

A distinctive road to energy transformation

Current and future challenges in the region's power utilities sector



Two-thirds (67%) of central and eastern European survey participants say current market models are unsustainable and the need for change is becoming urgent.

Three-quarters (76%) expect the market model in their home country will have undergone significant or very significant transformation by 2030.

Companies need to prepare for a major capability shift ahead.

Capturing central and eastern Europe's power and utility viewpoints

Contents

<i>Introduction</i>	3
<i>Executive summary</i>	4
<i>Dilemmas, disruption and transformation</i>	8
<i>A different emphasis in the energy trilemma</i>	8
<i>Disruption is gathering pace but its impact is not widespread</i>	10
<i>A more moderate transformation outlook</i>	11
<i>The future for the region's energy systems</i>	14
<i>What's the main focus of change in the region?</i>	14
<i>Significant changes expected in the region's energy mix</i>	15
<i>A shift from centralised to decentralised energy</i>	16
<i>Greater integration and energy connectedness</i>	17
<i>Market models, business models and company strategies</i>	19
<i>Market models are seen as unsustainable</i>	19
<i>The balance between the market and the state</i>	20
<i>Business model change needed to match energy transformation</i>	21
<i>The implications for companies' operational strategies</i>	24
<i>Major barriers remain in the way of modernisation</i>	25
<i>Contacts</i>	27

33

senior power and utility sector participants

18

countries

33

companies

About the survey

The PwC Central and Eastern Europe Power & Utilities Survey is based on research conducted between February and May 2016 with 33 senior executives from 33 power and utility companies in 18 countries across the region. The majority of participants were senior vice-presidents, senior general managers, directors or other department heads from power and gas utilities, with interests covering supply, transmission, generation and trading. Much of the survey is forward-looking, inviting participants to give their viewpoint on likely immediate and longer-term developments. Time horizons of 2020 and 2030 are used for these purposes.

Terminology

By the term 'energy transformation' we mean the convergent effects of technological advances, the growth of distributed generation, new forms of competition, changes in customer behaviour, regulatory direction and their combined impact on the nature of the power system and power companies.

'Disruption' is used to mean a change in the established way of doing business. It could arise from a single factor, such as technological change, regulatory change, competitive forces, changes in customer behaviour, or from the accumulated impact of a host of factors. The result is a challenge and a shift in existing business viability or ways of working.

'Market models' refer to the way a market is structured and designed, whether it is policy/regulator-led, market-led or a mixture of both, the extent of competition, separation or integration of roles and the 'policy goals' that are promoted.

By the term 'business model' we mean the means by which a power and utility company makes a profit or creates revenue – what it does, how it addresses its marketplace, and the business relationships it deploys to do so.

Acknowledgements

PwC thanks all the participants who took time to participate in the survey and the CEOs who have added their perspectives on the results.

Published October 2016

Azerbaijan

Belarus

Bulgaria

Croatia

Czech Republic

Estonia

Georgia

Hungary

Kazakhstan

Latvia

Lithuania

Poland

Romania

Russia

Slovakia

Slovenia

Ukraine

Uzbekistan

Introduction

Welcome to the first edition of the PwC Central and Eastern Europe Power & Utilities Survey. The survey goes to the heart of boardroom thinking in utility companies and other sector stakeholders across the region. It acts as a companion piece to our Global Power & Utilities Survey.

We look ahead to the future world of electricity in the central and eastern Europe region as well as considering the challenges the power sector faces today. The changes that lie ahead are of great potential significance. New technologies, upgraded infrastructure, different ways of generating, distributing, storing and using electricity will all play their part.

But we expect the region will follow its own distinctive path in addressing these changes. We find that senior executives from power and utility companies in the region expect an energy transformation will take place, but at a slower pace and with a less intensive disruptive impact than is anticipated by their counterparts in many other regions of the world.

The region is a diverse one in terms of the energy resources, market structures, and geopolitical circumstances in different countries. One of the factors in the pace of change in some countries will be how the sector and policymakers manage the pressing challenges that constrain some existing power systems. Market structures can inhibit the pace of energy innovation and modernisation. Some existing infrastructure requires replacement or overhaul. The investment requirement is substantial. The road of market reform remains long. And the scope for improvement within power companies themselves is substantial.

We look at these issues through the viewpoint of a survey that is extensive in scope as well as intensive in its depth. We have talked to senior power and utility company executives in 33 companies and 18 different countries around the region. The survey is supplemented by the 'on the record' perspectives of a number of CEOs that are also included in the report. We report survey responses to a range of questions and also, where relevant, highlight comparisons with the findings of our global survey.



Adam Osztoivits
Power & Utilities Leader
Central and Eastern Europe

Executive summary

Energy transformation is gathering pace all around the world. Rapid technological advances are changing the choices in front of power companies and their customers. Distributed generation is on the rise, complicating the task of balancing supply and demand, and bringing with it the potential to eventually undermine the traditional power utility business model. Advances in power storage are widely expected in the near to medium-term future. Power is being transformed from a top-down centralised system to one that is much more interactive, decentralised and fragmented. And digital technology is changing not just the way companies interact with their customers but is also bringing deep changes in the core operational activities of utilities.

These disruptive and transformative trends are also evident in central and eastern Europe (CEE). But the pace of energy transformation in the region is moving at a different speed and the nature of change is different, reflecting the various characteristics and policies in the region. In particular, geo-political circumstances are shaping the changes that are taking place more than the wider consumer and market forces that are playing a key role in a number of other countries. Our survey identifies a number of trends that indicate central and eastern Europe is on the path to its own distinctive kind of energy transformation rather than merely following in the footsteps of developments elsewhere.

A different energy trilemma emphasis in central and eastern Europe

Concerns about security of supply and affordability significantly outweigh cleaner energy priorities in the region. CEE survey participants don't expect to put the same emphasis on cleaner energy in the 'energy trilemma' trade-off as their global counterparts.

Currently they give it less than half (just 48%) of the emphasis given to security of supply compared to a 61% emphasis recorded in our global survey. And although companies in the region expect clean energy to move up in priority, they don't expect this to change as much as those elsewhere do.

The region remains partly sheltered from disruption and energy transformation

Most CEE respondents (58%) say that currently their markets are little affected by energy transformation and disruption, compared with less than a third (29%) of global survey participants reporting such relative calm at present.

Disruption is expected to gather pace but it is still forecast to fall significantly short of what is being experienced and predicted elsewhere in the world. Just over a third (36%) of CEE survey participants expect their market to be subject to high levels of disruption by 2030. In contrast, nearly half of global survey participants expect high levels of disruption to overtake their markets as soon as 2020.

The picture that emerges is that disruption of the power and utilities sector in the region is expected to be slower and less widespread in its impact than in many other parts of the world. Although just over a third of the companies we spoke to anticipate high levels of disruption, three in ten don't expect disruption will affect them in any significant way even as far out as 2030.

But there is widespread recognition of the need for market and business model change

Two-thirds (67%) of survey participants say current market models are unsustainable and the need for change is becoming urgent.

The need for business model transformation is seen as urgent by a significant segment of CEE survey participants. Over two-fifths (42%) say current power sector company business models are already broken and the need for change is already urgent, many more than the 29% of participants in our global survey.

By 2030, a majority (55%) of CEE survey participants expect their company business models to have undergone major or very major transformation. And three-quarters (76%) expect the market model in their home country will have undergone significant or very significant transformation.

Companies are planning a major shift away from centralised fossil-fuel generation

Companies are making some big strategic shifts as they position themselves for an era of technological transformation. Among our survey participants, 42% say large-scale centralised fossil-fuel generation is their most important strategy now, but only 21% expect it to remain so by 2030.

Instead, the focus will be on local energy systems and infrastructure. Activities such as off-grid energy solutions and smart city infrastructure, reported by hardly any as important for their companies today, become highly important for around a quarter or more of companies by 2030.

Indeed, off-grid solutions, smart infrastructure, large-scale renewable generation and local energy systems are all expected to outrank large-scale centralised fossil-fuel generation in 2030.

Survey participants also expect a significant shift from centralised generation to utility-scale distributed generation and customer-located generation. Our survey participants expect centralised generation will supply 81% of electricity demand in 2020 but that this will have declined to around 66% by 2030.

It is understandable why survey participants are anticipating such a shift, but the magnitude of the change expected is a surprise, given the relatively low current penetration of non-hydro renewables and distributed assets in the region's generation mix. The pace of adoption of these technologies would need to accelerate significantly, even in EU states within the region, for a shift of this magnitude to occur.

The need to prepare for a major capability shift ahead

The various energy system changes that lie ahead will require utility companies to think very differently about the capabilities they need to develop. Some capabilities will be challenging for them. The sector does not, for example, have a culture of or track record in product innovation.

And it is notable that, compared to the results from our global survey, companies in the region seem to be underestimating the importance of some capabilities. Despite a perception that customers will be more important in the future, capabilities such as digital customer management and pricing/margin improvement, which are viewed as highly important in our global survey, are only seen as of medium importance by companies in the region.

Similarly, survey participants are underplaying the importance of forming partnerships with other companies and possible collaborators as they make the transition to a future where different technological capabilities and skillsets are likely to play an important role.

Finally, many countries face the challenge of system renewal as well as energy transformation. Existing power systems are worn out, in disrepair or simply very inefficient. Big investment is needed for infrastructure renewal, yet we find that nearly half of survey participants have a high or very high concern about difficulties in attracting investment, saying better government guarantees and more regulatory certainty are needed.

PwC is working with companies in many different parts of the sector within the region and around the world, helping them assess the energy transformation road in front of them, to map strategic paths and to develop the capabilities and partnerships they will need. In many parts of the CEE region, the challenge will be to make timely moves to renew 'old energy' systems while, at the same time, transitioning to the introduction of modern infrastructure that can support and provide a foundation for energy transformation.

