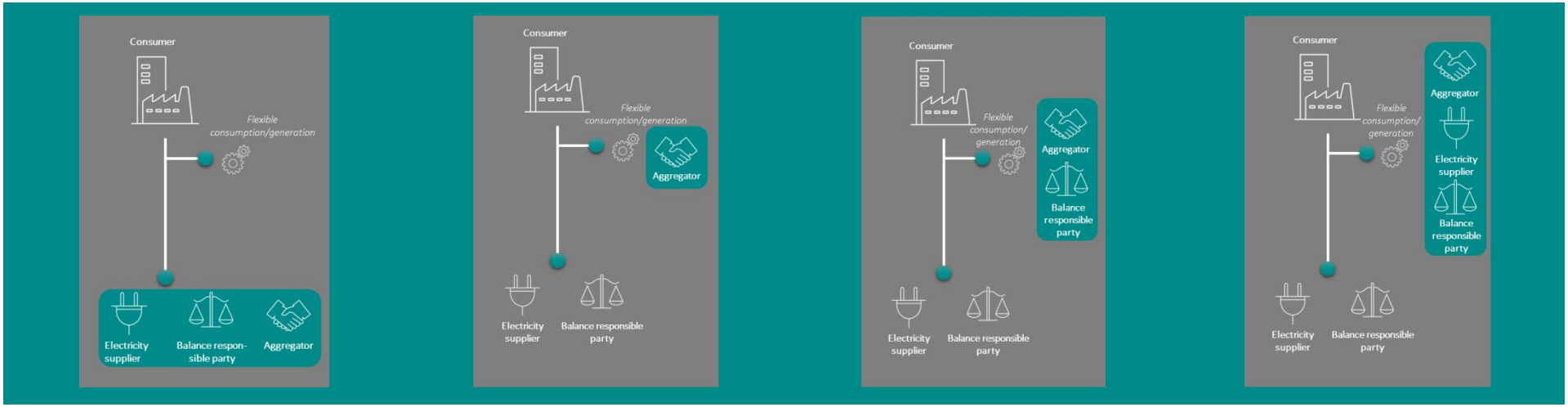
MARKET MODELS FOR AGGREGATORS

– Activation of flexibility



CONTENTS

THE TASK

In September 2015, Energinet published a report on the so-called Market Model 2.0[1] in cooperation with a large number of players. The report analyses current and future challenges facing the Danish electricity market and the solutions needed to future-proof the market. The report contains 24 recommendations for subsequent follow-up.

Some of the recommendations relate to the utilisation of flexible electricity demand. The Danish Energy Association has teamed up with Energinet, the Confederation of Danish Industry and the Danish Intelligent Energy Alliance to tackle this part of the ongoing work by:

1. Identifying relevant market models for activation of aggregated flexible electricity demand and generation for aggregators.

2. Assessing the possibilities of reducing barriers to activation of aggregated flexible electricity consumption and generation.

3. Recommending one or more models for how the aggregation of flexible electricity demand and generation can be carried out by market players that are not necessarily electricity suppliers and/or balance responsible parties as well.

[1]: https://en.energinet.dk/About-our-reports/Reports/Market-Model-2-0

PURPOSE – REALISING FLEXIBILITY FOR THE BENEFIT OF EVERYONE

The aim of the work is to select one or more market models that integrate the aggregator into a market design which is fair and works for all parties involved. To do this, the aggregator must be defined as a player in a Danish context.

Aim of the work

The work will be based on the current market framework combined with potential aggregators' expectations for value creation on activation of aggregated flexible electricity consumption and generation.

A key element is to create the necessary and best possible market framework for utilisation of flexibility on both the consumption and generation side.

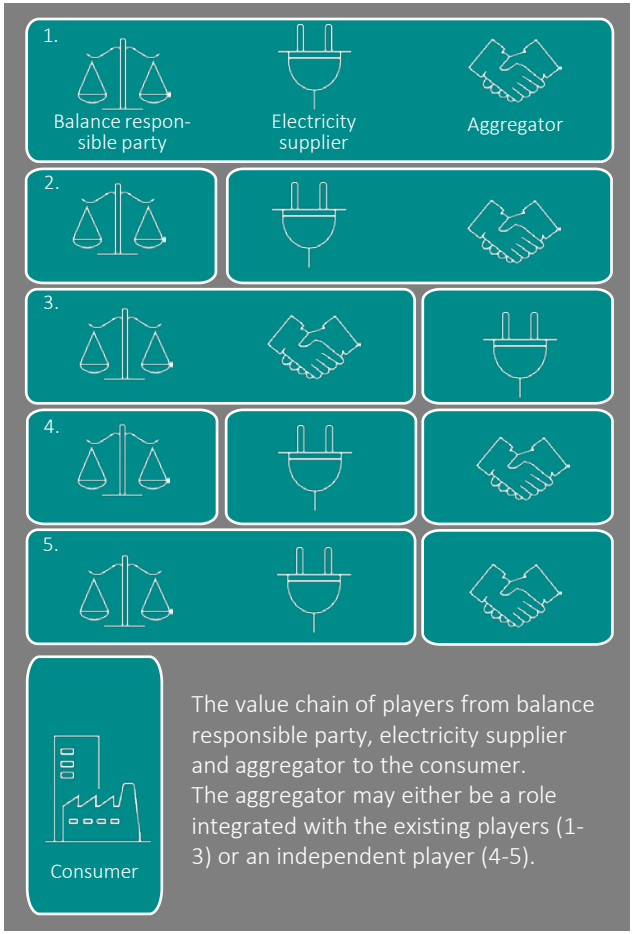
Via the recommended market models, efforts must be made to unlock the potential of flexibility from large and small units, without detriment to other players in the market. The aggregator may be an existing or new independent player.

