Energy Transition Readiness Index

2019

A new report from the REA, commissioned by Eaton and Drax.

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REA Introductory remarks

Flexibility is key to integrating more renewable energy and smart clean tech onto the system and delivering the UK's ambitions: the cheaper "net-zero" energy system we need. In the UK, Government and Ofgem have made progress in the past few years but the perception is that this has started to slow and renewed impetus, especially on the development of effective markets, is necessary.

The blackout of 9th August in the UK brought the changing energy system into sharp focus but the fact that energy storage responded so quickly to events helped manage the impact on the system and indicates the possibilities such services provide.

We are confident that with appropriate actions and renewed vigour, the system transition to be more smart, more decentralised and ultimately more secure and of course decarbonised will see the UK start to move up the Scorecard.

Dr Nina Skorupska CBE FEI

About the report author

Robert Hull is an accomplished utility industry leader with over 30 years of UK and global experience. He was previously a Managing Director with UK energy regulator Ofgem, and held Director roles with international utility National Grid and consultancy firm KPMG. He has extensive industry knowledge and led numerous investment campaigns in new energy, telecoms and utility businesses. He founded Riverswan in 2017 to provide advice to power and utility clients worldwide, also authoring several thought leadership papers on the energy transition. He currently serves in a number of non-executive roles and is an independent member of Ofgem's RIIO-2 Challenge Panel and ESO Performance Panel.

Summary

The global climate is changing due to growing emissions of greenhouse gases, largely caused by our demand for energy. Public and political support for action is increasing. Consequently, the global energy sector is undergoing a fundamental transition, driven by decarbonisation, decentralisation and digitisation. The rapid growth of renewable electricity, allied with smart distributed energy technologies and new business models, together with greater political commitment and customer engagement, is driving changes to energy markets to facilitate this transition.

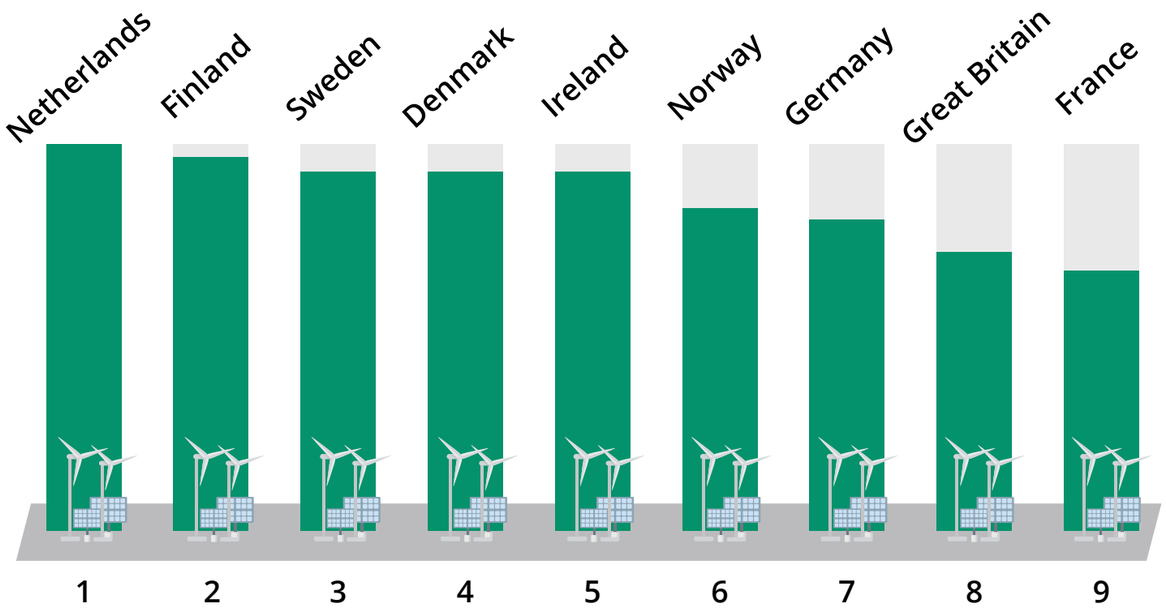
Importantly, the rapid growth in variable renewable electricity generation has meant that power systems and markets must be more flexible to compensate for the greater volatility in this generation and keep the balance with customer demand. The need for this flexibility, especially from distributed energy resources, is essential to facilitate the energy transition. Such flexibility resources are forecast to grow significantly in the future - electricity markets are key to enabling this investment and growth.