A diverse energy landscape in the region

The region covered by our survey is highly diverse and the findings of our survey need to be understood in that context. The countries covered are in a variety of situations. They include EU member states such as Hungary and Poland, the EU associate states of Ukraine and Georgia, as well as countries such as Armenia, Belarus and Kazakhstan that are part of the Russian Federation-led Eurasian Economic Union. Not surprisingly, as a result, there is a great deal of difference in the market and policy context of power systems in the region.

Moves to a liberalised market and market-driven pricing in the region are furthest developed in the EU countries in the region. Nonetheless, examples of state-regulated tariffs persist in those countries. Outside of EU countries, liberalisation is still at a very early stage. Even in countries that have strong policy decisions favouring a free market, such as Ukraine and Georgia, progress has been slow, mainly due to legislative hurdles, poor capacity-building and financing problems. Elsewhere there remain considerable barriers to private investment, with an absence of clear and transparent rules as well as independent agencies dedicated to regulation and consumer and business protection.

The physical energy context of the countries in the region is similarly diverse, ranging from countries that are rich in indigenous energy sources with a high level of security of supply to those dependent on fuel imports. Estonia, for example, is largely self-sufficient in energy, thanks to shale oil reserves, while Poland has extensive lignite and hard coal resources. Hungary, on the other hand, is largely dependent on natural gas imports. Nuclear power plays an important role in the region and a number of big new nuclear projects are in the pipeline. Hydropower makes a significant contribution in some locations and the potential for wind and solar renewable generation is also considerable in places, but relatively underdeveloped in the region as a whole.

High levels of energy resources in some countries do not always translate into reliable and secure power infrastructure. Uzbekistan, for example, is rich in natural gas resources but, despite energy self-sufficiency, its ageing electricity infrastructure and network underinvestment have led to electricity shortages, poor efficiency, high losses and lack of reliability.





Source: REN21. Renewables 2016 Global Status Report

Base year share of electricity generation from renewable sources refers to 2014

Dilemmas, disruption and transformation

The energy sector everywhere is in a state of change. As well as the eternal dilemma or 'trilemma' of security, affordability and cleaner energy, companies and policymakers are now grappling with a range of disruptive forces that are taking us into an era of energy transformation that has no parallel in history. Energy systems have the potential to look dramatically different in the medium-term future as technological advances transform the way we produce, consume and think about electricity.

One thing, though, is certain. The nature of change in energy is influenced by geo-political circumstances. It is the single most important reason why the particular characteristics and pace of disruption and energy transformation will be different from region to region, and from country to country within regions. Just as in western Europe, the energy transformation that is taking place in Germany is distinctive from that in France or Norway, so the path that will be taken in, for example, Poland will be different from that in neighbouring Ukraine or further afield Uzbekistan.

As we note in the 'background context' panel, the circumstances of countries in the central and eastern Europe (CEE) region are very diverse and this needs to be kept in mind when looking at the findings from the survey. The survey is region-wide and it is not intended to deliver a country-by-country examination of the very specific issues affecting particular companies in different countries. Instead, we show how the region as a whole is approaching the big issues of the energy trilemma, energy transformation, future energy technologies and how company strategies and market models need to change. Where appropriate, we include country examples and we also compare our findings with those from power and utility companies worldwide by looking at how the results from this regional survey compare with those from our global survey.

A different emphasis in the energy trilemma

Concerns about security of supply and affordability look set to continue to trump cleaner energy priorities in the region. CEE survey participants don't expect to put the same emphasis on cleaner energy in the 'energy trilemma' trade-off as their global counterparts. The trade-off between the three classic energy objectives of security of supply, affordability and cleaner energy has long been recognised as a central dilemma, or 'trilemma', for energy policy. Security of supply is a perennial concern in the region, with many countries reliant on imported gas from Russia and/or interconnection with neighbouring countries.

Security of supply is the dominant concern for utilities in the region, with clean energy taking a much clearer third place compared to the findings of our global survey (figure 1). Currently, CEE survey participants give it less than half (just 48%) of the emphasis given to security of supply, compared to a 61% emphasis recorded in our global survey. And although companies in the region expect clean energy to move up in priority, they don't expect this to change as significantly as those elsewhere do. By 2020 they say it will still remain firmly in third place, whereas in our global survey, companies worldwide rate it more on a par with affordability. Instead, in eastern and central Europe, companies put affordability much closer behind security of supply at the head of the energy policy trilemma, both well above the goal of cleaner energy.

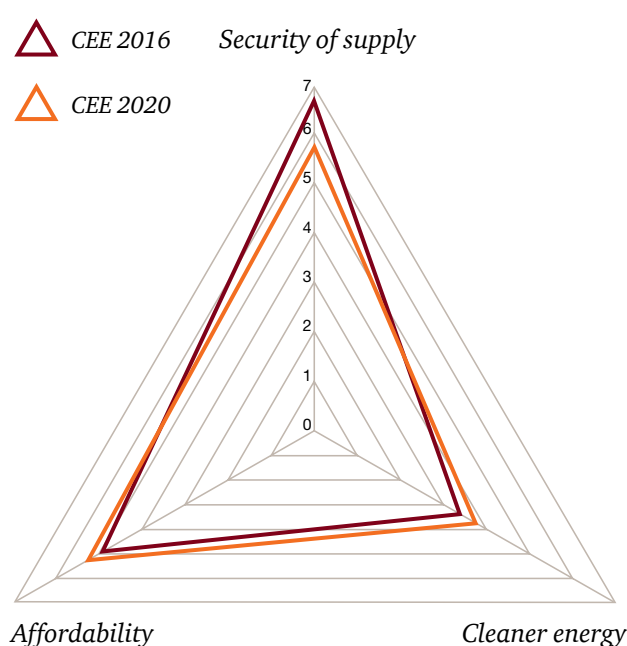
When we questioned survey participants more closely about the objectives that receive the greatest focus in their country's energy policy, 41% said security of supply was their top focus and 35% said it was affordability. In contrast, only 22% said promoting energy efficiency was their top focus, and just 18% pointed to mitigating the environmental impact of the energy system as a top focus. Of course, as we emphasise earlier in this report, these are aggregate results giving a region-wide view. Individual countries will have different policy

priorities with, for example, those in the European Union subscribing to the EU's 2030 targets for energy saving, emissions reduction and renewable energy. Away from the EU states, the role of renewables, with the exception of locations with significant hydro capacity, is still minimal, and such targets that are set are accordingly lower.

Even where hydropower resources are present, such as in the Ukraine where it provides some 10% of electricity generation¹, the move to renewable resources is coming from a low base. Ukraine's National Renewable Energy Action Plan (NREAP) envisages that the share of renewable energy in the country's total final energy consumption will increase from 3% in 2009 (the plan's base year) to 13.2% by 2030², around half of the 27% target in the EU, but nonetheless a big increase on the current situation. The challenge of reaching this target is all the greater given economic and security strains and the commitment to put resources into two new nuclear reactors.

Figure 1: CEE region vs. global: energy trilemma

Where is your 'home country' energy market positioned in the 'trilemma' between security of supply, affordability and cleaner energy now, and where do you expect it to be in 2020?



2015/2016	CEE Average score (index)	Global Average score (index)
Security of supply	6.8 (100)	5.9 (100)
Affordability	5.0 (74)	5.5 (92)
Cleaner energy	3.3 (48)	3.6 (61)
2020	CEE Average score (index)	Global Average score (index)
Security of supply	5.8 (100)	5.7 (100)
Affordability	5.3 (92)	4.7 (83)
Cleaner energy	3.9 (68)	4.6 (81)

Respondents were asked to allocate a total sum of 15 points across each of the three trilemma goals. The lead goal is then indexed to 100.

Global scores are from the 2015 Global Power & Utilities Survey. CEE scores are from 2016.

¹ CMS guide to electricity: Ukraine, CMS Group, 2015.

² IRENA, REmap 2030 Renewable Energy Prospects for Ukraine. 2015.

The PwC Power & Utilities Disruption Index

The PwC Power & Utilities Disruption Index is based on survey respondents' assessment of disruption in five key areas - policy and regulation, customer behaviour, competition, the production service model (the infrastructure, products and services provided by the sector), and distribution channels (how the sector reaches and delivers to customers). For each one it is possible to identify developments that are happening now and which, if they accelerate or impact in combination, could intensify disruption. The Disruption Index is a composite measure of a basket of these five disruption factors.

In our global survey, companies reported a disruption index level of 4.2 at the time of the survey, but expected this to rise by 42% to 6.0 by 2020. This indicates a 'low medium' level of disruption rising to a 'high medium' level of disruption. In contrast, in the CEE survey, companies report an index score of 3.1, implying a low level of disruption today, but rising to 4.8 by 2020, a medium level but still the lowest of all regions worldwide. The rest of Europe is expected to be the most disrupted region in 2020. All regions record significant increases in the disruption index, including the CEE region which is actually the second highest riser, albeit from a low base.

2020 ranking	2020 index score	2015/16*-2020 % increase
1. Europe	6.7	+33%
2. North America	6.3	+64%
3. Asia Pacific	5.5	+33%
4. Middle East & Africa	5.5	+50%
5. South America	4.9	+44%
6 Central & eastern Europe	4.8	+58%
Global	6.0	+42%

The index comprises the mean scores recorded for a basket of five disruption factors (policy & regulation, production service model, distribution channels, customer behaviour, and competition). Each disruption factor is given an equal weighting. Rated on a scale of 1-10 where 1 = no disruption; 10 = very disrupted.

