Energy Storage Systems Summit

Panel 1: The Present and Future of Energy Storage Systems - Transcript

Enerjide
Dijitalleşme
Derneği

ENERGY STORAGE SYSTEMS SUMMIT

8 JUNE 2023

WHO ARE WE?

The Energy Digitalization Association (EDİDER) was launched on January 9, 2020, as a leading high-tech association in Türkiye's energy sector that brings together all stakeholders establishes common platforms and supports decision-makers in determining a strategy for Türkiye to be a pioneer and competitive in the rapidly developing digital technologies in the field of energy.

With the contributions of its prominent members operating in the energy, technology, and communication in Türkiye, EDİDER has contributed to developing this field by raising awareness of the importance of digitalization in energy transformation by producing various organizations, workshops, and content in the last three years.

Energy Storage Systems Summit

Energy Storage in the Perspective of Local and Global Markets, Emerging Technologies & New Business Models

8 June 2023 / Sakıp Sabancı Museum The Seed - İstanbul

PROGRAM

13:30 - 13:40 Opening Remarks - Chen Le, Director, Huawei Digital Power, Europe

13:40 - 14:00 Event Launch - Dr. Alper Terciyanlı, CEO, Partner EGS

14:00 - 15:20 **Panel 1:** The Present & Future of Energy Storage Systems

Moderator:
Elif Düşmez Tek, Partner, Deloitte Türkiye & President, EDİDER

Panelists:
İbrahim Erden, CEO, Renecore Energy
Hakan Yıldırım, CEO, Sanko Enerji
Arkın Akbay, CEO, Polat Enerji
Enis Amasyalı, CEO, Borusan EnBW

15:30 - 16:50 **Panel 2:** New Business Models & The Role of Energy Storage in the Transition to Clean Energy

Moderator:
Dr. Alper Terciyanlı, Vice President, EDİDER

Panelists:
Murat Kirazlı, President, ETD
Erinç Kısa, Vice President, TÜREB
Cem Aşık, President, EÜD
Kutay Kaleli, President, GÜNDER
Prof. Dr. Kâmil Çağatay Bayındır, President, EDSİS

16:50 - 17:00 Closing Remarks - Zhao Guanliang, GM, Huawei Digital Power Türkiye

PANEL 1: THE PRESENT AND FUTURE OF ENERGY STORAGE SYSTEMS - TRANSCRIPT

Elif Düşmez Tek: Alper made such an excellent introduction that I don't know what to say. Now we will talk about the present and future of Energy Storage Systems, and I am very excited because, as you can see, we are here with our incredible panelists. I am sure we will learn a lot, talk and discuss a lot. In general, when we look at which topics we will discuss, there are many application areas. We want to touch on these various application areas and discuss which are prioritized for Türkiye. We have an existing legal arrangement. We went through an application process, and we are experiencing the reflections of this. What went well here, what could go better, and what are the points open for improvement? I want to discuss these with the panelists.

Again, we will have evaluations about the ancillary services applications, which we think are of great value for Türkiye in different application areas of energy storage. And, of course, Alper mentioned November 1, 2007. Now there is a new excitement like that, but we are very curious

to see how it will turn out. Will these investments come back to life? How fast will they return? What are the factors affecting feasibility? Are there difficulties in accessing financing? And ultimately, storage has a prominent place in the future of energy. It is essential because this change brings distributed energy, intermittent generation on the supply side, and intensive electrification on the consumption side. All this means that we need more flexible solutions. In fact, what is the place of storage in the energy world of the future? What else might be on the agenda? I want to learn from our panelists about their visions on this subject.

İbrahim, I would like to start with you. First, as I mentioned, when we talk about energy storage, we can talk about many different technologies, solutions, and applications, and these solutions have different uses. In other words, we can use it in energy management. To provide power quality and grid flexibility in the integration of renewable energy, in the realization of microgrids, or the areas of grid management, I would like to ask you, when you look at these application areas in general, I would like to invite you what are the applications that are needed for Türkiye, maybe inspired from there. And, of course, if there are any lessons to be learned about the recent application process, I would also like to hear them. Thank you very much.

İbrahim Erden: Thank you very much. I want to welcome everyone to this organization and their valuable participation. We are talking so much about batteries and storage systems because of the process we have experienced in the last six and eight months. Of course, this suddenly triggered this business. Maybe a year ago, maybe ten years ago, we talked about batteries in various ways and at different levels with different applications. I joined the energy sector in Türkiye in 2006. In 2007, for example, we talked about pumped storage in Türkiye, and in 2009 we were having talks with the State Hydraulic Works (DSİ) about it. There was another purpose at that time: how to implement pumped storage, should it be implemented, and why it should be implemented. Pumped storage was the solution for the irregularities in our rainfall in our water regulation and the peculiarities of the dams, the need for flexibility in the network that gradually started, and the need to manage it and use water more efficiently. So this was the need of the day.

After that day in 2009, especially with the Renewable Energy Law and the incentive mechanism being made more active, we have gradually come to the present day. Türkiye has passed 12 thousand MW of wind and 10 thousand MW of solar. But after October last year, in November-December, we saw that the applications for storage systems reached 260 thousand MW. Then in January, our Ministry of Energy announced the National Energy Strategy Document. We also saw the following there. Yes, 29 thousand MW of wind, 53 thousand MW of solar, and a fifteen thousand megawatts storage target. Somehow, the business has completely turned to renewables. Perhaps for the first time in our state, energy, strategy, documents, renewable energy entered as the leading actor.

