NordREG
Nordic Energy Regulators

Discussion of different arrangements for aggregation of demand response in the Nordic market – February 2016

Executive summary

In this paper, NordREG analyse four different models for aggregation of demand response and describe the consequences for the balance responsible parties (BRP) with relation to the settlement results. The models do not necessarily represent an exhaustive list of all possible setups, but serve as examples for the purpose of discussion.

The first model, Model 1 (one BRP – integrated), builds on the existing principle of one BRP per connection point, where the supply and aggregation of demand response is handled by one integrated unit offering these services as a "package" to the consumers. In practice, this unit could be a supplier offering aggregation services, a service provider specialised in aggregation services which also acts as a supplier for its customers, or a joint venture between a traditional supplier and a service provider specialised in aggregation. We conclude that we in general see no barriers for this model to be developed in a well-functioning and competitive retail market, and that this model is fully compatible with the current market setup applied in the Nordic market.

The three other models illustrates alternative solutions for so called "independent aggregators". The idea behind "independent aggregators" may be seen as a way to create more competition in providing demand response solutions to consumers. Such arrangements could possibly be relevant in retail markets with limited competition and/or a high degree of fixed prices.

We conclude that the first of these models, Model 2a (two BRPs – without correction), is not viable as a model for "independent aggregators", as the "independent aggregator" would not earn any profit.

We further conclude that Model 2b (two BRPs – with correction) in theory could lead to the same results as Model 1 (one BRP – integrated), but that the model has some inherent practical challenges. Firstly, it may be challenging or impossible for the settlement function to keep a correct track of the imbalances of the two BRPs. Secondly, it would most likely require a regulation of the price component which is used to compensate the BRP of the supplier for the imbalances caused by the activation of demand response bids from the "independent aggregator". This regulated price may not correctly represent the costs of the supplier. Thirdly, the model seems administratively complex and costly to implement.

For the last model for "independent aggregators", Model 3 (one BRP – independent aggregator without balance responsibility), we conclude that this model implies a free-riding of the "independent aggregator", and that it leads to unjustified costs for other market parties or grid users, since the "independent aggregator" is not liable for the imbalances it causes the BRP of the supplier. This model is therefore not viable within the Nordic market

We further conclude that both implicit and explicit demand response should be able to develop within well-functioning and competitive markets, such as the Nordic retail markets, if consumers are willing to change its consumption pattern and if it provides a benefit for the consumers.

To efficiently enable *implicit demand response,* it is necessary that the consumers are both metered and billed at the same resolution as the price signals. Further, the price signals should in some way reflect the

scarcity of either capacity in the grid or in the electricity production. As smart metering is already installed or planned to be installed in the Nordic countries, and as the consumers are free to choose a contract with variable prices from a wide variety of suppliers, NordREG sees in general no regulatory barriers for the development of implicit demand response in the Nordic retail markets. The level of implicit demand response in the market becomes merely a question of cost/benefit for the consumer, i.e. that the level of volatility of the price signals are sufficient to ensure that it is profitable for the consumer to change its consumption pattern as a response to the price signals.

Further, when it comes to enable explicit demand response through aggregation, we also consider that this is most efficiently developed by retail market competition, where the suppliers/aggregators compete in providing the best "package" of supply and demand response services, while preserving the fundamental principle of one BRP per connection point. The described Model 1 (one BRP – integrated) in this paper is an illustration of this.

As the maturity of the different European retail markets differs, we recognise that one solution may not be fit for all retail markets. We therefore acknowledge that some member states or regulators are considering compensating measures or interventions, such as models for "independent aggregators". Though regulatory interventions may be a tool for less well-functioning markets, we generally believe the priority for regulators or other decision makers should be to correct market failures and barriers. Obvious examples of such market barriers are regulated end-user prices and barriers to become a BRP or to start a supply business, and a lack of smart meters.

At last, we like to underline the importance of leaving the decision to intervene in the market to the competent national authorities after having conducted thorough impact assessments. This is built on the fact that one solution may not be fit for all markets, as their maturity may differ. When it comes to the role of aggregators, we currently believe that the most efficient setup for the Nordic retail markets is that aggregation services are developed by retail market competition through one integrated unit which has balance responsibility. That said, we as Nordic regulators, will continue to analyse how demand side flexibility may be improved in the Nordic market.

1. Purpose and Background

1.1. Purpose of document

The purpose of this paper is to describe some consequences of different models for aggregation of demand response within a well-functioning retail market, such as the Nordic retail markets. Even though the starting point for this analysis is the Nordic market, it also serves as an input to the current discussions on how to increase demand side flexibility in Europe.

A better understanding of the consequences of different regulatory choices to enable aggregation of demand response, would in NordREG's view be of benefit for stakeholders and decision makers, such as the European Commission, Member States, ACER and national regulatory authorities.

1.2. Background

In 2015, NordREG was asked by the Nordic ministries to analyse the report "Demand response in the Nordic electricity market"[1], written by Thema Consulting Group. One of the conclusions of that assignment was that is would be useful to analyse different market setups for aggregation of demand response and its consequences. This discussion paper is an attempt to do this.

There is an ongoing discussion regarding the role of aggregators in the electricity market, and lately it has increased in intensity. At least two external drivers can explain the growing attention regarding aggregators:

1. Availability of technological solutions to directly control consumption at lower costs
2. A gradually increased proportion of intermittent renewable energy sources increases flexibility needs, price volatility and thus also the potential benefit of demand response measures

In January 2015, the European Commission (EC)'s Smart Grid Task Force published a report on "Regulatory Recommendations for the Deployment of Flexibility"[2]. This report discussed different barriers for demand response, and possible ways to reduce these barriers. One solution which was described, was that aggregators should be able to act *independently* from the supplier and the supplier's balance responsible party (BRP). Such a solution would lead to what has been termed "independent aggregators". This work was followed up with a new report "Regulatory Recommendations for the Deployment of Flexibility – Refinement of recommendations" [3] in September 2015.

Further, the EC describes in its consultation on a New Market Design[4] an increased need for flexibility to be developed, and touches upon the role of aggregators. A result of this process may be that the EC propose common measures or legislation with the aim at improving Demand Side Flexibility (DSF).

As a response to this overall growing attention, The Agency of Cooperation of Energy Regulators (ACER) proposed 20 July 2015, in its recommendation on "Network Code on Electricity Balancing"[5], an article

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[1] Demand response in the Nordic electricity market, Thema Consulting Group (2014): http://www.nordicenergy.org/wp-content/uploads/2014/10/Demand-response-in-the-Nordic-electricity-market.pdf

[2] Regulatory recommendation for the deployment for the deployment of flexibility, January 2015: https://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Final%20-%20January%202015.pdf

[3] Regulatory Recommendations for the Deployment of Flexibility – Refinement of recommendations, September 2015: http://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Refined%20Recommendations_FINAL_clean.pdf

[4] Consultation of a new energy market design: https://ec.europa.eu/energy/en/consultations/public-consultation-new-energy-market-design

[5] Recommendation no. 03/2015 on the Network Code on Electricity Balancing, 20 July 2015: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Recommendations/ACER%20Recommendation%2003-2015.pdf

which provides two possible models for the role aggregator in the balancing markets. The application of the models would be dependent on the level of retail market competition.