* CEE results based on 2016 survey. Global and other results based on 2015 survey.

Disruption is lagging behind other parts of the world

Disruption is gathering pace in power markets around the world, arising from a combination of policy, technology and customer change. But it is clear from our survey results that disruption in the CEE region is lagging behind other parts of the world. Power and utility companies in the region expect a big increase in disruption in the coming years, but it falls significantly short of what is being experienced and predicted elsewhere (see separate disruption index sidebar).

Looking further ahead, just over a third (36%) of CEE survey participants expect their market to be subject to high levels of disruption by 2030. In contrast, nearly half of global survey participants expect high levels of disruption to overtake their markets as soon as 2020. Similarly, most CEE respondents (58%) say that currently their markets are little affected by disruption, compared with less than a third (29%) of global survey participants reporting such relative calm at present. Indeed, nearly a third expect this to continue to be the case by 2030, with the region split more or less three ways between those expecting high (36% of survey participants), medium (33%) and low (30%) levels of disruption by 2030. In contrast, only 3% of those in the global survey predict low levels of disruption in 2030.

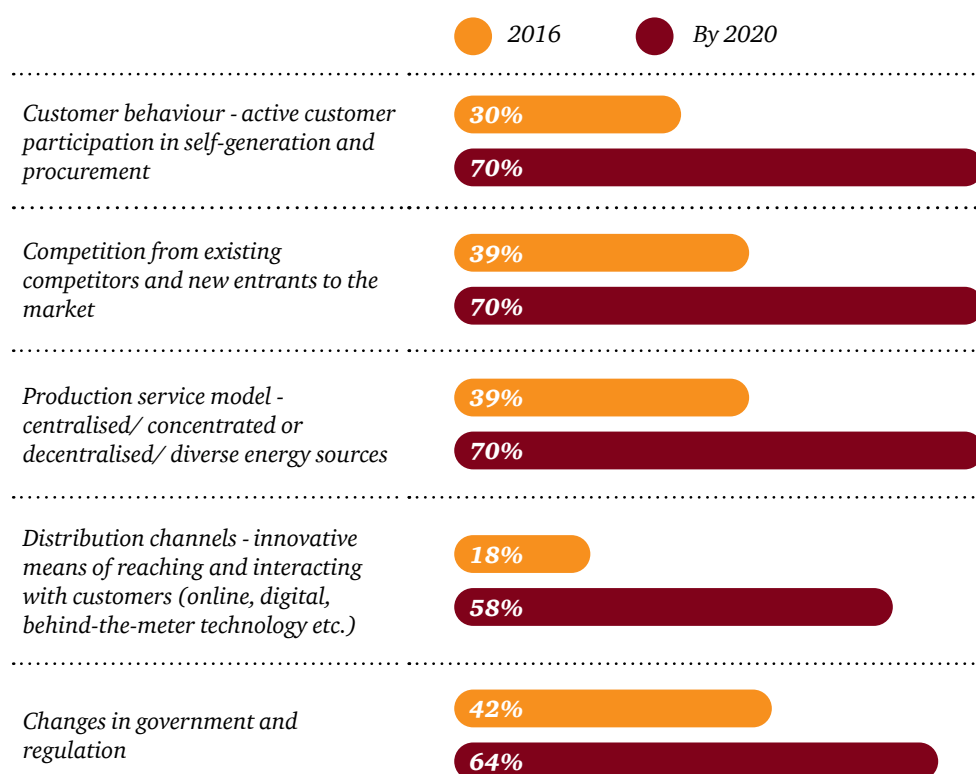
The picture that emerges is that disruption of the power and utilities sector in the region is expected both to be slower and less widespread in its impact than in many other parts of the world. Indeed, three in ten of the companies we spoke to don't expect it will affect them in any significant way, even as far out as 2030. This should come as no surprise. The industry in large parts of the region remains sheltered from some of the key components of the disruption index – particularly competition.

But to some extent, the march of technological progress will be a deciding factor. If the pressure does not come from market forces it will still come from technological forces. As technologies like distributed generation and storage take hold, even sheltered parts of the sector in the region can expect to undergo significant change. And there is also evidence that companies expect customers to become increasingly active in making their own technology choices and for the sector to become increasingly competitive (figure 2). Factors such as customer behaviour, competition and technology are expected to eclipse or at least rival policy and regulation as the main factors in disruption.

A more moderate energy transformation outlook

The perception of less intense disruption is also translating into a more moderate transformation outlook among power and utility companies in the region. We asked the survey participants about the extent and pace of energy transformation in their main home markets. Some expect it to intensify in the next five years, but most anticipate it will not be until the 2020s that significant transformation will take hold.

Figure 2: CEE region: The growing impact of disruption factors
% reporting medium to high impact on change



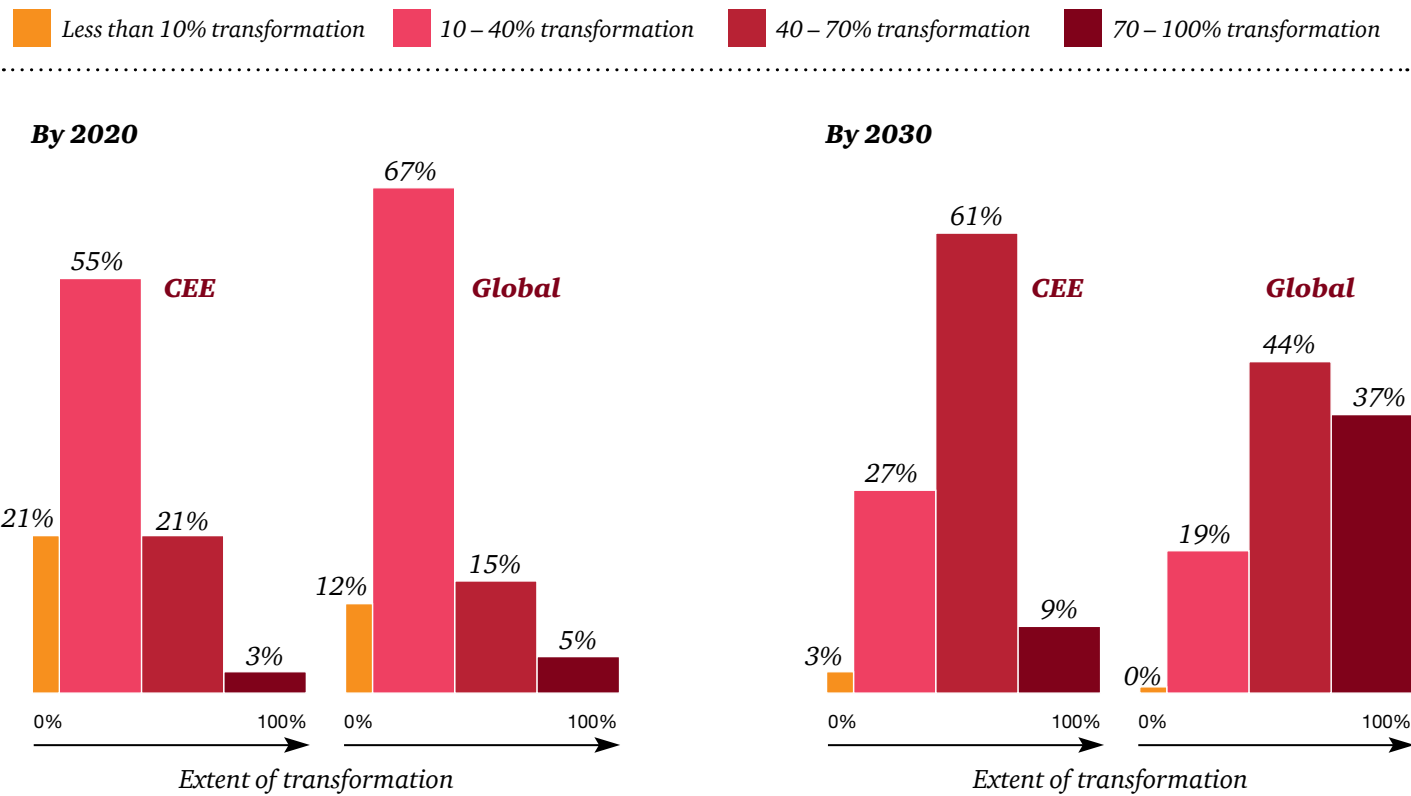
Rated on a scale of 1-10 where 1=no change; 10=major change.
Medium change - 4-6. High or very high change = 7-10. Scores 4-10 reported.

In this respect, CEE survey participants concur broadly with their global counterparts. Only a few (12%, versus 14% in our global survey) expect that their main home market will be more than ‘50% transformed’ by 2020. But by 2030, three-fifths (60%) of those in the region and globally anticipate transformation of this magnitude.

But expectations of ‘near 100%’ transformation do not come anywhere near matching the expectations of those in other parts of the world (figure 3). In our global survey, expectations of ‘near 100%’ transformation were recorded from over a third (37%) of participants and were very strong in Europe, where nearly half (48%) predicted 70–100% transformation by 2030. In contrast, in this CEE survey, only 9% expect transformation of this magnitude.

Figure 3: Extent of transformation

What will be the extent of energy transformation in the ‘home market’ that your company serves?