Finally, the aim is also to improve the overall framework for consumption flexibility in the electricity market in order to develop innovative business models for activating flexibility. In this way, new business models in the electricity market can help to support the green transition and intelligent utilisation of electricity grid capacity.

What is an aggregator?

Various roles and players – such as electricity suppliers and balance responsible parties – are clearly defined in the Danish market rules. First and foremost, it is recommended to introduce 'aggregator' as part of the market design of the electricity market. It is therefore recommended to base this on the following definition:

Aggregator: *Has entered into an agreement with an electricity customer on access to disposing of the electricity customer's flexible consumption and/or generation in the electricity market. The aggregator pools flexibility from customers and converts it into electricity market services, for example for use by the TSO, DSO and/or BRP.*



The value chain of players from balance responsible party, electricity supplier and aggregator to the consumer.
The aggregator may either be a role integrated with the existing players (1-3) or an independent player (4-5).

ABBREVIATIONS

BRP: Balance responsible party

DK1 & DK2: The two synchronous areas in Western and Eastern Denmark, respectively, which are separated by the Great Belt.

DSO: Distribution system operator, commonly referred to as a grid company.

TSO: Transmission system operator. Energinet is the TSO in Denmark.

Electricity market: A generic term for the wholesale and ancillary services markets[2], which are operated by Nord Pool and Energinet, respectively, and, in time, a market for DSO services.

[2]: https://en.energinet.dk/Electricity/New-player

OBJECTIVE – AGGREGATOR CREATES VALUE

As a market player, the aggregator can help to stabilise the electricity system and minimise the risk of power failures at times when the energy system is under pressure.

Energinet and grid companies use flexibility

Energinet needs flexible electricity consumption and generation in order to balance the electricity system. Demand increases as the share of fluctuating RE generation increases. Even today, there are times seen over a 12-month period when Energinet has difficulty balancing electricity generation and consumption. Enhanced flexibility may help to solve this problem.

In future, the grid companies will also call for more flexibility in order to meet the challenge of ensuring sufficient capacity in the distribution grid. Their demand will increase with the growing infeed of RE generation and the general electrification of our energy consumption.

Electricity generators deliver flexibility now

The vast majority of the flexibility currently being delivered to the electricity system comes from power stations, where flexibility is traded via the balance responsible parties in the electricity markets.

As the green transition gains momentum, the power stations will not be able to deliver the degree of flexibility demanded by the electricity system. Firstly, because an overall higher level of flexibility will be required to balance the growing volume of fluctuating generation, and secondly, because there will be fewer dispatchable power stations available.

As a result, in future we will be facing a growing demand for flexibility to balance the electricity system and a reduced supply of flexibility from the power stations.

Consumers can also deliver flexibility

We therefore need to take a close look at the consumer side and explore the opportunities offered by aggregating consumption flexibility in particular, for example by controlling and switching off the electricity consumption that is not necessarily needed at a particular time.

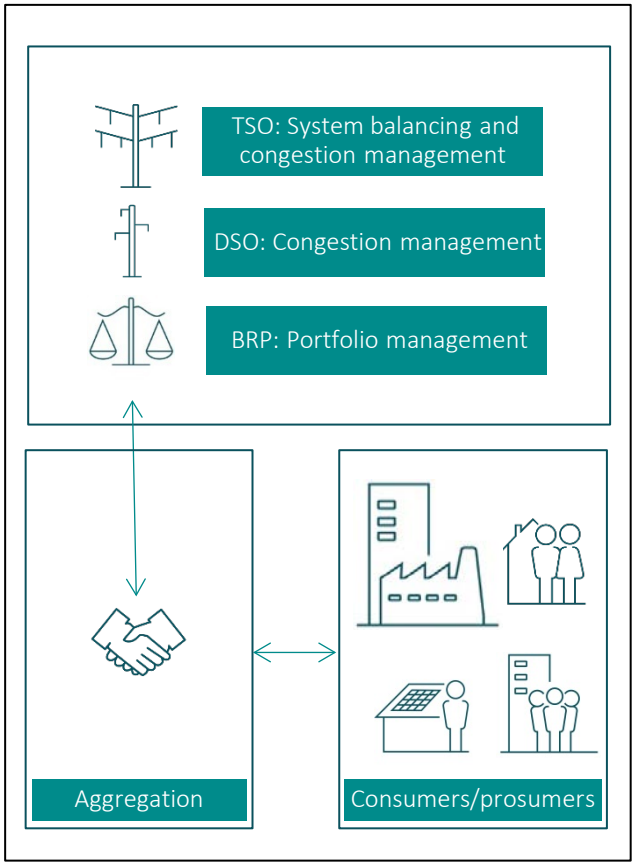
Some large industrial enterprises with very high electricity consumption are already utilising flexibility in the electricity market, but this is not enough to cover the future need.

It is therefore necessary to activate even more consumption flexibility from both small and medium-sized enterprises with, for example, heat pumps or cold stores, but also from households with, for example, electric vehicles or heat pumps.

Small units must be aggregated

The electricity market's need for aggregators is due to the fact that the current electricity market players are not able to establish a profitable business model on their own with the sole purpose of trading flexibility from small and medium-sized enterprises in the electricity market.

For the aggregator, however, it may be advantageous to collect this value and offer it as part of a complete service to the customer, e.g. heat, transport, energy optimisation etc. This allows the aggregator to build a flexible portfolio as part of its business model which can be utilised by the electricity market players, thereby also representing a value.