The energy transition, enabled by flexibility market reform, is already well underway in many European countries, enabled by public policy, regulation, power markets, and technology, but the pace of progress varies. We have engaged with experts across nine Northern European countries to assess and compare the current status of electricity flexibility markets in each country.

We scored each country's electricity market in the assessment according to its progress against:

- Open market access for flexibility services
- Socio-political support for the energy transition
- Ability to exploit new technologies and business models

The overall results of this analysis are shown in the following ranking:



The report shows that the Netherlands and the Scandinavian countries are more advanced in exploiting new distributed flexibility resources while Germany, Great Britain and France are slower.

Key features of the higher-ranking countries are that they benefit from flexibility markets that:

- allow fair, transparent, and easy access to all participants, addressing conflicts of interest and other barriers.
- provide market certainty and sufficient visibility on returns to support capital investments by flexibility providers.
- are supported by clear policy direction and the exploitation of available technologies.

However, all countries appear relatively weak on strategies for developing electric vehicle infrastructure and markets with vehicle to grid flexibility services.

Introduction

Electricity sector flexibility services offer major new investment opportunities, and strongly support the key goals of decarbonisation, decentralisation and digitisation. Flexibility is commonly defined as the extent to which generation and demand can quickly respond to a changing power system and market conditions. Flexibility services provide valuable support to stabilise grid operations, balance supply and demand and ensure that system frequency and voltage stays within operational limits especially when unexpected changes occur.

The demand for flexibility services is increasing as vast new sources of variable renewable energy are added and replace the large synchronous fossil-fuel generators that have mainly provided these services in the past. Power systems must be able to operate in circumstances where renewable energy output may vary significantly from hour to hour.

But as these generators are being displaced by renewable energy generation with more volatile outputs, new providers of flexibility services are emerging, including distributed generation, energy storage, and demand response. These new providers can face challenges to investment and deployment because of barriers such as limitations to access flexible power markets.

Energy Transition Readiness Index

This paper sets out the results of a review of nine European flexible power markets. We have presented an index of market attractiveness for new investors in flexible power, ranking the countries in terms of their relative attractiveness. The study has used publicly available information and interviews with an expert panel to determine the scores against detailed ideal state criteria.

Each of these markets has different characteristics - for example Great Britain and Ireland do not have synchronous connections with each other or with European electricity markets, resulting in different requirements for flexibility services. There are also different generation characteristics. Norway benefits from a very large volume of flexible hydro generation, France has a sizeable supply of power from its nuclear plant, whereas other countries have different levels of renewable electricity capacity. Some countries are reliant on interconnector imports for flexibility. There are different market designs, product definitions, and operational practices as well.

While there are significant differences between markets, our analysis has considered the attractiveness of each market from the perspective of new investors and how they might perceive the attractiveness of each individual market, seeking to take the differences into account.

Approach to evaluation

In performing our evaluation, the key questions that have been asked are:

- Do the regulatory and market arrangements enable or restrict new investment in flexibility services?
- Is the socio-political background supportive or an impediment to investment?
- Are measures in place to help develop and deploy flexibility technologies?

These questions have been structured into the following assessment framework, which examines the key factors in each area.

Transition factors

Market access

- Regulation enables fair access for all providers
- Trading - markets are open and effective
- Transaction costs are fair for flexibility

Socio-political support

- Flexibility needs are recognised
- Supportive political and public consensus
- Public policy and regulation aligned

Technology potential

- Grid accessibility
- EV Infrastructure deployment enabled
- Digitisation enabled
- Innovation enabled

Country comparison

Each individual item has been scored and used to present an overall score and ranking. Some key observations are set out below, with further detailed analysis explaining the scoring criteria and rationale for the scores given to each country in the annex at the end of this report.

Netherlands

A strong socio-political commitment to the energy transition that in particular enables flexible distributed energy resources, new technologies and business models.