Ten years ago, 15 years ago, we were not talking about this. We are still discussing when coal will be removed, but today we are moving forward on a different scenario. With the applications that come along with them being evaluated and now turning into pre-licenses,

we have seen that capacity allocations are being made beyond the targets. Exceeding 30 thousand megawatts is currently approved. Up to 30 thousand megawatts, it is envisaged to exceed this by a little more. In other words, we are experiencing a process similar to the 2007 application and 2011 competition process, with a different approach every 10-12 years. But it is the same thing. 2007, 2006, 2008. In those years, we used to go to the Turkish Electricity Transmission Company (TEİAŞ) and ask why we couldn't have a little more renewable energy, why we couldn't have more than 5 percent, why we couldn't have more than 5 percent, why we couldn't have more than 5 percent. Now we see a completely different world. The need here has become very different between 15 years ago and today. We have seen this. This is the production side. Of course, there is also the consumption side. On the consumption side, we have seen a completely different structure with on-site production applications, wind, solar, cogeneration-style generation, and the rapidly increasing penetration of electric vehicles. Now the production side works flexibly.

Let's say in a more volatile way. It's like, can we actually manage it flexibly? There will also be a fluctuation on the consumption side. I took a look at the electric vehicle sales figures and 3-4 years ago, I was an electric vehicle charging station, a company manager who was very interested in this for a while. I said let me see what the figures have been since then, and in 2020, when I left that job, there were a thousand-odd vehicles sold in Türkiye.

This year, more than 8 thousand electric vehicles were sold in the first 5 months. These are only electric, non-hybrid ones. There are also hybrids. More than 20 thousand hybrids were sold in Türkiye, approaching five percent. Last year it was less than half of that. Before that, it was one fifth of that. So there is an incredible increase. If we are going to see this fluctuation in consumption this year and in the years to come, then this is what we are actually looking at in Türkiye.

When we say lithium-ion, another thing we can do is to provide fast support to the grid, quick penetration, rapid entry and exit, more participation of renewables, and ease of use, but I wonder if and how we can and should make longer-term storage applications in medium-term, long-term storage using fluid account-based technologies, which we call flow batteries, or by integrating it with hydrogen and using hydrogen. I think this should be discussed and what should be on the agenda simultaneously. Likewise, we have an example of an application at the moment. Our legislation says that if you apply for a 100-megawatt wind power plant, you must install a hundred-megawatt-hour battery system. I am sure Hakan, Arkin, and Enis will mention this. While we are examining the feasibility of this in the preliminary application, I wonder if there is a need for this at this level. Let us not think of 100-megawatt hours of this as such, but if we think of some of it and how to integrate the others into the system into the application, I think it would be good to talk about it. Let me tie it with such a question mark.

Elif Düşmez Tek: Let's immediately turn that question mark into a new question and hopefully an answer. Now I would like to convey my question to Arkın. Now, I think we will give this 2007 reference throughout the summit. There is a severe stock of applications. Yes, some of them have been finalized and are ongoing. I wonder how much of it can be realized. Arkın, İbrahim

also mentioned that some storage-related elements have been added to YEKDEM. How is the economic dimension of the projects progressing? How is the feasibility shaped? Are there any issues related to access to finance? What should be done to overcome them?

Arkın Akbay: Thank you, I greet everyone. The question starts from where İbrahim left off. At the moment, we are always confusing power capacity definitions and megawatts with megawatt hours in capacities. I think it would be more accurate to talk about general megawatt hours in the storage world. Right now, we are talking about megawatts. There will need to be an optimization in terms of feasibility.

If we do, how much of it will materialize? What we want to do is also relevant. How much capacity do we have to allocate for frequency support, peak capacity shifting, points, and scoring work? Do we have to work on spreading our generation portfolio at the transmission level with the most optimum cost over time and to ensure the supply-demand balance? We can do this not only at the transmission level but also at the distribution level with storage, and in our new business models, perhaps electromobility was mentioned. Vehicle-to-grid, grid-to-vehicle, we need to look at how much macro storage we need at the distribution level, which we can balance with this at the residential level or the distribution substation level, and reveal the amount we need at the transmission level.

As in Türkiye, we preferred using storage as a renewable transformation tool. We started as a stand-alone storage; our need is to store at a level that will not disrupt the grid's frequency, will not disturb the power quality, and can go down to medium voltage, starting at the 380, 154 level. Here, the first address we will go to is the power plants with intermittent generation, and we will ensure that they are balanced first. We will come back from the secondary tertiary during the day.

Was it cost-effective to install storage for the primary? Or is it to manage it through the reserves in existing power plants? Because the existing power plants have been in operation for many years and have already reduced their costs to a certain extent. First of all, at what time will we do frequency control? Then we will do imbalance management. Which method will we choose here? A critical point is an approach that we will do the regional balancing. Because as you know, TEİAŞ has divided our country into various regions. There is logic in this.

Regional balancing can also be considered, but this creates a mechanism that leads to different market pricing. As a country, we do not prefer interconnected balancing. This costs us something like transmission system cost. In the total cost of producing in one place and transporting it somewhere else, would it manage it more efficiently with a warehouse? Or is this transportation a more reasonable arrangement until it pays for itself?

