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AGGREGATORS
GAP ANALYSIS OF BIH LEGAL AND REGULATORY
FRAMEWORK

AGGREGATORS GAP ANALYSIS OF BIH LEGAL AND REGULATORY FRAMEWORK

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COR: Ankica Gavrilovic

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CONTENT

Abbreviations.....	4
1. Introduction	6
2. General issues	8
3. Technical Requirements.....	16
4. Commercial Requirements	24
5. Prequalification	38
6. Planning and activation of the flexibility services	44
7. Validation, quantification and payment of flexibility services	48
8. Transparency and data disclosure	54
Annex 1 - Directive (EU) 2019/944 Requirements	57
Annex 2 - Aggregator implementation models	59
Annex 3 - Literature	65

Abbreviations

aFRR	Automatic Frequency Restoration Reserve
AGC	Automatic Generation Control
AGR	Aggregator
ARP	Allocation Responsible Party (ISOBiH)
ASP	Ancillary Service Provider (see also BSP)
BiH	Bosnia and Herzegovina
BRP	Balance Responsible Party
BRP _{AGR}	Balance Responsible Party (aggregator)
BRP _{EXT}	Balance Responsible Party (external)
BRP _{SUP}	Balance Responsible Party (supplier)
BSP	Balancing Service Provider (see also ASP)
CAPEX	Capital Expenditures
D	Current day
DSO	Distribution System Operator
EES	Power System
EIC	Energy Identification Codes
EMS	Energy Management System
ENTSO-E	European Network of Transmission System Operators for Electricity
EPA	Energy Policy Activity
EU	European Union
FCR	Frequency Containment Reserve
FRR	Frequency Restoration Reserve (could be automatic FRR (aFRR – secondary reserve) or manual FRR (mFRR – tertiary reserve))
GCT	Gate Closure Time
H	Current hour
h	Hour
HV	High voltage
IEC	International Electrotechnical Commission
ISOBiH	Independent System Operator in BiH
ISP	Imbalance Settlement Period
IT	Information Technology

KM	Convertible Mark
M	Current month
MW	Megawatt
OPEX	Operational expenses
SCADA	Supervisory Control and Data Acquisition
SERC	State Electricity Regulatory Commission
SOGL	System Operations Guidelines (guidelines for transmission system operation)
SUP	Supplier
TSO	Transmission System Operator
USAID	U.S. Agency for International Development
USEF	Universal Smart Energy Framework
VPN	Virtual Private Network
VPP	Virtual power plant
Y	Current year

I. Introduction

Aggregators represent a new category of electricity market participants, which aggregate distributed energy resources (distributed generation, controllable loads, electricity storage devices), which independently or through a balance responsible party enters the electricity market and ancillary services market.

The emergence of aggregators in the electricity market is relatively recent and is the result of a significant increase in the proportionate share of the renewable energy sources to total electricity consumption and an increase in the need for flexible resources in the power system. Aggregators bundle distributed energy resources (e.g., distributed generation, controllable loads and electricity storage devices, which are collectively referred to as a “virtual power plant”). “Both regulators and industry bodies agree demand-side response will be a vital part of future sustainable energy systems and that aggregators are necessary to make this possible. Also, it is generally accepted that regulation is requirement to secure Aggregators’ sustainable market access.”¹

The concept of aggregators is included in the EU’s “Clean Energy Package”² and the provisions of the recent Directive (EU) 2019/944, dated June 5, 2019,³ on common rules for the internal market in electricity (an excerpt from the Directive is presented in the Annex I). Flexibility services in a given context are considered to be the management of the generation/consumption of distributed energy resources with the aim of providing services for the purposes of power system balancing, network management and portfolio optimization.

The regulatory framework in Bosnia and Herzegovina does not explicitly provide for the possibility of aggregating distributed energy resources for participation in the wholesale and ancillary services market. In this regard, Bosnia and Herzegovina does not lag significantly behind the other Energy Community (EnC) Treaty signatories and most European Union countries, as in most of these countries projects involving aggregation of distributed energy resources and demand side management are at the level of research pilot projects. Significant development of the markets for distributed energy resources aggregation services has occurred in Germany, England, Norway and several other countries with developed electricity markets. To date, legislation in the field of aggregation is not standardized and harmonized at the EU level.

The primary goal of this gap analysis of the BiH regulatory framework is to review all important aspects for enabling the aggregation of distributed energy resources, the regulation of which will enable the level playing field for aggregators to participate in the electricity and ancillary services markets. The level playing field for the aggregators’ market participation means non-discriminatory treatment in relation to conventional market participants in terms of participation rights and conditions, rules for the activation of contracted services and the valuation of delivered capacity and energy.

This document lists and discusses the relevant provisions of applicable regulations in BiH, primarily the Market Rules, related Procedures for Ancillary Services and the BiH Grid Code, according to the relevance of specific provisions in relation to the reviewed aspects of the required nondiscriminatory treatment of aggregators. Regardless of the lack of an EU standard regulatory framework for the integration of aggregators, Annex 2 provides the additional explanations on the different aggregator

¹ De Heer, Hans, and van der Laan, Marten, [Universal Smart Energy Framework \(USEF\), USEF: Workstream on Aggregator Implementation Models, Version 2.0., Update September 2017, p. 3.](#)

² https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en.

³ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944>.

implementation models in the European Union, and Annex 3 provides references to the individual research projects aimed at defining options or standardized solutions for certain aspects of integration.

2. General issues

The implementation of the aggregator concept inevitably leads to the increase of complexity in the power system operation, the degree of which depends on the selected concept and implementation model. The increase in the complexity is particularly reflected in the following areas:

- Planning of generation/consumption and flexibility services⁴,
- Measurement and validation of performed flexibility services,
- Occurrence of the "rebound" effect (subsequent change in consumption as a result of the activation of flexibility services),
- Data exchange between participants in the flexibility services market,
- Energy transfer and settlement between aggregators and suppliers, and
- Quantification of imbalances during the period of flexibility services activation and during the "rebound" effect occurrence.

Depending on the selected implementation concept, the role of the aggregator can be performed either by suppliers who purchase electricity from distributed generators and/or supply end customers, or by independent aggregators that are not involved in the activities of generation and/or purchase/supply of electricity, but perform the aggregation activities only.

The concept of an independent aggregator requires significant changes of not only the regulatory framework, but also of business processes in the wholesale and ancillary services markets in which the aggregators participate.

It is important to emphasize that the formalization of the role of an independent aggregator that has the right to aggregate flexibility services from individual distributed energy resources, represents one of the key elements of the EU "clean energy package." In that sense, Article 13 of EU Directive 2019/944 addresses aggregation contracts, prescribing the right of all customers to conclude an aggregation contract with an electricity undertaking of their choice without the consent of their electricity supplier, while Article 17 prescribes the right of entry to the electricity markets for each market participant engaged in aggregation, including independent aggregators.

An indicative overview of commercial and contractual relations in the flexibility services market, when the independent aggregator concept is implemented, is shown in Figure 1:

⁴ Flexibility services are services provided by aggregators through the management of the generation/consumption of distributed energy resources for the purposes of power system balancing, network management and portfolio optimization.

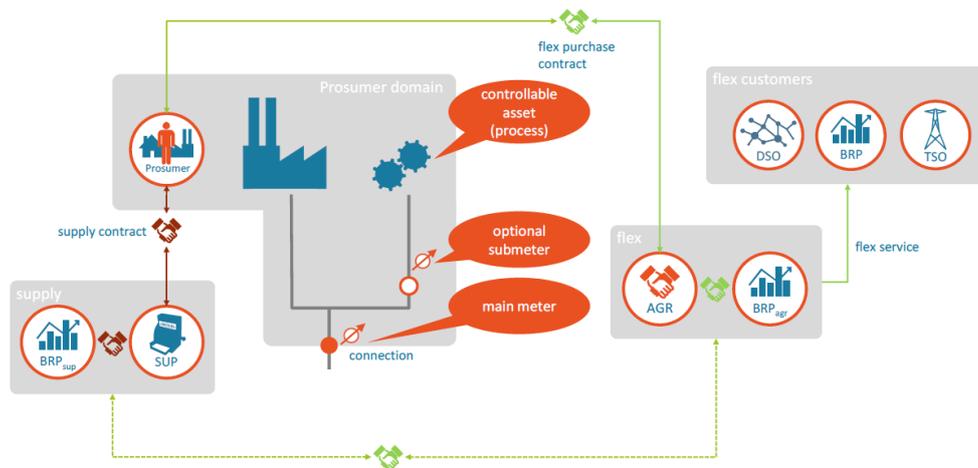


Figure 1 Commercial and contractual relationships in the flexibility services market Source: USEF⁵

This chapter analyzes the general issues for defining the term aggregator, enabling the participation of aggregators in the wholesale market and ancillary services market, selection of concepts and aggregator implementation models, roles and tasks of aggregators, balancing responsibility, and contractual relations with the other market participants related to the provision of flexibility services.

The selection of an aggregator implementation model and the regulation of contractual relations are both relevant to the concept of an independent aggregator. The specifics of the individual models are reflected through the tasks and competences of market participants, the method of determining an aggregator's balancing responsibility, the organization of energy transfer between aggregators and suppliers, and the imbalance settlement. Different aggregator implementation models are feasible in practice, depending on how the following issues are determined:

- Whether the aggregator and supplier are integrated,
- Whether the aggregator must independently regulate its balancing responsibility (independently of the supplier's balancing responsible party - BRP_{sup}),
- Whether the aggregator must have a contractual relationship with the supplier's BRP, and
- How the energy is transferred in models in which the aggregator independently regulates the balancing responsibility.

These issues are explained in more detail in Annex 2.

The analysis of the general aspects of legal and regulatory framework related to the establishment and market participation of aggregators is given the following table.

⁵ *Op. cit.*, fn. 1, p. 13.

Issue	BiH Regulations and Comments and recommendations
General definition of the term aggregator	<p>BiH REGULATIONS Regulations in BiH do not contain a definition of the term aggregator.</p> <p>COMMENTS AND RECOMMENDATIONS The term aggregator should be explicitly defined and consistently applied in the relevant primary (entity and state laws in BiH) and secondary legislation. An aggregator is a service provider that aggregates a number of generators, loads and energy storage devices with the aim of joint participation in the electricity and ancillary services markets. Aggregation is a commercial function of joint management of electricity generation and consumption of a number of aggregated units with the aim of electricity trading and provision of reserve capacity and flexibility services to electricity market participants.</p>
General definition of the term flexibility	<p>BiH REGULATIONS Regulations in BiH do not contain a definition of flexibility.</p> <p>COMMENTS AND RECOMMENDATIONS The definition of flexibility needs to be precisely defined and applied consistently through the legal and regulatory framework. Viewed from the perspective of a service provider, flexibility is a change in the electricity generation and/or consumption at the individual or aggregated level due to the reaction to an external price signal or with the aim of providing services in the power system. Viewed from a power system perspective, flexibility can be defined as the ability of an energy entity to respond to a request from a relevant system operator to change the power output in order to meet the needs of the power system.</p>
Recognition of Aggregators as entities in the energy sector	<p>BiH REGULATIONS Primary legislation in BiH does not recognize aggregators.</p> <p>COMMENTS AND RECOMMENDATIONS The primary legislation of the entities and at the BiH level should provide for and elaborate on the status of aggregators in the BiH power sector (in all Articles where necessary, and by adding provisions to the existing Articles),. The primary legislation needs to specify whether the independent aggregator concept is feasible.</p>
TSO and DSO activities related to aggregators	<p>BiH REGULATIONS Not defined by primary legislation.</p> <p>COMMENTS AND RECOMMENDATIONS The roles and tasks of the TSO and particularly the DSO in relation to aggregators should be defined.</p>

Issue	BiH Regulations and Comments and recommendations
<p>The right of participation of aggregators in the wholesale and ancillary services markets</p>	<p>BiH REGULATIONS</p> <p>BiH Market Rules⁶</p> <p>Article 4 Definitions</p> <p>The definition of "market participant" is "holder of a valid license for generation, supply, or trading of electricity."</p> <p>Article 8 Participants at the wholesale market</p> <p>A Wholesale Electricity Market Participant (hereinafter "a Market Participant") has at least one license that is related to electricity generation, trade and supply in BiH and is issued by the Regulatory Commission in BiH.</p> <p>Ancillary Services procedures</p> <p>4.1.1 Registration of facilities for the provision of ancillary tertiary regulation services</p> <p>The request for registration of a facility for the provision of ancillary tertiary regulation services may be submitted to the ISOBiH by other entities (generators and consumers) wishing to register their facilities for the provision of ancillary tertiary regulation services.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The existing regulations in BiH do not allow the participation of aggregator entities in the electricity market, since the participation in the electricity market is tailored to the needs of conventional market participants and is conditioned by the possession of a license for electricity generation, supply or trade.</p> <p>The primary legislation and market rules need to explicitly define the right of aggregators to participate in the wholesale and ancillary services markets on the level playing field with conventional market participants. This means, according to the existing definitions, that changes in legislation should also enable aggregators to obtain licenses to perform some of the activities in the electricity sector that would qualify them to be participants in the electricity and ancillary services markets.</p>
<p>Aggregator concept</p>	<p>BiH REGULATIONS</p> <p>The issue is not covered by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The role of an aggregator can be performed either by suppliers or balancing responsible parties of aggregated units, either by the entities that provide flexibility services and act together with the supplier, or by the entities that act independently of the supplier (independent aggregators).</p>

⁶ ISO BiH Market Rules, <https://www.nosbih.ba/files/dokumenti/Legislativa/Trzisna%20pravila/EN/Market%20Rules%202015%20-%20Translated.pdf>