CHALLENGE – AGGREGATOR INTRODUCES COMPLEXITIES IN THE ELECTRICITY MARKET

With a view to maintaining a well-functioning electricity market with fair competition for all players and simultaneously supporting low access barriers for aggregators, four models are recommended which collectively address a number of complexities related to the introduction of an aggregator in the electricity market.

Complexities

The dialogue with existing Danish and European players shows that the introduction of an aggregator as a player entails a number of complexities. Generally, these concern a need for:

- Distinguishing between so-called implicit and explicit flexibility
- Measuring and validating the activation of the flexible consumption/generation
- Exchanging information with existing players, for example when the aggregator enters into an agreement with a customer.

With respect to the recommended models, these challenges are generally manageable as long as the amounts of flexibility are relatively small (as in model 1), or in case of a complete separation of the customer's classic and flexible consumption where the aggregator wishes to enter into agreements with its own balance responsible party and electricity supplier (as in model 3).

The challenges are further compounded and become increasingly difficult to resolve in market models where the aggregator is independent, but has its own balance responsible party and offers flexibility only, i.e. not electricity (as in model 2). Discussions with existing players identify factors that represent a special challenge such as:

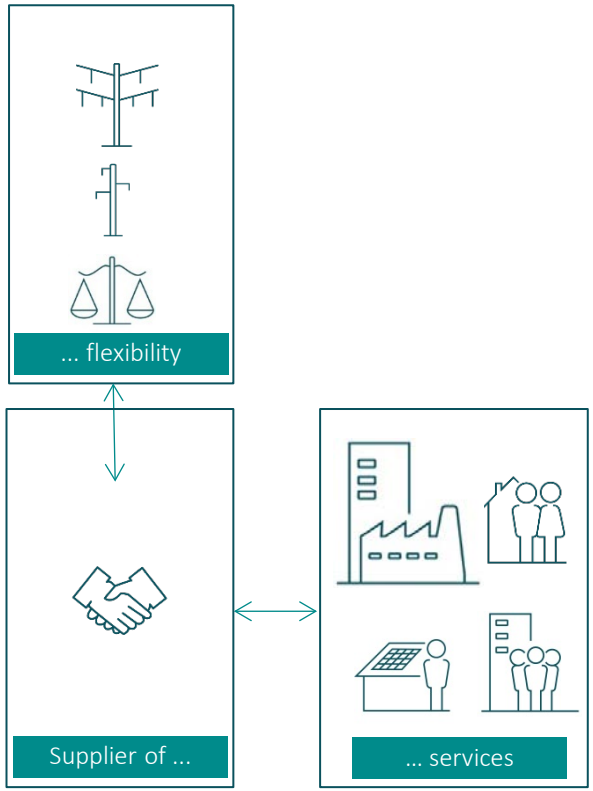
- Planning of activation and agreement on a baseline methodology
- Rebound effect[3]
- Method for correction between several balance responsible parties.

These challenges relate especially to the activation of less homogeneous units where it is necessary to keep down transaction costs.

Four suggested market models

Based on the notion that an aggregator may be an independent player in the electricity market with the same rights and obligations as the other players, four different market models are suggested, each with its own focus and complexities.

Together, the four models represent a variety of possible setups which may function in parallel, and where the business model may result in the aggregator acting as supplier of flexibility to the electricity markets as well as supplier of services, including electricity to electricity consumers.



GLOSSARY

Implicit flexibility is when the customer (or a player acting on behalf of the customer) reacts to the hourly price and is rewarded with an overall lower electricity bill. Assumes flexible settlement.

Explicit flexibility is when the customer (or an aggregator acting on behalf of the customer) is rewarded by adapting its consumption to the products in the electricity market.

[3]: The time before or after an activation (where a customer's consumption/generation has been revised up or down) where the customer compensates for the activation by increasing/reducing consumption relative to its consumption profile.

EUROPEAN OUTLOOK – NATIONAL SOLUTIONS

The challenge of ensuring the flexibility necessary to balance the electricity system is not only felt in Denmark, but also in its neighbouring countries. Several European countries have already come a long way in realising flexible consumption – an achievement that we of course must learn from.

Authorities

In parallel with this work, the European Commission has developed its own 'Clean Energy for All Europeans' package. Focusing on the consumer, the aim of the package is to strengthen the consumer's position in the electricity market, for example in relation to bringing flexible consumption and generation to the electricity market.

Consumption flexibility and a formalised role for the aggregator which can collect and pool individual customers' flexible consumption are key elements of the clean energy package. The European ambition thus supports the Danish authorities' call for balancing the increasing volumes of fluctuating renewable energy through demand-side flexibility, including via flexible autogeneration.

It is important that the clean energy package provide scope for the necessary flexibility to be realised in line with the needs of the individual countries. Even though the phrasing of parts of the package seems inadequate, it will not prevent the implementation of the suggested market models.