So, how much should I exceed the part where I answer a question with a question? As I said before, the first place to start was the imbalance method of the existing power plants at the transmission level. When we look at the prices there, even before we came to YEKDEM today, as you know, market prices were low in 2014 and 2015. There was a slight increase in 2018. It rose very high after the pandemic. Therefore, due to the an electricity-intensive

industry in Türkiye, industrial organizations have turned to unlicensed projects. Capacity has been created in that area, and there is no need for storage in itself, but it is a mechanism that will create imbalance. They will use the same transmission system due to inter-regional distribution, and there will be another imbalance. When I look at the applications, I don't see anyone staying in independent storage. Everyone seems to have combined it with renewables.

Then we should start with self-contained storage because it is less feasible. This is the first point. Because everyone has switched to renewable transformation. Now we need to separate these capacities. We have to use some power to balance our existing portfolio to ensure feasibility. And to provide some degree within the renewable transformation roadmap. YEKDEM is support, of course, but especially for new energy. If we are talking about a transformation again, our claim for so many years has been that we do not need a support mechanism. This had to occur in the free market. When we look at the financing conditions, especially in terms of equity adequacy, we need to transfer a certain amount of equity and be able to borrow to continue in the same way.

Borrowing interest rates are well known to everyone. So this is currently the case from Türkiye's perspective. When we look at the day-ahead or marginal electricity prices due to the financing conditions, and when we put the financing conditions on top of each other, we see that we need to store a certain amount of generation, which is what the grid needs. This needs to be separated in transmission based on generation type. Subjecting wind and

solar to the same storage is not a technically necessary arrangement if you stay within the power plant boundaries. They all have different characteristics. How can we dampen this? One of the solutions is not to do this only within the power plants. Again, there are places in the substations where we jointly make transmission lines at the transmission level, where we have been making transmission lines jointly for years. We can also pass an arrangement that can facilitate the work of TEDAŞ with a joint warehouse stage to increase the feasibility.

Regarding the YEKDEM side, we generally prefer to explain storage in combination with renewable energy. It is sufficient; it is not enough. The investor will decide on the amount of equity and return expectations, and the banks will look at how financially feasible it is. If finance costs become more affordable in the coming period, we can say that YEKDEM may be sufficient for this. But as of today, we think that after we talk about the amount of storage based on megawatt hours and after separating it according to the type of production, we believe that certain parts of the projects will be realized, especially the features that are preferred to invest in the right places. However, let me say that not only integrating wind with storage and solar with storage but perhaps revisiting the amount of storage after hybrid feasibilities and maximizing the capacities and utilization of existing transmission lines may also be advantageous in terms of total system cost.

Elif Düşmez Tek: Thank you. It is possible to summarize that the issue of balancing the existing power plants in transmission is currently ignored, or such a need is not expressed. Arkın conveyed that the current storage investments are progressing in a way to support the renewable transformation, and I think we will look at the developments within this framework. I would also like to suggest making storage more active to balance the existing power plants in transmission. Now I would like to give the floor to Enis. Of course, you are also investing in this field. Therefore, I would like to get your views, if any, on the factors affecting the feasibility of the work and the financing issue. But I would also appreciate it if you could talk a little bit about the areas of use of storage in terms of supporting the grid and improving power quality and how this can be supported.

Enis Amasyalı: Thank you Elif. I want to start my speech by greeting all the participants with respect and love—Arkın and İbrahim made precious contributions. I will be repeating some of them briefly to emphasize them again. Now three primary factors determine power quality. One is frequency within limits, voltage within limits, and it cannot be uninterrupted.

As you know, the frequency is determined by the production-consumption balance. Now, when you look from the point of view of the grid operator, things are straightforward. In classical conventional systems, the uncontrollable variability was on the consumer side. But over time, different types of consumers, but instead renewable energy. Especially with the increase in the proportion of variable-generation solar and wind power plants, grid operation has become more complex. The concept called system inertia, the contribution of rotating machines to the fluctuation of this frequency and the provision of quality, started to decrease gradually. Unfortunately, there is no such contribution in wind and solar systems.

On the other hand, the planning of the system operator has also become more complex. While planning the overall total load, the concept of the net load has entered the system operator's life, and it has become necessary to plan according to the net load, the part remaining after subtracting variable generation from the total load. Now, all this net load side inertia seems to have fallen and will no longer be in our lives. The increasing proportion of renewable energy, energy transformation, and all these together are perfect for managing this variability. There were also other methods in your question about flexibility, but the first one that comes to mind is energy storage. So let me start with a more system perspective.

Of course, the fact that the storage responds very quickly, the response time, and the high accuracy, on the other hand, provide synthetic inertia to the system. This includes frequency control. Now, 260 GW was mentioned a little while ago, I had left 250 at the last 260 GW, and roughly 25 to 26 GW of capacity is allocated to WPP-SPP facilities with storage. Now, 260 GW was mentioned a little while ago; I had left 250 at the last 260 GW, and roughly 25 to 26 GW of capacity is allocated to Wind Power Plant (WPP)- Solar Power Plant (SPP) facilities with storage. The 7 GW above comes from local facilities. What does this tell us? In the next five years, our story in renewable energy will be intertwined with storage, moving forward together with it.

Now that I've looked at things, the hockey stick-like progress we see in many classical technologies is also experienced in storage. Not only in our country, the installed power in the world at the end of 2021 was 16 GW. I am talking about grid-scale utility-scale storage. This is not far away. It is expected to reach 682 GW installed capacity in 2030, 43 times more than what we discussed. For what? To achieve net zero. To further increase the penetration of renewable energy. We have such multifold targets in front of us. On the other hand, the UK is far ahead in this regard, with a planned storage capacity of 110 GW in 2030. With the exit from natural gas, the departure from coal, and the increase in offshore wind, it says it will reach 110 GW. In the National Energy Action Plan, we say 7.5 GW.