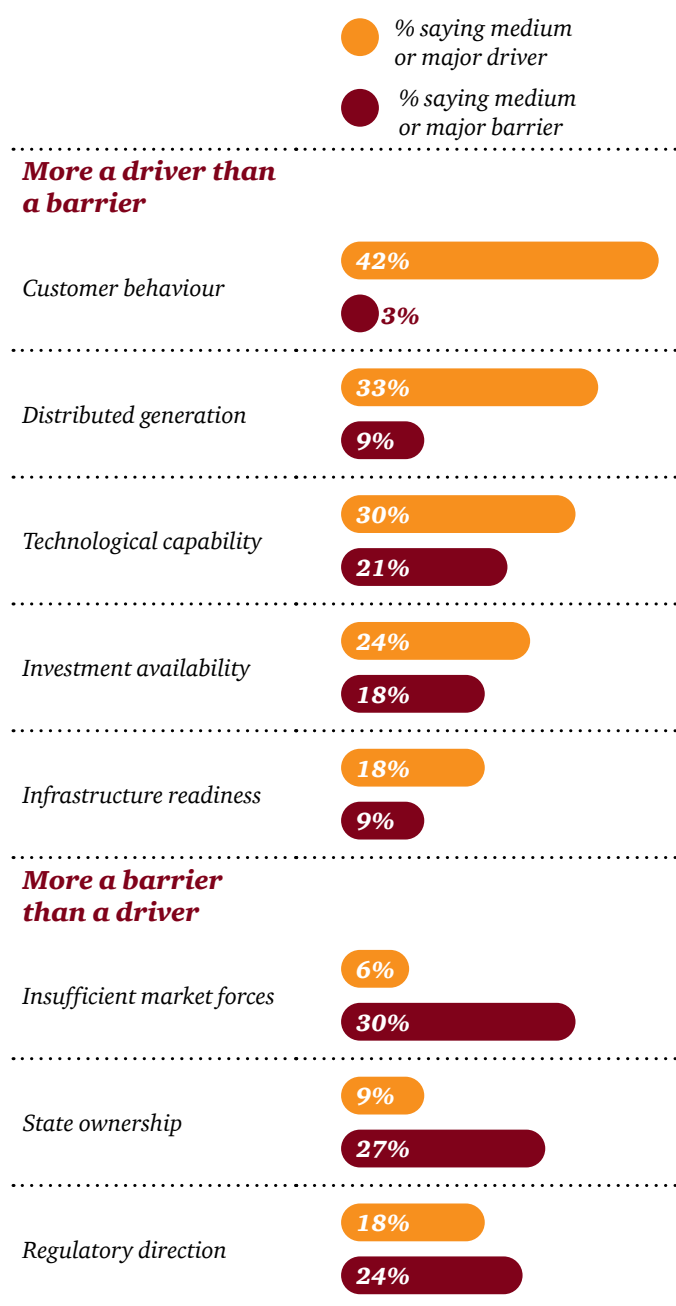


Scale of 0-100 where 0= no transformation; 100 = 100% transformation)

What is leading to a more moderate form of energy transformation in the region? We asked survey participants what they saw as drivers of and what are barriers to energy transformation (figure 4). Customer behaviour and distributed generation are seen as the main drivers of energy transformation. Insufficient market forces and state ownership are seen more as barriers, although the irony is that the spur for much of the development of new renewable technologies in nearly all countries around the world comes from state policies. Other important factors such as technological capability, investment availability and regulatory direction cut both ways. A significant slice of our survey participants see each of these as drivers while nearly as many, or more in the case of regulation, see them as barriers. Again, this is a reflection of the diversity of country situations across the region.

Figure 4: Drivers of and barriers to energy transformation in the CEE region

To what extent are the following factors a driver of or a barrier to energy modernisation and transformation in the 'home market' where your company operates?



The future for the region's energy systems

In the previous section we saw that although there is significant inertia affecting the pace of change in the region, there is nonetheless an expectation of major change ahead. In this chapter, we look at company expectations for changes in the region's energy mix as well as future developments for energy connectedness and energy technology. There is an anticipation of major change ahead, with changes in the energy mix also expected to be accompanied by a significant shift from centralised generation to utility-scale distributed generation and customer-located generation.

Technological innovation is at the heart of the shifts that are heralding the prospect of a different future power sector. They range from the spread of renewables, smart grids and large-scale technologies such as high-voltage DC transmission, all the way through to distributed and smaller-scale customer-based energy systems. These developments in power technology are running in parallel with the digital revolution, which is opening up new, easier ways of controlling, managing and trading energy.

What's the main focus of change in the region?

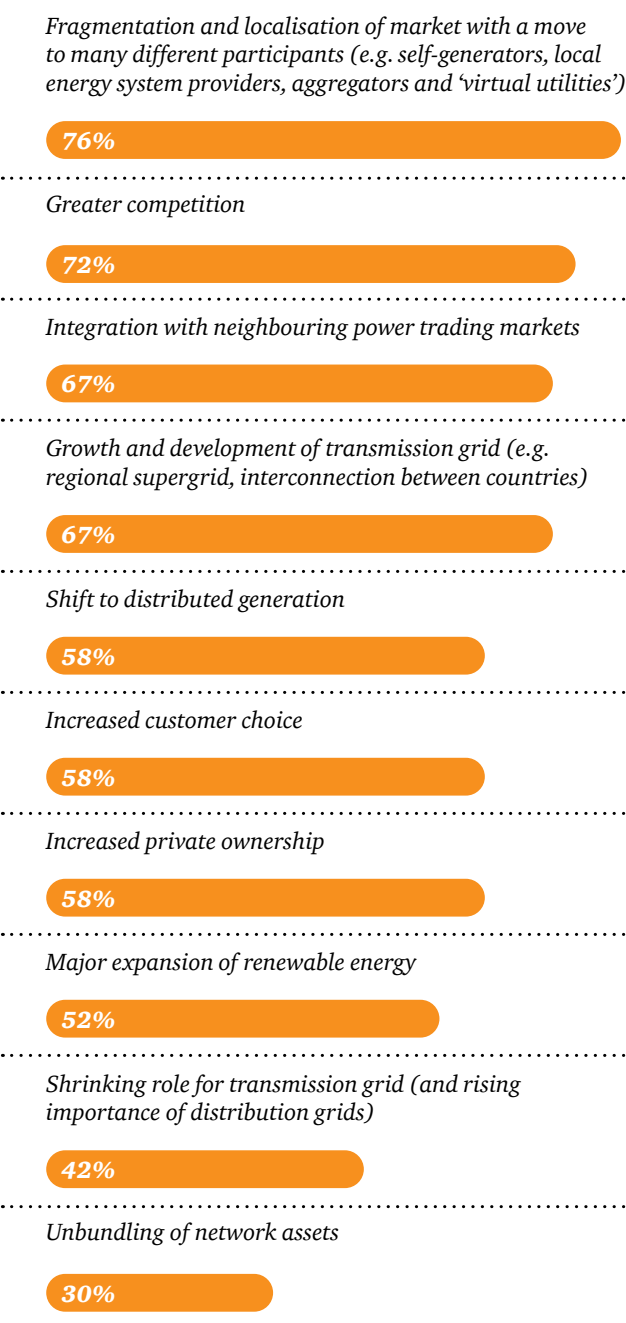
Local energy systems, greater competition and integration/interconnection with neighbouring markets head the list of changes that are expected to take place. Decentralisation of energy systems tops the list with three-quarters (76%) of survey participants saying there is a high likelihood their market will fragment and localise with a move to many different participants, such as self-generators, local energy system providers, aggregators and 'virtual utilities'.

At the same time, two-thirds (67%) of those we spoke to expect increased physical interconnection of transmission grids between countries. In turn, this is expected to produce close connection between trading and physical flows, with the same percentage anticipating greater integration of power trading markets. We discuss physical interconnectivity later in this chapter but, at this point, what is notable is an expectation in the region that both the centralised and the decentralised aspects of power will strengthen and develop. One will not necessarily be at the expense of the other. Instead, the outlook is for local energy systems and decentralised energy to develop at the same time as the centralised high-voltage grid is boosted with better interconnections.

Another notable finding is that 70% of the survey population say there is a high likelihood that power and utility companies will face greater competition. Market liberalisation in some parts of the region is an obvious spur to such competition but, increasingly, competition is also coming from the fact of technological change. Digitisation, data analytics, new power technologies, local energy systems and other technological innovations all mean the traditional power utility companies are, at the very least, dependent on, and in many cases in competition with, companies that are experts in these technologies.

Figure 5: CEE region: Energy change in the region: what is most likely to change by 2030?

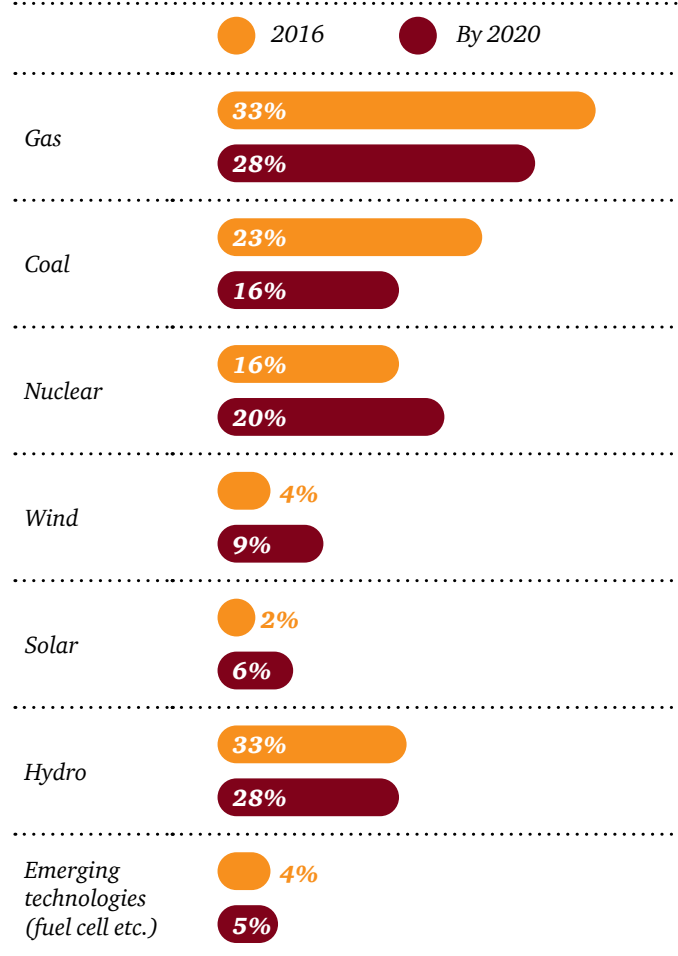
% reporting high or very high likelihood of change



Significant changes expected in the region's energy mix

Despite cleaner power appearing as less of a priority in survey participants' view of the energy trilemma (see earlier section), they do nonetheless expect a big move away from fossil fuel-fired generation towards nuclear power and renewable energy sources (figure 6). They forecast that the share of gas and coal in the generation mix will decline from an estimated 56% in 2016 to 44% by 2030, while nuclear generation is forecast to increase from 16% to 20%, and the contribution of wind and solar power to move up from a combined 6% today to 15% by 2030.³ The anticipated decline in the share of coal is particularly marked and, if such a shift takes place, it would have significant implications for lignite-producing countries such as Poland and the Czech Republic.