As the Network Code on Electricity Balancing has not yet entered into comitology process or been formally approved, changes to the current draft will most certainly apply. Regardless of possible changes, NordREG considers it useful to discuss some practical implications of the models proposed by ACER. An extract of the proposal by ACER is shown in the following box:

> *Art. 31 INDEPENDENT PROVISION OF DEMAND SIDE RESPONSE (as proposed by ACER)*
>
> *1. Where there are identified substantial entry barriers for providers of Demand Side Response including aggregation facilities or where they cannot compete at a level playing field, the Member State through national legislation or, where applicable, the regulatory authorities through an administrative decision shall:*
>
> *(a) implement adequate measures to mitigate the entry barriers for providers of Demand Side Response including aggregation facilities and ensure they can compete at a level playing field; or*
>
> *(b) enable provision of Demand Side Response independently of energy suppliers*.

The first model in the proposed Article 31, builds on the fact that the role of aggregators and provision of DSF services should be developed within competitive retail markets with low entry barriers, if there is a demand for such services. Such a solution implies that the consumer should have the freedom to choose an integrated service from a supplier who is also acting as an aggregator, allowing the consumer to both buy electricity and to sell its demand response back to the market through its supplier. If the supplier would not offers such demand response services, the consumer would have the choice to switch to a supplier offering these services. A vital element of this model is that it will preserve the framework of one BRP per metering point. Later in this paper, we will illustrate and explain the importance of this.

The second model in the proposed Article 31(1)(b), should be implemented if retail market conditions are not sufficient to develop such services as an option for all electricity consumers. If such a situation occurs, the competent authorities should amend the market rules in order to enable “independent aggregators”. The EC’s Smart Grid Task Force also discussed a similar model in the two above-mentioned reports.

In practice, to enable provision of demand response independently from suppliers would imply the need for new regulatory arrangements. The competent regulatory authorities would need to regulate the split of balance responsibility between two BRPs on each metering point, i.e. the BRP of the supplier and the BRP of the “independent aggregator”. This also implies that the TSO, which is responsible for the imbalance settlement (from hereon called the “settlement function”), would need to adjust the imbalances of the BRP of the supplier corresponding to the actions taken by the BRP of the “independent aggregator”. In addition, it would need to establish a financial transfer mechanisms between the BRP of the supplier and the BRP of the “independent aggregator” to compensate the imbalance of the BRP of the supplier.

This second model has received significant attention within the European fora, illustrated by the two above-mentioned reports and in ACER’s recommendation. NordREG finds it both necessary and useful to describe and discuss the possible consequences of introducing such a regulatory arrangement. We will also discuss the need for such regulatory interventions in a well-functioning retail market, such as the Nordic retail markets.

Proposed changes to the Network Code, 20 July 2015:
http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/ANNEXES_TO_RECOMMENDATION_032015/Annex%20II%20-%20Proposed%20amendments%20to%20the%20Network%20Code.pdf

2. Demand response

DSR plays and will continue to play an important role in the Nordic market. Prerequisites for an efficient use of the flexible resources, including demand response, is that they should be able to compete on a level playing field, and that the most efficient resources are utilised first. The Nordic regulators are therefore continuously working towards improved market functioning.

Before discussing different models to enable demand response, it could be useful to first look into the terminology often used today. The EC's Smart Grid Task Force divides demand response into two main types; implicit and explicit demand response.

2.1. Implicit demand response

"Implicit demand response (also sometimes called "price-based") refers to consumers choosing to be exposed to time-varying electricity prices or time-varying network grid tariffs that reflect the value and cost of electricity and/or transportation in different time periods. Armed with this information, consumers can decide – or automate the decision – to use less electricity at times of high prices and thereby reduce their energy bill. Time variable prices are offered by electricity suppliers or network operators. Examples include time-of-use tariffs, critical peak pricing, and real-time pricing" (EG3 report, September 2015, page 8).

To efficiently enable *implicit demand response,* it is necessary that the electricity consumer is both metered and billed at the same resolution as the price signals. Further, the price signals should in some way reflect the scarcity of either capacity in the grid or in the electricity production. As smart metering is already installed or planned to be installed in the Nordic countries, and as the consumers are free to choose a contract with variable prices from a wide variety of suppliers, NordREG sees in general no regulatory barriers for the development of implicit demand response in the Nordic retail markets. The level of implicit demand response in the market becomes merely a question of cost/benefit for the consumer, i.e. that the level of volatility of the price signals are sufficient to ensure that it is profitable for the consumer to change its consumption pattern as a response to the price signals.

2.2. Explicit demand response

"In explicit demand response schemes (sometimes called "incentive-based") the "freed-up/ shifted" electricity is traded in electricity markets or used for other purposes. Consumers receive specific remuneration to change their consumption upon request (using more or using less), e.g. triggered by activation of balancing energy [...]. " (EG3 report, September 2015, page 9).

A prerequisite to enable *explicit demand response* is, among other things, that the volume of the demand response bid is sufficiently large to meet the different minimum bid size requirement applied in the relevant market. For example, in the Nordic balancing markets, current bid sizes range between 5 MW and 10 MW, depending on the type of market and country. The Nordic TSOs are currently investigating possibilities to reduce these bid minimum sizes. It is also expected that the forthcoming European regulation on Electricity Balancing would set a harmonised European minimum bid size to ensure that demand response could be more easily equipped to meet these standards.

A way for smaller consumers to fulfil these minimum bid sizes, and to reduce the administrative costs of managing the demand response participation, is by aggregating smaller loads into larges loads and providing them to the relevant markets.

3. The Nordic Market

From NordREG's perspective, well-functioning wholesale and retail markets are prerequisites for a successful and cost effective implementation of both implicit and explicit demand response. NordREG

considers the Nordic wholesale market as an example of a well-functioning market[6]. Further, the Nordic retail markets can also be considered well-functioning, as it in general meet criteria such as low entry barriers for suppliers, easy suppliers switching, availability of a wide range of offers and no regulated prices[7].

The following table gives an overview of some fundamentals of the Nordic retail markets. The numbers are based on available statistics, and estimates where statistics are not available.