Issue	BiH Regulations and Comments and recommendations
	<p>The rules should specify that activities of an independent aggregator are allowed, defining an entity that is active exclusively in the field of flexibility services and does not participate in the supply/purchase of electricity. However, the implementation of the independent aggregator concept does not exclude the right of an electricity supplier to participate in the provision of flexibility services.</p> <p>A prerequisite for the sustainability of the independent aggregator concept is the satisfactory quality of baseline planning. Without fulfilment of this precondition, flexibility services can be provided exclusively within the integrated aggregator model, in which the supplier is only authorized to provide flexibility services.</p> <p>Facilitating the participation of an independent aggregator in the electricity and ancillary services markets is a complex process that requires resolving a set of issues regarding the energy transfer between the aggregator and the supplier, impact on the supplier's balancing responsible party, transfer of balancing responsibilities during the service's activation period, data exchange in the process of service's activation, data confidentiality and protection of competition.</p>
<p>Registration of aggregators as market participants</p>	<p>BiH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 9 Registration of Market Participants</p> <p>In order to achieve the right to participate in the market, the Market Participant shall be obliged to register with the ISOBiH. The registration procedure shall comprise the following activities:</p> <ol style="list-style-type: none"> 1. The Market Participant shall submit a request to obtain an EIC X Code, a unique identification code of a Market Participant which is... 2. The Market Participant shall submit to the ISOBiH: <p>...</p> <ol style="list-style-type: none"> b) A list of all injection and withdrawal points in the electricity transmission network in BiH, c) Data on the Balancing Group (BG) it belongs to and data on the authorized Balance Responsible Party in a filled-out BG form, d) Data on a method for daily schedules delivery (through BRP or independently). <p>COMMENTS AND RECOMMENDATIONS</p> <p>The existing concept of the registration of market participants is customized for the registration of conventional market participants and is not applicable for the registration of aggregators.</p> <p>In that sense, the rules for registering aggregators as market participants should be adjusted, particularly with regard to the submission of the list of electricity delivering points, since an independent aggregator and supplier can both hold balancing responsibility for the same delivery points in the same time period.</p> <p>Furthermore, the rules for the aggregator's access to the market (independently/through suppliers/through BRPs) should be prescribed.</p> <p>The above-stated issues are much more complex when the balancing market is considered, as compared to the wholesale electricity market. However, the complete existing legal and regulatory framework for the balancing mechanism and the electricity and ancillary services markets will need to be amended to incorporate the aggregator model.</p>
<p>Licensing of aggregators</p>	<p>BiH REGULATIONS</p> <p>The issue is not covered by BiH regulations.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The rationale for aggregator’s licensing should be considered, especially in terms of the potential for market abuse and necessity for additional protection of the customer’s rights, which would justify the licensing of aggregators by the competent regulator.</p> <p>In this regard, it is important to note that inadequate licensing can pose a barrier to the development of aggregators’ markets and services at an early stage. As an alternative, there is the possibility of prescribing an accreditation process for an aggregator, which is equivalent to licensing.</p>
<p>Aggregator implementation model</p>	<p>BiH REGULATIONS</p> <p>The issue is not covered by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The application of appropriate aggregator implementation models, depending on the type of flexibility services,⁷ need to be prescribed, taking into account the selected concept of aggregators.</p> <p>An integrated aggregator model is a model in which the role of aggregator is performed by the supplier. This model is in principle always available, since any supplier can perform aggregation with the aim of participating in the wholesale market.</p> <p>The models that are applicable when the concept of an independent aggregator is allowed, are:</p> <ul style="list-style-type: none"> • Broker model - suitable for encouraging the participation of independent aggregators, as it does not require a contractual relationship between the aggregators and suppliers, where communication and billing is performed through a central agent. • Contracting model - in principle, a market-preferred model, where entities (aggregator, supplier and balancing responsible parties) regulate the market participation of the aggregated resources by concluding mutual agreements. The risk of applying this model is reflected in the right of suppliers to prevent the participation of distributed energy resources in the balancing market by refusing to conclude contracts or by demanding an excessively high price for transferred energy. • Model without correction - a model suitable for products that include capacity payments only or if the volume of activated energy and the impact on other market participants are negligible, e.g., Frequency Containment Reserve (FCR) services or capacity payment mechanisms). • Model with correction - not suitable for the residential sector and other low-capacity service providers, since the quantification of delivered flexibility services is performed through the correction of consumption/generation that is registered on the metering devices of the individual service providers. • Central Settlement Model - a model in which the aggregator acts through its own balance responsible party, while the TSO is in charge of correcting the supplier’s balancing perimeter and energy transfer by applying a predefined formula for price determination. • Net benefit model - a model similar to the central settlement model, with the difference being that the costs of compensation of the supplier’s balancing responsible party are not covered by the aggregator, but they are partially or fully socialized. <p>Different models can be applied to different services; however, the total number of models should be limited to avoid overly complex and excessive implementation costs. Aggregator implementation models are presented in more detail in Annex 2.</p>
<p>Aggregator’s roles and tasks</p>	<p>BiH REGULATIONS</p> <p>The issue is not covered by BiH regulations.</p>

⁷ USEF, Op. cit., fn. 1.

Issue	BiH Regulations and Comments and recommendations
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The roles and tasks of the aggregator depend on the selected implementation model. Roles and tasks must be specified precisely and clearly, especially in circumstances when a single entity can have several roles in the electricity market.</p> <p>For the selected aggregator implementation model, the roles and tasks of other market participants (TSO, DSO, suppliers) that are related to the integration of aggregators and the participation of distributed energy resources in the market, should be defined as well.</p>
<p>Balancing responsibility of aggregator</p>	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by the BiH regulations, the general provisions on the balancing responsibility of market participants are contained in the Market Rules.</p> <p>BiH Market Rules</p> <p>Article 13 Structural change of a balance group</p> <p>4. Structural change of a Balance Group, i.e., change of BRP, shall be applied from the first day of M month as for the requests, i.e., BG forms submitted to the ISOBiH by the 10th day of M-1 month. The requests for change of BRPs submitted to the ISOBiH in BG forms after the tenth day of month M-1 shall start to apply on the first day of M+1 month.</p> <p>Article 22 Balance Responsibility of BRP</p> <p>1. Balance responsibility of BRP means that it shall undertake financial responsibility for the imbalance of the Balance Group it represents.</p> <p>...</p> <p>3. Balance responsibility of BRP in respect of the ISOBiH shall be regulated by the Agreement on Balance responsibility which can be found on the ISOBiH web page.</p> <p>Article 23 Agreement on balance responsibility</p> <p>1. The Agreement on balance responsibility shall, among other things, define a method of payment between the ISOBiH and BRP for the imbalance of a Balance group, payment security instrument, conditions for activation, validity period and the conditions for a change of payment security instrument.</p> <p>...</p> <p>3. In case no electricity generation or final consumers supply are planned within the Balance Group, the BRP shall not be obliged to issue a bank guarantee.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The balancing responsibility of the aggregator should be defined, whereas existing rules should be reassessed with regard to the permitted periodicity of changing the balance responsible party and its impact on the aggregator's operational flexibility.</p> <p>The right of an aggregator to contract for balance responsibility with a balance responsible party that is not the balance responsible party of the buyer/supplier of electricity should be specified. If permitted, it would enable the so-called dual BRP model; otherwise the aggregator must provide its services within the perimeter of the balance responsible party with which the supplier associates.</p> <p>Depending on the selected implementation model, the duration of the balancing responsibility of the independent aggregator should be prescribed. Its duration should be limited to the period of services activation.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>The rules relevant to the aggregator's balancing responsibility during the period of services activation should be clear regarding the aggregator's balance responsibility during the sub periods of power change and during the "rebound" effect. The rules should therefore define whether the "Ramp up" and "Ramp down" periods are contained or not within the activation period. The rules should be consistently applied to all types of services.</p> <p>The concept of balancing responsibility must avoid situations in which there may be either simultaneous overlapping of balancing responsibility of different subjects on the same distributed energy resource for the same part of the load diagram or undefined balancing responsibility for a certain delivery point or during a certain period of time.</p>
<p>Contractual relations in the market</p>	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>For the selected aggregator implementation model, the contractual relations of the aggregator with the flexibility services providing the customer/generator its own balance responsible party, the supplier of the customer/generator and the balance responsible party of the supplier, should be prescribed.</p> <p>The contracting rules related to the aggregation of distributed energy resources, should also state that a the supplier does not have the right to prevent the provision of flexibility services and the conclusion of contracts between the service providing customer/generator and the independent aggregator. However, it must be specified whether the supplier has the right to change the supply contract conditions due to the provision of flexibility services by the customer/generator (i.e., to be reimbursed by the customer for the rebound effect,⁸ the impact on the cost of sourcing electricity). Under the given conditions, the supply contract adjustments can be performed either in advance (at the conclusion of the contract, regardless of the subsequent provision of flexibility services), either at the time of concluding the contract on the provision of flexibility services or subsequently after a defined period of time. The aggregator should in principle have an obligation to inform the supplier on how it manages and minimizes the "rebound" effect within the group of service providers.</p> <p>The rights and conditions under which the service providing customer/generator terminates the contract with the aggregator should also be defined. Contractual relationships should be unambiguous and simple, reflecting the relevant costs and risks to the parties. The development of standard contract templates that would be binding for market participants should be envisaged, thus facilitating contracting and the regulatory monitoring.</p>
<p>Recovery of DSO costs related to aggregators</p>	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The right of the DSOs to recover increased capital and operating costs that are result of new roles and tasks in relation to the aggregator model implementation (e.g., supervision and management, increase of "users visibility" in the distribution network, metering data management, IT and telecom systems), should be prescribed by the primary legislation and the respective tariff methodologies.</p>

Table I General Issues

⁸ The rebound effect represents a side effect caused by the activation of flexibility, which is registered as the power deviation from the scheduled consumption/generation outside the flexibility activation period

3. Technical Requirements

The technical requirements given in this chapter relate primarily to the provision of flexibility services for TSO needs as part of a developed market, in which the TSO as a regulated company may be a customer of flexibility services. Technical requirements for flexibility service providers for the DSO's needs might be defined as an integral part of the DSO's SCADA system requirements, applying the principles set out in this chapter.

Technical requirements for aggregators are related to the control center and telecommunication systems for communication by aggregators with the control centers of flexibility customers, along with communication protocols, measurements of generated/consumed electricity, and a real-time data exchange between the control center of flexibility customers, the aggregator's control center and individual service providers. The fulfilment of technical requirements is subject to verification during the prequalification process.

The standardization of technical solutions, especially in the areas relating to the application of communication protocols and interfaces in the individual service providers' facilities, facilitates the interoperability of different vendors' systems and eliminates the risk of restricting competition.

An example of the general design of an aggregator/virtual power plant, particularly addressing the application of communication protocols in communication to the individual service providers and participants in the electricity and ancillary services markets is given in Figure 2.

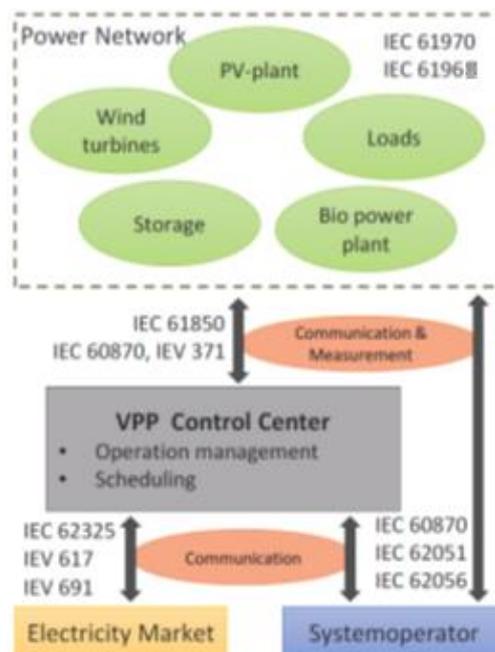


Figure 2 Virtual Power Plant – Communication scheme general design⁹

A particular aspect of the technical requirements given in this chapter refers to the measurement of flexibility. The standard practice for flexibility measurement is to install separate sub-metering devices

⁹ Richter, Andre & Hauer, Ines & Wolter, Martin. (2018), "Algorithms for Technical Integration of Virtual Power Plants into German System Operation," Advances in Science, Technology and Engineering Systems Journal 3, pp. 135-147, January 2018, <https://www.researchgate.net/publication/323899993>.

for flexible controllable assets. The sub-metering device should be used as a basis for the settlement of flexibility services, energy transfer and calculation of imbalances of all relevant market participants.

The technical requirements considered in this chapter are generally applicable, regardless of the adopted aggregator concept and the selected implementation model.

The BiH Grid Code, Chapter 5.6. Telecommunications and SCADA, contains general requirements for telecommunications and remote monitoring and control systems, which are applicable to users connected to the transmission network. These chapters do not specifically provide for the requirements for aggregated resources.

Issue	BiH Regulations and Comments and recommendations
Aggregator architecture	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS The general principles of an aggregator’s architecture should be defined, depending on the selected aggregator implementation model, specific technical solutions for IT and telecommunication systems, metering systems and real-time measurements and monitoring.</p>
Redundancy of the aggregator control center	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS Requirements for redundancy of the aggregator’s control center (location, hardware and software, communication, auxiliary power supply) may be prescribed, depending on the installed capacity of the aggregated portfolio and the marketed volume of the reserve capacity. Redundancy with regard to the physical dislocation of control centers may, as a rule, be required from the service providers whose reserve capacity exceeds several tens of MWs. Under the given conditions, the TSO should be responsible for setting the requirements for the speed of switchover from the main to the reserve control center. The requirements for the telecommunication system should additionally take into account the conditions and manner of establishing communication links when the establishment of a physically dislocated redundant control centers of an aggregator is required. Redundancy of communication links to the TSO control center requires a completely redundant design without multiple usage of any device or cable routes.</p>
General requirements of IT and Telecom systems	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS The general requirements of IT and telecommunication systems relate to the availability, protection against unauthorized access, integrity, reliability, authentication of persons and devices in communication ("authenticity") and the inability to deny receipt of the message ("non-repudiation") and data transfer speed in the communication between Service Providing Unit, the Aggregator Control Center and TSO Control Center. The general requirements also include requirements for protection against unauthorized access to the premises, systems and network infrastructure that are necessary for the provision of ancillary services within the aggregator.</p>
Technical requirements for interface in the service unit/group facility	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS Standardization of the interfaces through which the connection is established between the service providing a unit/group with the control center of the aggregator, facilitates the interoperability regarding the communication protocols and eliminates the risk of restricting competition due to the service providers' specific technological solutions.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>The achieved degree of standardization at the level of relevant international standardization bodies should be analyzed, and depending on the achieved level, the basic technical requirements should be prescribed for the interoperability of the interface by which an individual service providing facility is integrated into the aggregator system.</p>
<p>Telecommunication requirements Aggregator Control Center - TSO Control Center</p>	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS Requirements for communication links between the TSO control center and the aggregator control center should ensure reliable and secure communication. The TSO should set the minimum availability requirements for the telecommunication links between the control centers of the aggregator and the TSO, requirements regarding the speed of the telecommunication systems troubleshooting, as well as requirements regarding the information exchange and elimination of consequences for when the security of telecommunication systems is compromised and violated.</p>
<p>Requirements for the telecommunication system within the aggregator</p>	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS Requirements for the separation of the communication system within the aggregator (system of individual service providers and control center of the aggregator) from other user networks (e.g., internet, communication network of other providers) should be prescribed by using the closed user groups, which can include only individual service providers and an aggregator control center. Communication within the group should be done solely for the purpose of providing flexibility services. Any communication with the external systems, including the public internet network, should be prohibited. Individual service providers should not be able to communicate with each other. The obligations regarding the "end-to-end" traffic encryption within the aggregator should be stipulated, also prescribing specific requirements and standards for encryption. Specific requirements should be prescribed for the availability of telecommunication links for the communication from the service providing units/groups to the control center of the aggregator (95% as standard).</p>
<p>Communication protocols</p>	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS Requirements for communication protocols on the route TSO control center to the aggregator control center should be prescribed, whereas these protocols are applied for the exchange of data, measurements and control signals. Communication protocols for communication between regulated flexibility customers (TSO and DSO) and the aggregator should be prescribed as mandatory (application of standard communication protocols, e.g., IEC 101 or IEC 104), while communication protocols for communication between the unregulated market participants should be standardized.</p>
<p>Special telecommunication</p>	<p>BiH REGULATIONS The issue is not explicitly addressed by BiH regulations.</p>

Issue	BiH Regulations and Comments and recommendations
requirements for small installed power service providers	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Specific requirements and exemptions from the general rules may be allowed for the aggregation of low capacity service providers (e.g., up to 25kW), over the public internet network by applying the encrypted VPN traffic, with a limitation of the total installed capacity of grouped units (e.g., up to 2 MW). Under these conditions, additional requirements should be prescribed for the establishment of telecom links between the aggregated group and the aggregator control center.</p>
Special requirements for external IT service providers	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Information on external procurement of IT services must be explicitly stated in the pre-qualification documentation. The flexibility customer (TSO or DSO) has the right to demand stricter conditions for the IT systems protection in the given circumstances.</p> <p>The aggregator should be responsible for the security of IT system regardless of the manner of providing these services.</p>
IT and telecom information exchange	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The following requirements should be prescribed: the exchange of data and information between the system operator and the aggregator, relating to the concept and characteristics of IT and telecommunication systems, IT security and availability, changes affecting network security, information on security incidents, data transmission problems, faults and the time required for troubleshooting.</p> <p>The system operator should be allowed to amend the IT and telecommunication requirements, which would be binding for aggregators and service providers. The manner of publishing and informing service providers should be defined as well.</p> <p>The documentation by which the aggregator proves compliance with the IT and telecommunication requirements during the prequalification procedure should be defined (e.g., submission of a detailed IT and telecommunication concept, checklist with IT requirements with a description of the applied encryption).</p>
Energy measurements	<p>BiH REGULATIONS</p> <p>Regulations in BiH (network rules, general conditions for electricity supply, rules on connection) define the technical requirements to be met by energy metering devices at the point of connection of users to the transmission or distribution network.</p> <p>BiH Grid Code</p> <p>Chapter 8.2.2.</p> <p>Each metering point must have the possibility of registration and remote reading of active and reactive power every fifteen (15) minutes, and peak power.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>When flexibility services are not provided at the facility level (on the main energy metering device), an obligation to install an additional sub-metering device on an individual generator/load that provides flexibility services should be defined.</p> <p>In order to reduce the total cost of aggregator integration, an analysis needs to be performed of the possibility of applying alternative meters built into the device itself (e.g., inside inverters, electric vehicle chargers) for the purpose of flexibility services measurement. The exception to the obligation of installing a</p>