Figure 6: CEE region: What is your main home country's electricity energy mix now and what do you expect it to be by 2030?



³ Please note these are rough estimates by survey respondents of the energy mix in the region and won't correspond to the actual generation mix. They are indicative of the survey participants' expectations of trends rather than a measure of actual current or future generation capacities.

The commitment to nuclear is strong in many countries in the region. Nuclear is seen as a way of diversifying away from coal and gas dependency, as well as in some cases import dependency, and it is a technology that is already well-established with significant existing nuclear power capacity in many countries. Slovakia, for example, has four nuclear reactors generating half of its electricity and two more under construction. In Hungary, where nuclear dominates the electricity mix with a share of more than 40% of electricity generation, there are plans for further expansion, with construction of reactors 5 and 6 of the Paks II plant expected to start in 2018 and 2019.

Russia is moving steadily forward with plans for an expanded role for nuclear energy, including the development of new reactor technology. An average of one large reactor per year is due to come on line up to 2028, balancing retired capacity.⁴ Elsewhere, nuclear power has a high share of generation in Ukraine and is also well established in Bulgaria and Romania. And Poland plans to introduce nuclear power into its energy mix from around 2030 onwards, seeing it as a way of reducing CO2 emissions as well as filling gaps left by decommissioning of depleted lignite mines. In the south east of the region, countries such as Kazakhstan and Uzbekistan are major world suppliers of uranium.

When it comes to renewables, hydropower has long played a key role in many parts of the region, but 'modern renewables' such as solar and windpower are not very well established generally. Among the EU countries in the region, movement towards the EU's 2020 and 2030 targets is set to change that. Across the wider region, the International Energy Agency observed in its review of eastern Europe, the Caucasus and central Asia: "The contribution of modern renewables...remains marginal across the region, hindered mainly by the energy sector's inability to attract investors due to evident price competition from other energy sources and conventional fuel industry resilience."⁵

But the same report also highlights considerable potential for renewables in the region and notes the existence of targets in many countries: "Some countries....have set ambitious goals for renewable energy and primary source diversification, principally Kazakhstan with its goal of having a 50% share of alternative and renewable sources in its primary energy mix by 2050, while Azerbaijan, Georgia, Moldova and Ukraine are aiming at their declared energy efficiency and renewable targets for 2020."⁶

And as we noted earlier, Ukraine has a target to increase the share of renewables in its total final energy consumption from 3% in 2009 to 13.2% by 2030.⁷

A shift from centralised to decentralised energy

Changes in the energy mix are also expected to be accompanied by a significant shift from centralised generation to utility-scale distributed generation and customer-located generation. Our survey participants say centralised generation will supply 81% of electricity demand in 2020, but that this will have declined to around 66% by 2030 (figure 7).

That is a remarkable shift and would constitute a true energy transformation if it materialised. It is understandable why survey participants are anticipating such a shift, but the extent of it is a surprise given the relatively low current penetration of non-hydro renewables and distributed assets in the region's generation mix. The pace of adoption would need to accelerate significantly, even within EU states within the region, for a shift of this magnitude to occur.

On the other hand, in some respects, it would be building on an already established element of decentralisation in some parts of the region. In Poland, for example, there are smaller generators, in particular smaller cogeneration plants connected to non-centrally coordinated 110kV lines, that are not dispatched centrally, although some of these are coordinated by distribution service operators (DSOs).⁸ And the system of local heat and power plants feeding into the local distribution grids is a feature of many countries in the region. Our survey respondents envisage a growing share of utility-scale distributed generation, with new renewable generation projects adding to traditional co-generation. Customer self-generation is also seen as taking a growing share of electricity production, more than doubling from an estimated 6% share today to 14% in 2030.

The shifts in generation carry significant implications for the asset management strategies and practices of utility companies. While some smaller-scale technologies can be planned for and built quickly, the timescales for new nuclear and for network infrastructure to service new large-scale renewables will soon shrink the 2030 horizon that survey participants were asked about. More fragmented and localised systems will also bring new complexities and, alongside all of this, there is the question of how best to phase out and decommission old assets.

4 World Nuclear Association, country report.

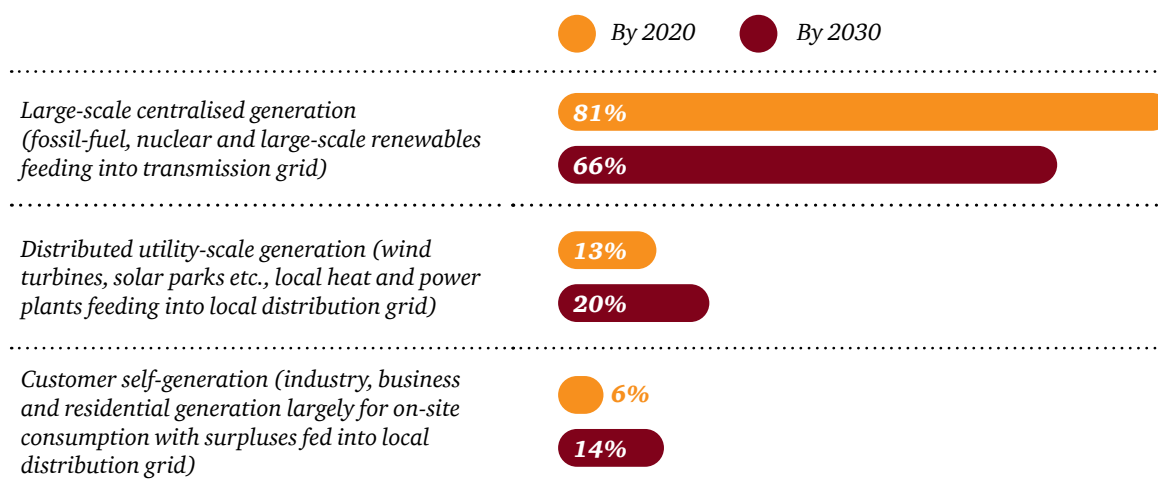
5 International Energy Agency, Eastern Europe, Caucasus and Central Asia, 2015.

6 Ibid.

7 Op. cit. IRENA.

8 CMS, Guide to Electricity: Poland, 2015

Figure 7: CEE region: What share of electricity demand you expect to be served by different generation 'locations' in your 'home market'?



Greater integration and energy connectedness

At the same time as decentralised energy and local grids are expected to grow, survey participants also anticipate interconnector capacity for the main grids within the region and between the region and neighbouring western Europe to expand from a low level of interconnectivity today to a medium level by 2025 (figure 8). Alongside this growth of physical interconnectivity, survey participants also envisage greater trading integration between their main home country markets and neighbouring markets, saying this will grow from an estimated average of 44% to 60% between 2016 and 2025 (figure 9).

Interconnection of grids already plays an important role in many parts of the region. For example, the Czech electricity transmission network is part of the most interconnected electricity network in Europe and provides a transit system for the five neighbouring transmission systems including SEPS (Slovakia), PSE (Poland), APG (Austria), and Vattenfall Europe Transmission (VET) and E.ON (Germany).⁹ Interconnection is vitally important because the region contains countries that are net exporters of electricity, such as Estonia, and others that rely on imports, such as Slovakia. Hungary also imports much of its electricity, typically between a quarter and a third of its total requirements.

Figure 8: CEE region: Extent of supra-regional physical grid interconnection for your main regional market, now and in 2025

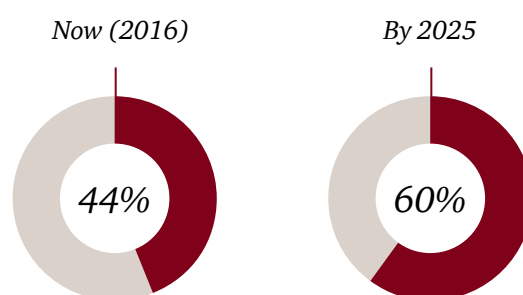
	2016	By 2025
Interconnection within the wider central and eastern European region	1.8	2.6
Interconnection with neighbouring Europe	1.9	2.8
Interconnection with neighbouring Asia	1.0	1.5

Rated on a scale of 1-5 where 1=no integration; 2 = low integration; 3 = medium integration; 4 = high integration; 5 = very high integration.

Average score reported.