If you look at the capacity recommended by TEİAŞ and, therefore, EMRA, there is a potential of 26 GW in two months towards the 2030s. Gradually, these licenses started to be distributed. It seems to have exceeded 10 GW. Now, if it comes to frequency control briefly from here, in fact, the application purposes are very, very different. İbrahim and Arkın both mentioned that there is confusion in storage. Looking at the global scale, 50 percent of the applications are in frequency control. Today, storage investors create value mainly from frequency control worldwide. They make money, which is not a tiny rate. But frequency markets, that is, services, also have a feature like this.

On the one hand, the pie is specific. No matter how much it varies, that market becomes saturated when there is a rush there. There was a market called Firm Frequency Control in the UK, and it became saturated. Other sub-markets were opened to serve this fast response and accuracy of storage underneath. They called it Dynamic Containment; they called it Dynamic Reserve. In a much shorter period, sub-markets where the features of this storage are crowned, and market signals to the investor are formed have come to the agenda, and I

think that a similar development should be in question in our country.

Now, within the framework of the flexibility you mentioned, storage is the first thing that comes to mind. Still, I cannot go without saying that aggregation is one of the essential focal points, whether in EDİDER or ETD. Naturally, demand-side management, pumping, and storage is the first part of this story. Increasing interconnection capacities provide flexibility and hot reserves in renewable energy generation. This is a dangerous sentence. When I say it with the identity of an investor, when appropriate mechanisms are established, we can see that it can find a reserve in different foreign countries in terms of flexibility. With your permission, I would like to add another investor perspective to the feasibility approach left by Arkin in the last part. First of all, we are confused. I mean, I liken storage to Rubik's cubes. It takes some time to put them together and create that perfect surface. But slowly, many perspectives are starting to come together.

When you look at the CAPEX side, costs have dropped considerably since 2010. As we have seen in the classic economies of scale, but not yet at a sufficient level. On the other side, there is the battery. The technology has advanced, but here is the action in the circuit, the number of cycles, their lifespan, and how many processes they can do. There will be some progress here. But first of all, Arkın touched on this. Where are we going to add value? How are we going to generate revenue? This is the most fundamental question of the investor, and we have repeated the analysis that many investors have recently made in many places, whether it is arbitrage. Whether it is arbitrage, i.e., services, balancing the power market, or cropped energy in wind, solar, and hybrids. Whether it is the storage of the curtailed idle energy.

When you study these purposes one by one, none of them are. As long as you can use these several purposes together, and as long as a specific part of these purposes creates value, the system becomes meaningful. In our case, I think we still have a long way to go on the technical and legislative sides.

In other words, when you look at the C-Rate of 1 MW - 1 MWh or the existing storage capacity, the coefficients in the primary frequency of 50%, the coefficients in the secondary frequency, when you add a possible arbitrage on top of that, these coefficients are not very responsive, it does not seem likely. This is not adding value on top of each other; it is not adding turnover on top of turnover and is not very meaningful. Let me say arbitrage or something concise. In today's regulated market, of course, in the world of AUF, these words are not very meaningful, but when you look at it in general terms, when renewable energy increases, when solar energy increases, which we see in other countries, states, for example in California, the daily curve starts to resemble a duck curve, arbitrage opportunities arise. This arbitrage is the primary purpose the storage investor claims to have bought in advance. Another issue is that we will open that gap in our education over time. In other words, advanced services, that is, services markets, will open up. Whether it is regulation, congestion, or regional parts, we need to enter a period where these can come and signal to investors.

Let me summarize what I said at the beginning. The next part of the story is WPP with storage. Therefore, we need to be able to do these with legislation, financing, and other parameters. Türkiye is growing, demand will increase, and the answer will come from renewable energy. Developments in YEKDEM are positive—introducing the floor price and the regulations on domestic contribution escalation. However, I agree, as Arkın said, it is not yet at a sufficient level. Therefore, as all sector stakeholders, we need to move to an order where we can collect all these together. But I think the way we are moving forward is promising.

Elif Düşmez Tek: Thank you. You mentioned different areas that can create value in the feasibility of storage, but you said that we are doing the math in the current conditions. Except for investing together with renewable energy, we have not been able to move towards a value that will support feasibility. When we bring it side by side with the issue Arkın mentioned, independent storage is not on the agenda. But they are more marginal when we consider renewable energy investment and add them to the others. First of all, I think we can make this clear.

You said that the capacity development in renewable energy in the next five years seems to go hand in hand with storage investments. We and other experts also express this in different environments. The focus should be on the development of renewable energy. So the focus is not on storage. The focus is on describing renewable energy development within the generation portfolio. Storage is a supportive element. But at the moment, there seems to be

a storage-oriented transformation. Of course, if you would like to comment on these. Now I want to give Hakan the floor for the first round. Again, Enis mentioned how much capacity increase is foreseen globally. We have entered a new era in storage and the production of clean energy technologies in many sub-elements of energy transformation. The International Energy Agency describes this period as a new industrial revolution. Now, of course, we are talking about storage today. In terms of storage, can Türkiye have a role and place in producing energy storage technologies? Because you have served in the field of wind energy for many years, you have been a manager in the association, and there are lessons learned there. We have experienced this regarding the production of wind energy technologies in Türkiye. Are there lessons that can be learned there? Can we take storage as an example?