Issue	BiH Regulations and Comments and recommendations
	<p>sub-metering device refers to the FCR frequency regulation services, when, as a rule, the transfer and settlement of activated energy between the aggregator and the supplier is not performed.</p> <p>The installation of a sub-metering device enables the quantification of the performed flexibility services and creates preconditions for the monitoring of individual flexibility services providers.</p> <p>The obligation to install an interval metering device that is remotely monitored and controlled should be included in the regulation for these purposes, as a precondition for participation in the flexibility services market. The metering interval must correspond to the settlement period in the balancing market.</p> <p>The frequency of meter reading should be prescribed depending on the applied periodicity of the imbalance calculation and settlement. At the request of the network user, metering data can be submitted at shorter intervals, whereas it is necessary to prescribe whether the costs should be directly transferred to the user or socialized to all network users.</p> <p>Back-up generators within the consumer facilities, which are providers of flexibility services, should have a separate sub-metering device installed in relation to other loads within the facility.</p> <p>The additional competences of the DSO in terms of installation, maintenance and reading of additional metering devices within the service provider's facility should be determined, thus enabling the implementation of the aforementioned obligations. The rules and obligations regarding the procurement and installation costs of additional metering equipment should be defined.</p>
<p>Real-time measurement and statuses</p>	<p>BiH REGULATIONS</p> <p>BiH Grid Code</p> <p>Chapter 5.6.2.</p> <p>(1) Elektroprijenos BiH and users shall be obliged to ensure appropriate metering installations and reliable communication so as to provide that the requested data in real time are continuously entered into the data base of the authorized managing centers.</p> <p>(2) The ISOBiH monitors and manages the work of EES BiH in real time. Real time data shall be directly sent to the ISOBiH's SCADA/EMS equipment and to SCADA equipment at Elektroprijenos BiH through remote terminals from HV plants regardless of ownership. Collection of data from Users' undertakings shall be done directly through Users SCADA/EMS equipment or through the SCADA equipment of the authorized managing center to the ISOBiH SCADA/EMS equipment and to SCADA equipment at Elektroprijenos BiH; and Elektroprijenos BiH and the Users shall ensure a regular, timely and reliable method of transfer of all data required.</p> <p>(3) The following type of data are collected in real time:</p> <ul style="list-style-type: none"> - Measurements (active and reactive power, voltage, frequency); - Signalization of switching devices (switchers, disconnectors, grounding units); - Positions of tap changers for power transformers of interest; - Alarm signals used for protective and managing equipment; - Wind speed and direction, pressure and temperature at Energy park locations - Other data, as appropriate. <p>(4) The User shall be obliged to ensure technical possibility for remote control of HV switching devices which serve for electricity transfer.</p> <p>(5) Type of data and their exchange method in real time shall be defined by the Management Agreement.</p> <p>Ancillary services procedures</p>

Issue	BiH Regulations and Comments and recommendations
	<p>3.2 Ancillary service of secondary regulation</p> <p>Secondary regulation service providers are obliged to automatically submit real-time information on the upper and lower generation limits of MEGAUNIT to the SCADA / EMS system in the ISOBiH. The difference between the upper and lower generation limits represents twice the value of the available secondary regulation range (positive and negative regulation range).</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Procedures for ancillary services of the ISOBiH prescribe requirements for data submission for providers of secondary regulation services on the transmission network, which, according to the ISOBiH, act as one entity - MEGAUNIT¹⁰.</p> <p>Requirements related to aggregators are not explicitly addressed by regulations in BiH.</p> <p>Technical requirements for the real-time measurements and monitoring system between the aggregator and the system operator as a flexibility customer should be prescribed. An integral part of these requirements refers to the periodicity of updating and time resolution of stationary ("offline") and "online" data which are exchanged between the service providing units/groups, aggregator and flexibility customer.</p> <p>The flexibility customer (TSO or DSO) should prescribe a list of signals and measurements in real time that an individual service provider delivers to the aggregator, a list of signals and measurements that the aggregator delivers to the flexibility customer, and a list of signals that the flexibility customer delivers to the aggregator through the SCADA system.</p> <p>The flexibility customer should also prescribe the minimum threshold of installed capacity of the service providing units/groups for which the establishment of a real-time measurements and monitoring system is mandatory at the individual level.</p> <p>Establishing real-time measurements and monitoring of individual service providers is within the responsibilities of the aggregator. In order to reduce the total cost of aggregators' integration, the application of alternative technical solutions should be considered for the establishment of real-time measurements and monitoring systems within the aggregator, especially for units/groups which have small installed capacity. This group of service providers might be allowed to provide measurements and signals at an appropriate level of aggregation that is equivalent to the basic telemetry requirements.</p> <p>For the providers of frequency regulation ancillary services, the aFRR active power setpoint signal is typically the only signal delivered from the TSO control center to the aggregator control center.</p> <p>For communication purposes with the aggregator control center, the service providing units/groups should be allocated by portfolios (pools) established for each type of service. The single aggregator might have several portfolios, the number of which corresponds to the number of services offered in the market. Reallocation of service providing units/groups between different portfolios should be allowed only at the end of the imbalance settlement period (ISP), with the exception when a failure occurs in one of the units/groups.</p>
<p>Activation of real-time measurements and data exchange</p>	<p>BiH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Real time data communication between the aggregator and TSO control center in principle should be performed only during the engagement period, as well as during the one settlement period (ISP) that precedes and follows the engagement period. The same requirements regarding the duration of communication</p>

¹⁰ The term MEGAUNIT is applied to denote "bundled service providers" that provide services at the portfolio level

Issue	BiH Regulations and Comments and recommendations
	also apply to stationary data, which should be recorded, archived and delivered to TSOs only during these time intervals. In the case of larger aggregators this communication should be continuous and in line with the corresponding requirements for the conventional or RES power plants.
Accuracy of frequency measurement	<p>BiH REGULATIONS BiH Grid Code Chapter 5.8.1.1, paragraph (8) Accuracy of frequency measurements must be 10 mHz or better.</p> <p>COMMENTS AND RECOMMENDATIONS Frequency measurement at the FCR service providers should be decentralized, with a minimum requirement that includes one measuring device per one connection point (which can have several service providing units/groups). In case of lowering the installed capacity threshold for FCR frequency regulation service providers, which would include also the facilities connected to the distribution voltage levels, the requirements for the accuracy of frequency measurement in these facilities (required accuracy of 10 mHz according to the System Operation Guidelines (SOGL) Annex) should be prescribed .</p>

Table 2 Technical requirements

4. Commercial Requirements

In general, the regulatory framework should allow the removal of unnecessary commercial barriers to aggregators' participation in the wholesale and ancillary services markets in a way that promotes and protects the rights and interests of aggregators, but without negative effects on the other market participants and power system security.

Commercial requirements refer to the type and characteristics of products on the ancillary services market, the manner and period of services procurement, the price formation methodology of ancillary services, and the method of calculating the remuneration for delivered services.

The subject of the analysis in this chapter are commercial requirements for products on the balancing market and the congestion management market in the transmission and distribution networks, which are within the competences of the regulated entities – transmission system operators and distribution system operators. The products on the wholesale electricity market are not the subject of this analysis, since they represent a deregulated segment in which the conditions of procurement and sale of flexibility services are contracted on market principles.

Commercial aspects are primarily considered in terms of the possibility of meeting the existing requirements by aggregated market participants, product standardization, creation of a more flexible legal framework for the ancillary services market that allows bidding in shorter time periods, and reviewing the flexibility services settlement methodology in order to reduce the risk and promote market participation of aggregators.

For illustration purposes, Figure 3 provides a graphic representation of the characteristics of a standard product in the ancillary services market.

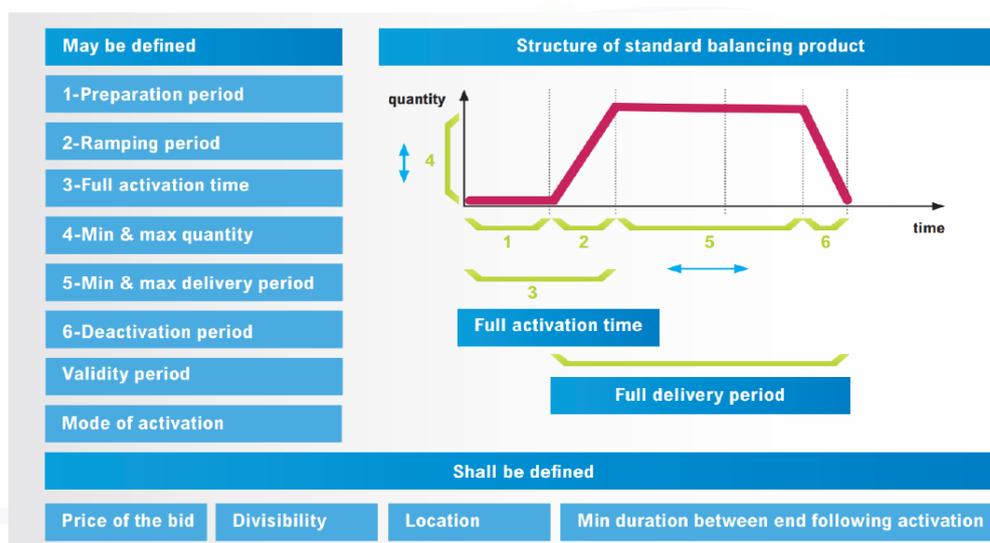


Figure 3 Standard product characteristics

Source: ENTSO-E¹¹

The commercial aspects considered in this chapter are generally applicable, regardless of the adopted aggregator concept and the selected implementation model.

¹¹ ENTSO-E, 'An Overview of the European Balancing Market and Electricity Balancing Guideline', November, 2018, p. 8, https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Network%20codes%20documents/NC%20EB/entso-e_balancing_in%20_europe_report_Nov2018_web.pdf.

Issue	BiH Regulations and Comments and recommendations
Types of products in the ancillary services market	<p>BIH REGULATIONS BiH Market Rules</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Regulations in BiH define the standard products on the balancing market, while products related to the congestion management services are not standardized. Market rules in BiH stipulate that ISO BiH may activate ancillary services and also use balancing energy for congestion management purposes within the BiH regulation area.</p> <p>The products accessible to aggregators on the ancillary services market should be tailored to enable their market participation, taking into account that existing rules do not explicitly prescribe which of the defined products can be provided by aggregators.</p>
Products characteristics	<p>BIH REGULATIONS BiH Market Rules</p> <p>Article 29. Primary regulation</p> <p>ASPs whose structures are obliged, according to the Grid Code, to provide ancillary service of primary regulation shall do that at their own expense and without any compensations.</p> <p>Rules on daily balancing energy market operations</p> <p>Article 9. Delivery of bids in intra-day activities</p> <p>Mandatory bids – Minimum duration of tertiary regulation engagement is 1 hour.</p> <p>Total daily duration of tertiary regulation engagement of one mandatory bid is up to at most 8 hours, in a single activation or a few of them.</p> <p>The time period between engagements of one bid is 2 hours.</p> <p>Voluntary bids – The minimum duration of tertiary regulation engagement is 30 minutes.</p> <p>Ancillary services procedures</p> <p>Secondary regulation - Quantities are integer power values expressed in MW. Tertiary regulation - Power is an integer value in MW. The ISOBiH gives instructions to the ASP at least 15 minutes before the moment of engagement.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Market rules, Procedures for ancillary services and the Rulebook on daily balancing energy market contain basic requirements that define the types and characteristics of products on the ancillary services market in BiH.</p> <p>The characteristics of products in the ancillary services market (e.g., minimum bid threshold, bid step, power gradient, time granularity notification time, minimum duration of activated service, frequency of activation, time between successive activations) should be analyzed regarding both their compliance with the requirements of the EU guidelines and network rules, and the existence of barriers to the market participation of aggregators.</p> <p>The characteristics of products in the balancing market directly determine the pre-qualification requirements for market participants. The harmonization of these products at a wider regional level removes one of the barriers to the market participation of aggregators, given that under these conditions the aggregators have no obligation to adapt to individual national markets.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>Changes of specific products on the ancillary services market should be implemented, if necessary to meet the system operator needs and to remove barriers for the market participation of aggregators. Particular attention should be paid to compliance with the standard products according to the EU Network Codes. The market product's modification must not impair the overall efficiency and functioning of the balancing market.</p> <p>The necessity of time-differentiation of the ancillary services market products should be considered (e.g., during the day, week or month). The possibility of offering the products during a limited time interval should be considered as well.</p> <p>The required response and delivery times for the provision of frequency regulation ancillary services are defined by the relevant EU Grid Code, which stipulates that the service providing unit/group must reach the set power value within 30 seconds for FCR, 5 minutes for aFRR and 15 minutes for mFRR service.</p>
<p>Voluntary (non-contracted) bids for energy in the ancillary services market</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 32. Daily Balancing Energy Market for Tertiary Control</p> <ol style="list-style-type: none"> 1. The ISOBiH shall use the daily balancing energy market for tertiary control in order to maintain the balance in the BiH Control Area. 2. The ASP, which contracted the provision of tertiary control reserve capacity, shall be obliged to submit one bid for the balancing energy for tertiary control per each Agreement on tertiary control capacity. ASPs may submit their bids in the daily balancing energy market notwithstanding the lack of contracted capacities. Bids shall be submitted separately for upward and downward tertiary control. 6. Detailed information relating to the functioning of the daily balancing energy market for tertiary control shall be provided in Balancing Market Operation Rules. <p>Rules on daily balancing energy market operations</p> <p>Article 2. The right to participate in the daily balancing energy market</p> <p>The following have the right to participate in the daily balance energy market:</p> <ul style="list-style-type: none"> • ASPs with facilities registered to provide ancillary secondary regulation services, in accordance with the Ancillary Services Procedures and the capacity allocation agreement, • ASPs with facilities registered to provide ancillary upward / downward tertiary regulation services, in accordance with the Ancillary Services Procedures, with or without a capacity reservation contract. <p>Article 7. Voluntary bids</p> <ol style="list-style-type: none"> 1. Voluntary bids are submitted for upward/downward tertiary balancing energy in accordance with abilities of the market participants. Voluntary bids may be shareable, non-shareable and combined. <p>The providing unit from which the bid is procured must be specified when submitting non-shareable and combined voluntary bids, and voluntary shareable bids may be submitted as portfolio.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Non-contracted energy bids on the BiH ancillary services market are allowed for tertiary regulation services.</p> <p>The possibility of introducing the non-contracted balancing energy bids for the aFRR frequency regulation services should be considered in order to increase balancing market liquidity. The introduction of non-contracted bids and shortening the gate closure times for their trading, beside the effects on increasing the liquidity of the ancillary services market, also encourages the participation of aggregators through the reduction of risks which are related to the quality of planning and availability of resources in the long-term FRR reserve capacity markets.</p>
<p>Asymmetric products in the ancillary services market</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 31. Tertiary regulation</p> <p>3. The scope of required tertiary reserve capacity shall be determined on a monthly basis and separately for the scopes of required upward and downward reserve capacities in accordance to the rules of the Grid Code and taking into consideration the existing arrangements for the joint reserve in the SHB control block¹² and other arrangements at the ENTSO-E level.</p> <p>Rules on daily balancing energy market operations</p> <p>Article 4. Bids for secondary reserve</p> <p>3. The bids for secondary regulation imply a symmetrical range of upward and downward regulation.</p> <p>Ancillary services procedures</p> <p>4.1 Procurement of tertiary regulation</p> <p>... In particular, the tertiary reserve capacity for upward and downward regulation is being procured.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Asymmetric products on the ancillary services market in BiH are currently allowed for tertiary regulation services.</p> <p>Generally speaking, the existence of asymmetric products in the balancing services market facilitates the participation of aggregated sources, especially distributed generators that are using variable renewable energy sources. In that sense, the introduction of the asymmetric ranges of reserve capacity and balancing energy for aFRR frequency regulation services should be considered, taking into account the technical capabilities of the ISOBiH.</p>

¹² Serbia (S) - Croatia (H) – Bosnia and Herzegovine (B) SHB control block

Availability of the products**BIH REGULATIONS****Rules on daily balancing energy market operations****Article 6. Mandatory bids**

Submission of mandatory bids for delivery of a contracted amount of tertiary reserve is the responsibility of ASPs which concluded a contract on procurement of upward or downward tertiary reserve with the ISOBiH.