Figure 9: CEE region: Extent of trading interconnection and integration of neighbouring country markets

Trading interconnection and integration between your main country market and neighbouring markets



Rated on a scale of 0-100 where 1=no integration; 100=100% integration.

Average score reported.

In addition, an increase in intermittent renewable power sources, both within the region and in neighbouring countries such as Germany, is heightening the importance of having flexible interconnector capacity. Further closures of nuclear power stations in Germany will also increase interdependency. The ten-year network development plan of the European Network of Transmission System Operators¹⁰ identifies a number of locations in the region among its list of ten main barriers to electricity exchange in Europe:

- interconnection of the Baltic states to Europe, in order to secure their supply from the west;
- western and southern interconnection of Poland with Germany, Czech Republic and Slovakia, in order to increase market capacities;
- further interconnection of south-east Europe with central Europe, to allow for mutual support against a background of low capacity within countries;
- further interconnection across the Balkan peninsula, taking advantage of the high renewable energy potential in the east (e.g. Romanian wind, Greek solar) to supply load centres in the west, from Serbia through Montenegro to Italy.

Much of the region is also dependent on natural gas imports through pipeline networks, predominantly from Russia. There has been stop-start progress on a number of big gas pipeline projects. Progress on the Southern Gas Corridor project, which will take gas from Azerbaijan's Shah Deniz 2 field in the Caspian Sea to consumers in Europe, is moving forward. Russia and Turkey have revived plans for the so-called 'Turkstream' pipeline which would open up a new route for Russian gas to Europe, bypassing Ukraine. The Nabucco project, which was to have transported gas from the Caspian Sea to Europe in order to bypass Russia, was cancelled in 2013. Bulgaria is currently trying to revive the western part of it. Its rival Trans-Adriatic Pipeline (TAP) project has suffered delays, while some other gas interconnector capacity, such as the Slovakia-Hungary pipeline, is out of use. On the other hand, recent investment in smaller projects to enable reverse flows in existing pipelines and to add new pipelines have increased flexibility and helped ease dependency on Russia.

There is less energy connectedness between the region and neighbouring countries to the south east. In part, this is due to significant geopolitical instability in parts of the neighbouring region. Subject to this, there is potential for new developments. For example, with the opening of Iran, there is the opportunity to address an imbalance of gas and electricity between Armenia and Iran, with the possible scope for trading electricity from Armenia in exchange for gas.

10 ENTSO-E, Ten-Year Network Development Plan 2016.

Market models, business models and company strategies

Change in the region's energy sector has so far been largely incremental and certainly stands in contrast to the more transformative change taking place in western Europe and Germany in particular. German utilities have embarked on radical business model change in response to the changed market conditions that have accompanied energy transformation there. In this last chapter, we look at what survey participants are saying about the future for market models and company business models in central and eastern Europe. We also consider the barriers and risks that lie ahead and the implications for the modernisation of energy systems in the region.

Market models are seen as unsustainable

What's the future for current market models in the region? We presented a series of scenarios to survey participants and asked them to assess each one (figure 10). Two-thirds (67%) of survey participants say current market models are unsustainable and the need for change is becoming urgent. A number go as far as saying that market models are already broken and the need for change is urgent. Only a fifth (21%) believe that their current market models will serve them well into the future.

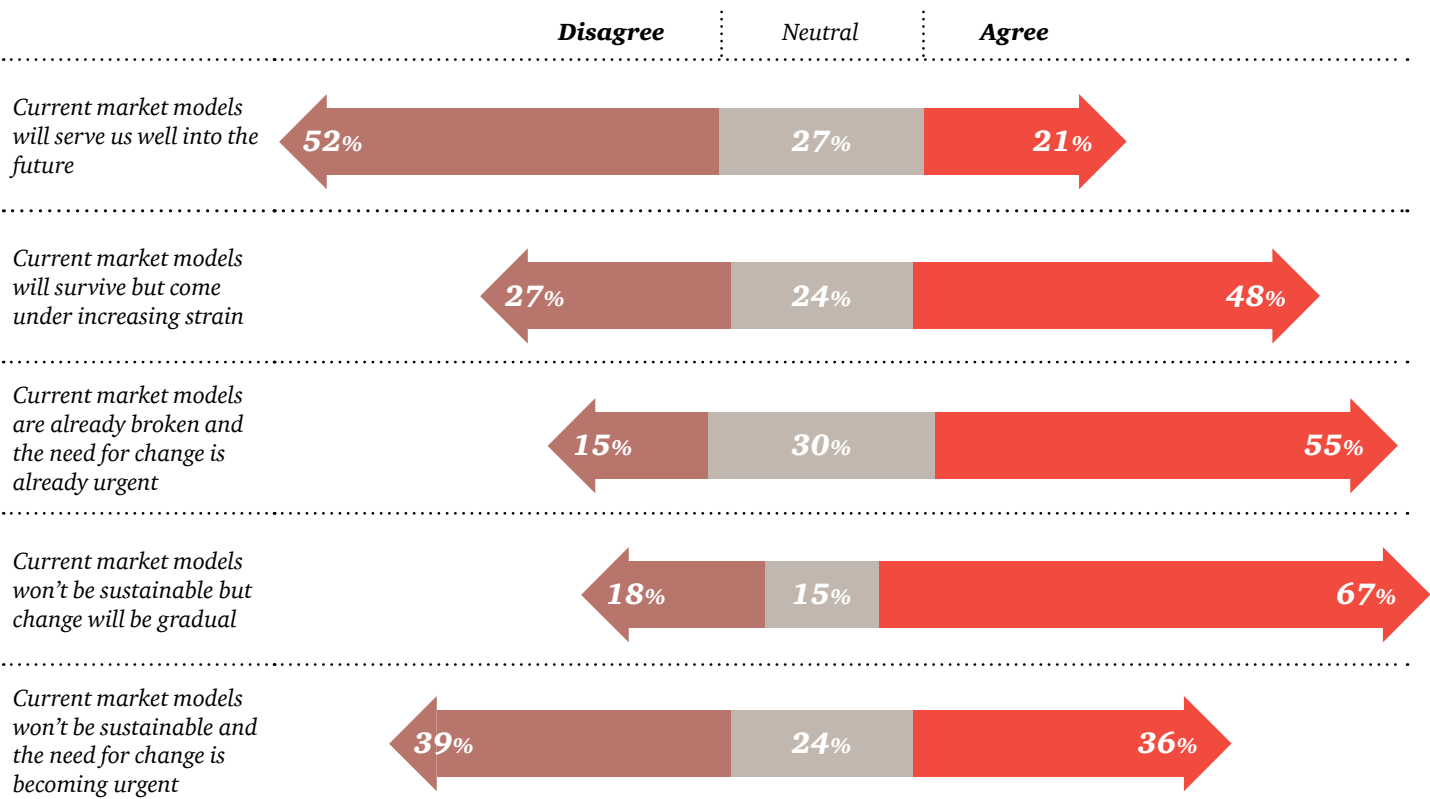
The results are broadly in line with those in our global survey although, notably, rather more of those in the CEE survey tend towards the extremes of either 'already broken' or 'serve us well' than in the global survey. But while the need for change is seen by the majority as urgent, 55% also subscribe to the view that in reality, although current market models won't be sustainable, actual change will be gradual. Nonetheless by 2030, three-quarters (76%) expect the market model in their home country will have undergone substantial change by 2030 (figure 11) and very few hold out in the belief that current market models will survive even relatively unchanged.



76%

expect major change to the market model in their home market by 2030

Figure 10: CEE region: The future for current market models
% of respondents



Rated on a scale of 1-5, where 1=fully disagree; 2=partially disagree; 3=neither agree nor disagree; 4=partially agree; 5=fully agree.

The balance between the market and the state

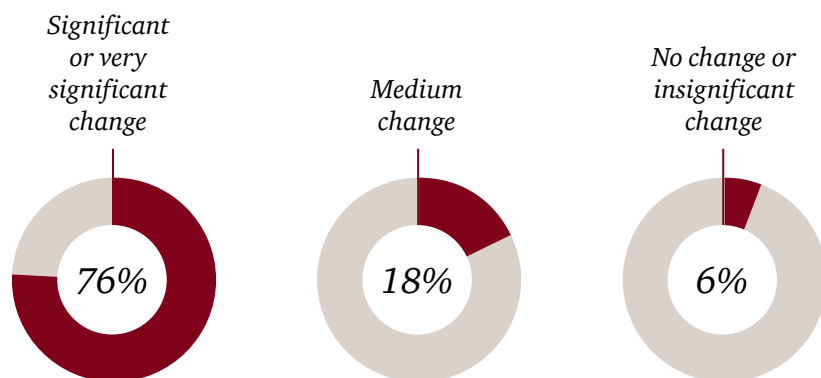
As we reported in the previous chapter, local energy systems, greater competition and integration/interconnection with neighbouring markets head the list of market changes that are expected to take place (see earlier figure 5). We asked survey participants their views on the extent to which these will be market-led or policy-led or a mix of both (figure 12).

Not surprisingly, some developments such as increased competition, increased customer choice and increased private ownership are expected to be more likely to arise from policy

moves in these directions. But, interestingly, a number of developments that many might have assumed would be spurred predominantly by policy, such as the growth of local energy systems, grid interconnector projects and renewable energy expansion, are either seen as being more likely to be led by market forces or, at least, fairly evenly driven by both market and policy forces.

Figure 11: CEE region: How much change do you expect the current market model in your home country will undergo by 2030?

% of respondents



* Scale of 1–5 where 1 = no change; 5 = very significant change.