Hakan Yıldırım: First, thank you very much to the team organizing this event. It is adorable to be together. Now, if I present in such panels, I usually listen to the speakers and try to approach them from a different angle. Of course, when I have three very experienced panelists with me, I am not left open. There is nothing to talk about inside the box. The battery is just a battery when we talk about it. Therefore, I would like to talk a little more out of the box, a little more provocative, from a different trajectory. Now, if we give these conditions in Türkiye today. 200,000 MWh of applications, YEKA projects, but no realized projects. If we say that the wind power plant installed in the last five months is only 50 MW or something like that, and if we say, hodja, what do you think about this battery, the battery is entering? ChatGPT would probably say: I haven't tried it; I'll do it when I go. The battery field Is also a significant threat to the short-term interests of the country. He might say it can be a substantial gain for long-term goods. Now the battery is a boring subject, very dull to me. When I talk about the storm, when I talk about storage, my heart swells. Why? Because I am an electricity producer, what we are talking about first consumes electricity. So we say battery, battery, battery. When we put the battery in, it is as if the wind will be such a power plant. In a 50 MW power plant, you put a battery with a capacity of 50 MWh. The wind blows at 13 m/sec and fills it in an hour. The wind blows for three weeks. You don't know what to do with the electricity in that battery. You can't discharge it because there is an electrical limit. Therefore, it is an electricity-consuming solution.

The second issue is that we must do this as an obligation as electricity producers. So we want to build a wind power plant. We want to install period equipment. We want to generate electricity from air, water, and the sun. But at the point we are at now, if you want to do this, you will put a 300-400 thousand dollar battery. It is of no use to me. Your electricity will be less. Is there a benefit to the grid? Of course, it does in the long run.

Now I'm just going to say that in the short term, the answer ChatGPT is likely to respond to is threats. Why threat? 25-30 thousand MW capacity will be allocated to this, and they will say yes, we have given this capacity. But the reality of the country. 50 MW wind power plant in 5 months; unfortunately, there are 10 thousand MW and 11 thousand MW wind power plants. There are 10 thousand megawatts of solar power plants in Türkiye. TEİAŞ's figure in April announced as a capacity increase for existing power plants, is 170 MW, only 170 MW capacity increase, but besides this, 25 thousand MW, 30 thousand MW battery WPP, SPP. Feasible? It is

not possible. It is impossible; it does not pay for itself in 25 years. If you make a wind power plant a battery today, why?

Because previously, there were wind fields in Türkiye with a capacity factor of 35 percent and 40 percent. These have been exhausted. Whatever the capacity factor was 32, 33, or 30 percent, the interest rate was 1-2 percent. Is there less than 9-10 percent interest today? Not in euros or dollars. I exaggerated the turbine price to 400-500 thousand 400, maybe Chinese suppliers can offer it today, but it was 500-600 thousand Euros. Today it is 800-900 thousand Euros. Put a battery of 300 thousand 400 thousand Euros on top of that, and then talk about the battery while laughing. Unfortunately, the battery path is a path that can lead to the lockdown of the electricity generation system in the country in the short term. Therefore, this needs to be seen.

The second issue is localization. Domestic manufacturing. Now that I have said these things from a different trajectory, manufacturing is also a fascinating subject. I want to explain this with three examples. I started working at ASELSAN in 1998 when I was a university student. Our project was a domestic inverter project. In 1998, we would make it indigenous with its software and everything by using those bitter plants. At that time, there was neither solar nor wind in the market, at least not on a mega scale. I made a very rough calculation. Approximately how much inverter was used in these 10 thousand MW of solar installed in Türkiye? Otherwise, inverters worth 250-300 million dollars were used. The project started that day can also be done; inverters have been produced.

Therefore, there are two issues in manufacturing. One is being able to make, and the second is being able to sell. So we focus too much on being able to do it. Those inverters were made, but now they can dominate the world. So you entered this market in '98. You said that you would manufacture it locally. Nothing like that happened. Similarly, ASELSAN produced cell phones in '99. It was a cell phone that could compete with Nokia, though. So there were vibrating cell phones in a market where shaking cell phones were almost non-existent. Again, he did not care much about the function of being able to make but not being able to sell. In 2012, there was a platform called the Wind Energy Technology Platform. I was in that group with the coordination team of the National WPP project and we were going to make a national wind turbine. At that time, I was working for an international turbine supplier. A wind turbine is assembled. It's just an asynchronous motor that is put 80 meters up. But it is essential to be able to sell it after making it. In other words, it is essential to be able to do this on a global scale. It can establish that supply chain. It has been done. It stands at 2.5 megawatts. About 45-50 million dollars was spent. Now I hear that ASELSAN can hopefully do it again.

When we talk to many manufacturing companies and friends, the focus is always on being able to produce, but being able to take this to a global scale and sell it is a huge issue. That is, in this type of manufacturing when you are not in the global market. This is what our previous mission was all about. We constantly went to China to build a solar factory, now a factory with a capacity of 500 MW. The big brothers we talked to were saying that next year we will increase our capacity by 16 thousand MW. So can 500 MW really be competitive on a global

scale? So, when we talk about this battery issue, it is definitely a long-term opportunity. A friend of mine showed me this thing in California. From 2015 onwards, as MW increases, the price of electricity during daytime hours is zero. As the sun puts in, the price decreases. There is something called cannibalism. That's why batteries are a must. Storage is a must. But if you lock your entire short-term future, your project portfolio with this, you will either have to do this, or you will have to say that we were saying 1MW for 1 MW hour, but let's do 0.2 MW with friends because there is no project. Then someone will say, "If only you had told us this from the beginning, we would have entered," or it will continue to be locked, and you will have to produce new pipelines. That's why I find the developments in Türkiye on the manufacturing side very positive. There are many collaborations. There are also local brands, but we should never forget the global sales side. Otherwise, there will only be a form of production that needs national protection. I think that will not benefit the country in the long run.