Mandatory bids for upward/downward tertiary regulation are shareable, which means that the ISOBiH may activate a part of the bid. With mandatory bids it is obligatory to define the unit providing the specific service.

Ancillary services procedures**3.3.3 Penalties in case of unfulfilled obligations**

The amount of the penalty for unfulfilled capacity obligations shall be determined depending on the type of unfulfillment:

1. If the ASP within an hour has failed to provide qualitative supply of secondary regulation, the penalty shall be calculated in relation to the nominated reserve. The quality of provided secondary regulation service of the BSP within an hour shall be calculated by the rules under 3.3.3.1.
2. If the ASP has failed to nominate the contracted reserve in nomination process for the next day, the penalty amount shall be determined in relation to the non-nominated reserve.
3. If the ASP, by submitting a statement, has informed the ISOBiH on its inability to provide the contracted secondary reserve, the penalty amount shall be calculated for the reserve indicated in the statement.

If the ASP has failed to provide the nominated reserve in real time, the penalty shall be calculated for the difference between the nominated and actually delivered secondary reserve.

COMMENTS AND RECOMMENDATIONS

Market rules, Ancillary services procedures and the Rules on daily balancing energy market operations contain basic requirements regarding the availability of products and the methodology of determining penalties for unavailability, methodology of calculating the remuneration of service providers depending on the achieved level of availability. One hour is a prescribed time interval for determining availability, non-availability penalties and remuneration of the service provider.

An analysis should be performed to determine whether the availability requirements prescribed for conventional service providers are adequate for aggregated service providers. If necessary, the availability requirements should be adjusted to enable the participation of aggregators, without impairing the system security and functioning of the ancillary services system in BiH.

Availability requirements should, among other things, prescribe the methodology for determining the realized availability during the standstill period that follows the activation of services (observed in terms of whether the reduction of available capacity during this period affects the calculated availability coefficient).

In order to provide reserve capacity services, the aggregator should have the right to replace a service-providing unit in case of its failure, whereas the reserve capacity might be provided internally within the pool or externally by procurement from a third party.

The communication and information exchange rules should be prescribed for communication between the aggregator and the flexibility customer in case of failure of one of the service-providing units. The replacement unit engagement rules should be defined as well.

The right of the flexibility customer (TSO) to prohibit participation in the balancing market of service providers who repeatedly fail to execute flexibility customer orders for unjustified reasons, should be considered.

Issue	BiH Regulations and Comments and recommendations
<p>Ancillary services procurement method</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 30. Secondary regulation The ISOBiH shall procure secondary control reserve capacity through the public purchase procedure.</p> <p>Article 31. Tertiary regulation The ISOBiH shall carry out the procedure of public procurement of upward tertiary reserve capacity and downward tertiary reserve capacity.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Regulations in BiH oblige the Transmission System Operator to conduct public procurement procedures on the ancillary services market. The public tender procedures are applied for the procurement of the secondary and tertiary control reserve capacity. The balancing energy for secondary and tertiary control is provided by the ASPs who have contracted reserve capacity through the previously mentioned tender procedures. The tertiary control daily market is of particular interest for aggregators, since the registered ASPs that have not sold and contracted their reserve capacity (and received remuneration for reserve capacity), can also offer balancing energy on a daily basis if they have surpluses.</p>
<p>Ancillary services procurement time schedule</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 30. Secondary regulation</p> <p>4. The procedure to purchase secondary control reserve capacity shall be carried out on an annual basis, at the end of the current year for the next 12 months of the next year. If an annual public procurement procedure has not provided the required secondary control capacity for any month, the missing quantities of secondary control capacity shall be purchased through a monthly public procurement procedure.</p> <p>Article 31. Tertiary regulation</p> <p>4. The procedure to purchase tertiary reserve capacity shall be carried out on an annual level and on a monthly level for purchase of the missing reserve. The Procedures for procurement of tertiary reserve capacity shall be specified in the Procedures for Ancillary Services.</p> <p>Ancillary services procedures</p> <p>3.1.3 Procurement of secondary reserve</p> <p>ISOBiH shall carry out the procedure to purchase secondary reserve in June of current year for next year. Contracting of secondary reserve shall be done on a monthly basis, for peak load periods and off-peak load periods separately. If the required scope of secondary reserve has not been purchased for a certain month, the missing quantities shall be provided through a monthly procedure for that month.</p> <p>3.1.3.1 Framework agreement</p> <p>The dynamics of an annual procurement procedure for year Y shall be as follows:</p> <ol style="list-style-type: none"> 1. Procurement publishing by June 15 in Y-1 year, 2. Receiving bids by July 30 in Y-1 year, 3. The bids' evaluation by August 6 in Y-1 year,

Issue

BiH Regulations and Comments and recommendations

- 4. Publishing the tender results by August 8 in Y-I year,
- 5. The deadline for complaints and appeals by August 18 in Y-I year,
- 6. Discussing possible complaints and appeals and creating a final list by August 20 in Y-I year,
- 7. Concluding framework agreements by September 10 in Y-I year.

3.1.3.2 Invitation to bid submission

An invitation for annual bids submission shall be organized in November of the current year for next year. The procurement procedure shall be organized for 12 months, for peak load periods and off-peak load periods separately.

If the required scope of reserve has not been purchased in an annual procurement procedure, the invitation for providing ancillary service of secondary regulation on a monthly basis shall be announced in month M-I for calendar month M.

Final bids (pairs reserve - price) within a monthly cycle, **on the basis of signed framework agreements**, shall be delivered as appropriate in month M- 1 for M month in line with ISOBiH's invitation and instruction.

4.1.3 Procurement of tertiary reserve

The ISOBiH shall carry out an annual procedure to purchase upward and downward tertiary reserve separately in June of the current year for the next 12 months. Contracting of upward and downward tertiary reserve shall be done on a monthly basis.

If the required scope of tertiary reserve has not been purchased for a certain month, the missing quantities shall be provided through a monthly procedure for that month.

4.1.3.1 Framework agreement

The Procedure for providing upward and downward tertiary regulation shall be carried out by the ISOBiH at the beginning of June of the current year for next year...

4.1.3.2 Invitation for bids submission

In accordance with signed framework agreements, the ISOBiH shall organize an annual cycle and monthly cycles for submission of bids for providing upward and downward tertiary reserve.

An annual cycle of collecting bids shall be organized as instructed by the ISOBiH in the end of current year for next 12 months. If the required scope of tertiary reserve has not been purchased for a certain month in the annual cycle, the missing quantities for that month shall be provided through a monthly procedure in month M – 1 for month M.

COMMENTS AND RECOMMENDATIONS

The ancillary services procurement schedule, should be assessed from the aspects of the:

- period of procurement of reserve capacities by the type of service, deadlines for submission of bids and the contracting period regarding their impact on the possibility of aggregators participation in the balancing market,
- implementation of mandatory framework agreements for aggregated ancillary service providers,
- possibilities of splitting the procurement of reserve capacities into quantities that are procured annually and quantities that are procured in shorter time intervals (quarterly, monthly or weekly),

Issue	BiH Regulations and Comments and recommendations
	<ul style="list-style-type: none"> • period of procurement of the non-contracted energy bids by type of services and respective gate closure times in terms of their impact on the possibility of aggregators' participation in the market. <p>Depending on the results of the analysis, the proposals should be defined to change the time schedule of procurement and contracting of ancillary services. The proposed changes need to achieve an appropriate balance in the use of long-term and short-term products in the balancing market, while facilitating the participation of aggregators on the reserve capacity and balancing energy markets.</p> <p>The inability to guarantee long-term capacity availability, as well as the relatively high amount of the compensation and penalties for non-performance of services, may represent a constraint for aggregator ancillary service providers intending to offer reserve capacity services on an annual and monthly basis. Shortening the procurement deadlines and introduction of weekly auctions for the part of the required FRR capacities, directly encourages the participation of aggregators in the balancing market through the reduction of risks related to the capacity unavailability.</p> <p>The proposed changes must not have a negative impact on the system security and quality of the functioning of the ancillary services market in BiH.</p>
Gate Closure Time	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 14. Nomination and re-nomination of daily schedules</p> <p>3. Nominations and re-nominations of daily schedules shall be done within the deadlines as defined in the Instructions for daily schedules delivery.</p> <p>Rules on daily balancing energy market operations</p> <p>Article 8. Delivery of bids in day-ahead activities</p> <p>1. Bids in the daily balancing energy market for a day of delivery or D day may be submitted until the market's closure in D-1 by 14:30 hrs.</p> <p>Article 9. Delivery of bids in intra-day activities</p> <p>1. Bids in the daily balancing energy market may be delivered/changed from 18:00 hrs in day D-1 for day of delivery D.</p> <p>2. Bids for secondary regulation may be changed in intraday activities one hour before the real time, i.e., until H-1 for hour H in day D. The price within the bid must not be changed in that case.</p> <p>3. Mandatory bids for upward/downward tertiary regulation may be changed provided that the amount of power remains the same. Time schedule of nomination and re-nomination of mandatory bids is by hour H-1 for hour H at the latest, but an already-engaged bid may not be changed. Voluntary bids of upward/downward tertiary regulation may be changed in all parameters, i.e., they may be corrected or new ones may be delivered in intraday activities. The time schedule of nomination and re-nomination of voluntary bids is by H-30 min for hour H at the latest, but an already -engaged bid may not be changed.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The deadlines for submission of daily schedules on the wholesale market and bids on the balancing market are defined by the by-laws within the competences of the Independent System Operator of BiH.</p> <p>The deadlines can generally be assessed as flexible and tailored to the needs of market participants as there is a possibility of the renomination of the daily schedules and bids shortly before the time of delivery.</p>

Issue

BiH Regulations and Comments and recommendations

Ancillary service pricing method

BIH REGULATIONS

BiH Market Rules

Article 30. Secondary regulation

1...The selected bids shall be paid by the price offered for tertiary control reserve capacity (Pay-As-Bid). The price cap for tertiary control reserve capacity pMaxTerCap shall be established by SERC for annual and monthly procurement procedures.

...

9. The activated energy of secondary control shall be compensated according to offered prices of energy, in particular for upward and downward tertiary control. The price of the energy for two directions of regulation the ASP submits to the ISOBiH through the activities in Daily Balancing Market for day-ahead.

Article 31. Tertiary regulation

1. ... selected bids shall be paid by the price offered for tertiary control reserve capacity (Pay-As-Bid). The price cap for tertiary control reserve capacity pMaxTerCap shall be established by SERC.

....

6. The activated energy of tertiary control shall be compensated according to offered prices of the energy, in particular for upward and downward tertiary control. The price of the energy for two directions of tertiary control shall be delivered through the activities in the Daily Balancing Market. The price of activated energy for upward tertiary control shall be limited with the price cap pMaxTerEnCap which shall be established by SERC.

Article 32. Daily Balancing Energy Market for Tertiary Control

4. Activated bids for tertiary balancing energy shall be paid the offered price.

COMMENTS AND RECOMMENDATIONS

BiH market rules stipulate that prices for reserve capacity services and activated balancing energy of secondary and tertiary regulation on the BiH balancing market are formed according to the "pay-as-bid" principle.

The effects of implementation of different pricing models should be analyzed, which includes "pay-as-bid" or "market-clearing-price" principles for capacity prices and "pay-as-bid","market-clearing-price" or "margin-price" (the most expensive activated bid) principles for determining the balancing energy prices. The analyses should be performed in terms of both the functioning of the ancillary services market, and the integration of aggregators.

Depending on the results of the analysis, the changes of the ancillary services price determination methodologies should be defined, with the aim to encourage the participation of aggregators in the BiH balancing market.

The proposed methods may differ depending on the type of product.

Issue

BiH Regulations and Comments and recommendations

Remuneration for provided services

BIH REGULATIONS

BiH Market Rules

Article 29 Primary Regulation

ASPs whose structures are obliged, according to the Grid Code, to provide ancillary service of primary regulation shall do that at their own expense and without any compensations.

Article 30. Secondary regulation

10. ... If an ASP has failed to provide secondary control service or if the service has been of insufficient quality, the ASP shall be obliged to pay compensation to the ISOBiH. The way of determining the compensation amount and the quality of provided service shall be described in detail in the Procedures for Ancillary Service.

Ancillary services procedures

3.1.6 Penalties in case of unfulfilled obligations

If an ASP has failed to provide or nominate the contracted secondary reserve in the activities for the next day, it shall be obliged to pay penalties to the ISOBiH for missing quantities for each hour of not providing reserve. The penalty amount is defined in 3.1.6.1 of these Procedures.

3.1.6.1 Penalty price for non-provided reserve

The amount of penalty for each non-provided MW of secondary reserve shall be equal to the higher price of the price caps for secondary reserve, which are determined for annual and monthly procurement for a specific month, increased by coefficient $k_{PenSecCap-1}$. SERC shall in its decision determine the coefficient $k_{PenSecCap}$, and it shall be between 11 up to 1,25.

3.3.1. The cost of secondary reserve

The cost of secondary reserve of the ASP in one hour shall equal the total amount of costs in that hour per individual agreements of secondary regulation of the ASP. In this process it shall be taken into account that in a daily market, the agreements with lower prices of reserve are nominated and operationally delivered first.

3.3.2 The cost of secondary regulation energy

The amount of penalty shall be equal to the product of the delivered energy of secondary regulation and the price of energy for upward regulation that has been offered by the ASP in activities of the balancing market for a next day (day ahead).

Ancillary services procedures

4.3 Settlement of tertiary regulation

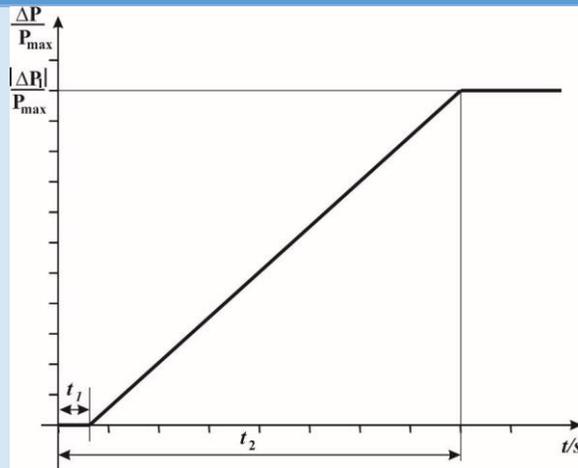
The cost of provided service of upward and downward tertiary regulation shall consist of the payment for tertiary reserve and payment for activated energy of tertiary regulation.

4.3.1 The cost of reserve

The cost of reserve in one hour shall equal the product of nominated reserve and contracted unit price of reserve (KM/MW/h) under individual agreements. If the nominated reserve is smaller than the contracted amount, it is considered that the ASP has failed to provide the contracted reserve from the agreement with higher price of reserve.