	Denmark	Finland	Norway	Sweden
Number of residential customers	2.750.000	3.100.000	2.540.000	4.600.000
Number of non-residential customers	487.000	371.000	360.000	700.000
Number of suppliers[8]	51	74	140	123
Yearly supplier switching rate	8.0 %	9.8 %	12,5 %	10,4 %
Smart meter implementation	57 %	95 %	5 %[9]	100 %
Rate of customers with contracts linked to the spot price[10]	9 %	8 %[11]	56 %	47 %[12]
Rate of customers with other variable price contracts	60 %	54 %	39 %	

Though both the Nordic wholesale and retail markets are expected to undergo further efficiency improvements over the coming years, e.g. through the ongoing work to implement data hubs and roll-out of smart meters, NordREG's view is that Nordic markets in general fulfils the prerequisites to enable both implicit and explicit demand response if costumers are interested to offer this. The fundamental prerequisite to enable demand response if that the market prices are sufficient to ensure a positive benefit for the consumer, and that demand response is able to compete with other sources of flexibility, e.g. from generation and storage. As the Nordic markets in general have a high degree of flexible hydro generation, the market prices for flexibility are in general still low compared to other parts of Europe. However in the future the need for more flexible sources may increase. We will therefore continue to analyse in what ways demand side response may be enhanced in the Nordic area.

[6] See e.g. ACER Market Monitoring Report 2014: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Market_Monitoring_Report_2015.pdf

[7] 10 % of Danish end-users have regulated prices until 2017 due to "old supply obligations products". By 2018 there will be no regulated prices in Denmark.

[8] Though there are no regulatory barriers for suppliers to be active in all bidding zones, some suppliers are not active in all bidding zones

[9] In Norway, DSOs are required to install smart meters for all custromers by 2019. Thus, toward 2019, this will gradually increase to 100 %

[10] The way the contracts are linked to the spot price may vary between the contries and the different contracts

[11] In Finland, 8 % of the contracts are hourly prices linked to the day ahead market

[12] For Sweden, there are no accurate statisitics to distiguish contracts linked to the spot price and other variable price contracts. Aggregated numbers are therefore presented

4. Different models for balance responsibility and settlement consequences

In order to evaluate the pros and cons of different models to enable explicit demand response through aggregation, it is necessary to evaluate the consequences for the BRP and the imbalance settlement.

In order to participate in the wholesale market, the market participant need to do this through the role of a Balance Responsible Party (BRP). The BRP is responsible for the balancing of the portfolio of generation and/or consumption, and is required to submit generation and/or consumption schedules to the TSO. Further, the BRP is financially liable for the deviations between the submitted schedules and final position in the imbalance settlement. In practice, if the BRP is "short", it would need to buy energy from the settlement function. If the BRP is "long", it would need to sell energy to the settlement function. As the system would need to be in balance, that is, the sum of "long" and "short" positions would need to be equal, the settlement is a zero-sum game as long as the prices for "long" and "short" positions are similar, when applying a "single pricing system".

In practice, a market participant, e.g. a supplier, can be its own BRP, or it could delegate its balance responsibility to a BRP representing several market participants. Further, in order to keep a correct track of the schedules and the imbalances, it is required that each connection/meter is represented by only one BRP.

In this section, we illustrate four different models where a BRP of a supplier or a BRP of an aggregator sells *upward regulating bids* to the TSO in the balancing market (by reducing consumption). The models do not necessarily represent an exhaustive list of all possible setups, but serve as examples for the purpose of the discussion. The four models apply different solutions for the balance responsibility, and we illustrate the settlement results for the BRP of the supplier and/or the BRP of the aggregator related to each model.

For the purpose of the examples, the following underlying assumptions apply:

- All actions are within one hour and one bidding zone
- The BRP of the supplier procures electricity only in the day ahead (DA) market
- The BRP of the supplier and/or the BRP of the aggregator sells electricity only in the balancing market
- The consumption schedule of the BRP of the supplier is in accordance with what it procured in DA market. Without activation of balancing bids, the final position will then be equal to the consumption schedule
- The clearing price in DA market is 50 €/MWh
- Imbalances are settled based on single pricing, implying that the settlement price for both positive and negative imbalances is equal to the clearing price of the balancing market, in these examples 55 €/MWh
- The system enters into a state of imbalance of -10 MWh which the TSO mitigates by activating an upward regulating bid of 10 MWh

4.1. Model 1 (one BRP – integrated): Supplier and aggregator as one entity

In this model, the BRP of the supplier also acts as an aggregator, implying that it has an agreement with the consumers to reduce the aggregated consumption with 10 MWh compared to the consumption schedule. This implies that there is only one BRP responsibility for the consumers' load and only one BRP of each connection. We call this party, BRP (supplier/aggregator).

This model is in line with the current Nordic market setup.

Scenario in *Model 1 (one BRP – integrated):*

1. The BRP (supplier/aggregator) has procured 10 MWh in the DA market
   ➔ submits a consumption schedule of 10 MWh
2. The BRP (supplier/aggregator) submits a 10 MWh upward regulating bid to the balancing market
3. The TSO buys the 10 MWh upward regulating bid from the BRP (supplier/aggregator)

Financial result of the BRP (supplier/aggregator) in *Model 1 (one BRP – integrated):*

Market	**Volume**	**Price**	**Cost/payment**
Procurement in DA	-10 MWh	50 €/MWh	-500 €
Sale of balancing bid	10 MWh	55 €/MWh	550 €
Settlement position	0 MWh	55 €/MWh	0
Net result			**50 €**

In this example, the BRP (supplier/aggregator) would end up with a net result of 50 € due to the sale of the upward regulating bid to the TSO. Depending on the private agreement between the BRP (supplier/aggregator) and its consumers, the profit may be shared between them.

4.2. Model 2a (two BRPs – without adjustment): "Independent aggregator" and supplier with balance responsibility on same connection point – without adjustment

In this model, we introduce the concept of an "independent aggregator" which also is a BRP. We call this party, BRP (independent aggregator). The BRP (independent aggregator) has an agreement with the consumers of the BRP of the supplier, which we call BRP (supplier), to sell upward regulating bids based on a reduction of the consumers' consumption.

This implies that there are two BRPs active on the same connection point, that is BRP (supplier) and BRP (independent aggregator). In this model, we do not introduce the arrangements of adjusting the BRP (supplier)'s imbalance caused be the actions of the BRP (independent aggregator), nor do we introduce the financial adjustment mechanisms between BRP (supplier) and BRP (independent aggregator), as proposed in the above-mentioned Article 31 and discussed in the paper by the EC's Smart Grid Task Force.

Scenario in *Model 2a (two BRPs - without adjustment)*:

1. The BRP (supplier) has procured 10 MWh in the DA market
   ➔ submits a consumption schedule of 10 MWh
2. The BRP (independent aggregator) has no supply commitment and therefore does not procure any electricity in the DA market
   ➔ submits a consumption schedule of 0 MWh
3. The BRP (independent aggregator) submits a 10 MWh upward regulating bid to the balancing market
4. The TSO buys the 10 MWh upward regulating bid from the BRP (independent aggregator)

Financial result of the BRP (supplier) in *Model 2a (two BRPs – without adjustment)*:

Since the BRP (supplier) had a consumption schedule of 10 MWh, but ended up consuming 0 MWh, the BRP (supplier) would have a positive imbalance of 10 MWh. Further, the BRP (supplier) had already procured 10 MWh in the DA market.