Finland, Sweden, Denmark, Norway

A strong commitment to renewables and the energy transition. The Nordic markets have advanced flexibility trading arrangements, including for distributed energy. Norway scores slightly lower than the other Nordic markets as it can cover many of its flexibility needs through its large hydro capacity, curtailing the development of arrangements for distributed flexibility.

Ireland

With major renewable energy penetration on a small energy system with limited interconnection, Ireland is actively reforming its energy markets to enable distributed energy resources.

Germany

A strong commitment to the energy transition and distributed energy resources and encouraging new technologies. But change to market structures to enable distributed flexibility is slow.

Great Britain

A strong policy commitment to decarbonisation, encouraging new technologies and business models. But regulatory and market change to enable flexible distributed energy is complex and slow.

France

Today, hydro generation and interconnectors offer significant volumes of flexibility, but as the share of renewables in the energy mix grows and nuclear capacity declines, more distributed flexibility will be needed. There is lack of transparency in the provision of some of the flexibility services. Certain balancing services are met through the mandatory participation from large generators, rather than competitively procured from the market.

Conclusions

This report shows that readiness for the energy transition and the development of flexibility markets is at different stages of maturity in different countries for the key areas we have assessed:

Market factors

In high scoring countries, regulatory arrangements and market rules allow a wide range of distributed flexibility resources to participate in a variety of markets, but in lower scoring countries, there are often unclear rules, conflicts, and market access barriers, thereby hindering development.

Market trading arrangements range from transparent markets that allow different contract terms and volumes that enable flexibility and aggregation, to those where trading of flexibility is limited.

In high scoring countries, market transaction costs are equitable with other technologies, whereas in lower scoring countries, these can penalise flexibility and present a barrier.

Socio-economic factors

In high scoring countries, there is a clear roadmap for the electricity market transition involving all key participants, whereas in lower scoring countries the roadmap and roles of individual industry participants is less clear.

In addition, in high scoring countries, there is a clear public social and economic acceptance of the energy transition and of the costs and mitigations involved. In lower scoring countries, this may not be so well understood or accepted.

In high scoring countries, there is a strong political commitment to a zero-carbon economy, and this is translated into a strong regulatory framework that will deliver the objectives particularly in the area of flexibility. The lower scoring countries have weaker commitments to deliver the regulatory reform necessary to incentivise investment in flexibility resources.

Technology factors

In high scoring countries, the grid network is easily able to integrate new distributed flexibility resources, whereas lower scoring countries will have technical or operational barriers that inhibit the application of distributed flexibility services.

For EV infrastructure, high scoring countries may be expected to have a clear roadmap for providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market. However, progress appears relatively slow across all countries resulting in average to low scores.

In high scoring countries, digital technologies i.e. communications, dispatch, smart meters, data standards, and IT systems across markets, are a key enabler for flexibility markets. In lower scoring markets not all this digital infrastructure is in place.

Finally, good performing countries have a clear route for technology innovation to participate in flexibility markets perhaps using regulatory sandboxes, whereas in lower performing countries there are often barriers to new technologies.

In summary, this assessment has shown that there are many challenges that may delay the introduction of flexibility services and put the achievement of the energy transition at risk. All countries in this assessment are clearly addressing the problems but it is evident that some are further ahead than others in achieving this goal.

Annex - Individual country

Our approach

The scoring and ranking of each country have been carried out by scoring a series of questions against each of the sub-elements listed for our three key transition factors defined above.

The scores range from 5 (green), which shows the most ideal state, to 1 (red) which shows the least ideal state. The table also shows overall country averages across all the sub-elements (set out below each column) which have been used to derive the country rankings.

Rating 1-5 (worst-best)

5
4
3
2
1

Rating criteria

The report is the contributors' collective assessment against the detailed scoring criteria of how close the country is to the ideal state (L5) descriptions defined below - with a score of 5 indicating exact alignment with all criteria, 1 no alignment at all.