Elif Düşmez Tek: Thank you very much. When you said it, I couldn't stop without repeating it. We focus on making, but we should focus on being able to sell. You said that we should always focus on how we can be competitive. Now, looking at the time, I will make a 2nd Round. There I want to talk about the storage of the future, the energy storage of the end, so let's zoom out. Can you share your vision for the future? Of course, today, we have several technological options. What can be added to these, what should we pay attention to, and what should we do to integrate them into our energy system? İbrahim, would you like to start?

İbrahim Erden: Now Hakan looked at it from a different angle, of course. He never offered us 400-500 thousand dollars in Euros; I'm sorry. So there is no such turbine offer; I hope there will be in the future. It's a matter of competition. But I would like to add this from where the minister comes from. We had something together. There was a process in which we worked shoulder to shoulder. It is about localizing and producing the sun first. Now it is in front of Türkiye. We need experience in solar and wind. There is an experience in the past. There is also such an opportunity in batteries. When you say the future, why are we doing this now? Let's integrate renewable energy more into the grid. Let's use more of the free resource you don't pay for that is, the free resource. Therefore, instead of importing, let's meet our energy needs by feeding our domestic resources with renewable energy in our grid. Where does this finally lead? Energy security in quotation marks, and security of supply in point is a bonus.

We are not doing this, but every country started to do it more after the Ukraine-Russia War after COVID, and we suddenly, you know, in the renewable past, which we have been trying little by little, there is a capacity there that surprises us, maybe huge. 260 thousand MW of applications may still be underway. During one of our visits to EMRA, Hacı Ali said that when you entered, it was this much; let's look at it now. There was something different. In other words, 2-3 thousand MW entered during the 2-hour meeting. But this is a considerable capacity. In terms of applications, it shows how high the interest is. Feasibility is another thing. The administration and the public are required to improve its feasibility. It said this is enough; this is necessary and put a YEKDEM in front of us. Detached storage, yes, there is no feasibility at the moment, but it has put a figure that can at least provide a basis for financing this with renewables. Will this be enough in the coming period?

I hope the figures Hakan, Enis, and Arkin have mentioned will reach the desired levels. Maybe these figures can provide a story that we can call financing insurance. This is my hope. But I am saying something like this in terms of capacity. We are talking about a battery close to 40 thousand MW. I mean, 30 thousand MW. I don't want to be a doomsayer for the unlicensed, but I think the unlicensed will also have to integrate with storage in the coming period. Because almost 20 percent of our country's grid will be composed of unlicensed energy-generating sources, can licensed power plants carry such a sizeable unlicensed load alone? Probably not, and the cost will have to be shared somehow. Either there will be storage, or there will be other applications within the framework of the legislation. Therefore, we will see a larger storage capacity. In short, this country has experienced an adventure of indigenization with its slowly increasing capacity in wind and solar power and has achieved specific production industrial facilities. The current work in solar has come to a point in solar. This country has started to produce cells, and many of our companies are now seeing and hearing about it. We went to China; they went together, talked about cells, and wanted to make them.

But there, this was a slow, gradual progress. Now, if we have a potential of 40,000 MW, then I'm not sure how right it is to say, let's start with the packaging of this, make it local, and get support from here. I believe that there is an opportunity here. To utilize this opportunity, entrepreneurs and investors must work and somehow turn it into an industrial facility.

Therefore, only packaging should not be the future for Türkiye. In other words, when we say the future perspective, let's bring a packager or a container from outside and put it in our wind power plant. Let's add two turbines from there right away. That's our capacity increase. This should not happen. There will be incredible opportunities on the software side. There will be a completely different SCADA structure. I consider all this an opportunity and a vision for the future.

On the investment side, we went through the 2007 application and 2011 tender process together with our friends. Many of our friends in the hall were at those desks, at the tender desks, or friends we worked with when we were doing the projects, and suddenly 8 thousand MW had come. On the investment side, I think these projects should be developed as much as possible without waiting for feasibility, taking lessons from experience, and not staying at A4 licenses. Today, if financing can be done at 12-13 percent interest rates and the process is short, this belongs to today. There is no need to be gloomy, to put it mildly. It is essential to make that project feasible. Because we see that what investors worldwide need and seek the most is quality projects, when this is not the case, investors look at several tasks in a country. He looks at the other one and the other one. Now they turn to where they can realize the most accurate project fastest. A source I recently read about the financing resources that will flow into renewable energy specifically said this, and where we generally see this project's development quality, of course, in developed countries.

Yes, the margin is lower in more developed countries, but the quality of work and project development is higher. Why? The legislation is more established, permitting processes, planning, and engineering processes can progress faster. The more we can bring this to our country, the more the financing environment will improve in the coming period, and investment costs will stabilize. Although there is a new severe measure in the global economy, we must be ready not to waste time when conditions normalize again. The investor also thinks that they have to take advantage of this opportunity.

Elif Düşmez Tek: Thank you, thank you very much. Let's continue with Arkın; I will wrap up later. Please continue Arkın. Thank you.