Market	**Volume**	**Price**	**Cost/payment**
Procurement in DA	-10 MWh	50 €/MWh	-500 €
Sale of balancing bid	0 MWh	55 €/MWh	0 €
Settlement position	10 MWh	55 €/MWh	550 €
Net result			**50 €**

The BRP (supplier) would end up with a net result of 50 €, since the positive imbalance of 10 MWh would be remunerated at the single imbalance price of 55 €/MWh. As we can see, this is the same result as in *Model 1 (one BRP – integrated)*, where the BRP (supplier) also acted as the aggregator.

Financial result of the BRP (independent aggregator) in *Model 2a (two BRPs – without adjustment)*:

Since the BRP (independent aggregator) is not active in the DA market, it provided a consumption schedule of 0 MWh. As the TSO procured 10 MWh upward regulation from the BRP (independent aggregator), the BRP (independent aggregator) ended up with an imbalance of - 10 MWh. Further, it would receive payment from the TSO for the 10 MWh upward regulating bid.

The net result of this would be:

Market	**Volume**	**Price**	**Cost/payment**
Procurement in DA	0 MWh	50 €/MWh	0 €
Sale of balancing bid	10 MWh	55 €/MWh	550 €
Settlement position	-10 MWh	55 €/MWh	-550 €
Net result			**0 €**

As we can see, the BRP (independent aggregator) would, in this mode setup, not benefit by selling energy to the TSO in the balancing energy market.

4.3. Model 2b (two BRPs – with adjustment): "Independent aggregator" and a supplier with balance responsibility on same connection point - with adjustment of imbalances and reimbursement of sourcing costs

This example is an illustration of the second solution proposed on the above-mentioned Art. 31, and the model discussed in the papers of EC's Smart Grid Task Force.

Similarly as in the previous example, an "independent aggregator" with balance responsibility, which we call BRP (independent aggregator), has an agreement with the consumers of the supplier. This implies that there are two BRPs active on the same connection point, namely BRP (independent aggregator) and BRP (supplier). In addition to this, we introduce a requirement for the TSO's settlement function to "adjust" the imbalances of both the BRP (supplier) and BRP (independent aggregator), and establish a mechanism for a financial settlement between the BRP (supplier) and the BRP (independent aggregator) at a price which represents the sourcing costs for the BRP (supplier). In this case the sourcing cost of BRP (supplier) is the DA price of 50 €/MWh.

Scenario in Model 2b (two BRPs – with adjustment):

1. The BRP (supplier) has procured 10 MWh in the DA market
   ➔ submits a consumption schedule of 10 MWh
2. The BRP (independent aggregator) has no supply commitment and therefore does not procure any electricity in the DA market
   ➔ submits a consumption schedule of 0 MWh
3. The BRP (independent aggregator) submits a 10 MWh upward regulating bid to the balancing market
4. The TSO buys a 10 MWh upward regulating bid from the BRP (independent aggregator)

Financial result of the BRP (supplier) in *Model 2b (two BRPs – with adjustment)*:

Since the BRP (supplier) had a consumption schedule of 10 MWh, but ended up consuming 0 MWh, it would have a positive imbalance of 10 MWh. However, in line with the described adjustment scheme, the settlement function "adjusts" this positive imbalance from 10 MWh to 0 MWh. In addition, the settlement function would need to establish a financial settlement scheme in which the BRP (independent aggregator) reimburses the BRP (supplier) for its sourcing costs, in this example 50 €/MWh.

Further, the BRP (supplier) had already procured 10 MWh in the DA market.

The net result of this would be:

Market	**Volume**	**Price**	**Cost/payment**
Procurement in DA	-10 MWh	50 €/MWh	-500 €
Sale of balancing bid	0 MWh	55 €/MWh	0 €
(adjusted) settlement position	0 MWh	55 €/MWh	0 €
Reimbursement from aggregator	10 MWh	50 €/MWh	500 €
Net result			**0 €**

As we can see, the net results for the BRP (supplier) would be zero due to the adjustment of imbalances and the reimbursement from the BRP (independent aggregator). Thus, the BRP (supplier) will not be affected by the activation of the bid.

Financial result of the BRP (independent aggregator) in *Model 2b (two BRPs – with adjustment)*:

Since the BRP (independent aggregator) is not active in the DA market, it provided a consumption schedule of 0 MWh. As the TSO procured 10 MWh upward regulation from it, the BRP (independent aggregator) would end up with an imbalance of - 10 MWh. However, in line with the described adjustment scheme, the settlement function "adjusts" this negative imbalance from - 10 MWh to 0 MWh.

In addition to this, the settlement function would need to establish a financial settlement mechanisms in which the BRP (independent aggregator) reimburses the BRP (supplier) for its sourcing costs, in this example 50 €/MWh.

Further, the BRP (independent aggregator) would receive payment from the TSO for the 10 MWh upward bid.

The net result of this would be:

Market	Volume	Price	Cost/payment
Procurement in DA	0 MWh	50 €/MWh	0 €
Sale of balancing bid	10 MWh	55 €/MWh	550 €
(adjusted) settlement position	0 MWh	55 €/MWh	0 €
Reimbursement to supplier	-10 MWh	50 €/MWh	-500 €
Net result			**50 €**

As we can see, the BRP (independent aggregator) would end up with a profit of 50 €, i.e. in the same situation as the BRP (supplier/aggregator) in *Model 1 (one BRP – integrated)* and BRP (supplier) in *Model 2a (two BRPs – without adjustment)*.

In this simplified example, the described adjustment of imbalances and the financial reimbursement, from the BRP (independent aggregator) to the BRP (supplier) would lead to the same result as Model 1 (one BRP – integrated), where the supplier acted as aggregator in an integrated manner.

However, as will be discussed in the next section, such an adjustment and reimbursement would at least have practical limitations when the BRP (independent aggregator) contracts with multiple consumers having different BRPs. Further, as the sourcing costs of the supplier may not solely based on DA market price, it may in practice be challenging or even impossible for the settlement function to know the correct sourcing costs of the supplier to perform a correct financial transfer.

4.4 Model 3 (one BRP – Independent aggregator without balance responsibility) - Independent aggregator without balance responsibility

As a last example, we illustrate the consequences of a model where the "independent aggregator" does not have balance responsibility at all. We call this party Independent Aggregator (not BRP). The reason for presenting this model, is that it has been proposed by some stakeholders.

Since the Independent Aggregator (not BRP) does not have balance responsibility, it is only the supplier who has balance responsibility in this model. As previously, we call this party, BRP (supplier).

Scenario in *Model 3 (one BRP – Independent aggregator without balance responsibility)*:

1. The BRP (supplier) has procured 10 MWh in the DA market
   ➔ submits a consumption schedule of 10 MWh
2. The Independent Aggregator (not BRP) does not have balance responsibility, no supply commitment and therefore does not procure electricity in the DA market
   ➔ Does not submit a consumption schedule to the TSO
3. The Independent Aggregator (not BRP) submits a 10 MWh upward regulating bid to the balancing market
4. The TSO buys a 10 MWh upward regulating bid from the Independent Aggregator (not BRP)

Financial result of the BRP (supplier) in *Model 3 (one BRP – Independent aggregator without balance responsibility)*:

Since the BRP (supplier) had a consumption schedule of 10 MWh, but ended up consuming 0 MWh, the BRP (supplier) would have a positive imbalance of 10 MWh. Further, the BRP (supplier) had already procured 10 MWh in the DA market.