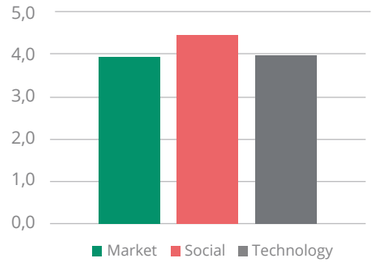
	Market factors			Socio-political factors			Technology factors				
	Regulations	Compensation structures	Transaction costs	Transparency on system needs and policy direction	Socio-economic impact	Political and regulatory alignment	Grid accessibility	EV infrastructure and EV charging	Digital technology enablers	Innovation	Overall average
Definition of ideal state	Clear regulatory framework for flexible assets - Product requirements and regulatory arrangements enable a range of resources to participate even in different markets	Market bids with different time scales and sizes reward flexibility	The transaction costs of flexibility are fairly allocated. - This could include an appropriate asset certification regime, absence of double charging for storage, equal and fair VAT, policy levies and network charges	Clear road map, all market participants are involved in the decision-making process	Energy transition is accepted and endorsed, negative socio-economic impacts are safe guarded	Strong political and/or statutory commitment to zero carbon economy fully supported by regulatory framework to strongly incentivise investment in flexibility resources	Integration of flexibility sources is backed and supported by grid infrastructure	Charging signals incentivising flexibility to minimise system costs, bi-directional charging enabled	Harmonised communication, dispatch, measurement & verification IT systems across markets	Market is technology open, implementation of new technology is straightforward	
Netherlands	4	4	4	5	5	4	4	3	4	4	4,1
Finland	4	5	4	4	4	4	5	2	5	4	4,0
Sweden	3	5	4	4	4	4	5	2	5	4	3,9
Denmark	3	5	4	4	4	4	4	2	5	4	3,9
Ireland	4	4	4	4	4	4	4	2	3	4	3,8
Norway	4	3	3	4	4	4	4	3	4	3	3,5
Germany	4	3	4	4	4	4	3	2	4	3	3,3
Great Britain	3	3	3	4	4	4	3	2	3	4	3,2
France	3	3	3	3	3	3	5	3	4	3	3,1
Definition of least ideal state	Unclear rules. Low visibility, bias towards a specific type of resources	No market signals for flexibility	Transaction costs penalise flexibility	No visibilty on further market development, constantly changing market environment	Energy transition increases social inequality	Weak or no political commitment to zero carbon targets combined with no regulatory mandate to incentivise investment in flexibility resources	Grid infrastructure presents a barrier to flexibility	No participation in the electricity market	Analog meters, self reporting / inspection readings required	Market is closed to new technologies	

The following pages of this annex describe some of the key features associated with the scores for each country, or groups of countries. This has been done by examining and comparing the three key transition factors of markets, socio-political and technology in further detail.

1. Netherlands

Overall, in the Netherlands there is a strong political and public consensus around the energy transition, especially the need for flexibility services and decentralised energy. This is supported by strong progress on exploiting new technologies, and the associated market and regulatory reforms.

This results in the following average scores for each of the main three evaluation categories.



Market factors

Regulatory arrangements and market rules allow a wide range of distributed flexibility resources to participate in a variety of markets. Some demand response is actively participating in balancing markets, albeit independent aggregation is not enabled yet

Market trading arrangements generally provide open and flexible markets that allow volumes to be traded efficiently in response to price signals.

Socio-economic factors

There is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition and of the costs involved.

There is a strong political commitment to decarbonisation and decentralised energy, and this is translated into a strong regulatory framework that will deliver flexibility objectives.

Technology factors

The grid network can easily integrate new distributed flexibility resources, without any significant technical or operational barriers.

While the Netherlands is a leader in EV rollout, progress is slower in providing EV charging signals and bi-directional charging so that EV's can participate in flexibility markets.

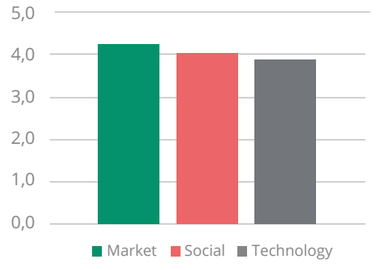
Strong development of digital technologies provides a key enabler for flexibility markets.

There is a clear route for technology and business model innovations to participate in flexibility markets.

2. Finland

There are many similarities between the Nordic countries and their approach to flexibility development.

In Finland, there is a strong political and public consensus around the energy transition and decarbonisation. This is supported by the closely aligned market regimes across the Nordic region and proven flexibility service trading through a common electricity market.