**Figure 12: CEE region: The top changes by 2030 *
- market-led or policy-led?**

More market-led 50/50 More policy-led

1. Fragmentation and localisation of market with a move to many different participants (e.g. self-generators, local energy system providers, aggregators and 'virtual utilities')

42% 12% 45%

2. Greater competition

33% 21% 45%

3. Integration with neighbouring power-trading markets

45% 18% 36%

4. Growth and development of transmission grid (e.g. regional supergrid, interconnection between countries)

48% 15% 36%

5. Shift to distributed generation

55% 15% 30%

6. Increased customer choice

33% 15% 52%

7. Increased private ownership

42% 3% 55%

8. Major expansion of renewable energy

48% 6% 45%

* Changes that 50% or more of respondents say high or very high likelihood of change

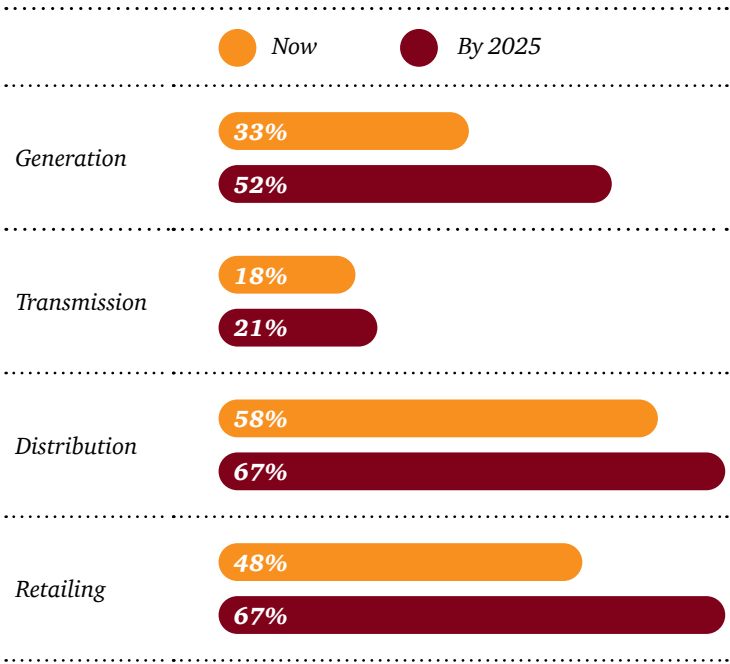
Many changes are being fairly evenly driven by both market and policy forces.

The region contains a wide spectrum of ownership and market situations, from relatively liberalised markets to much more highly state-controlled systems. The extent of competition, private ownership and customer choice varies from country to country. The trend is towards increased private ownership but it is far from a certain trend. Over half (57%) of survey participants say increased private ownership is likely. But only 9% think it is highly likely and another 12% rule it out altogether, or view it as unlikely. The remainder (30%) fall in between the likely and the unlikely camps. The greatest increase in private ownership is expected in generation and retailing (figure 13). Transmission networks are expected to remain in national ownership while the picture is mixed for distribution networks. Indeed, in distribution there are some instances of renationalisation, such as the moves taking place in Hungary.

Business model change needed to match energy transformation

It will be important for companies to take a clear view on the ways in which their marketplace is likely to evolve and their company’s place in a transforming energy systems. Companies need to determine the future direction of their own markets, how these markets are affected by technological advancement and what this means for their business strategies. In such a diverse region, the urgency of their responses will vary by location and our survey results on future business models reflect a polarisation within the region, with some companies saying business model change is urgent and others being much more relaxed.

Figure 13: CEE region: Extent of private sector ownership in your country's power utility sector
% of survey participants saying more than 50% private ownership

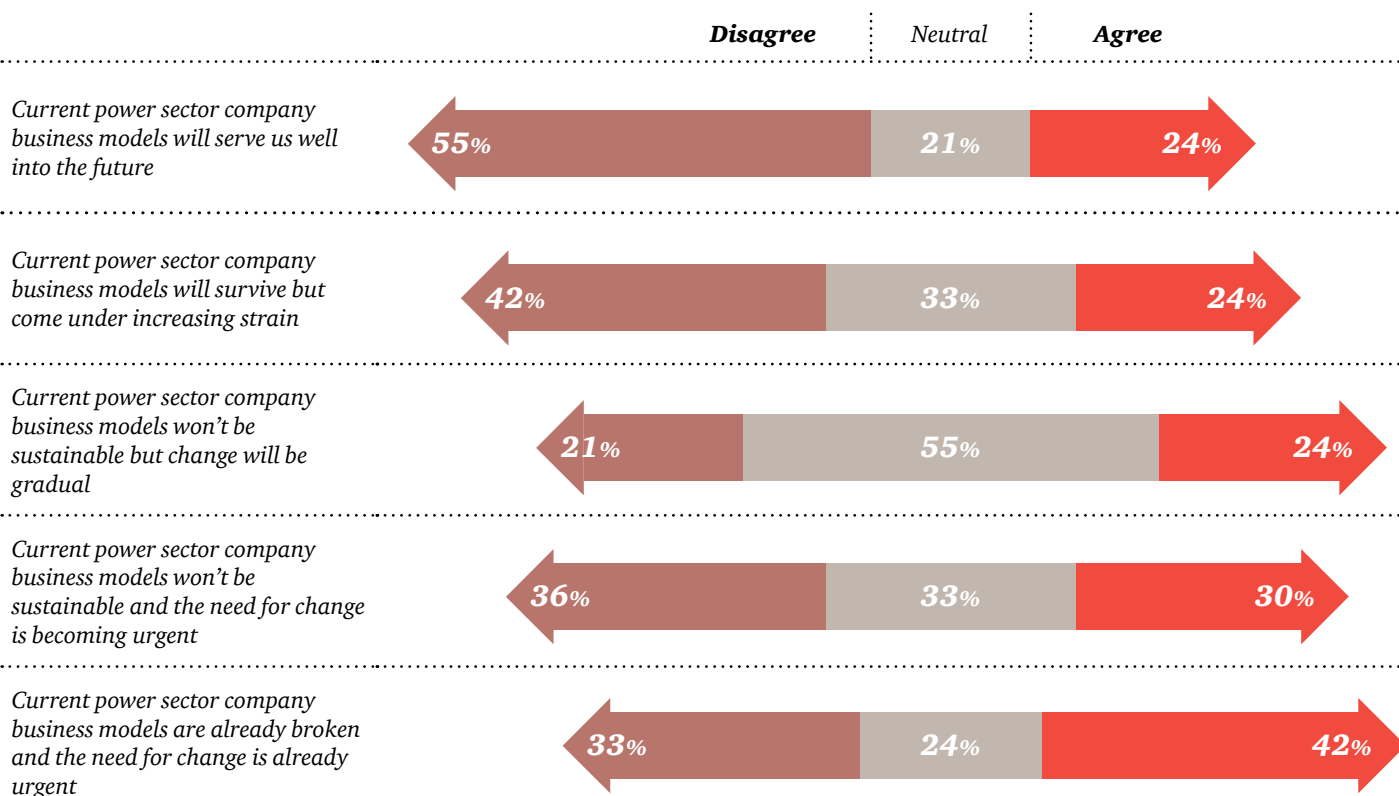


The need for business model transformation is seen as urgent by a significant segments of CEE survey participants. Over two-fifths (42%) say current power sector company business models are already broken and the need for change is already urgent, many more than the 29% of participants in our global survey. Another 30% say change is becoming urgent. But a quarter (24%) say current business models will serve the sector well into the future (figure 14).

Indeed, if we look ahead to 2030, only just over half (55%) of CEE participants actually expect their company business models to have undergone major or very major transformation by then, fewer than the nearly three-quarters (73%) in our global study anticipating such transformation (figure 15). It is clear that there is a dichotomy between companies in parts of the region that are relatively sheltered from some of the drivers of change, such as competition and customer behaviour, and those in more liberalised markets where market change and energy transformation are taking hold sooner.

Figure 14: CEE: The future for current power sector company business models

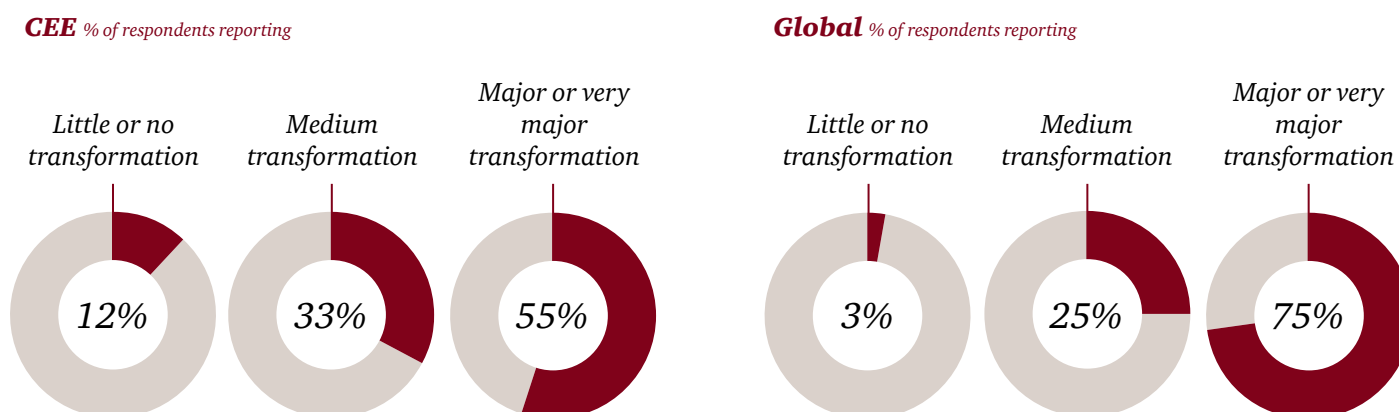
% of respondents



Scale of 1-5, where 1=fully disagree; 2=partially disagree; 3=neither agree nor disagree; 4=partially agree; 5=fully agree.