The net result of this in would be:

Market	Volume	Price	Cost/payment
Procurement in DA	-10 MWh	50 €/MWh	-500 €
Sale of balancing bid	0 MWh	55 €/MWh	0 €
Settlement position	10 MWh	55 €/MWh	550 €
Net result			**50 €**

The BRP (supplier) would end up with a net result of 50 €, since it would end up with a positive imbalance of 10 MWh. As we can see, this is the same result as in *Model 1 (one BRP – integrated)*, where the supplier acted as the aggregator.

Financial result of the Independent Aggregator (not BRP) in *Model 3 (one BRP – IA without balance responsibility)*:

Since the Independent Aggregator (not BRP) does not have balance responsibility, it would not have an imbalance or even be settled for imbalances. It would only receive a payment from the TSO for the 10 MWh upward regulating bid. This net result of this would be:

Market	Volume	Price	Cost/payment
Procurement in DA	0 MWh	50 €/MWh	0 €
Sale of balancing bid	10 MWh	55 €/MWh	550 €
Settlement position	0 MWh	55 €/MWh	0 €
Net result			**550 €**

As we can see, since the "independent aggregator" does not have balance responsibility, it would, in this setup, end up with a positive net result of 550 €, i.e. the full costs of the upward regulating bid. These cost are not covered by any other party within the settlement function and will therefore imply a net loss for the settlement function. These losses would somehow need to be covered, either by the grid users through tariffs or by other BRPs in the balance settlement.

5 Discussion on the alternative models

5.1. Model 1 (one BRP – integrated)

This model was the one where the supplier/aggregator acts as one unit towards the TSO and the settlement function, and it keeps the principle of one BRP per connection point. This model is also in line with the current Nordic market setup, and it can be realised in the following ways:

5.1.1. Supplier acts as aggregator

If the supplier and its customers agrees, the suppliers can install technical equipment to control their consumption. By this, the supplier can aggregate a load sufficient to fulfil the TSOs minimum requirements for participation in the balancing market, and thus act as an aggregator.

If the consumers' supplier does not offer such opportunities, the consumers would, in a well-functioning market such as the Nordic ones, have the possibility to switch to another supplier which is offering such services.

Conclusion: NordREG does not see any obvious regulatory barriers for the development of such services from the suppliers in the Nordic area.

5.1.2. Aggregator cooperates with supplier

If the supplier considers that it does not have sufficient competence or resources to offer such aggregation services, while its consumers demands such services, the supplier could decide to contract with an entity specialising in such aggregation services. The supplier and the aggregator would then need to agree on how the profit from the DSF services are shared between the supplier, aggregator and the consumers.

If the supplier is not willing to enter into such a cooperation, the consumers demanding such services could, in a well-functioning market, easily switch to a supplier who is either offering such services or is willing to cooperate with an aggregator.

Conclusion: NordREG does not, in a well-functioning market, see any regulatory barriers for the development of aggregation services based on cooperation between a supplier and an aggregator in a well-functioning retail market.

5.1.3. Aggregator becoming a supplier

If an entity specialised in aggregation services for some reasons does not wish to cooperate with a supplier, this entity have the possibility to instead set up its own supply business and by this offer a combined "package" of supply and demand response services to its customers. In practice this model could differ from the above described *5.1.1 Supplier acts as aggregator.* For instance the aggregator could decide solely to contract only with consumers who wish to offer demand response services. The aggregator would therefore not necessarily need to professionalise in the supplier business.

In general, the entry barriers for this to be realised in the Nordic electricity market can be considered as comparably low. The aggregator would need to procure energy at Nord Pool, be a BRP, and provide the sufficient collateral to Nord Pool and to the settlement function, etc. Fulfilment of such requirements should be expected from a professional market actor and is necessary to order to ensure that risks are properly dealt with.

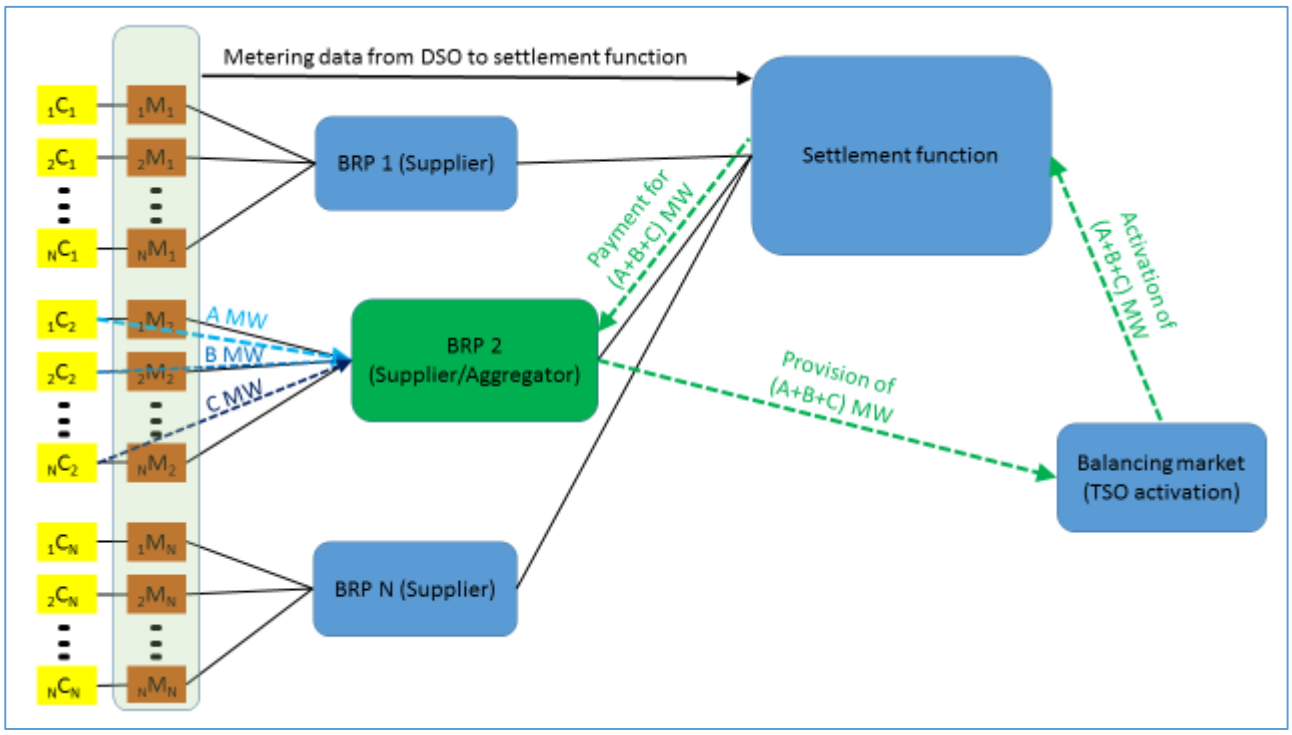
Conclusion: NordREG does not see any unjustified regulatory barriers for the development of such services within the Nordic retail markets, if the aggregator desires to operate on its own.