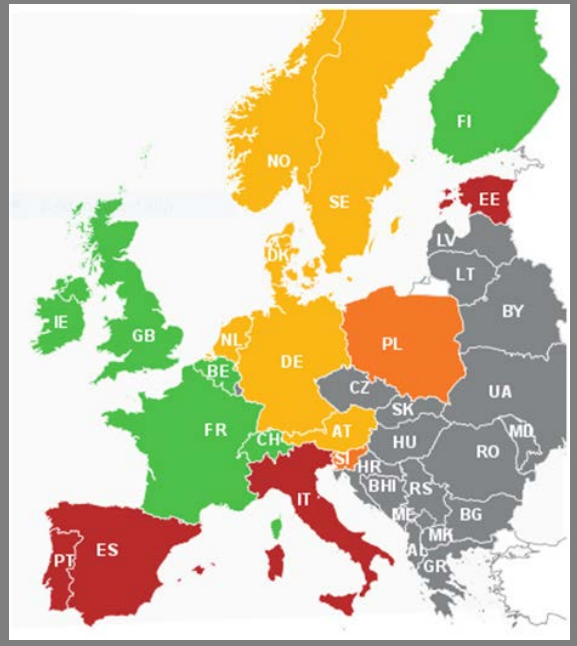
NGOs

With respect to the work undertaken by the European organisations, the work carried out by the Dutch-based organisation Universal Smart Energy Framework (USEF)[4] has been the main inspiration for the present work, and they were also directly involved in the work. USEF thus puts forward a range of models inspired by the needs of the European electricity markets. These models form the basis for the market models proposed in this report.

Smart Energy Demand Coalition (SEDC[5])'s mapping in 2017 of "Explicit demand response in Europe" demonstrates that many European electricity markets are not open to demand response from smaller units. However, inspiration can be gained from other European countries, but due to different balancing philosophies and market rules, it is not possible to apply a 'one size fits all' approach across all of Europe. Common to the countries shown as having made the biggest progress in terms of consumption flexibility is that their electricity markets are very open to trade in flexibility and aggregated bids. Moreover, most of these countries have passed specific legislation that ensures competition between the players and opens their markets to aggregators.

International recommendation

Denmark is not classified by SEDC as a commercially active market as the demand for flexibility is limited, and regulatory barriers also prevent independent aggregators. Specifically, the present definition of the roles and responsibilities of the aggregator and the balance responsible party/electricity supplier is cited as an issue. The implementation of the market models proposed in this report may lead to better conditions for the aggregator, thereby paving the way for a more active market for demand response.



Source: Explicit Demand Response in Europe – Mapping the Markets 2017, SEDC[6].

[4]: www.usef.energy/
[5]: www.smartenergydemand.eu/
[6]: www.smartenergydemand.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf

MODEL 0 – AGGREGATOR's CURRENT OPTIONS

What is the model about?
In model 0, an existing electricity supplier/balance responsible party takes the role of aggregator. Alternatively, they have made an agreement with an aggregator and therefore appear as a single player to the customer and in the electricity market. Flexibility is not separated from the classic electricity supply.

The model is mainly aimed at the players that want – or have already accepted – the obligations of being an electricity supplier/balance responsible party in the market, and whose current market role brings them in close contact with consumers.

What opportunities and complexities does the model hold?
The model provides excellent scope for integrating flexibility as part of an overall service offering to the customer. This may include the delivery of heat or transport services where the aggregator/electricity supplier is authorised to manage and purchase power and is able to optimise energy consumption according to specific comfort requirements set by the customer.

Due to its contractual relationship with a balance responsible party, the aggregator may sell flexibility to all the electricity markets, and activation of flexibility will be agreed and thus handled as part of the relationship between the aggregator and the electricity supplier/balance responsible party. Consequently, the model does not increase the present level of complexity.

Both implicit and explicit flexibility are handled by the same player, which settles this with the customer on a combined basis.

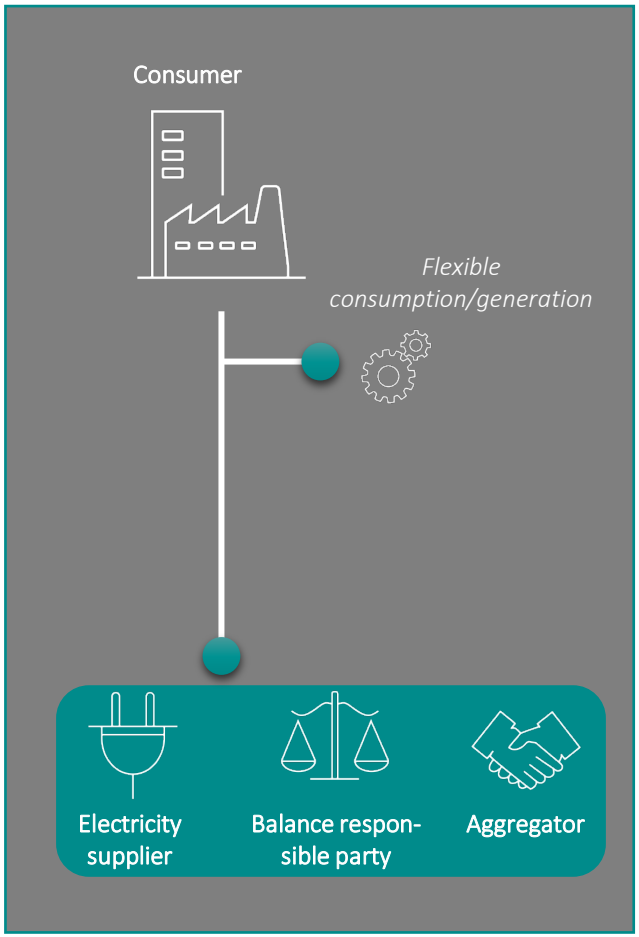
Comments by the players
The model is currently used by balance responsible parties which have an agreement with power stations with electric boilers. In due course, treatment plants and business centres also plan to sell their flexibility. However, the model does not encourage independent aggregators looking to trade in explicit flexibility as aggregators are required to enter into bilateral agreements with the current market players in order to form part of the electricity market. The costs of doing so are seen as a significant barrier.