4.3.1.1 Penalties in case of unfulfilled obligations

Issue	BiH Regulations and Comments and recommendations
	<p>If the ASP has failed to provide/nominate the contracted reserve of tertiary regulation for next day activities, it shall be obliged to pay the ISOBiH the penalty for the missing quantities for every hour of non-provided reserve. The penalty's amount is defined in Chapter 4.3.1.2 of these Procedures.</p> <p>If the ASP that contracted upward or downward tertiary reserve on ISOBiH request has failed to provide tertiary regulation service in line with the quality criteria defined in Chapter 4.3.1.3, it shall be obliged to pay a penalty. The penalty amount shall equal the weekly compensation value of contracted tertiary reserve.</p> <p>Tertiary control energy is registered and calculated by the ASP in line with point 4.3.2, regardless of the penalties in case of a failure to meet the obligations for tertiary regulation.</p> <p>4.3.1.2 Penalty price for non provided reserve</p> <p>The penalty amount for each non-provided MW of upward/downward tertiary reserve shall be equal to the price that is higher than the price caps for upward/downward tertiary regulation, which are determined in an annual and monthly procurement for a specific month increased by coefficient $kPenTercCap-1$.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>By-laws within the competence of the Independent System Operator prescribe that remuneration for secondary and tertiary regulation services consist of the:</p> <ul style="list-style-type: none"> • contracted capacity fees, and • balancing energy fees. <p>The capacity fee takes into account the execution of the long-term reserve capacity contracts regarding the daily nominations of the contracted capacity. The compensation for unrealized capacity and penalties for services' nonperformance are envisaged too.</p> <p>The analysis should be performed to address the applicability of the prescribed compensation and penalty mechanisms for the aggregated service providers. The analysis especially needs to consider the possible levels of compensation and penalties for the non-performance or poor performance in relation to the revenues of service providers. The analysis needs to determine whether the amount of penalties might have a disincentivizing effect on the participation of aggregators in the balancing market.</p> <p>The changes should be proposed to the mechanism for determining the compensation and penalties in case of ancillary services non-performance, provided that it proves necessary from the aspect of aggregators integration. The proposed model should establish an appropriate balance between the needs of the system operator and the certainty of the fulfillment of contractual obligations on one hand and reducing the revenue risk of the aggregator on the other.</p>
<p>Specific requirements for FCR services</p>	<p>BIH REGULATIONS</p> <p>BiH Grid Code</p> <p>Chapter 5.8.1.1.</p> <p>(1) Each generation unit (turbo generators and hydro aggregates) connected to the transmission system, must be equipped with turbine regulators that have the capability of automated regulation of the speed of rotation. A new generation unit must ensure capability of remote monitoring of the primary regulation status.</p> <p>(2) The droop of the regulator should be adjustable in the range of 3-4% for hydro generator, and 4-6% for turbo generators.</p> <p>(3) Each turbine regulator should have the possibility to adjust the deadband zone within the range of ± 10 mHz.</p> <p>(4) Response of active power of the generation unit during the process of frequency maintenance must be on or above the solid line shown in the following diagram,</p>



whereby:

P_{max} – is the maximum output power of the generating unit as defined by the generation permit to which ΔP refers to

ΔP – is change of the generator's active power

t_1 – is initial time delay

t_2 – is time of full activation.

(5) The generation unit must provide ΔP of output active power by point ΔP I in accordance with the values defined in the following table.

Parameters	Range
Max.allowed initial time delay t_1 , unless otherwise indicated for technologies of the generators without inertia	2 s
Max.allowed full time of activation t_2 unless longer time is approved for the purpose of the system stability	30 s

(6) Initial time delay of the activation (t_1) must be as short as possible. If the initial time delay is longer than two seconds (2 s), the generation unit owner must explain the need for a longer time by providing technical explanations.

(7) The generation unit must be capable of ensuring a full response of active power within the time of up to 30 min, having in mind the amount of active power and the primary source of the generation unit.

(8) Accuracy of frequency measurements must be 10 mHz or better.

Issue	BiH Regulations and Comments and recommendations
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The basic requirements for the provision of FCR regulation services are prescribed by Article 154, paragraph 7 of the SOGL. It is important to emphasize that the given requirements relate to the provision of services at the level of the complete regulation area, whereby the TSO has the right to prescribe identical or different requirements for individual service providers.</p> <p>The obligation to provide FCR regulation services refers to all frequency ranges within which the power plant must be able to operate for an appropriate time period, as prescribed by the Requirements for generators Network Code.</p> <p>Activation of FCR regulation services must start no later than 2 seconds from the occurrence of frequency deviation. The response characteristic must be at least linear during the power change period (if the generator does not have the possibility of continuous active power regulation, regulation is performed by applying relays activated at appropriate frequency change steps). Specific prequalification requirements and conditions may be prescribed for service-providing units that activate FCR services on a disproportionate basis (response only within a certain frequency range or after reaching a certain frequency threshold).</p> <p>The maximum allowed insensitivity to frequency changes for the FCR frequency regulation service providers includes the generator's inherent insensitivity and the intentional frequency response dead band of the governor of the FCR providing units/group.</p>
<p>Congestion management, distribution network development planning methods</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 45. Management of internal constraints</p> <ol style="list-style-type: none"> 1. If internal constraints appear in the BiH power system, the ISOBiH may instruct the generator units to change their generation. 2. The generator units instructed by the ISOBiH to change generation/off-take due to internal constraints in the system will be compensated for the increase/decrease of generation according to imbalance prices as given in Article 40 of these Market Rules. <p>COMMENTS AND RECOMMENDATIONS</p> <p>BiH market rules define the congestion management in the transmission network and the right of the ISOBiH to redispatch generators in the given circumstances. Congestion management in the distribution system is not defined by regulations in BiH, except for the right of the DSO to limit the output power of distributed generators or to perform load shedding in case of endangered security of the distribution system.</p> <p>Congestion management at the distribution level is conventionally addressed by capacity reinforcements of the distribution network and changing the design of network tariffs. The alternative methods are related to the application of flexible connection agreements with the right to limit the output power of network users or the application of market methods for procurement of flexibility.</p> <p>Generally, the use of flexibility at the distribution level is justified in a case where the net benefits for the distribution system and distribution system users are positive, i.e., when flexibility services are the most economically advantageous solution in the management of the distribution system.</p> <p>The application of the flexibility concept is possible only when the needs for flexibility within the distribution system are precisely defined.</p> <p>Flexibility services at the distribution level can be secured through the connection agreements with the service provider or through the application of market mechanisms.</p> <p>The connection agreement may prescribe the right of the DSO to limit the output power of a generator under predefined conditions, while the generator in turn bears lower connection costs.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>Procurement of flexibility services using market principles can be done through the application of bilateral agreements or through appropriate platforms, which apply market procurement methods. Long-term bilateral agreements with flexibility service providers are necessary in conditions where the flexibility services market in a particular distribution area is not sufficiently liquid.</p> <p>Given the above, the introduction of constraint management services in the distribution network should be considered, as an alternative to the conventional network capacity reinforcement in conditions where the costs of flexibility services are lower than or equal to the sum of CAPEX and OPEX costs of avoided investments. An integral part of these rules should be the rules of a generator's remuneration in case of power curtailments due to the occurrence of overloads, overvoltages in the network, excessive fault currents levels or when system stability is endangered. In this context, it is necessary to consider whether the regulatory framework and relevant tariff methodologies provide for the recognition of the DSO operating costs related to a generator's power curtailment.</p> <p>The rules addressing the responsibility for redispatching and establishing the power system balance during congestion management activities should be defined, taking into account that activation of flexibility services for congestion management purposes at the distribution level causes an imbalance in the power system. The responsibility for imbalances during the power curtailment period should be defined as well.</p>
Commercial relations aggregator - individual service providers	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Commercial relations between aggregators and service-providing units/groups in terms of the quantification, valuation and payment for the delivered services, should not be subject to regulation. The regulation of these issues should be done bilaterally, by applying market principles.</p>

Table 3 Commercial requirements

5. Prequalification

The prequalification rules define the procedure and the way of checking the compliance of the service provider with the requirements prescribed for a certain type of service. The rules prescribe the basic technical requirements and operational tests, the implementation of which verifies the compliance of the aggregator response with the prescribed requirements for specific products on the ancillary services market. The impact of the activation of flexibility services on the operating parameters of the power system is also assessed during the prequalification process, and potential operational limitations are defined by the relevant system operator to whose network the service provider's facility is connected.

The prequalification process should be user-friendly, standardized to the extent possible, with clearly defined roles and tasks of the participants in the process and with a minimum required number of steps adapted to the complexity of the product for which the compliance assessment procedure is performed. The prequalification process should not be a barrier to the implementation of the aggregator concept, and it should be harmonized with the best European practice to the extent possible.

The gap analysis of the regulations in Bosnia and Herzegovina was performed for frequency regulation ancillary services, given that these services are commercially available in an already matured market. It is worth to note that setting of the prequalification process for these services is mandatory according to the requirements of the EU Network Codes.

An analysis was not performed for flexibility services provided in the wholesale market, as it represents an unregulated segment where the terms and conditions of service provision are determined bilaterally between the flexibility customers and aggregators.

The prequalification rules analyzed in this chapter are generally applicable, regardless of the adopted aggregator concept and the selected implementation model.

Prequalification rules**BIH REGULATIONS****BiH Market Rules****Article 30. Secondary regulation**

The right to participate in the market procedure belongs to ASPs whose structures satisfy the technical preconditions for providing secondary regulation service and that are registered at the Registry of secondary regulation service providers. The processes related to the technical validity and registration of the structures for providing secondary regulation service shall be defined by the Ancillary Services Procedures.

Article 31. Tertiary regulation

The right to participate in the market procedure belongs to ASPs whose structures satisfy the technical preconditions for providing tertiary regulation service and that are registered at the Registry of tertiary regulation service providers. The processes related to the technical validity and registration of the structures for providing tertiary regulation service shall be defined by the Ancillary Services Procedures.

Ancillary Services Procedures**Item 3.1.1. and 4.1.1.****Registration of Reserve providing Units for secondary (tertiary) regulation**

When the Reserve-providing unit is determined as adequate to provide ancillary service, it is entered in the Registry of ancillary service providers for a period of the next five years, and the ASP with that unit may participate in the purchase procedure of a specific ancillary service. Otherwise, an ASP's Request for registration of Reserve providing unit to provide ancillary services shall be denied.

If within a period of five years, there are some changes in technical characteristics of the concerned structure, the ASP shall be obliged to submit any change, and the ISOBiH shall have the right to test the structure in accordance with the procedures set in item 3.1.1.1.

3.1.1.1 Technical inspection of the Reserve providing Units for providing Secondary Regulation

Technical inspection of reserve-providing Units shall involve the testing of:

- Operational telecommunication and controlling infrastructure that enables efficient and correct transmission of the managing signal and response,
- Real time measurements of active output power of the generation structures that provide automatic secondary regulation,
- The ability for remote meter reading, and
- Speed of response to the managing signal.

Technical validity verified upon the technical inspection shall last for five years and may be extended with no further testing if the Units successfully provided the secondary reserve within the previous period, which is to be finally decided by the ISOBiH.

Issue	BiH Regulations and Comments and recommendations
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The TSO is normally responsible for prescribing the prequalification requirements and procedure for the frequency regulation services, as well as for conducting the compliance verification tests.</p> <p>The ISOBiH has prepared the acts prescribing the technical requirements for ancillary services providers, as well as the rules for the compliance testing and registration of the qualified ancillary services providers ("Compliance testing of generation facilities"). The rules and compliance tests are tailored to the conventional power plants and do not address the technical requirements and the prequalification procedure for aggregators.</p> <p>The prequalification rules for aggregated FCR and FRR ancillary services providers should be defined in order to create preconditions for the participation of aggregators in the ancillary services market, as well as in order to timely harmonize the BiH regulations with the requirements of the SOGL.</p> <p>The prequalification rules should specifically define the procedure and the method to determine the:</p> <ul style="list-style-type: none"> • volume of the reserve capacity that is the subject of prequalification, • compliance with specific requirements for certain types of ancillary services, e.g., response time, activation time, • quality of the regulation services in terms of the permitted fluctuations of activated reserve capacity, with defined limits for allowed and tolerable ranges of power response during the power change period, transitional period and stationary period, for each type of service separately, <p>The rules should also define the conditions in which the aggregated ancillary services provider is obliged to re-qualify (e.g., change in the composition of the service providing group, after a period of five years, change in the characteristics of the service providing equipment that affect the qualification of the service provider, at the legitimate request of TSO). According to the SOGL requirements, the qualification should be reassessed where the equipment has been changed, but the character of equipment change that requires reassessment is not unambiguously defined. In this sense, the character of the equipment change that requires reassessment of the aggregator qualification, should be defined.</p>
<p>Pre-qualification procedure and data exchange</p>	<p>BIH REGULATIONS</p> <p>Ancillary Services Procedures</p> <p>3.1.1.1 Technical inspection of the Reserve providing Units for providing Secondary Regulation</p> <p>The ISOBiH shall conduct a technical inspection of the Reserve-providing unit that may provide secondary reserve during its initial registration for providing secondary reserve or during its operation, if the ISOBiH finds it necessary.</p> <p>4.1.1.1 Technical Inspection Reserve providing units for providing Tertiary Regulation</p> <p>The ISOBiH shall conduct technical inspection of the unit that may provide upward and downward tertiary regulation during its initial registration for providing tertiary regulation or during its operation, if the ISOBiH finds it necessary.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Existing prequalification procedures are tailored to the requirements for conventional service providers, therefore they are not fully applicable for the aggregator prequalification process.</p> <p>The prequalification requirements for aggregated service providers should also define the procedural rules that determine the:</p> <ul style="list-style-type: none"> • Conditions in which the ancillary service provider independently conducts the tests with/without informing the TSO, • Minimum threshold of installed capacity of the service provider when the TSO must be informed about the planned pre-qualification tests, • Right of the TSO to supervise the pre-qualification process,

Issue	BiH Regulations and Comments and recommendations
	<ul style="list-style-type: none"> • Method of submitting an application form, information and documents for the qualification assessment, • Deadlines for application assessment, • Right of the TSO to conduct control tests and to check the test results submitted by the service provider. <p>The content of the application forms and standard technical data on the service providing units to be submitted in the prequalification process, should be defined as well.</p>
Changes of aggregator composition	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The prequalification requirements for aggregators acting as the ancillary services providers, should also address the rules for adding/excluding service providing units from the group.</p> <p>The rules should consider and prescribe whether the prequalification is carried out at the level of individual service providing units/groups or at the portfolio level. It should take into account that the individual resources may not meet the specific requirements for providers of certain services; but through the aggregation, they may contribute to meeting of the prescribed requirements at the group level.</p> <p>When the composition of an aggregator changes, the prequalification reassessment might be carried out by associating/removing data for the relevant service providing units/groups. In case a new unit is added, the prequalification reassessment can be performed only for the additional service providing units, whose parameters are added to the existing dataset of the aggregator. In case of removal of the service providing unit, it is necessary to check whether the aggregator after the change of its composition meets the prequalification requirements, given the parameters of the removed unit.</p> <p>Specific requirements for aggregators should also include the rules for the dynamic change of the aggregator composition during the service-providing period. As a rule, a change in the group composition should not be allowed during an imbalance settlement period (ISP), except in the event of a failure of one of the service units.</p>
Rules for the provision of multiple reserve capacity services by the same service unit	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Simultaneous provision of multiple reserve capacity services by the same service-providing unit is generally allowed. Under these conditions, the capacity ranges used for a particular service should be separated and should meet the requirements specific to the individual services.</p> <p>The rules for allocating imbalances by the type of ancillary services should be defined, depending on the combination of services provided by the unit. Monitoring whether services are delivered in the contracted quantities and their quality is a key prerequisite, which is based on the availability of the real-time data with the appropriate time resolution.</p>
Service providers with limited energy storage capacity	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The criteria according to which the service providers should be considered to be providers with limited energy storage capacity should be defined.</p>

Issue	BiH Regulations and Comments and recommendations
	<p>This category represents the service providers who cannot provide the required reserve capacity services continuously without the application of additional energy storage management measures. Electricity storage is considered to be the accumulation of the hydroelectric power plants, battery energy storage and other technologies of electricity accumulation.</p> <p>Verification of the usable energy capacity should be an integral part of the prequalification procedure for this category of service providers.</p> <p>The TSO prescribes the rules of registration and delivery of stationary data related to the energy capacity of aggregators and individual service providing units/groups that have limited energy capacity.</p> <p>General and specific requirements for this category of service providers are prescribed by the types of ancillary services.</p> <p>Specific requirements for the energy storage capacity of the FCR regulation service providers should take into account the effects of the previous activation of services (due to frequency deviations before the "alert" state), as well as the effects of energy storage management measures that have a delayed impact on the available capacity. Depending on the value of the reserve capacity for the FCR regulation purposes, the maximum and minimum state of the energy capacity of the energy storage device should be determined, within which the permitted operating points of the FCR service providing units/groups should be located.</p> <p>For the FRR frequency control, the service provider is obliged to verify that the service providing unit/group has usable energy capacity at all times. The usable energy capacity, which depends on the value of the FRR regulation reserve capacity, should ensure the provision of service in the minimum duration prescribed by the TSO. In addition, the service provider must verify that it has developed energy storage management measures that enable the continuous and secure provision of services for the duration prescribed by the TSO.</p>
Specific requirements for downward regulation services	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Specific requirements may be prescribed for downward frequency regulation services (reduction of generation or increase of consumption), which prohibit the provision of services through the increase of electricity consumption without technological purposes or through the reduction in electricity generation involving water spilling at hydropower plants or unused burning of primary fuel.</p>
Prequalification procedure costs	<p>BIH REGULATIONS</p> <p>Ancillary Service Procedures</p> <p>3.1.1.1 Technical inspection of the Reserve providing Units for providing Secondary Regulation</p> <p>Each party shall itself bear the testing costs.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Ancillary Service Procedures stipulate that the costs of testing the technical eligibility of the ancillary service providing facilities are borne by each party separately, which corresponds to the standard applied solutions.</p> <p>Under the given conditions, the aggregator bears its own prequalification costs, while the TSO/DSO bears the costs of its staff engaged in supervising the prequalification tests and analyzing the documentation to assess the prequalification criteria fulfillment.</p>
TSO-DSO cooperation in	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>

Issue	BiH Regulations and Comments and recommendations
the prequalification process	COMMENTS AND RECOMMENDATIONS The rules should be defined for the exchange of information during the prequalification process between the DSOs and TSOs, for the service providing units/groups which are connected to the distribution network.