5.1.4 Illustration of Model 1 (one BRP- integrated)

The figure below illustrates flows of information, energy and financial compensation in *Model 1 (one BRP – integrated)*. The yellow boxes illustrates a number of consumers connected to the electricity system through their meters (brown boxes) operated by a DSO. The DSO distributes the metering data to the settlement function, operated by the TSO. The green box illustrates a supplier who also acts as an aggregator, which has a contact with three consumers to offer demand response on their behalf. The supplier then aggregates this load and provide it as an upward regulating bid to the balancing market. When the bid is activated, the BRP (supplier/aggregator) is remunerated for this energy through the settlement function.

This model is fully compatible with the current Nordic market setup, and there is a complete track of the energy flows through the meters operated by the DSO. Opposed to this, which we will see in section 5.3, this will not necessarily be the case for *Model 2b (two BRPs – with adjustment)*.

Figure no. 1: Illustration of the information and settlement flows within Model 1 (one BRP – integrated)



Conclusion: This model provides a correct track of energy flows through the DSO-operated meters, ensures a correct imbalance settlement, and is fully compatible with current market arrangements in the Nordic market.

5.2. Model 2a (two BRPs – without adjustment)

As shown by calculations of the of the settlement results in section 4.2, this type of model is not likely to be developed within a competitive market since it would not lead to any profit for the aggregator. We will therefore not discuss this model further.

Conclusion: This is not a viable model to be developed within a competitive market.

5.3 Model 2b (two BRPs – with adjustment)

As explained in the introductory chapters, this is the model discussed in the papers by the EC's Smart Grid Task Force, and also proposed as an option in Art 31(1)(b) in ACER's recommendation on the Network Code on Electricity Balancing.

The idea of the model is to allow aggregators to act independently of the suppliers if there exist extensive barriers for the development of aggregations services. This could especially be relevant in retail markets where there is a limited amount of suppliers offering aggregation services (as described in section 5.1.1), a limited amount suppliers willing to enter in cooperation with aggregators (as described in section 5.1.2) or where the regulatory barriers for aggregators to become a supplier are high (as in section 5.1.3). Reasons for this to be the case, may e.g. be due to the existence of regulated prices which the consumer may lose if it switches to another supplier, or if it in general are other high barriers for suppliers to enter the market. The existence of regulated prices may also in itself be a barrier for suppliers to enter the market.

The model implies that there will be two BRPs active on the same connection point. Further, the model relies on at least two measures taken by the settlement function in order to ensure that the BRP (supplier) is not financially disadvantaged by actions taken by the BRP (independent aggregator). Firstly, the position of the BRP (supplier) would need to be adjusted corresponding to the volume of activated demand

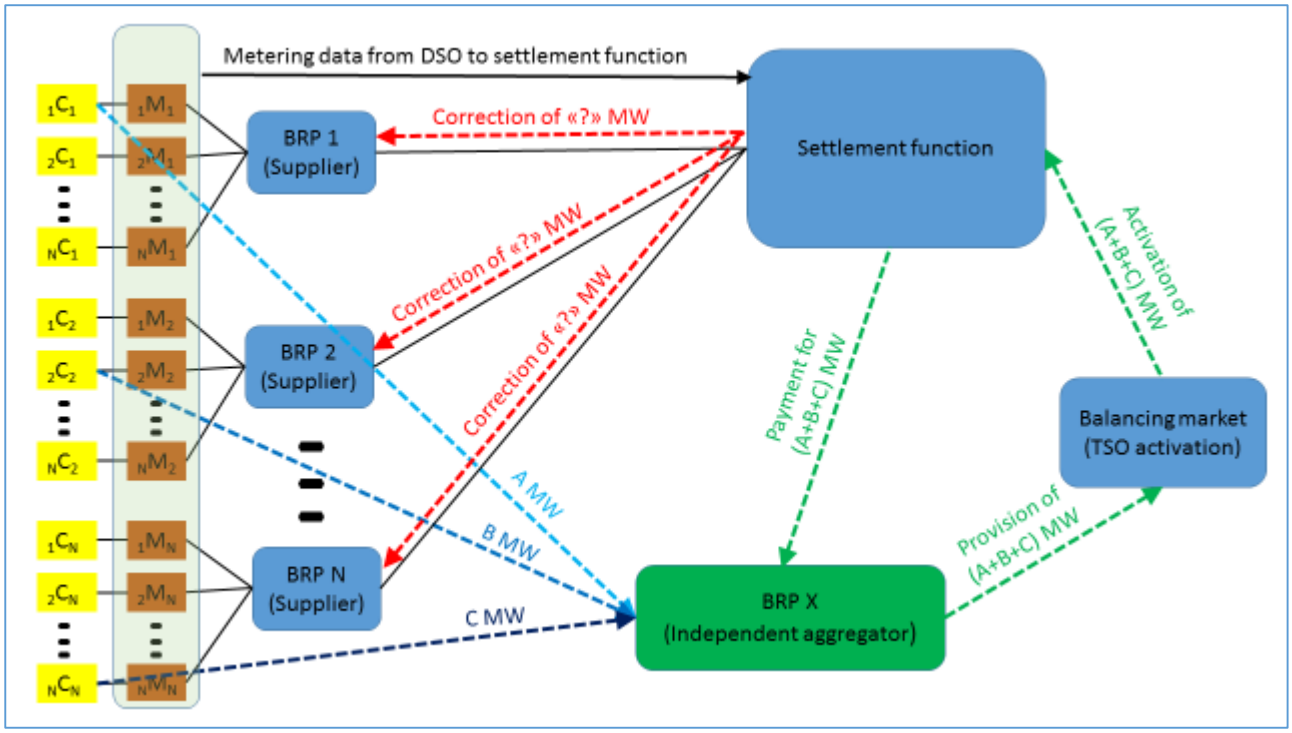
response by the BRP (independent aggregator). Secondly, a financial reimbursement would need to go from the BRP (independent aggregator) to the BRP (supplier), covering the BRP (supplier)'s sourcing costs. A simplified example of this settlement was illustrated in section 4.3.

Below we discuss these two adjustment measures in more detail, and show that there in practice may be challenging or impossible to implement this in a correct and neutral way.

5.3.1. Adjustment of the BRP (supplier)'s position

The figure below illustrates the challenge of adjusting the BRP (supplier)'s imbalances if a balancing energy bid is activated from a BRP (independent aggregator) who has contacted with consumers having different suppliers and BRPs.