Figure 15: Extent of business model transformation

How do you anticipate your company's current business model to be transformed by 2030?



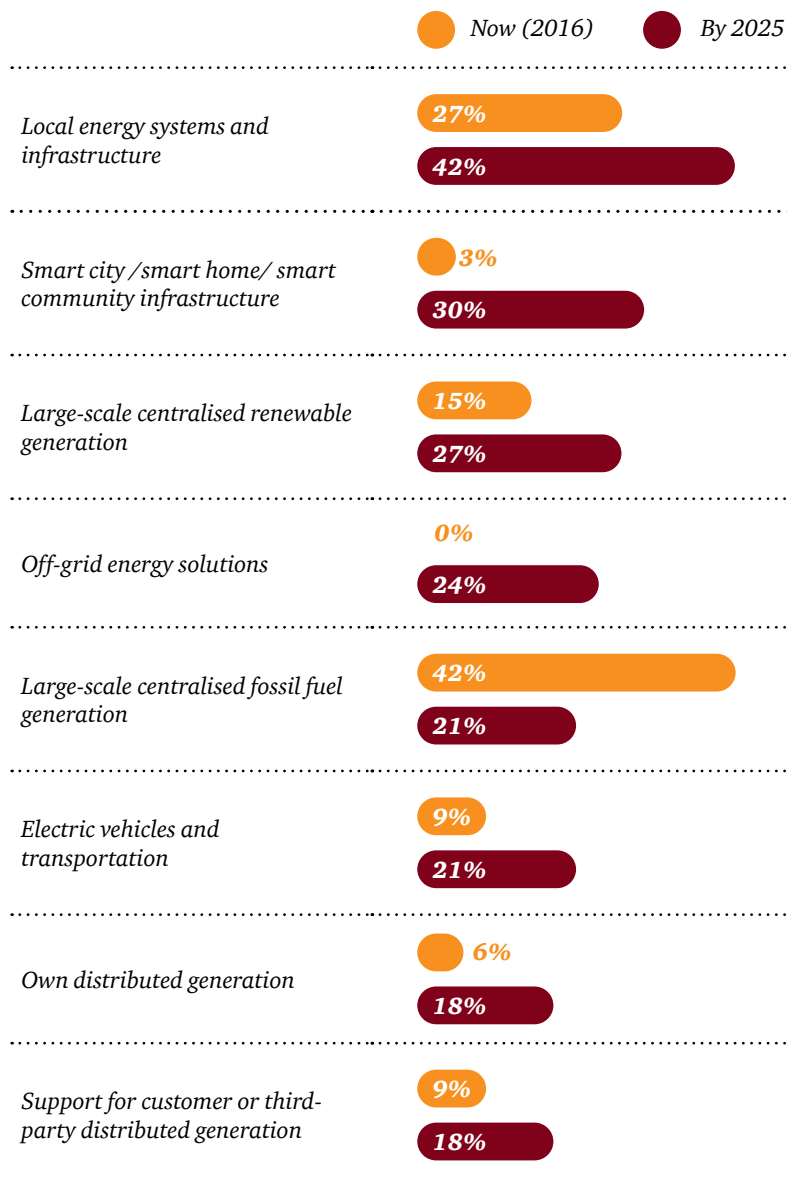
Scale of 1-5 where 1=no transformation; 5=very major transformation.

The implications for companies' operational strategies

Companies around the world are already making some big strategic shifts as they position themselves for an era of unprecedented technological transformation in energy systems. And our survey participants in central and eastern Europe are also setting their sights on similar moves.

One of the shifts is a progressive move away from centralised generation. In our survey, 42% say large-scale centralised fossil-fuel generation is their most important strategy now but only 21% expect it to remain so by 2030. Instead, it will be overtaken by a number of other priorities. Twice as many say that by 2020, local energy systems and infrastructure will be of high importance to them as say the same thing about centralised fossil fuel generation. Activities such as off-grid energy solutions and smart city infrastructure, reported by hardly any as important for their companies today, become highly important for around a quarter or more of companies by 2030. Indeed, off-grid solutions, smart infrastructure, large-scale renewable generation and local energy systems are all expected to outrank large-scale centralised fossil fuel generation in 2030.

Figure 16: What operational strategies are most important to your company now and what will be most important in 2030?
% of survey respondents



Rated on a scale of 1-5 where 1=not important; 5=very important.
Scores 4/5 reported.

The various energy systems changes that lie ahead will require utility companies to think very differently about the capabilities they need to develop. Some capabilities will be challenging for them. The sector does not, for example, have a culture of or track record in product innovation. And it is notable that, compared to the results from our global survey, companies in the region seem to be underestimating the importance of some capabilities (figure 17). For example, despite a perception that customers will be more important, capabilities such as digital customer management and pricing/margin improvement, which are viewed as highly important in our global survey, are only seen as of medium importance by companies in the region. Similarly, the importance of forming partnerships with other companies and possible collaborators is ranked higher in our global survey than by companies in the CEE region.

Major barriers remain in the way of modernisation

Many countries face the challenge of system renewal as well as energy transformation. Existing power systems are worn out, in disrepair or simply very inefficient. In Ukraine, for example, much of the generation and transmission system suffers from disrepair. It is not uncommon for thermal power stations to be unavailable because equipment has been used to repair other stations, and transmission network losses are high. A 2014 World Bank document observed: “As currently configured, the transmission network is characterised by high technical losses and poor reliability, instability, and unavailability and low quality of power supply. This is costly, inconvenient, and potentially dangerous to customers.”¹¹

Figure 17: Capabilities for delivering future business model success
How important will the following company strategies/capabilities be to delivering future power sector business model success?

Average score CEE (vs global)	
3.8 (3.9)	Innovation of grid, generation or other 'core' operational technologies
3.8 (3.6)	Data security and confidentiality
3.7 (3.9)	Customer data analytics
3.5 (4.0)	Behind-the-meter innovation (e.g. user-friendly smart control and price optimisation systems for homes and businesses)
3.5 (3.6)	Product innovation
3.5 (4.2)	Asset management and optimised supply chain/field service
3.4 (3.8)	Energy trading and hedging
3.4 (4.0)	Digital customer management
3.4 (4.0)	Managing partnerships and alliances
3.4 (4.3)	Pricing and margin enhancement
3.3 (3.9)	System operation data analytics
3.0 (3.4)	Managing 'big data' platforms

Scale of 1-5 where 1=not important; 5=very important. Average results reported.

¹¹ World Bank, Second Power Transmission Project, project information document (appraisal stage), 27 June 2014.

In this context, the energy transformation that lies ahead presents a major modernisation opportunity for companies and country energy systems, but is also a major challenge. It will require big investment and if investors are to come forward they will require reassurance there is an adequate level of regulatory stability and certainty. Yet concerns about unpredictable regulations and policy, as well as worries about attracting investment, top the risks that survey participants identify in their power sector. Around half express high or very high concern about these two risks (figure 18) and, asked in a separate question about the outlook for these and other difficulties, survey respondents rated the prospects for improvement only slightly above a medium likelihood (figure 19).

The challenge will be to make timely moves to renew ‘old energy’ systems in ways that can transition to the introduction of modern infrastructure that can support and provide a foundation for energy transformation. Thus, for example, World Bank investment in Ukraine’s transmission infrastructure is designed to support efforts to develop plans for renewable power integration, applying smart grid solutions into the power transmission system, as well as providing for system rehabilitation measures and upgrades to increase basic reliability.

Figure 18: What is your assessment of the following power sector risks?
% expressing high or very high concern

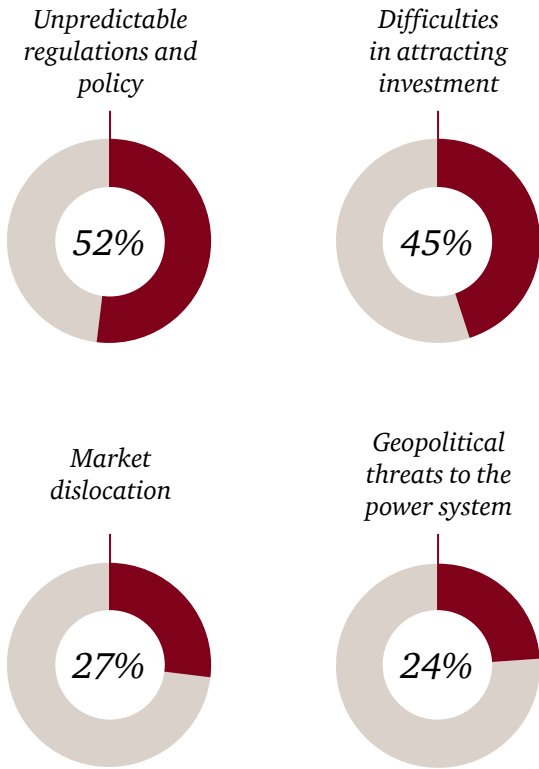


Figure 19: Prospects of improvement - key barriers in the way of asset expansion and modernisation?

	Prospect of improvement
Lack of or uncertainty about government guarantees	2.7
Regulatory and legal concerns	3.1
Lack of technology and skilled know-how	2.7
Insufficient capital market attractiveness	2.7

* Scale of 1-5 where 1 = little or no chance of improvement in next five years. Average score reported.

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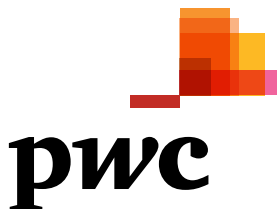
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