What does it take to realise the model?
It is unclear how large the potential for activation of flexibility in industrial and other energy-intensive processes is. It is possible that model 0 can be applied to a greater extent than is the case today. Players lack adequate information about the potential for activation, and their knowledge of this should therefore be increased.

The limited use of model 0 may also be due to the fact that small electricity consumers are not covered by the so-called flex-settlement, which will be introduced on 1 December 2017, and entails hourly settlement for all customers in DK.

As is the case with the other models, the wider fluctuations in electricity prices that are expected to occur will strengthen the business case for the model.

Recommendations and implementation
Efforts should be made to promote awareness of the model and the possibilities in the electricity market, and this requires participation and commitment on the part of both consumers and professional players. For example, aggregation of flexible consumption is not part of the existing core business of many electricity suppliers and balance responsible parties.



MODEL 1 – AGGREGATOR DELIVERS FREQUENCY STABILISATION

What is the model about?
The aggregator is independent in model 1 and delivers frequency stabilisation (FCR)[7] to the TSO without being responsible for the actual supply of electricity to the customer.

Frequency stabilisation contains such small amounts of energy that the imbalance is negligible.

As a result, the aggregator is able to activate and sell the customer's flexibility without exposing the balance responsible party to considerable imbalance costs.

What opportunities and complexities does the model hold?
The model has low entry barriers for the aggregator and a minimum of complexity.

Because the aggregator deals directly with Energinet without a balance responsible party, exemption is granted for the fundamental electricity market principle that all consumption and generation must be assigned to a balance responsible party.

The model is possible as the duration and volume of energy on delivery of FCR is very limited. This prevents significant energy imbalances that require subsequent correction via the balance settlement.

In other words, no significant imbalance costs are incurred by the other players in the value chain as a result of the aggregator's activation of flexible resources.

Comments by the players
This model is inspired by the so-called Parker Project[8] where a number of electric vehicles are used to deliver FCR-D in DK2, among other things. The project has contributed to eliminating the requirement for online metering of each individual unit delivering services to Energinet.

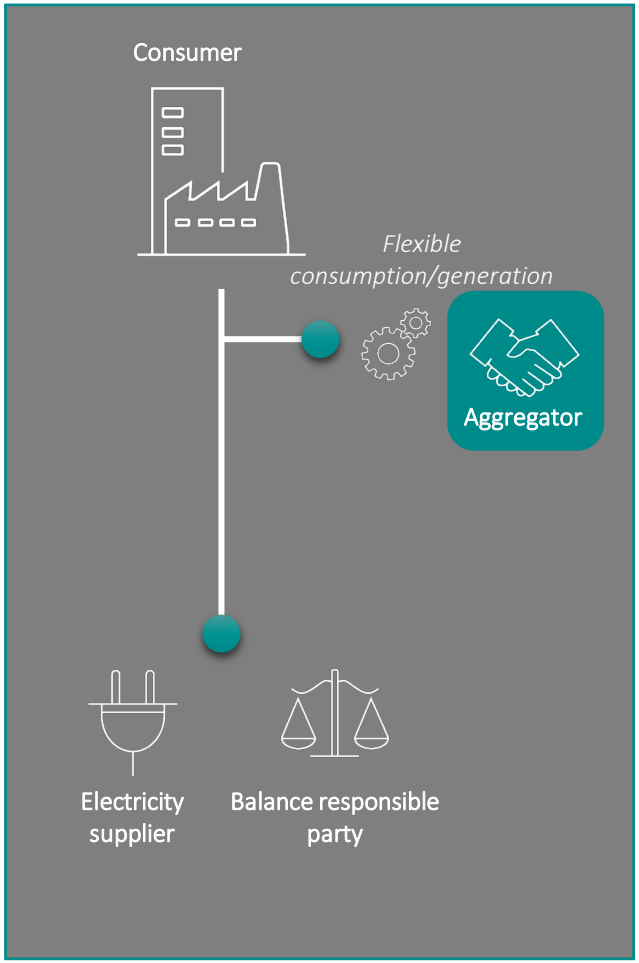
Energinet's validation requirements can be met by using the units' internal electricity meters. There remains a need for assessing whether the use of portfolio metering aggregated from many small units is acceptable from a settlement point of view.

What does it take to realise the model?
The model will require changes to the market design to allow the aggregator to deal independently with Energinet when it comes to delivery of FCR services.

Recommendations and implementation
Changes should be made to the market rules and Energinet's terms for the delivery of ancillary services to formally allow an aggregator to enter into agreements on the delivery of FCR services with Energinet, i.e. independently of a balance responsible party.

Pilot projects should be launched to assess whether portfolio metering is acceptable for settlement purposes and, specifically in DK1, to assess whether similar delivery of FCR without a balance responsible party is acceptable.

Regardless of the duration of an activation and irrespective of whether the activation is positive or negative, a physical exchange of energy will take place (particularly for FCR-N) which will affect the energy balance – albeit to a limited extent – and, by extension, the balance settlement. In light of the above, it should be monitored and assessed whether the model is robust in terms of the implicit collectivised balancing cost, or if it should be adjusted.



[7]: Consists of several different services; FCR in DK1, while both FCR-D and FCR-N occur in DK2. FCR and FCR-D are chiefly power (W), while FCR-N also includes energy supply (Wh). Formerly known as primary frequency reserves.
[8]: www.parker-project.com

MODEL 2 – AGGREGATOR DELIVERS FLEXIBILITY

What is the model about?

The aggregator works with one balance responsible party without being responsible for the actual electricity supply which is handled by the customer's existing electricity supplier and its balance responsible party. This means that electricity metering and settlement of the customer account remain unchanged, resulting in no additional costs in this respect.