Figure no. 2: Illustration of the information and settlement flows within Model 2b (two BRPs – with adjustment)



As illustrated by the figure, the settlement function will only have information regarding the total aggregated volumes activated by the TSO (illustrated by the green dotted lines) and not which part of the aggregated volume belonging to the different consumers (illustrated by the various blue dotted lines), as these consumers all have different suppliers and BRPs. As the settlement function relies on official metering data provided by the DSOs, which are assigned to the consumers' BRPs, it seems to our knowledge not possible for the settlement function to separate and correctly assign the origination of the aggregated volumes to the BRPs it belongs.

One could argue that it may be possible for the BRP (independent aggregator) to provide such information separately to the TSO on its own initiative, but it would be a question whether such "privately provided" metering data from one BRP could be used in an official financial settlement between two "competing" market actors

The complexity of adjusting the imbalance of the supplier's BRPs will increase the more independent aggregators one will have, and the more the "independent aggregator" contract with different consumers having different BRPs.

One possible solution to this issue, may be that the provision of demand response bids from the "independent aggregator" would need to be split and separated by the different supplier-BRPs, in order for the settlement function to be able to keep track of the adjustment of the imbalances of the different BRPs. But even if this is done, it would most likely be challenging for the settlement function to validate if the demand response bid in reality is split between the different suppliers, as the settlement function would to our understanding have no system or means to validate this.

Conclusion: In NordREG's view, it seems challenging to ensure a correct adjustment of the different BRP's imbalances, as the settlement function would not be able to separate the origination of the aggregated volumes. One mitigating measure may be to require the independent aggregator to split and separate the demand response bids according to which supplier's BRP the demand response originates. Even if this separation is done, it seems challenging for the settlement function to validate if the bids are correctly split between the different supplier's BRPs.

We recognise that the intention with Model 2b is to create a more competitive environment for aggregation of demand response, by allowing "independent aggregators" to challenge the usual business of traditional suppliers. Though this may especially be relevant in markets with limited retail market competition, we would recommend that regulators first and foremost assess the existence of market failures and regulatory barriers, and undertake measure to remove those market failures and barriers. Obvious examples of such market barriers are regulated end-user prices and barriers to become a BRP or to start a supply business.

5.3.2 Financial compensation from the independent aggregator to the supplier based on sourcing costs

As the reimbursement of costs from the BRP (independent aggregator) to the BRP (supplier) would need to be based on the sourcing costs of the supplier, in order to ensure a correct financial compensation, the settlement function would need to have correct information of these costs. In the simplified example in section 4.3 it was easy to identify the sourcing costs, as it was simply the DA price.

In practice though, suppliers may have different strategies on how to source its energy. Some suppliers may procure all its energy in the DA market, other may be more active in the ID market, while some source its energy through bilateral agreements. It therefore seems challenging or maybe even impossible for the settlement function to identify the correct sourcing cost for each supplier in order to ensure a correct financial reimbursement of the costs the "independent aggregator" impose on the suppliers.

One solution to this problem may be that the regulators would need to define a regulated price at which the reimbursement should be based on. But this regulated price may in practice not correctly represent the suppliers sourcing costs, and would lead to a regulatory regime where costs and benefits are arbitrarily distributed between two market parties, i.e. the supplier and the "independent aggregator". NordREG would in general have strong reservations towards the regulation of prices between two private market actors.

Conclusion: In NordREGs' view, Model 2b (two BRPs – with adjustment) does not seem to ensure a correct financial reimbursement between the market participants, i.e. the BRP of the supplier and the BRP of the "independent aggregator". Further, Model 2b (two BRPs – with adjustment) would in practice imply the introduction of a regulated of a price component, to ensure a solution which could be realised by the market in Model 1 (one BRP – integrated). Thus, this model is not aligned with the NordREG's target of applying market solutions where possible.

5.3.3 Administrative complexity of the adjustment scheme

Disregarding the weaknesses and practical challenges illustrated in section 5.3.1 and 5.3.2, the introduction of *Model 2b (two BRPs – with adjustment)* would most likely be administratively costly and complex. In

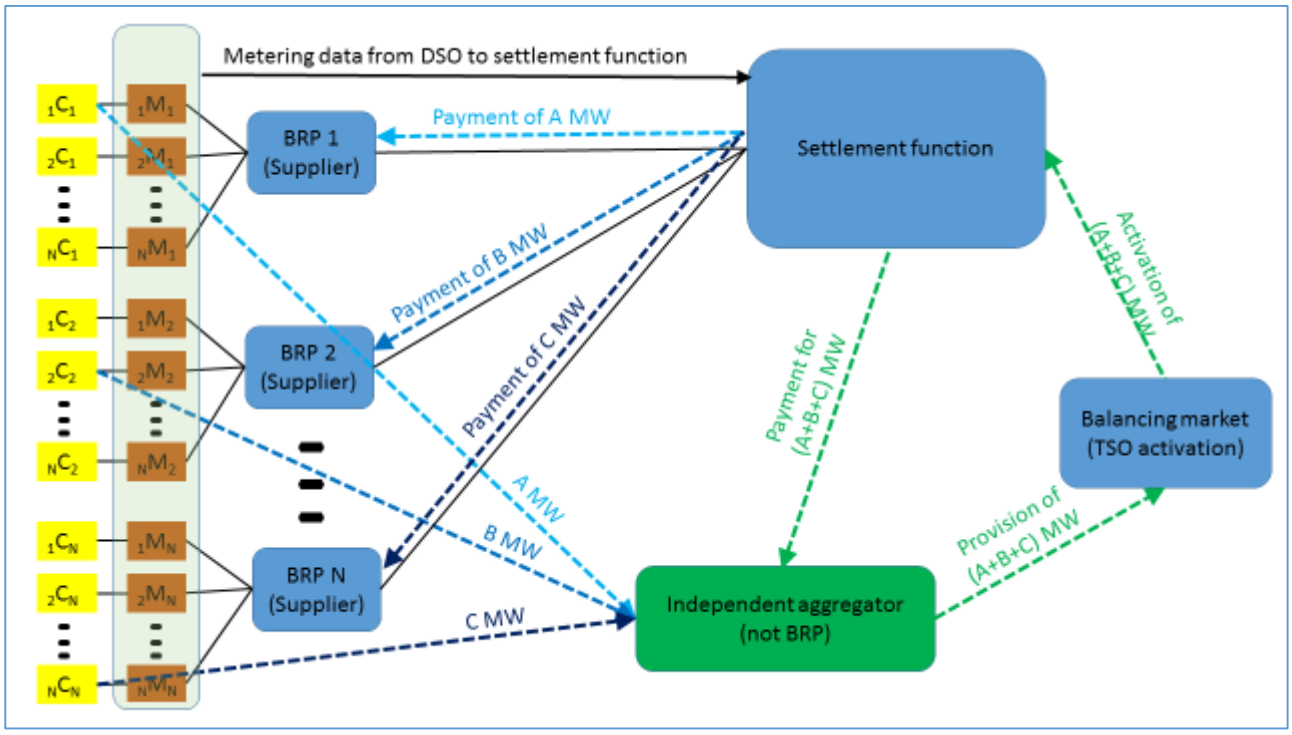
general, NordREG questions the advantages of setting up such a complex a scheme if solutions that are more efficient could be realised within a competitive and well-functioning retail market.

