized the need for greater cooperation between various industry players and the governments that have a vested interest in shepherding the energy transition. There is clearly a pressing need for more open dialogue and active collaboration that will drive a more integrated and efficient clean energy industry, from standardization and project development to energy efficiency, transmission and distribution.

Regulations will shape adoption rates: The need for agile, flexible and intelligent regulatory guidelines was regularly cited. From ensuring fair competition to creating effective incentivisation, regulators will continue to have a crucial role in guiding behaviors at both the production and consumption ends.

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