Through its own balance responsible party, the aggregator is able to deliver flexibility to all electricity markets, without this giving rise to any accountability on the part of the customer's original electricity supplier/balance responsible party. Balance responsibility is thus transferred to the aggregator's own balance responsible party during the activation period. In other words, imbalance costs are carried directly by the aggregator and its balance responsible party.

What opportunities and complexities does the model hold?

The model has relatively low entry costs, but there are many complexities that need to be resolved before the model can be implemented.

The model's key challenge is the accounting and settlement between the two or more balance responsible parties involved.

The aggregator can relatively cheaply increase the number of units in its portfolio within the same balancing agreement. As such, the model also enables the same customer to have multiple aggregators, for example linked to individual technologies.

Comments by the players

Experience gathered from the Ecogrid 2.0 project and Best Green indicates that settlement between the balance responsible players can either take place by using disaggregation of main meter data or by utilising the electricity metering that is already integrated into the systems that the aggregators have in their portfolio.

The players consider the model to be the most complex, but nevertheless interesting due to the low entry costs.

What does it take to realise the model?

In order to reduce transaction costs and the risk of disputes among the players, standardised methods for validating activated/delivered flexibility are required. This includes establishing a baseline, i.e. a forecast for the consumption profile that would occur without activation of flexibility.

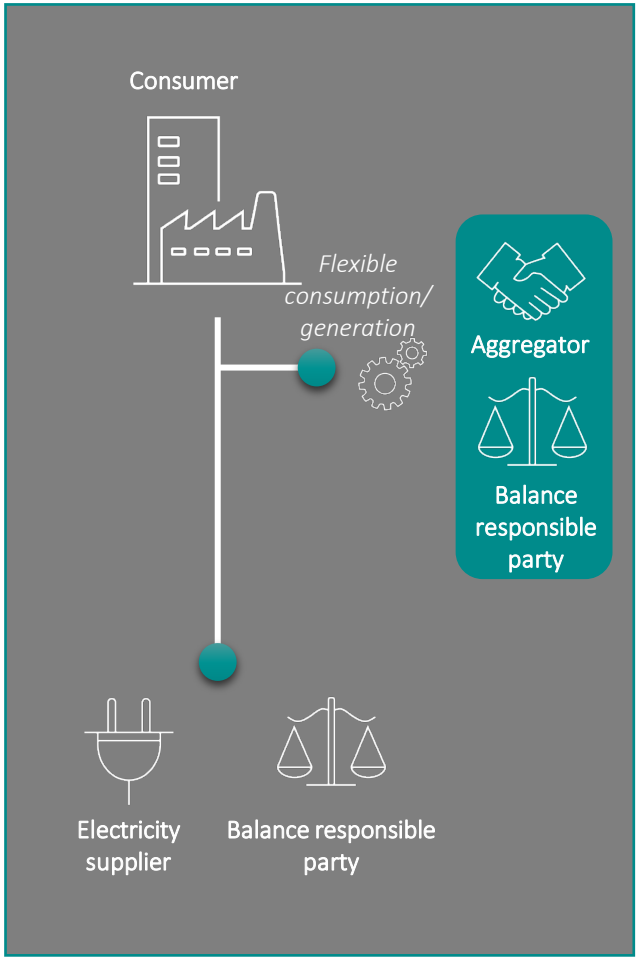
The model requires that the division of responsibilities between the players is described clearly and accurately. Furthermore, methods for validating the aggregator's activation of flexibility and making the necessary correction in the balance settlement must be developed.

Recommendations and implementation

Given that the model requires extensive changes to the market rules, it is recommended to test the model in a pilot project. This includes further exploring methods for establishing a baseline and the price used in the settlement of corrected balances between the players.

It should also be examined and clarified whether the aggregator should/can be held liable for any rebound effects in the period before or after activation.

It is recommended to base this work on existing balance settlement principles where possible and not least on existing data infrastructure, such as the DataHub.



MODEL 3 – AGGREGATOR DELIVERS FLEXIBILITY AND ELECTRICITY

What is the model about?

Basically, the customer demands a single service such as a heat service (heat pump) or transport service (electric vehicle). Electricity supply and flexibility management are integrated into the single service received by the customer from the aggregator.

The aggregator can activate flexibility in all electricity markets, and the aggregator is also responsible for the supply of electricity to the end user.

In the model, the aggregator works with its own electricity supplier/balance responsible party across its entire portfolio of customers and flexible units.

The customer's total consumption is divided into classic (existing) and flexible electricity consumption through the establishment of a serial metering point. This allows the customer's classic and flexible consumption to be settled separately.

As a result, the model particularly favours the aggregator's role as a service supplier that can combine electricity and flexibility into a single service to the customer.

Imbalances resulting from the aggregator's activation of flexibility are handled as part of the current balance settlement.

What opportunities and complexities does the model hold?

The aggregator's activities do not impose unintended costs on other players.

Metered data that can validly be used for settlement purposes is included directly in the electricity settlement, and the activation of flexibility in the ancillary services markets is settled as part of the current balance settlement with the aggregator's balance responsible party.

The model has relatively high entry costs per flexible unit due to the need for establishing a serial metering point.

The aggregator's own aggregated metered data can be utilised for validation of flexibility delivered to the electricity markets.

Comments by the players

The model is easy to understand for the players due to the complete separation of flexibility and electricity supply combined with the service provided by the aggregator. The transparency that serial metering points and new players bring for the individual customer, however, requires a certain level of consumption in order to compensate for the additional costs. On the other hand, transaction costs for several balance responsible parties, as stated in model 0, could be prevented through the separation of consumption/electricity supply.