Table 4 Prequalification

6. Planning and activation of the flexibility services

This chapter analyzes the provisions related to the operational planning of flexibility services, the baseline methodology, the process of services activation and the exchange of information between market participants.

Since the activated flexibility service cannot be directly measured, it is necessary to define the rules for determining the baseline diagram, which represents the estimated generation or consumption of electricity that would have occurred without activating the flexibility services.

The activated flexibility might be provided within time intervals that are shorter than the actual billing interval of 60 minutes. Therefore, the daily schedule as a work plan of aggregator units is not suitable for determining whether the flexibility service has been provided or not. Besides that, at the time of the flexibility unit activation, its generation or consumption may generally be different from that specified in the daily schedule.¹³ The baseline diagram (baseline, base level) is therefore used as a basis for quantifying the activated reserve and determining the amount of energy that is the subject of transaction between the aggregator and the supplier. The activated flexibility for a given time interval is determined as the difference between the measured value of generation/consumption and the baseline diagram.

An illustrative example of a base diagram with flexibility service activation is given in Figure 4:

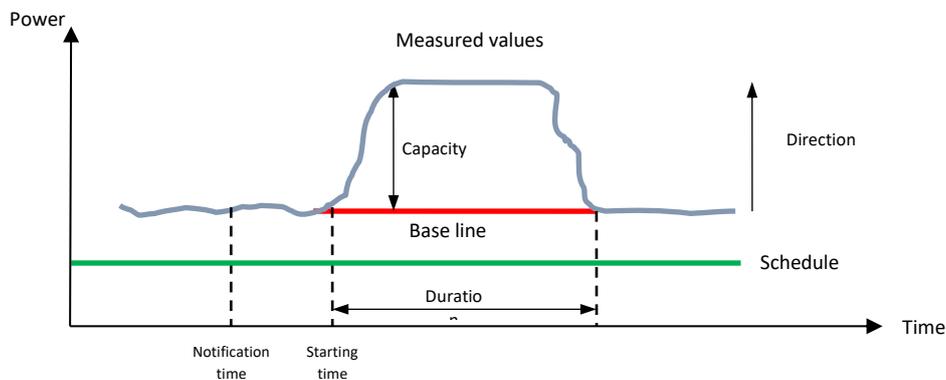


Figure 4 Quantification of the active reserve using a baseline diagram Source¹⁴

The flexibility activation in Figure 4 is determined by the difference between the blue line (measured value) and the red line. The figure shows also the green line representing the daily schedule, which is unusable for determining the activated flexibility.

For each of the products on the wholesale and the ancillary services markets, the methodology for determining the baseline and the nomination periodicity need to be defined. Adequate baseline methodology is a key prerequisite for establishing a flexibility services market; thereby, the methodology needs to meet the requirements related to the accuracy, reasonable complexity that does not require excessive implementation costs, transparency and impartiality in relation to the market participants.

The requirements considered in this chapter are generally applicable, regardless of the adopted aggregator concept and the selected implementation model.

¹³ An example is the FCR service, where the current capacity before activating the reserve (i.e., significant changes in the system frequency) is taken into account when evaluating the service provided, but not the daily schedule for that billing interval.

¹⁴ Simone Minniti, Niyam Haque, Phuong Nguyen and Guus Pemen, "Local Markets for Flexibility Trading: Key Stages and Enablers", 2018, p.4, <https://www.mdpi.com/1996-1073/11/11/3074/htm>.

Planning and activating flexibility services

Issue	BiH regulations	Comments and recommendations
Base diagram	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Since the flexibility activation cannot be directly measured, a baseline should be determined representing the planned generation or consumption of electricity that would have been realized without activating the flexibility services.</p> <p>The baseline should be used as a basis for the quantification of delivered flexibility services, energy transfer and billing and allocation of imbalances and settlement.</p> <p>For each of the products in the wholesale and ancillary services market, the methodology for the determination of the baseline should be established, including the time resolution and time window of nomination.</p>
Daily schedule and baseline submission rules for aggregators	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The baseline methodology should define whether the aggregator provides the flexibility service customer with a daily schedule and a base diagram at the portfolio level or at the level of individual resources, and whether different rules should be applied depending on the type of services provided.</p> <p>As a rule, the aggregator should be obliged to create a baseline at the level of individual service providing units/groups, thus creating preconditions for the identification of flexibility service providers and for the accurate quantification of performed services, imbalances and transferred energy.</p> <p>The exception to the obligation of baseline determination at the level of individual service providing units/groups may be applied in a situation where the service provider demonstrates that the determination of the baseline at the level of one or more service providing units (generating modules and power plants) is not possible, provided that these facilities are connected to the same segment of the distribution network and the service providing units have the same electricity generation technology.</p> <p>It should be considered whether and how the information on the location of the nominated service providing units/groups should be submitted, especially in terms of assessing the impact of the flexibility services activation on the operating parameters of the power system.</p>
Baseline methodology, responsibility for establishment of the baseline methodology, periodicity of the baseline nomination	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The baseline methodology depends on the type of the market product.</p> <p>The responsibility to establish the baseline methodology for the ancillary services should be delegated to the flexibility customer (TSO or DSO). It is necessary to specify whether the methodology is subject to regulatory approval.</p> <p>The baseline methodology for products in the wholesale market should be determined by the regulator.</p>

Planning and activating flexibility services

Issue	BiH regulations	Comments and recommendations
	<p>Depending on the type of product, the methodology for the baseline determination might be¹⁵:</p> <ul style="list-style-type: none"> FCR service - "meter-before/meter-after" methodology, the baseline represents the last measured value of active power. The measurement resolution is prescribed by the requirements for the FCR product. The baseline is determined at the level of the individual service providing unit. aFRR service - a methodology based on the aggregator's "rolling" nomination for the next 15-minute period. The basis for nomination is the current power level determined by the real-time measurements, which is extrapolated to the next imbalance settlement period (ISP), thus preventing gaming by resources that have variable output power. The time resolution, time window, and periodicity of nomination updates should be adjusted to the specific characteristics of the aFRR products. Nomination is made at the level of the individual service providing unit. mFRR service - a methodology identical to the methodology for aFRR service, with the specificity that the length of the nomination should be equal to the full duration of the service providing period (depending on the product definition). The baseline should be frozen at the moment when the activation signal of the TSO is received. Intra-day market - the methodology depends on the time planning horizon and the gate closure time (GCT). For GCTs above time period of three hours, the methodology corresponds to the methodology for the day-ahead market, and for shorter GCTs it corresponds to the methodology for tertiary regulation services (mFRR). Day-ahead market - nominations should be made at the level of the service providing unit, in order to prevent potential "gaming". Otherwise, the aggregator could "activate" in real time those units that would regularly change its operating point at a given moment even without activating flexibility services. <p>The entity responsible for the creation and submission of the baselines should be explicitly defined. Available options are an aggregator or supplier (or their balancing responsible parties). As a rule, responsibility should be assigned to the aggregator, since the allocation of responsibility also implies responsibility for the accuracy of baseline planning.</p>	
<p>Baseline submission at the individual service providing units/groups</p>	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by the regulations in BiH for AGRs (aggregators) because they do not exist as a category, but it is regulated for the existing market participants through the balancing mechanism.</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The installed capacity threshold of individual service providing units/groups for which the submission of individual baselines is mandatory should be prescribed.</p>
<p>Services activation</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 30. Secondary regulation</p> <p>The secondary control service is automatic and is activated when the SCADA system, located in ISOBiH, sends a signal to ASPs' Regulators. The signal of secondary control shall be allocated to ASPs in proportion to their participation in totally available secondary control reserve capacity.</p> <p>Article 32. Daily Balancing Energy Market for Tertiary Control</p> <p>3. Tertiary regulation shall be engaged in accordance to the merit order list which shall be created by ISOBiH on the basis of submitted bids in the daily balancing energy market for tertiary control.</p>	

¹⁵ USEF, *Op. cit.*, fn. 1, p. 54-58.

Planning and activating flexibility services		
Issue	BiH regulations	Comments and recommendations
		<p>COMMENTS AND RECOMMENDATIONS</p> <p>The existing rules in BiH for ancillary services activation are general in nature and tailored to the activation of conventional service providers connected to the transmission network.</p> <p>In addition to the existing rules, a procedure for flexibility activation through aggregators should be established as well, depending on the selected implementation model and the requirements for data exchange between the market participants. The procedure should also envisage an obligation to inform suppliers about the intended/performed activation of flexibility services.</p> <p>The specific rules of communication with the supplier should be prescribed when the real-time measurements are provided from the delivery point of the activated unit, in order to avoid counter balancing activities by the supplier.</p> <p>The manner of informing the DSO about the intended/performed activation of flexibility services in its the distribution area should be defined as well. The DSO should be entitled to limit and terminate flexibility activation if it leads to the violation of grid parameters or causes the instability of system. Furthermore, an obligation of the DSO should be prescribed to provide information on the occurrence of the local constraints in parts of the distribution network (e.g., due to faults, planned outages), which may affect flexibility services providers in the respective area.</p>

Table 5 Planning and activating flexibility services

7. Validation, quantification and payment of flexibility services

This chapter considers the provisions related to the exchange of billing data, quantification of delivered flexibility services, quality of services, calculation of remuneration for delivered services, calculation of imbalances during the flexibility services activation period, determination of quantities and prices of transferred energy between the independent aggregator and supplier and the financial transactions between the participants in the flexibility market.

The provisions of this chapter relating to:

- Balancing responsibility of the aggregator during the services activation period,
- Imbalance settlement due to the activation of flexibility services,
- Energy settlement,
- Price determination methodology of the activated energy for transactions between aggregators and suppliers,
- Payment rules on the relation supplier to aggregator to service provider,

are relevant only in connection with the independent aggregator concept.

Activation of flexibility services by an independent aggregator causes an imbalance in the supplier's portfolio. When flexibility services are activated, the supplier will take over/deliver the changed quantity of electricity from/to the activated distributed energy resource compared to the contracted and scheduled quantities. In order to avoid negative impact on the electricity supplier, the energy settlement (energy transfer) and correction of supplier's balancing perimeter should be performed for the period of the flexibility services activation by an independent aggregator.

An indicative overview of energy flows and commercial transactions in case of activation of flexibility services by an integrated and independent¹⁶ aggregator for TSO needs is shown in Figures 5 and 6.

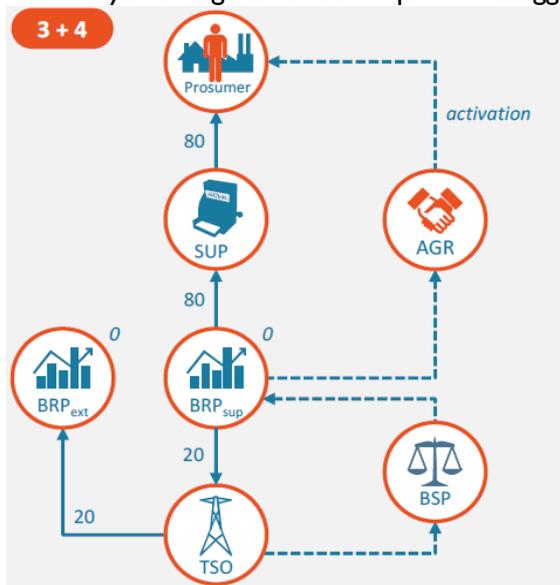


Figure 5 Energy flows and commercial transactions - Integrated aggregator – Source USEF¹⁷

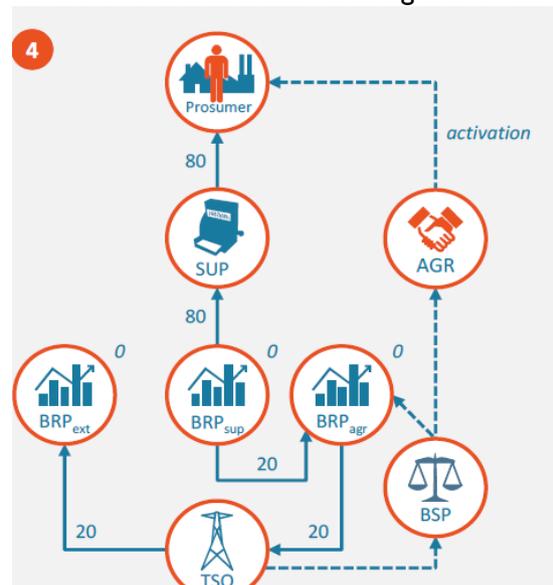


Figure 6 Energy flows and commercial transactions – Independent aggregator – Source USEF¹⁸

Both overviews are given for the case of flexibility services activation by reducing the consumption of the service provider from 100 to 80 units, while the difference of 20 activated units was delivered to the TSO in the balancing services market.

¹⁶ This specifically relates to the Contracting Model - more details are set out in Annex 2.

¹⁷ USEF, *Op. cit.*, fn. 1, p. 31.

¹⁸ USEF, *Op. cit.*, fn. 1, p. 36.

Energy and commercial flows in the presented cases include:

Transaction type	Integrated model	Independent aggregator
Energy transaction in the balancing market	The aggregator/supplier delivers 20 units through BRP _{SUP} for the TSO needs.	The aggregator delivers 20 nominated units for the TSO needs through BRP _{AGR} .
Energy transaction between the aggregator and supplier	Integrated subjects ¹⁹ – without transaction.	By the activation of the flexibility services, the aggregator "takes over" the energy belonging to the supplier. The transaction is performed through BRP _{SUP} and BRP _{AGR} . The quantification of the transaction is the difference between the measured consumption and the baseline value.
BRP_{SUP} perimeter correction due to the activation of flexibility services	Integrated subjects – no correction performed.	The BRP _{SUP} perimeter is corrected for the number of energy units corresponding to the activated flexibility services. In the diagram shown in Figure 6, the perimeter correction is performed indirectly through the energy transfer between the BRP _{SUP} and BRP _{AGR} .
Imbalance settlement	BRP _{SUP} is the balancing party that is responsible for the overall imbalance, which includes customer consumption and flexibility services.	BRP _{AGR} is responsible for the imbalance given as the difference between the nominated energy transaction for the TSO needs (20 units) and the volume of actually-activated flexibility services. BRP _{SUP} is balancing responsible during the period of services activation, for the deviation of the nominated procurement (100 units) in relation to actual consumption and activated flexibility services.