Market factors

Balancing and flexibility markets are open and accessible to a wide range of participants and technologies. There is good participation of generation and demand response providers across a variety of products.

Market trading arrangements provide open and flexible markets that allow aggregation and different contract terms and volumes to be traded.

Socio-economic factors

There is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition.

Similarly, there is a strong political commitment to decarbonisation, supported by a strong and aligned regulatory framework that will also enable flexibility needs.

Technology factors

In Finland, the grid network can easily integrate new distributed flexibility resources, without any significant technical or operational barriers.

Progress is slower in providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market.

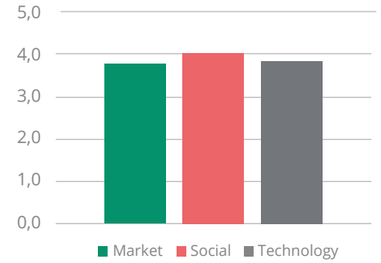
Strong development of digital technologies provides a key enabler for flexibility markets.

There is a clear route for technology and business model innovations to participate in flexibility markets.

3. Sweden

There are many similarities between the Nordic countries and their approach to flexibility development.

In Sweden, there is a strong political and public consensus around the energy transition and decarbonisation. This is supported by the closely aligned market regimes across the region and proven flexibility service trading through a common electricity market.



Market factors

Balancing and flexibility markets are open and accessible to a wide range of participants and technologies. There is good participation of generation and demand response providers across a variety of products.

Market trading arrangements provide open and flexible markets that allow aggregation and different contract terms and volumes to be traded.

Socio-economic factors

In Sweden, there is a clear roadmap for the electricity market transition involving all key participants, and strong public social and economic acceptance of the energy transition.

Similarly, there is a strong political commitment to decarbonisation, supported by a strong and aligned regulatory framework that will also enable flexibility needs.

Technology factors

The grid network can easily integrate new distributed flexibility resources, without any significant technical or operational barriers.

Progress is slower in providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market.

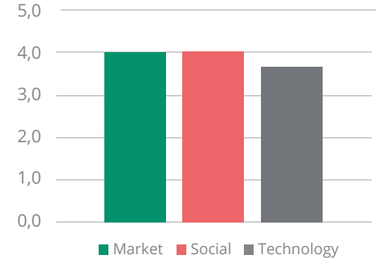
Strong development of digital technologies provides a key enabler for flexibility markets.

There is a clear route for technology and business model innovations to participate in flexibility markets.

4. Denmark

There are many similarities between the Nordic countries and their approach to flexibility development.

In Denmark, there is a strong political and public consensus around the energy transition and decarbonisation. This is supported by the closely aligned market regimes across the region and proven flexibility service trading through a common electricity market.



Market factors

Balancing and flexibility markets are open and accessible to a wide range of participants and technologies. There is good participation of generation and demand response providers across a variety of products.

Market trading arrangements provide open and flexible markets that allow aggregation and different contract terms and volumes to be traded.

Denmark has high levels of wind generation and therefore high variability, driving a significant requirement for flexibility services.

Socio-economic factors

In Denmark, there is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition.

Similarly, there is a strong political commitment to decarbonisation, supported by a strong and aligned regulatory framework that will also enable flexibility needs.

Technology factors

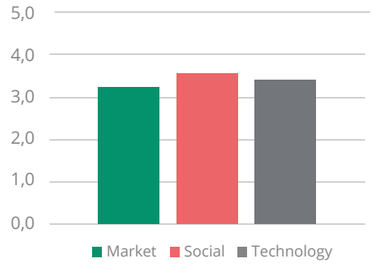
The grid network can easily integrate new distributed flexibility resources, without any significant technical or operational barriers.

Progress is slower in providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market.

Strong development of digital technologies provides a key enabler for flexibility markets.

There is a clear route for technology and business model innovations to participate in flexibility markets.

5. Norway



There are many similarities between the Nordic countries and their approach to flexibility development.

In Norway, there is a strong political and public consensus around the energy transition and decarbonisation. This is supported by the closely aligned market regimes across the countries and proven flexibility service trading through a common electricity market.