Arkın Akbay: Now electricity has an excellent characteristic: Sine curve is good if you are there at the ascent, bad if you are there at the descent. Suppose there is too much of it; its resonance drops. The team sitting before you enjoyed doing projects while that sine curve was ascending. Today, when many people who share their experiences with you enter, the work is somehow restricted, just like the electrical characteristics. At the moment, it seems to be at the exit regarding storage; when you first do these works, you are at the beginning of the learning curve, and there is a process that everyone will learn. If many people enter simultaneously, we will experience the same 2014-2018 period with the same capital. There will be a severe drop in electricity prices. This can be useful for storage. It has a balance in itself. The important thing is that we, as a country, reduce our marginal cost. In other words, if our main thing is to increase this level of prosperity, if we are to transform it into renewable

resources, we will have a little bit of difficulty here from the outside. Since we are in electricity-intensive sectors, fossil resources generally meet our base load, so there will be severe carbon tax pressure on this. The more this carbon tax pressure will be, the faster the storage sector will move with the renewable transformation.

Where will we be now? We will have to grow cautiously due to these financing conditions. But we need to say this with the right investor. To choose the right investor, there must be specific criteria, the most important of which is the ability to do this. I'm not talking about experience; I'm talking about capital adequacy. Today, when these licenses are at the level of pre-licenses and license amendments, I think EMRA should immediately ask for capital to be put in so that genuine investors and entrepreneurs who are not real investors but who extract money from the energy sector should be differentiated.

The country does not have a minute to waste on renewable transformation. These are all elements that can reduce the level of welfare. Our iron, steel, and petrochemical industries are under severe tax pressure today. If they cannot win, interest cannot spread, employment cannot apply, and growth cannot be achieved. We will expand our electricity generation investments. We cannot go to alternative areas. Therefore, the first thing we need to do is to distinguish who can do these jobs and who cannot. To differentiate very quickly. Not with periods like he gave. Look, not 24 months; 24 months is a painful period lost for this country. It is essential which project will be realized where. We have entered into a process where storage and renewable energy investment are not measured. Today, some things claim to produce wind energy in areas not Class 3. You put them all, and you see where and what is happening. We have been collecting data for 15 years. We know what is happening. It is not easy to shift them from one side to the other. That is also a process. When you put force majeure over those 24 months, this is it. It is the loss of everyone in this hall, in this country. Therefore, we must distinguish between real investors and those who apply for this business only because they have low capital needs and are trying to create value from it. Are we going to manage our imbalance by separating functions? Are we going to work on frequency control? Will we shift the peak or change the period? Maybe tomorrow, we will talk about solid-state batteries. Which job will we do most efficiently with which technology? We must invest in them as soon as possible, keep our learning curve shorter, reduce costs, and put them into practice.

Elif Düşmez Tek: Thank you, Enis; we can take your last sentences.

Enis Amasyalı: With pleasure. Let me open another window, talking a little bit about the technical side of technology. If we start with batteries or general storage, İbrahim mentioned that we are talking about batteries, but there are actually completely different technologies. Now basically there are actually four sections. We call it electrochemical, which includes lithium-ion sodium sulfur flow batteries; the flow battery has just been commissioned in China, with a capacity of 100 megawatts, and 400-megawatt hours has just been authorized. They are gradually coming in different scales. Of course, we need to clarify the application areas. The chemical side of hydrogen is thermal. Here, the parts for heat storage or mechanical pumping come first, but various storage technologies work with flywheel systems, the principle of air

compression, or gravity systems. However, today, when you look at the development levels of these technologies, the latest commercialization has now reached the deployment level. The number of technologies is small. At the top of the list are lithium-ion batteries, sodium sulfur batteries, and pumped hydroelectric power plants. Other than that, the others are in the R&D and pilot testing stages.

Now let me open the battery in a small window. This battery has also been mentioned a little earlier. Now different minerals and elements are used. When you look at lithium-ion, it is a combination of nickel, manganese, cobalt, nickel, and aluminum. On the other hand, lithium and iron phosphate. There is a trend among these. Although the energy density is relatively low, it is now easier to find nickel cobalt, which is less. It is shifting to lithium and iron phosphate technologies, including electric vehicles. Tesla just announced that the NMC type uses nickel, manganese, cobalt. Russia is the number one nickel supplier in the world, especially after the Russian war. The same things are in the graph when you look at the materials in the anode-cathode. The same is true for cobalt.

Therefore, there is such a shift in technology in this story. But on the other hand, of course, issues such as increasing energy density and efficiency continue.

Now I would like to talk more generally about what the technology will provide. We spoke of storage technologies as these technologies spread and become honey. The applications of renewable energy will be increasing; I will give you two numbers, attractive, of course. Spread over more extensive periods. The renewable energy capacity waiting in the "backlog pay" plan in the US is 1 TW, with a backlog of around 600-750 GW waiting in Europe. Therefore, access to these will become easier.

On the other hand, I think that the decrease in transmission line investments, together with storage, are the things we will see. Another critical issue is the interaction of electric mobility, electric vehicles, and storage. It was briefly touched upon. One sub-headings of this is the second-hand status of batteries, allowing them to live their second life. Our shareholder EnBW was in December at the end of 2022. If I am not mistaken, it started a study with Audi. Containers of batteries from Audi vehicles were placed with the cells being handled again. It now stores one megawatt of renewable energy, and trials and errors are being made. It has a 5 to 10-year life expectancy.

Now numbers in terawatt hours have been mentioned. There is also consumption in the order of terawatt hours. In other words, in terms of performance in electric vehicles, when the battery reaches more or less 80 percent, it can no longer meet the requirements. It has to be recycled. However, we have the opportunity to use them here. But it is not that easy to make this widespread. How much will the prices of batteries drop? The cost of this re-handling process is the standard certification; we bought a second-hand battery with a second lifespan. What will be the guarantee for this? These norms also need to be established. But since we are discussing technology and vision, I see a painful area in this section.