Table 6 Energy flows and commercial transactions of the integrated and independent aggregator

¹⁹ An integrated subject is a supplier performing both the energy supply and the aggregation activities

Issue	BiH Regulations and Comments and recommendations
Data exchange and delivery	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>Rules should be prescribed for delivery and exchange of data that are needed for the quantification and settlement of flexibility services, depending on the selected implementation model and type of flexibility service.</p> <p>Open and interoperable standard communication protocols should be prescribed for the exchange of billing data.</p> <p>In general, the flexibility customer (TSO, DSO, wholesale market party) should be responsible for defining the format, content and frequency of billing data submission.</p>
Quantification of the delivered services	<p>BIH REGULATIONS</p> <p>Ancillary Services Procedures</p> <p>3.3.2.1 Secondary regulation energy</p> <p>Secondary regulation power for the ASP in one hour shall be calculated as follows: $W_{SekReg} = W_{act} - (PG + PD) / 2$</p> <p>Wact shall be actual generation of the ASP (MEGAUNIT) measured by the ISOBiH SCADA system in a specific hour</p> <p>PG shall be the integral of the upper generation limit for the ASP from the ISOBiH SCADA system</p> <p>PD shall be the integral of the lower generation limit for the ASP from the ISOBiH SCADA system</p> <p>4.3.2.1 Tertiary regulation energy</p> <p>Activated energy upward and downward tertiary regulation shall be equal to the requested (required) energy as integral of the power of upward and downward tertiary regulation which ISOBiH required from the ASP in one hour.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>ISOBiH Procedures for ancillary services are general provisions relating to the quantification of the activated energy of secondary and tertiary regulation for conventional ancillary service providers connected to the transmission network. Aspects related to the provision of ancillary services by aggregators are not defined by regulations in BiH.</p> <p>Responsibilities for quantification of delivered flexibility services should be assigned either to the metering operator (DSO or TSO, depending on the connection point of the service provider) or to the flexibility customer of specific service.</p> <p>The precise rules for the quantification of activated energy of ancillary services should be prescribed in terms of the metering data aggregation (at the generator/power plant level), start of metering, and treatment of energy during the power change period (ramp times when activating and deactivating services).</p> <p>The methodology for the quantification of delivered flexibility service should be defined as well, which includes the measurements at the level of individual service-providing units. The delivered flexibility should be calculated as the difference between the registered generation/consumption and the corresponding baseline value. The values at the aggregator level should be determined as the sum of individual values of activated flexibility/generated energy.</p> <p>Quantification of delivered services might be performed at the group level for an aggregated group of service-providing units connected to the same segment of the distribution network and having the same electricity generation technology, for which the TSO approved the submission of baseline at the group level.</p>

<p>Quality of the delivered services</p>	<p>BIH REGULATIONS</p> <p>Ancillary Services Procedures</p> <p>3.3.3.1 Quality of secondary regulation work</p> <p>Secondary regulation of an ASP within an hour would be considered to have satisfying quality if the following conditions are met:</p> <ul style="list-style-type: none"> • The regulation has not been disconnected on the ASP side longer than 5 minutes cumulative within a specific hour (AGC signal at SCADA/EMS system at ISOBiH: "Unit blocked" or "Unit off remote control"), and • If the AGC signal "Unit Not Following" has not been active longer than 15 minutes cumulative within a specific hour. <p>The ASP shall be entitled to compensation for secondary reserve for the hours in which the secondary regulation has not been working properly due to the reasons which are out of the ASP's control, which shall, for each particular case, be determined by the ISOBiH and ASP staff.</p> <p>4.3.1.3 Quality of work for tertiary regulation</p> <p>It is considered that upward/downward tertiary reserve is provided if the reserve is nominated in the Daily Balancing Energy Market.</p> <p>Since tertiary balancing energy is not measured or calculated but is considered to be delivered, all missing/undelivered quantities shall become deviations of the BRP to which the ASP belongs.</p> <p>Monitoring the quality of tertiary regulation shall be done by following activation of contracted tertiary reserve.</p> <p>The ISOBiH shall analyze activation of tertiary regulation by comparing actual and planned generation of the units, which at a given moment, were nominated for providing tertiary regulation service. If this indicates that the ASP has engaged less than 80% of required tertiary regulation power within any hour in a day, it shall be considered that the service has not been adequately provided and the ASP shall pay a penalty in line with 4.3.1.1.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>ISOBiH procedures for ancillary services prescribe the requirements related to measuring the quality of secondary (aFRR) and tertiary (mFRR) regulation services.</p> <p>An analysis should be performed to determine whether the prescribed criteria are also applicable to aggregators. In addition, if necessary, amendments of the quality criteria should be proposed, but without jeopardizing the achieved level of functionality and quality of secondary and tertiary regulation in the BiH balancing market.</p>
<p>Calculation of delivered services</p>	<p>BIH REGULATIONS</p> <p>Market Rules</p> <p>Article 37.</p> <p>Calculation of Ancillary Services and Reporting</p> <p>The ISOBiH shall create a daily report on ancillary services for each ASP separately and in each working day for the previous working day and all previous non-working days, i.e., on day D+1 for day D. A daily report shall contain all energy and financial standings of provided ancillary services and balance energy that is engaged by an ASP.</p> <hr/> <p>COMMENTS AND RECOMMENDATIONS</p> <p>In addition to the existing provisions on the calculation of ancillary services for the needs of the ISOBiH, the responsibilities for the calculation of other flexibility services should be defined, depending on the type of services:</p> <ul style="list-style-type: none"> • The DSO should be responsible for calculation of services where it is a flexibility customer.

	<ul style="list-style-type: none"> The TSO should be responsible for the calculation of the delivered flexibility services between different balancing responsible parties in the wholesale electricity market for portfolio optimization purposes.
Billing aggregator - an individual service provider	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Basic principles should be prescribed that require the aggregators to present the information on services provided in a way that is simple, unambiguous and allows precise separation from other transactions between the aggregator/supplier and individual service provider.</p>
Imbalance settlement due to flexibility services activation	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>Activation of flexibility services by an independent aggregator causes an imbalance in the supplier's portfolio that needs to be corrected to avoid a negative impact on the supplier and its balancing responsible party.</p> <p>Depending on the selected implementation model, it is necessary to determine the explicit rules that will address the calculation of imbalances due to the activated flexibility services by an independent aggregator, correction of the balancing perimeters of the supplier and its balancing responsible party, and the imbalance settlement during the service activation period.</p> <p>The balancing responsibility of an independent aggregator should be limited to the resources covered by the aggregation. Under the given conditions, the aggregator's balancing responsible party should hold balancing responsibility only for the distributed resources that are activated and only for the part of the load/capacity related to the flexibility services. The supplier's balancing responsible party should hold balancing responsibility for the rest of the load/capacity. During the service activation period, the remaining load is equal to the nominated baseline for that type of service.</p>
Energy settlement	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>
	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The energy sourced by the supplier but sold by the independent aggregator on the flexibility market (positive regulation service) should be transferred between them, in order to avoid a negative impact of the flexibility services activation by the independent aggregator on the supplier and its balancing responsible party. For negative regulation services, it is necessary to transfer the energy purchased by the independent aggregator on the flexibility services market from the aggregator to the supplier.</p> <p>The methodology should be defined for determining the volume of activated energy, which is based on the baseline and registered quantities on the metering devices of the service providing units/groups for each ISP.</p> <p>The energy transfer method and method of compensation depends on the selected aggregator implementation model.</p>
Methodology for determining the	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>

<p>value of activated energy between aggregators and suppliers</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The methodology for determining the value of activated energy must be known in advance in relation to the time of services activation.</p> <p>The time resolution of the energy price should be as high as possible, preferably at the level of either the billing period on the balancing market or the billing unit on the day-ahead market.</p> <p>The price of energy should reflect the sourcing cost at the time of procurement or the missing revenue of the supplier due to the activation of flexibility services.</p> <p>The price of energy could be based on the:</p> <ul style="list-style-type: none"> • Energy component of the retail price, • Imbalance energy prices, • Wholesale prices on the electricity market, • Energy sourcing costs reported by the supplier, • Negotiated energy price. <p>The price of energy can be further differentiated depending on the time of procurement of flexibility services. The basic division is into the services where flexibility is provided in the long run (e.g., strategic reserves, hedging in the balancing market) and services where flexibility is traded intraday. Intraday trading can be further differentiated depending on whether the bidding period is up to the three hours ahead of the real time or the bidding period is 3-24 h when the conditions are more similar to the day-ahead market conditions.</p> <p>Energy prices may also be differentiated depending on the category of customers/generators involved in the provision of flexibility services.</p> <p>Furthermore, the transfer of energy price methodology might be the dual pricing methodology, when different prices are applied for different directions of service activation.</p> <p>The number of implemented methods should be reasonably low in order to avoid excessive complexity of the model.</p>
<p>Settlement rules supplier - aggregator - service provider</p>	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p> <p>COMMENTS AND RECOMMENDATIONS</p> <p>The explicit rules of financial settlement and payment between the independent aggregator and the supplier should be prescribed for the energy transfer that is a result of the flexibility activation.</p> <p>The method of settlement and payment between the aggregator and individual service providers is not subject to regulation. These aspects should be defined on a bilateral basis by applying the market principles.</p>

Table 7 *Validation, calculation and payment of flexibility services*

8. Transparency and data disclosure

This chapter defines the general rules for the publication and protection of confidential information, publication of data on the ancillary services market in BiH and the basic principles of communication and data exchange between the independent aggregator and supplier.

The basic principle for defining the rules of data publication and availability is that any subject should be authorized to access the information it needs to perform its tasks.

The generator and the electricity customer must have access to their own data on electricity generation and consumption at the appropriate granularity level, which are needed for the comparison of different bids and selection of aggregation services providers. Measurement data and any other data relating to the customer/generator are under the ownership of that entity and their delivery to third parties is possible only with the prior consent of the entity to whom the data relates.

A special aspect of the rules for publishing and protection of the confidential and commercially sensitive data relates to the use of data on the contracted energy price between the supplier and the individual service provider and data on the energy sourcing price within the supplier's portfolio. These issues are relevant when the above-stated prices are used for the settlement of the transferred energy between the independent aggregator and the supplier.

Issue	BiH Regulations	Comments and recommendations
<p>Ancillary services market data publication</p>	<p>BIH REGULATIONS</p> <p>BiH Market Rules</p> <p>Article 43. Data publication</p> <p>The ISOBiH is obliged to present any information and data concerning the balancing energy market that are not deemed confidential to Market Participants through its website in a transparent, unbiased and non-discriminatory manner.</p> <p>No later than eight working days after the observed market day, the ISOBiH is obliged to publish the following data for each settlement interval:</p> <ul style="list-style-type: none"> • total volumes of balancing energy engaged in tertiary control, • total volumes of balancing energy engaged in secondary control • the settlement price for deviations by balancing group. <p>For each settlement interval, ISOBiH is obliged to publish on its website on day D+1 a preliminary settlement price for day-D deviations by balancing groups (on Mondays for weekend days).</p> <p>Rules on daily balancing energy market operations</p> <p>Article 14. Daily, monthly and annual report on the balancing market operations</p> <p>The ISOBiH on its web site publishes daily, monthly and annual reports on the daily balancing market operations.</p> <p>Information published in daily reports consists of:</p> <ul style="list-style-type: none"> • engaged energy for upward/downward secondary regulation on an hourly basis, • engaged energy for upward/downward tertiary regulation on an hourly basis, • the price of negative/positive imbalance, i.e., the maximum/minimum price of activated energy for upward/downward regulation for each hour. <p>The information published in monthly reports consists of the:</p> <ul style="list-style-type: none"> • total quantity of engaged balancing energy for secondary regulation, • total quantity of engaged balancing energy for tertiary regulation, • engaged crossborder balancing energy, • total cost of energy for secondary regulation and its average price, • total cost of energy for tertiary regulation and its average price, • average imbalance price for deficit/surplus of energy, and • max/min imbalance price for deficit/surplus of energy. <p>The ISOBiH also creates an annual report on ancillary services and the balancing market operations containing the following information:</p> <ul style="list-style-type: none"> • required, contracted and delivered secondary reserve, • the price of contracted reserve and total cost of delivered secondary reserve, • required, contracted and delivered tertiary reserve, • the price of contracted reserve and total cost of delivered tertiary reserve, 	

Issue	BiH Regulations	Comments and recommendations
	<ul style="list-style-type: none"> engaged balancing energy, balancing cost and realized average price, engaged crossborder balancing energy, and average imbalance price for deficit/surplus of energy. <p>Ancillary services procedures Chapter 8. Reports on ancillary services The ISOBiH shall be obliged to create an energy and financial report on ancillary services for each BSP on a daily and monthly level. 8.1.1 Daily report on ancillary services ... a detailed daily report for each service provider 8.1.2 Monthly report on ancillary services The monthly report consists of the adopted daily reports during a specific calendar month. The monthly report on ancillary services contains the following energy and financial positions for the ASP:</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>BiH market rules and accompanying documents provide a formal framework for the timely publication of data on the functioning of the balancing market and a structured analytical presentation by type of ancillary services, with the protection of confidential and commercially sensitive data.</p>
<p>Publication of data in the aggregator - supplier - balancing responsible party communication</p>	<p>BIH REGULATIONS</p> <p>The issue is not explicitly addressed by BiH regulations.</p>	<p>COMMENTS AND RECOMMENDATIONS</p> <p>The following issues need to be considered and defined regarding the competition and commercially-sensitive data protection:</p> <ul style="list-style-type: none"> obligation of the aggregator to inform a supplier about a concluded contract with the service provider with whom the supplier has concluded the electricity purchase/supply contract; alternatively, it might be the obligation of the service providing generator/customer, manner of informing the supplier and its balancing responsible party about the activation of flexibility services within their portfolio; the information is needed at the level of the service providing unit to avoid counter-balancing when the real-time measurement is provided. <p>manner of delivery and publication of data on the supplier's energy prices for the energy settlement with an independent aggregator, where protection of confidential data must be ensured with regard to the sourcing costs and retail energy price.</p>

Table 8 Transparency and data publication

Annex I - Directive (EU) 2019/944 Requirements

By the Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019, on common rules for the internal market for electricity and amending Directive 2012/27/EU, basic requirements for load management and aggregator's participation in the electricity market and ancillary services are prescribed.

Article 13 of the Directive states:

Article 13.

Aggregation Contract

1. Member States shall ensure that all customers are free to purchase and sell electricity services, including aggregation, other than supply, independently from their electricity supply contract and from an electricity undertaking of their choice.
2. Member States shall ensure that, where a final customer wishes to conclude an aggregation contract, the final customer is entitled to do so without the consent of the final customer's electricity undertakings. Member States shall ensure that market participants engaged in aggregation fully inform customers of the terms and conditions of the contracts that they offer to them.
3. Member States shall ensure that final customers are entitled to receive all relevant demand response data or data on supplied and sold electricity free of charge at least once every billing period if requested by the customer.
4. Member States shall ensure that the rights referred to in paragraphs 2 and 3 are granted to final customers in a non-discriminatory manner as regards cost, effort or time. In particular, Member States shall ensure that customers are not subject to discriminatory technical and administrative requirements, procedures or charges by their supplier on the basis of whether they have a contract with a market participant engaged in aggregation.

Article 17 of the Directive prescribes:

Article 17.