The model is to be applied in the Best Green case for the delivery of heat services for large buildings.

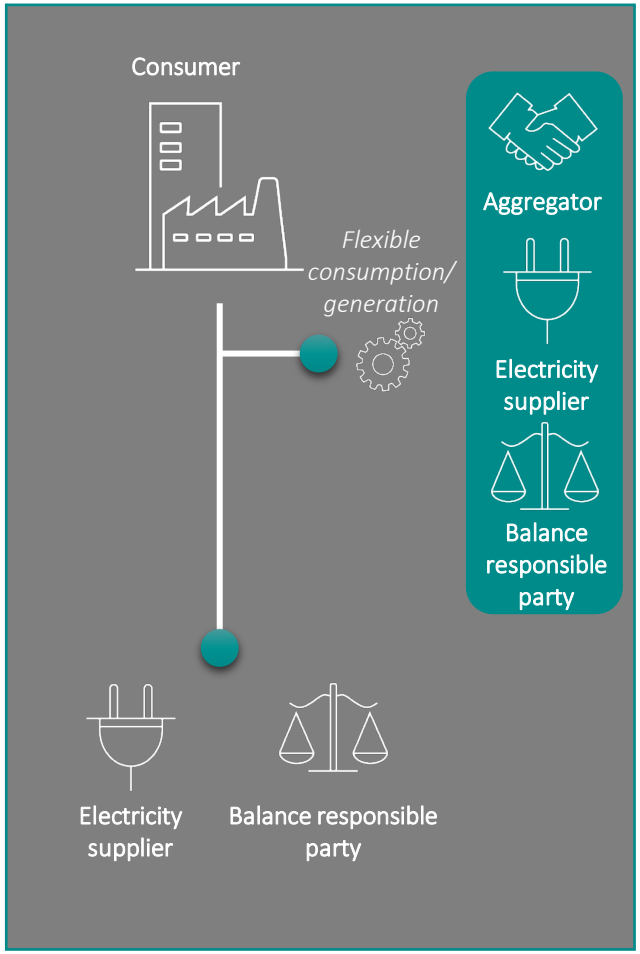
The players experience relatively large variations in terms, service and payment for the establishment and operation of a serial metering point among different grid companies.

What does it take to realise the model?

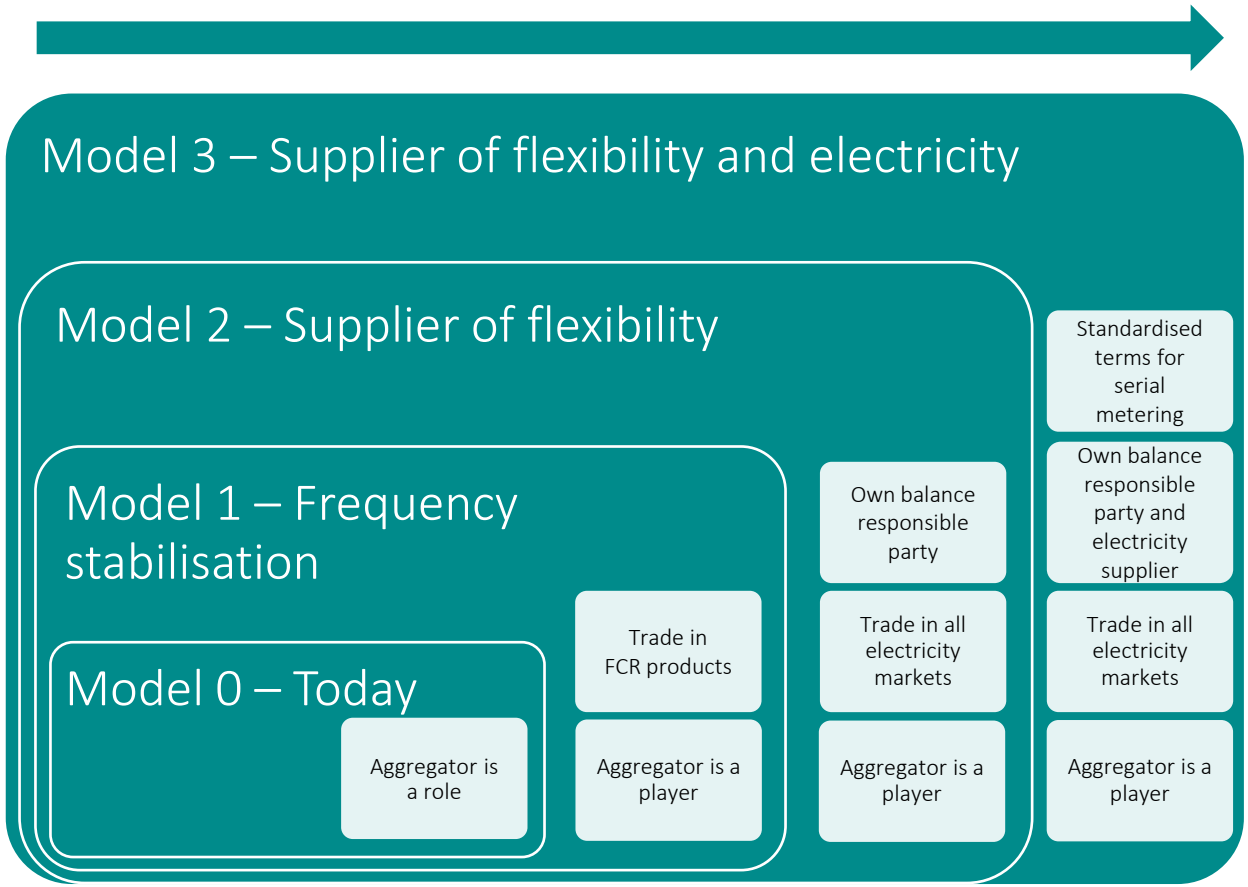
Classic and flexible consumption/generation can be separated by introducing serial metering points.