Market factors

Balancing and flexibility markets are open and accessible to a wide range of participants and technologies. There is good participation of generation and demand response providers across a variety of products.

Market trading arrangements provide open and flexible markets that allow aggregation and different contract terms and volumes to be traded.

Norway scores slightly lower than the other Nordic countries as it can cover its flexibility needs through its large hydro capacity, reducing the relative requirement to develop detailed arrangements for distributed flexibility. However, this is expected to change as electric vehicle rollout increases.

Socio-economic factors

In Norway, there is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition.

Similarly, there is a strong political commitment to decarbonisation, supported by a strong and aligned regulatory framework that will also enable flexibility needs.

Technology factors

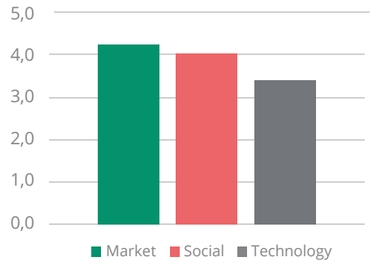
The grid network is strong and can integrate new distributed flexibility resources. These may become increasingly needed to balance new demand from electric vehicle rollout.

Norway is a leader in EV rollout, but progress is slower in providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market.

Strong development of digital technologies provides a key enabler for flexibility markets.

There is a clear route for technology and business model innovations to participate in flexibility markets.

6. Ireland



Overall, in Ireland there is a good political and public consensus around the energy transition, especially on the need for decarbonisation. This is supported by good progress on market and technology developments.

This results in the following average scores for each of the main three evaluation categories.

Market factors

Ireland has high levels of wind generation and therefore high variability, driving a significant requirement for flexibility services.

Balancing and flexibility markets are run by the TSO and are open and accessible to mainly industrial scale participants. There is good participation of generation and demand response providers for a variety of products.

There is a Single Electricity Market (I-SEM) on the island of Ireland and market trading arrangements. This market is being developed to allow aggregation and different contract terms and volumes to be traded as elsewhere in Europe.

Socio-economic factors

In Ireland, there is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition.

Similarly, there is a strong political commitment to decarbonisation, supported by a strong and aligned regulatory framework that will also enable flexibility needs.

Technology factors

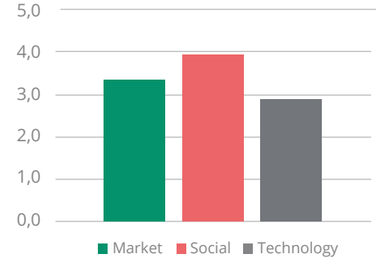
The Irish grid network can generally address the technical and operational challenges to integrate new distributed flexibility resources.

Progress is slow in providing EV charging signals and bi-directional charging so that EVs can participate in the flexibility market.

Good development of digital technologies provides a key enabler for flexibility markets.

There is a reasonable route for technology and business model innovations to participate in flexibility markets.

7. Germany



Overall, in Germany there is a strong political and public consensus around the energy transition ‘Energiewende’ to a low carbon energy system. This is supported by good progress on market/technology developments across a very large electricity market.

This results in the following average scores for each of the main three evaluation categories.

Market factors

Regulatory arrangements and market rules previously restricted distributed flexibility resources from participating in a variety of markets.

These arrangements are in the process of being changed to allow more open access to markets for alternative technologies, aggregation and flexible contract terms.

Socio-economic factors

There is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition and of the costs involved.

There is a strong political commitment to the Energiewende, and this is translated into a strong regulatory framework that should deliver decentralised energy and flexibility objectives.

Technology factors

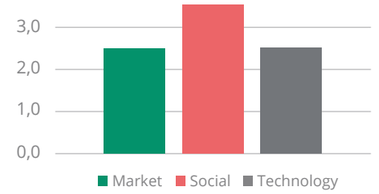
The grid network can integrate new distributed flexibility resources but has some technical or operational barriers.

Progress is slow in providing EV charging signals and bi-directional charging so that EVs can participate in flexibility markets.

Development of digital technologies e.g. smart meters helps to enable flexibility markets.

There is support for technology and business model innovations to participate in flexibility markets, but potential for more to be done.

8. Great Britain



In Great Britain, there is a good political and public consensus around the need for the energy transition, but this has not translated fully into regulatory and market change.