On the other hand, microgrids are also within the framework of energy independence. Of course, it is interesting there too. However, at the micro-grids and distributed systems level, the applications and rates of batteries are increasing significantly, and I see no harm in referring to a Bloomberg finance estimate. Predictions are that one-fourth of the entire battery fleet will be blocked in micro-grids. Therefore, this is the part that awaits us. I have just talked about the storage of electric vehicles, talking to the grid, talking to the market, and becoming commercialized. This is, of course, a must.

It's the catalyst for all of this. There is no digital license in the connecting part. So data analytics capabilities, digitalization capabilities. In this new world, we must move beyond where we are now, from system operators to investors at every level. Otherwise, we can't survive.

Elif Düşmez Tek: Thank you. We say that energy transformation cannot happen without digitalization. As EDİDER, I thank you. You spoke in support of this, Hakan Bey, now, I would like to get information about your vision at the closing, but I know you are closely following the global energy transformation. Introducing storage into our lives is indispensable as part of energy transformation. Well, do you see a Harmony station at a net zero target in the world in general here? I would be glad if you could answer by integrating it with this.

Hakan Yıldırım: Thank you. Now I will speak as if I am talking to a family. I try to raise awareness on one issue in such panels. I mean within the time allocated to me. And that is this. I mean, why are we making all this effort? Why are we here today? Why have we been building wind power plants for years? Why is Yusuf building hydroelectric power plants? Why are we building wind power plants? Because there is such a thing as a climate crisis. And there is a war against this climate crisis in the world. When I ask myself this question, I find the answer harmful. Sometimes I wonder if I am looking too negatively. Will the world win this war? In my opinion, it won't. I don't even see a 1% chance of winning. So, should we invest in wind or natural gas power plants today? Should we invest in the technology that will make us competitive on that day, thinking ahead to the day when we will not win this war or when we see all the effects of that crisis? Why do I believe, as a country today, that it will not succeed? Is it in my interest? Sure. Because this is a severe harmonic movement, a market that requires a consensus, a war. There are no borders because there are no walls. Now I have attended two meetings in the last four months. One was just a week ago, the leader of an international organization. And the other one, again in this way, I heard that implementing a new energy project in the European Union would encourage local content in energy projects.

This was confirmed four months ago and a week ago. The gentleman I spoke to one-on-one in Brussels, I had dinner with him, one-on-one in Brussels. This is the head of one of the organizations that influence lawmakers. I said, why are you doing this? For years, the World Bank, the World Trade Organization, and banks like IBAD. They put a lot of pressure on Türkiye because there is local content. What kind of a free market is that? Why are you doing this now? Because somehow we have to protect the industry in Europe. We cannot depend on a single source.

There are Chinese friends here. I have a lot of respect for them. When we were doing solar, we went back and forth all the time. Indeed, China is the country behind why solar costs have fallen so much. If this is perceived as a threat, we need to minimize it; we need to go to the minimum price to reach the final goal. Imagine four or five Hollywood movies in front of your eyes. The world is coming to an end and a meteor strikes. All the world leaders are on a screen, and each drops their priorities. Someone brings a piece of the rocket; the Chinese worker says, "I'll get this, brother, and that's how you eliminate the threat. It is said that a huge threat is coming, but on this side, we say, Professor, he is lowering the LCOE, but I will put a barrier on him. Why does he bring a wall? It brings an increase in LCOE.

Then I ask myself: Is our goal really to defeat the threat, or is our goal to get the maximum share from the green economy that comes along with this threat, that is, in 2023 alone, 2.8 trillion dollars will be spent on energy, 1.7 trillion dollars will be spent on new energy in the world. Or is our aim to get the maximum share from this green economy? The world needs to ask itself this question. I mean, if the European Union takes this decision and puts this as a barrier, I will be looking at it as a guarantee that we will hit the wall. Of course, the priorities of our countries are essential here. We also need to manufacture. They also need to manufacture. If the threat is so close and will have such clear consequences, and if a country produces cheaper than all the rest of the nations, we need to provide incentives to make that

country more affordable. We need to develop other instruments that lead to results. That is why I try to raise awareness about this in all the panels I attend. This will also raise awareness among the people we all meet and talk to. In total war, if a ship is drifting, but the people and countries I see are trying to sell each other razor blades, lotions, etc., on board the vessel. This is a considerable threat.

Elif Düşmez Tek: Thank you very much, we finished just in time, but I would like to summarize as follows: We are now in a period where 200 GW of applications have been made, and we expect approximately 40 GW of this to be realized. I guess we can say that we are living in historic days. There are both opportunities and situations that need to be considered. First of all, maybe it is not the only reason. Still, it is evident that the applications in energy storage and the realization of the investment as it is currently being done support the renewable transformation. Secondly, it creates a potential on the production side. In other words, we can play a role in producing these technologies. In this sense, of course, we need to pay attention to some things. We need to focus not only on production capabilities but also on being competitive and perhaps creating reliable brands here. And when we look at the areas that need to be further developed or the elements that need to be considered, we have said that it is essential that this great transformation is carried out with the right investors and investments focusing on the right area, that is, focusing on the right places because all storage touches different regions. I, for my part, tried to listen carefully without missing a single word while listening to you, and I learned a lot. Thank you very much. I hope it was a valuable session for everyone. Thank you again for your participation.

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