Recommendations and implementation

The grid companies should standardise and elaborate on the description of terms and service as well as harmonising the method for determining payment for installation and ongoing subscription payments for a serial metering point.



SUMMARY – GRADUAL EXPANSION OF AGGREGATOR MARKET MODEL



It is a fundamental principle in the Danish electricity market that rules and frameworks must be objective and non-discriminatory. The same principle applies to demand response. Basically, flexibility has the same value for the electricity system, irrespective of whether it comes from a consumption or generation unit or from an aggregator, electricity supplier or balance responsible party.

In the course of 2016 and 2017, Energinet, the Danish Energy Association, the Danish Intelligent Energy Alliance and the Confederation of Danish Industry have been involved in various national and international partnerships, and the conclusion is clear: International differences in regulation, IT and markets make it impossible to find a solution that everyone can agree on. Furthermore, existing and new players have different business models. It is therefore recommended to allow more models in the Danish market. This would enable a gradual development and several types of players to function as 'aggregator', without all complexity necessarily having to be implemented from day one. Where models 0 and 3 favour players that want to assume responsibility for both flexibility and electricity supply to the customer, models 1 and 2 focus more on the value of the actual flexibility towards the electricity markets.

With the market models, the possibilities for the aggregator can be explored gradually, and the necessary market frameworks and IT initiatives to support the aggregation of consumption flexibility can be implemented continuously in partnership with players, where this makes sense.

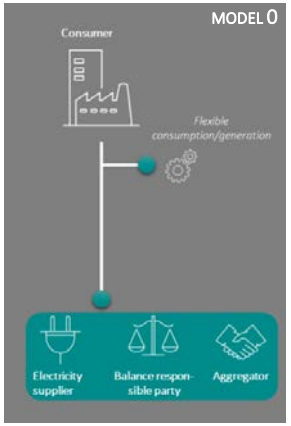
RECOMMENDATIONS – SUM UP

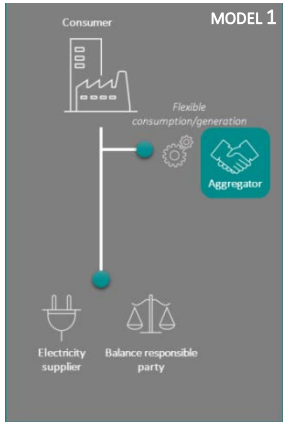
The implementation of recommendations is believed to be feasible within the framework of current legislation.

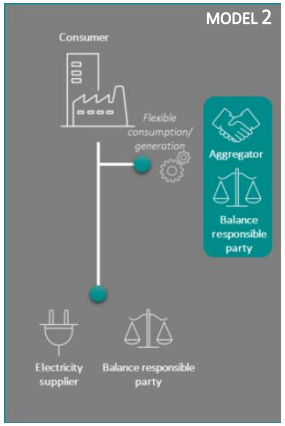
However, this requires changes to be made to market rules, the contractual basis for players in the electricity market as well as connection conditions for DSOs.

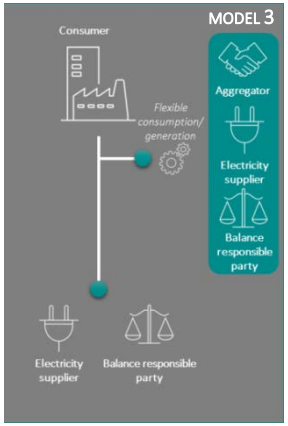
As required by law, these measures are subject to method approval by the Danish Energy Regulatory Authority and will therefore, in addition to the players' efforts, be conditional upon the specific approval procedure of the Danish Energy Regulatory Authority.

The work on the recommendations should continue to involve a broad range of industry players, which will be guaranteed by the bodies responsible.









Recommendations

DEFINE 'AGGREGATOR' IN MARKET RULES

- CHECK IMPACT ON REGULATIONS, DATAHUB AND CONTRACTUAL BASIS
- ENSURE START-UP AND PREPARE PLAN FOR DEVELOPMENT AND IMPLEMENTATION OF NEW MARKET RULES

PROMOTE MODEL 0

IMPLEMENT MODEL 1

- LOOSEN REQUIREMENT FOR BALANCE RESPONSIBLE PARTY FOR FCR
- USE AGGREGATED METERED DATA FOR VALIDATION
- MONITOR IMBALANCES
- COMPLETE PILOT TEST WITH FCR FOR DK1

LAUNCH PILOT TEST OF MODEL 2

- CREATE POSSIBILITY OF MULTIPLE AGGREGATORS PER CUSTOMER
- UTILISE AGGREGATOR'S METERED DATA
- EXAMINE DATA INFRASTRUCTURE
- DEVELOP BASELINE METHOD
- DEVELOP PRICE MODEL FOR CORRECTION OF IMBALANCES

OPERATIONALISE MODEL 3

- STANDARDISE TERMS FOR SERIAL METERS

WORKING GROUP MEMBERS

Michael Guldbæk Arentsen, Danish Energy Association (chairman)
Helle Juhler-Verdoner, Danish Intelligent Energy Alliance
Jeannette Møller Jørgensen, Energinet
Ulrik Stougaard Kiil, Energinet
Marie Holst, Confederation of Danish Industry

June 2017