Demand response through aggregation

1. Member States shall allow and foster participation of demand response through aggregation. Member States shall allow final customers, including those offering demand response through aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets.
2. Member States shall ensure that transmission system operators and distribution system operators, when procuring ancillary services, treat market participants engaged in the aggregation of demand response in a non-discriminatory manner alongside producers on the basis of their technical capabilities.
3. Member States shall ensure that their relevant regulatory framework contains at least the following elements:
 - (a) the right for each market participant engaged in aggregation, including independent aggregators, to enter electricity markets without the consent of other market participants;

(b) non-discriminatory and transparent rules that clearly assign roles and responsibilities to all electricity undertakings and customers;

(c) non-discriminatory and transparent rules and procedures for the exchange of data between market participants engaged in aggregation and other electricity undertakings that ensure easy access to data on equal and non-discriminatory terms while fully protecting commercially sensitive information and customers' personal data;

(d) an obligation on market participants engaged in aggregation to be financially responsible for the imbalances that they cause in the electricity system; to that extent they shall be balance responsible parties or shall delegate their balancing responsibility in accordance with Article 5 of Regulation (EU) 2019/943;

(e) a provision for final customers who have a contract with independent aggregators not to be subject to undue payments, penalties or other undue contractual restrictions by their suppliers;

(f) a conflict resolution mechanism between market participants engaged in aggregation and other market participants, including responsibility for imbalances.

4. Member States may require electricity undertakings or participating final customers to pay financial compensation to other market participants or to the market participants' balance responsible parties, if those market participants or balance responsible parties are directly affected by demand response activation. Such financial compensation shall not create a barrier to market entry for market participants engaged in aggregation or a barrier to flexibility. In such cases, the financial compensation shall be strictly limited to covering the resulting costs incurred by the suppliers of participating customers or the suppliers' balance responsible parties during the activation of demand response. The method for calculating compensation may take account of the benefits brought about by the independent aggregators to other market participants and, where it does so, the aggregators or participating customers may be required to contribute to such compensation but only where and to the extent that the benefits to all suppliers, customers and their balance responsible parties do not exceed the direct costs incurred. The calculation method shall be subject to approval by the regulatory authority or by another competent national authority.

Annex 2 - Aggregator implementation models

Annex 2 presents relevant information from the USEF document “Recommended Practices and Key Considerations for the Regulatory Framework and Market Design on Explicit Demand Response,”²⁰ which refers to aggregator implementation models. The annex describes the relationship between the aggregator, the supplier and the balancing responsible party in terms of organizing balancing responsibility, energy transfer and information exchange.

In the aggregator implementation models, flexibility is separated from energy supply. The aggregator takes responsibility for flexibility activation, and the supplier for energy supply.

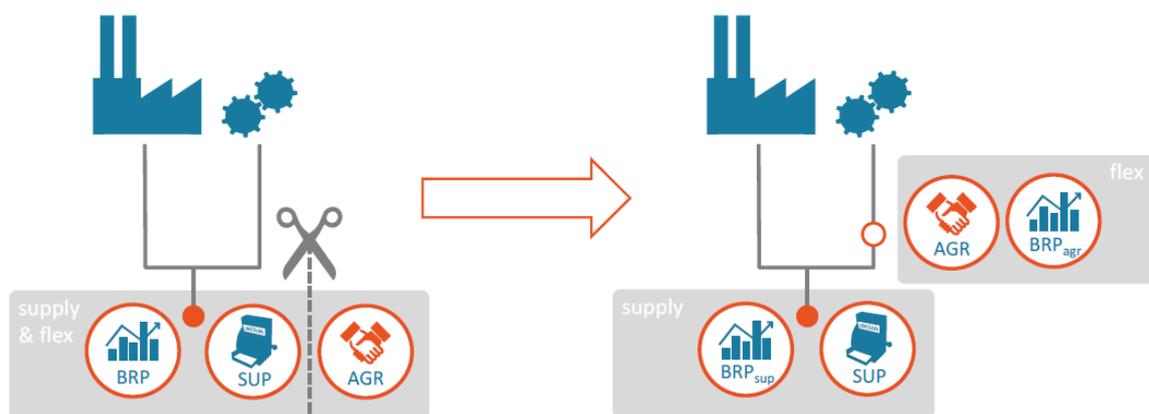


Figure 7 Separating flexibility from supply

Source: USEF

In separation of flexibility from supply, three main principles are applied:

- The responsibilities of the aggregator (and its BRP) are restricted to the:
 - Activation periods,
 - Flexibility resources that are activated,
 - Deviation from the baseline,
- The aggregator is not responsible for the energy supply to the Prosumer²¹
- The effects of the DR activation for the supplier and its BRP should be compensated.²²

The aggregator associates with the balancing responsible party to cover imbalances or in case it wants to trade on the electricity markets.

²⁰ <https://www.usef.energy/app/uploads/2017/09/Recommended-practices-for-DR-market-design-2.pdf> - Chapter 5

²¹ The prosumer is a neologism denoting consumer who is producing electricity for his/her own needs

²² Depending on the implementation model, compensation is done in two ways:

(i) by adjusting the deviation of the supplier's balancing responsible party for the activated flexibility; and
(ii) by the energy transfer from the (balancing responsible party) *supplier* to the (balancing responsible party) *aggregator* in case of the load reduction/generation increase or by the energy transfer in the opposite direction in case of the load increase/generation reduction.

There are seven different aggregator's implementation models.

	Contract between aggregator and supplier	No contract between aggregator and supplier
Single BRP	- Integrated model - Broker model	- Uncorrected model
Dual BRPs	- Contractual model	- Corrected model - Central settlement model - Net benefit model

Table 9 Different models of aggregator's implementation

In models with one BRP, the supplier and the aggregator have the same balancing responsible party, while in the model with two BRPs, the supplier and the aggregator have different balancing responsible parties. Each of these models has certain advantages and limitations. The applicability of certain models also depends on the flexibility products, asset types, customer segment and/or country. It is recommended to use several models, but the number of allowed models should remain low for reasons of simplicity and efficiency.

Six aggregator implementation models with their characteristics, are presented in the following tables: (Note that the net benefit model is considered to be a sub model of the central settlement model.²³)

Model	Integrated model	Broker model
Synopsis	The supplier is also an aggregator. The supplier can organize the "aggregation" itself or uses the services of a third party.	The aggregator transfers the balancing responsibility to the balancing responsible party of the supplier. Compensation for imbalances between suppliers and BRP is regulated by a bilateral agreement.
Main characteristics	- Aggregator does not have its own ²⁴ BRP - Aggregator does not need a contract with the supplier - No energy transfer	- Aggregator doesn't have its own BRP - Aggregator needs a contract with the supplier - No energy transfer
Contractual relationships	- Flexibility purchase agreement ²⁵ between aggregator (supplier) and flexibility provider.	- Bilateral agreement between the aggregator and the supplier/balancing responsible parties of the supplier. - Contract for flexibility services between the aggregator and the balancing service provider, who offers the flexibility to the TSO
Balancing responsibility	Supplier's BRP	Supplier's BRP
Perimeter correction	No correction	No correction
Transfer of energy	No energy transfer	No energy transfer

²³ Unlike the model with central settlement, the costs of compensation of the supplier's balancing responsible party are not borne by the aggregator, but these costs are partially or completely socialized.

²⁴ Different from the supplier's balancing responsible party - in this case the aggregator and the supplier have the same balancing responsible party.

²⁵ This contract is the basis for an operation in all models.

Model	Integrated model	Broker model
Settlement phase		
Synopsis	<p>The Balance Service Provider (BSP)²⁶ provides balancing energy by activating flexibility through the aggregator. From an initial consumption of 100 units, the prosumer consumption is reduced to 80 units (-20 units) in order to establish the balance after some (external) balance responsible party (BRP_{EXT}) has made an imbalance of +20 units.</p> <p>The balancing service provider is associated with the balancing responsible party of the supplier. The supplier's balancing responsible party (BRP_{SUP}) calculates the balancing energy received by the TSO. In this case, the aggregator does not communicate with the TSO through the balancing service provider. In the case of a partial (incomplete) activation of flexibility, the BRP_{SUP} imbalance is treated in the same way as the other BRP imbalances.</p>	<p>The supplier's balancing responsible party (BRP_{SUP}) delivers the balancing energy to the TSO. Balancing energy is paid for with the price determined by the balancing market. The aggregator does not directly benefit from activating the flexibility service, so it can set a high price for the service. Another possibility is for BRP_{SUP} and the aggregator to introduce a mutual settlement mechanism.</p>
Comments	<p>This model is always a feasible option. Usually, when selecting several aggregator implementation models, the question is which of the other models will coexist with the Integrated Model.</p>	<p>If the balancing responsible party of the aggregator and the balancing responsible party of the supplier are different, this model can be developed into a Contractual model.</p>

Table 10 Implementation model characteristics: integrated and broker

Model	Contractual	No correction
Synopsis	<p>The aggregator has its own balancing responsible party. Imbalances between the aggregator's balancing responsible party and the supplier's balancing responsible party are adjusted (corrected) through the ex-post energy transfer, with energy prices based on contracts.</p>	<p>There is no correction of imbalances and no energy transfer between the aggregator and the supplier.</p>
Main characteristics	<ul style="list-style-type: none"> - The aggregator has its own balancing responsible party - The aggregator needs a contract with the supplier - Bilateral energy transfer 	<ul style="list-style-type: none"> - The aggregator doesn't have its own balancing responsible party - The aggregator doesn't need a contract with the supplier - No energy transfer

²⁶ Or Ancillary Service Provider (ASP)

Model	Contractual	No correction
Contractual relationships	<ul style="list-style-type: none"> - The aggregator has a contract with a balancing responsible party for correction of imbalances and entering the energy markets - The aggregator has a bilateral contract with the supplier about the transfer of energy - The aggregator has a contract with the balancing service provider for the provision of flexibility services, which offers flexibility to the TSO. 	<ul style="list-style-type: none"> - The aggregator²⁷ has a contract with the balancing service provider for the provision of flexibility services, who offers flexibility to the TSO.
Balancing responsibility	The supplier's balancing responsible party has full balancing responsibility. The aggregator's balancing responsible party has an implicit balancing responsibility during the flexibility services activation period.	Supplier's balancing responsible party.
Perimeter correction	It is corrected ²⁸ by the energy transfer between BRP _{SUP} and BRP _{AGR}	No correction.
Transfer of energy	The aggregator buys the transferred energy (ex-post) from the supplier's balancing responsible party at the contracted price. The volume of transferred energy is equal to the difference between the measurement and the baseline.	No energy transfer, flexibility activation will result in an imbalance for the supplier's balancing responsible party.
Settlement phase		
Synopsis	<p>The balancing service provider (BSP) provides balancing energy by activating flexibility through the aggregator. From an initial consumption of 100 units, the prosumer consumption is reduced to 80 units (-20 units) in order to establish the balance after some (external) balancing responsible party (BRP_{EXT}) has made an imbalance of +20 units.</p> <p>The balancing service provider is associated to the aggregator's balancing responsible party. By activating the flexibility services, the Prosumer's supplier (SUP) has a de facto positive imbalance of +20 units. On the other hand, the aggregator delivered the required flexibility, causing an imbalance of -20 units to its balancing responsible party (BRP_{AGR}).²⁹ Imbalances of the balancing responsible parties are adjusted in the</p>	<p>The aggregator has a contract with the balancing service provider. The supplier was supposed to deliver 100 units, but it delivered only 80 units, so the remaining +20 units were delivered to the external balancing responsible party through the balancing mechanism. Through the balancing mechanism, the imbalance of the supplier's balancing responsible party passively contributes to the elimination of systemic imbalance. If the balancing mechanism rewards the participants who</p>

²⁷ In case the flexibility managed by the aggregator is included in the balancing product.

²⁸ No need for additional adjustment by ARS (allocation responsible sides).

²⁹ The numbers in parentheses in the figure indicate the deviations of the BRP_{AGR} before the settlement.

Model	Contractual	No correction
	settlement phase, which establishes an energy balance between them.	are passively contributing to the elimination of the system imbalances, BRP _{SUP} will be paid for the activation of services.
Comments	This model should be based on standardized contracts. In the open market, participants are allowed to enter into bilateral agreements. If the aggregator's and supplier's balancing responsible parties are the same, this model is transformed into the broker model.	Capacity-based flexibility products, which require very little or no activation, can fit well into this model. This model is not suitable for hybrid (capacity-energy) or energy-only products, nor for the residential consumption segment.

Table II Characteristics of the implementation model: model with contracting and no correction model

Model	Corrected	Central settlement model
Synopsis	The prosumer consumption is corrected directly at the meter, by modifying the registered metered quantities for the volume activated by the aggregator.	The aggregator has its own balancing responsible party. Imbalances are corrected by the central body, at a price determined by a predefined formula.
Main characteristics	<ul style="list-style-type: none"> - The aggregator has its own balancing responsible party - The aggregator needs a contract with the supplier - Energy transfer via prosumer. 	<ul style="list-style-type: none"> - The aggregator has its own balancing responsible party - The aggregator does not need a contract with the supplier - Central energy transfer
Contractual relationships	The aggregator has a contract with the aggregator's balancing responsible party to cover imbalances and enter the electricity markets.	The aggregator has a contract with the aggregator's balancing responsible party to cover imbalances and enter the electricity markets.
Balancing responsibility	The supplier's balancing responsible party holds a full balancing responsibility, which includes the responsibility for the adjusted consumption during the activation period. The aggregator's balancing responsible party has the balancing responsibility during the activation period for the difference between the actual consumption and the baseline.	The supplier's balancing responsible party holds the full balancing responsibility for all periods, except during the period of the flexibility service activation. During the activation period, the aggregator's balancing responsible party has a balancing responsibility for the difference between the actual consumption and the baseline. ³⁰
Perimeter correction	The meter reading is modified ³¹ (adjusted) by increasing or decreasing the energy activated by the aggregator, which is further notified to the TSO. The imbalances of the balancing responsible parties of suppliers and aggregators are adjusted (corrected) for activated energy.	The central body (the party responsible for the allocation) adjusts the imbalances between the balancing responsible parties of the supplier and the aggregator.
Energy transfer	The supplier can charge Prosumer the same energy as if there was no flexibility activation. The aggregator will compensate Prosumer for energy that is charged but not consumed (or generated, depending on the direction of flexibility activation).	The central body enables the transfer of energy between the balancing responsible parties of the supplier and the aggregator.

³⁰ That is, the base level - the best approximations of electricity consumption or generation that would have happened if the flexibility service had not been activated.

³¹ The meter reading is corrected by the responsible party - in the DSO distribution network.

Model	Corrected	Central settlement model
Settlement phase		
Synopsis	<p>The balancing service provider (BSP) provides balancing energy by activating flexibility through the aggregator. From an initial consumption of 100 units, the prosumer consumption is reduced to 80 units (-20 units) in order to establish the balance after some (external) balancing responsible party (BRP_{EXT}) has made a deviation of +20 units.</p> <p>The balancing service provider is associated with the aggregator's balancing responsible party. The metering responsible party (DSO) corrects the Prosumer measurements during the periods of flexibility service activation. The measurements are changed to a fictitious value, which would have been realized if there had been no flexibility activation (baseline diagram). In this way, the supplier delivered 100 units (as much as it needed), Prosumer bought 100 units, consumed 80 units and resold 20 units to the aggregator's balancing responsible party, which further sold them to the TSO. In this way, the energy balance is established by the correction of the measurements.</p>	<p>The balancing service provider is associated with the aggregator's balancing responsible party. The party responsible for allocation (TSO) adjusts the imbalances of the balancing responsible parties through the energy transfer from the supplier's balancing responsible party to the aggregator's balancing responsible party (or vice versa, depending on the direction of flexibility activation).</p> <p>The allocation responsible party (ARP) also performs a financial settlement based on the quantity of transferred energy and the predefined price formula that applies to the respective energy volume.</p>

Table 12 Characteristics of the implementation model: correction model and central settlement model

Annex 3 - Literature

1. USEF, “Recommended practices and key considerations for a regulatory framework and market design on explicit Demand Response” 2017.
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3. Richter, Andre & Hauer, Ines & Wolter, Martin. (2018), “Algorithms for Technical Integration of Virtual Power Plants into German System Operation,” *Advances in Science, Technology and Engineering Systems Journal* 3, January 2018,
4. An Overview of the European Balancing Market and Electricity Balancing Guideline’, no. November, 2018.
5. Simone Minniti, Niyam Haque, Phuong Nguyen and Guus Pemen, “Local Markets for Flexibility Trading: Key Stages and Enablers”, 2018.