There is good progress on developing new technologies but there are barriers to implementation.

This results in the following average scores for each of the main three evaluation categories.

Market factors

Markets are generally open to all forms of flexibility. Aggregation is enabled in most of the balancing services and wider access to the Balancing mechanism is expected in December 2019.

Since 2018, GB DNOs have been tendering and procuring for various flexibility services to help solve congestion in the local electricity grids. In 2019, all GB DNOs published jointly a roadmap setting out the steps they intend to take to enable a smarter and more flexible energy system.

However, the market is highly fragmented and complex with specific products essentially targeted to specific technologies. Major improvements are planned to include charging, access and product reforms, but implementation is slow which gives rise to market uncertainty.

Socio-economic factors

There is a strong political commitment to decarbonisation and the energy transition, with a Net Zero target for 2050 having recently been passed into legislation. There is evidence of good public support.

The GB’s regulatory framework will need to be further aligned with this new target and to deliver the associated transition and flexibility changes and objectives.

Technology factors

The grid network has technical/operational constraints in several regions, which can delay access by distributed energy resources. In the future, with the right network access framework, distributed energy resources may play a more important role in optimising future grid investment needs.

Progress is slow in providing EV charging signals and bi-directional charging so that EVs can participate in flexibility markets.

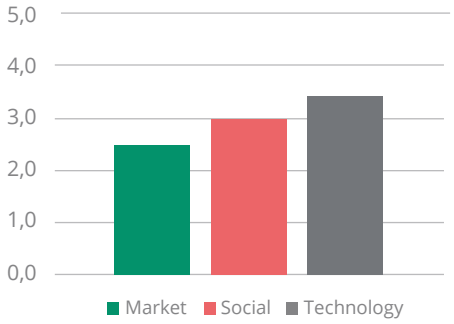
Delays to deployment of digital technologies such as smart meters and open data standards may constrain flexibility markets.

There is good support to enable technology and business model innovations to test their participation in flexibility markets.

9. France

Overall, in France there is a good political and public consensus around the energy transition, especially on the need for decarbonisation. This is supported by good progress on market and technology developments.

This results in the following average scores for each of the main three evaluation categories.



Market factors

France's growth in renewables means that distributed flexibility needs will increase in future.

Regulatory arrangements and market rules allow trading of distributed flexibility resources. Independent generation and demand providers and aggregators can participate in most products and markets.

France scores slightly lower than other countries mainly because of lack of transparency in some of the flexibility services, as well as the fact that certain balancing services are met through the mandatory participation from large generators, rather than competitively procured from the market.

Socio-economic factors

There is a clear roadmap for the electricity market transition involving all key participants, together with a clear public social and economic acceptance of the energy transition and of the costs involved.

There is a strong political commitment to the energy transition with a clear regulatory framework that should deliver decentralised energy and flexibility objectives.

Technology factors

The grid network can easily integrate new distributed flexibility resources.

While EV development plans have commenced, more progress is needed in providing EV charging signals so that EV's can participate in flexibility markets.

Development of digital technologies e.g. smart meters helps to enable flexibility markets.

There is good support for technology and business model innovations to participate in flexibility markets.

About the REA

The REA is the UK's largest trade association for renewable energy and clean technologies with around 550 members operating across heat, transport, and power. The REA is a not-for-profit organisation that represents renewable energy and clean technology companies operating in over fourteen sectors, ranging from biogas and renewable fuels to solar and electric vehicle charging. Membership ranges from major multinationals to sole traders.

For more information, visit: www.r-e-a.net

About Eaton

Eaton is a power management company with 2018 sales of $21.6 billion. We provide energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton is dedicated to improving the quality of life and the environment through the use of power management technologies and services. Eaton has approximately 100,000 employees and sells products to customers in more than 175 countries. For more information, visit Eaton.com.

About DRAX

Drax owns and operates a portfolio of flexible, low carbon and renewable electricity generation assets across Britain. The assets include the UK's largest power station, based at Selby, North Yorkshire, which supplies five percent of the country's electricity needs. Since converting two thirds of Drax Power Station to use sustainable biomass instead of coal it has become the UK's biggest renewable power generator and the largest decarbonisation project in Europe.