Conclusion: NordREG questions the efficiency of introducing a complex and most likely costly adjustment scheme.

5.4. Model 3 (one BRP – independent aggregator without balance responsibility)

As described in section 4.4, this model has been proposed by some stakeholders. The model would not require the "independent aggregator" to have balance responsibility at all, and could in principle entail low entry barriers for the "independent aggregator".

Figure no. 3: Illustration of information and settlement flows within Model 3 (one BRP – independent aggregator without balance responsibility)



Regardless of the apparent low barriers, NordREG would have principal reservations against this model since it causes unjustified costs for third parties since the "independent aggregator" would not be financial liable for its imbalances. Thus, when the "independent aggregator" receives the full monetary value of the balancing energy bid, this would be at the expense of other market participants. Further, it would deviate from the fundamental principles behind a single pricing settlement scheme, where the costs of activated balancing energy bids are covered by the BRPs who are causing the imbalances.

As an example, consider an annual system imbalance of 1 TWh, and an average balancing energy price of 55 €/MWh. If these imbalances were to be handled by the activation of balancing energy bids from such an "independent aggregator" without balance responsibility, a total cost of € 55 million would not be accounted for in the settlement function. Depending on the regulatory setup, these costs may need to be covered by e.g. grid users through the network tariffs or by other BRPs through fees in the settlement scheme. It could hardly be justified that these third parties should be reliable the costs related to such a "free-riding" of an aggregator without balance responsibility As both Nordic and European regulation[13]

[13] E. g. EC 714/2009, Preamble 16: "The precondition for effective competition in the internal market in electricity is non-discriminatory and transparent charges for network use including interconnecting lines in the transmission system." See also Article 14.

requires tariffs to be non-discriminatory and transparent, one must also consider whether this model at all could be in line with the current regulation.

Conclusion: NordREG would not promote this model as it is based on "free-riding" of one market participant, which is an independent aggregator without balance responsibility, as it causes unjustified costs for other market participants.

6. Conclusion

In NordREG's view, a well-functioning and competitive retail market should be able to bring forward demand response through aggregation, if consumers are willing to change its consumption pattern and if the value of doing so is sufficient to cover the consumer's costs.

Within a well-functioning market, aggregation of demand response seems, in our view, to be most efficiently enabled within a framework of one BRP per connection point, as the described *Model 1 (on BRP – integrated)*. In this model, the suppliers/aggregators acts as one BRP and competes by offering the best "package" of supply- and aggregation services to its customers. Those suppliers/aggregators who does not offer such services to consumers demanding this, or does not offer sufficiently competitive solutions, would most likely lose its consumers to another supplier/aggregator. NordREG is confident, that in a competitive and well-functioning market, the dynamics of competition should be able to bring innovation and cost-efficient solutions over time.

If it the retail markets are not sufficiently well-functioning to deliver the choice of demand response services for the consumers, regulators should, in our view, asses the existence of market failure and consider the possibility to remove or reduce potential barriers. First and foremost, regulated prices should be removed in order to ensure that all suppliers can compete at a level playing field. Further, one should assess whether there are unjustified barriers to enter the market, such as the requirements to become a BRP or to start a supply business. As a general task, one should also investigate the barriers for provision of explicit demand response, e.g. minimum bid size requirements, requirements for locational information, reporting format, etc.

In this paper we have, from a Nordic perspective, discussed some consequences of three different models for "independent aggregators" with relation to the balance responsibility and the settlement. As shown, the illustrated Model 2a (two BRPs – without correction), is not viable as a model for "independent aggregators" since the "independent aggregator" would not earn any profit. Further, both Model 2b (two BRPs – with adjustments) and *Model 3 (one BRP – independent aggregator without balance responsibility)* have some inherent drawbacks compared to *Model 1 (one BRP – integrated*), which may not be possible to solve. For example, if more than one BRP per connection should be allowed, as in *Model 2b (two BRPs – with adjustment),* it would require a split and separation of the balance responsibility and a need to set up a compensating financial transfer mechanism. We have difficulties seeing how such a model could ensure a fair and correct distribution of costs and benefits between the market parties, and it would also require regulatory interventions such as regulation of the price to compensate the supplier. As was shown in *Model 3 (one BRP – independent aggregator without balance responsibility)*, this model would entail a free-riding of the "independent aggregator", leading to costs which would need to be covered by other market parties or grid users.

As the maturity of the different European retail markets differs, we recognise that one solution for DSR may not be fit for all retail markets. We therefore acknowledge that some member states or regulators are considering compensating measures or interventions, such as models for "independent aggregators". Though regulatory interventions *may* be a tool for less well-functioning markets, NordREG generally believes the priority should be to improve market functioning, before market interventions are considered.

At last, we underline the importance of leaving the decision to intervene in the market to the competent national authorities after having conducted thorough impact assessments. This is built on the fact that one solution may not be fit for all markets, as their maturity may differ. When it comes to the role of aggregators, we believe that the most efficient setup for the Nordic markets may be that aggregation services is developed by retail market competition though one integrated unit which has balance responsibility. That being said, we as Nordic regulators, will continue to analyse how demand side flexibility may be improved in the Nordic market.

Annex – Other relevant work from NordREG

NordREG is an organisation for the Nordic energy regulators. Our mission is to actively promote legal and institutional framework and conditions necessary for developing the Nordic and European electricity markets.

To find out more about NordREG and NordREG's work, please visit NordREG's website http://www.nordicenergyregulators.org/

There you can find publications such as:

Publications 2015

- Main developments and trends 2014
- Dataset NMR
- Mapping of TSOs and DSOs role and responsibilities
- THEMA Report 2015-02: Mapping of TSO and DSO responsibilities related to information exchange
- THEMA Report 2015-03: Framework for DR and MP
- NordREG Work Programme 2015.

Publications 2014

- NordREG Work Programme 2014
- Common Nordic Metering Methods
- Framework for a harmonized model for moving
- BRS-Report
- Covernote-on-BRS-report
- Continuation of technical work after BRS
- Nordic Market Report 2014
- NordREG status report to EMG on the Nordic End-User Project
- NordREGs_work_towards_a_harmonised_Nordic_retail_market
- Strategy for a harmonised Nordic retail market
- Position paper on competition between PXs within bidding zones
- NordREG Market_Entry_Barriers_Public Draft
- VaasaETT Report Market Entry Barriers
- Summary of public consultation

Publications 2013

- NorgREG status report to EMG
- NordREG Road Map
- NordREG recommendations on implementation of combined billing
- Nordic Market report 2013
- Future model for switching
- NordREG recommendations on transparency
- Gaia Payment requirements with combined billing
- Nordic harmonisation of universal service supply obligations
- NordREG Work Programme 2013
- Economic regulation of TSOs in the Nordic countries
- NordREG-memo: EIP-workshop