

ASSESSING THE PERFORMANCE OF A NEW TENDER FOR FREQUENCY REGULATION SERVICES IN CHILE

Lucas Neira, Donny Holaschutz, Jorge Moreno, Joaquin de la Barra, Elizabeth Paduro, Altamiro Pina

Prepared for:



8th May 2021

- 1. Chilean system and regulation
- 2. Scope of study
- 3. New tender development methodology
- 4. Analysis of new tender implementation
- 5. Conclusions

Chilean system operation and development

Historically, Chilean National Electric System ("SEN") has been primarily a hydrothermal system, however over the past few years integrated significant levels wind and solar. Additionally, there have been commitments to retire coal facilities and decarbonization goals defined, which could lead to adequacy and flexibility challenges for the system.





Ancillary services regulation

Chilean system has defined primary frequency control (PFC), secondary frequency control (SFC) and tertiary frequency control (TFC) services as part of ancillary services market. The process used by the ISO to determine the ancillary services has evolved during past years.





- 1. Chilean system and regulation
- 2. Scope of study
- 3. New tender development methodology
- 4. Analysis of new tender implementation
- 5. Conclusions

Impact of ancillary services on system costs

The ancillary services market can have an effect on the marginal cost electricity and side-payments for end consumers. Therefore, changes to the ancillary services market must be made using a holistic approach which considers all system costs.



Do changes in ancillary service market incentivize investments and an efficient operation of the system?



- 1. Chilean system and regulation
- 2. Scope of study
- 3. New tender development methodology
- 4. Analysis of new tender implementation
- 5. Conclusions

Phases in ancillary services allocation strategy

Ancillary services payments are adjusted considering a performance factor that reflects the quality of the response of each unit. Additionally, wear costs should not be considered simultaneously in the payment of reserves and energy. The bidding period takes place at least 13 hours prior to the actual operation, which can be inadequate.

First Phase

(Until Dec 31, 2019) Audited

- Activation costs
- Variable cost above marginal costs

Activation costs are **not** modeled the day ahead.

Second Phase

(Jan 1st, 2020 - Sep 27^{th,} 2020) **Tender**

- Activation costs
- Variable cost above marginal costs
- Opportunity costs
- Utility risk

Tender costs modeled the day ahead.

Performance factor applied to all tender costs.

Third Phase

(Sep 28th, 2020 - Dec 15th, 2020) Audited

- Activation costs
- Variable costs above marginal costs
- Opportunity costs

Activation costs (estimation) **are** modeled the day ahead.

Performance factor applied only when variable cost is above marginal costs.

Fourth Phase

(Dec 16th, 2020 - today) Tender

- Wear costs*
- Utility risk

Audited

- Activation costs
- Variable costs above marginal costs
- Opportunity costs

Activation costs (estimation) and tender are modeled the day ahead.

Performance factor applied to tender costs and when variable cost is above marginal costs.



8

Phases in ancillary services allocation strategy

Ancillary services payments are adjusted considering a performance factor that reflects the quality of the response of each unit. Additionally, wear costs should not be considered simultaneously in the payment of reserves and energy. The bidding period takes place at least 13 hours prior to the actual operation, which can be inadequate.

First Phase (Until Dec 31, 2019) Audited • Activation costs • Variable cost above marginal costs Activation costs are not	Second Phase (Jan 1 st , 2020 - Sep 27 ^{th,} 2020) Tender • Activation costs • Variable cost above marginal costs • Opportunity costs • Utility risk		 Third Phase (Sep 28th, 2020 - Dec 15th, 2020) Audited Activation costs Variable costs above marginal costs Opportunity costs 		Fourth Phase (Dec 16 th , 2020 - today) Tender • Wear costs* • Utility risk Audited • Activation costs
modeled the day ahead.	Tender costs modeled the day ahead. Performance factor applied to all tender costs.	Ρ	Activation costs (estimation) are modeled the day ahead. Performance factor applied only when variable cost is above marginal costs. aid according to		 Variable costs above marginal costs Opportunity costs Activation costs (estimation) and tender are modeled the day ahead.
(Until December 31, 2019)		ре	rformance factor		Performance factor applied to tender costs and when variable cost is above marginal costs.
	11 am	6 pm	11 am 6 pm		
Daily bid process	2 day a 2 day a optimiz	head head ration Bidd	1 day ahead Day ahead optimization	24 h	ours operation
energy & sustainability		ind	Ddú ¹ System security control an	* Wear co d optimal prici	osts may be also considered on variable cost 9 ng of electricity. MC Caramanis, RE Bohn, FC

Schweppe

- 1. Chilean system and regulation
- 2. Scope of study
- 3. New tender development methodology
- 4. Analysis of new tender implementation
- 5. Conclusions

Participation in different implementation phases

At the beginning of the process, the bids were mostly completely allocated and adjudicated to two companies. After some months, the bidding was insufficient to supply demand, however the allocation was more diversified.



inodú

Structure of the ancillary services market affects the system operation

When the auction system began (second phase), the secondary and tertiary frequency control services were awarded mostly to hydroelectric resources. As the availability of hydroelectric resources decreased, reserves were allocated mainly to gas and, to a lesser extent, coal. In the third phase, when the auction system was eliminated, the allocation to coal and biomass increased, while the allocation of gas and reservoirs decreased.



inodú

How can we benchmark the efficiency of the bid-based system?

During the second phase of implementation, the use of hydroelectric resources to provide reserves was significantly higher from January through March, than April and May. An alternative day ahead unit commitment, based on cost audited reserve allocation, was simulated for the same period and the use of hydroelectric resources for reserves was more balanced between January and May.



Second Phase

Original day ahead unit commitment by **ISO**

- Last day unit commitment
- Technical parameters
- Water mid-term costs
- Expected generation and load profiles
- Ancillary services bids
- Audited costs

Alternative day ahead unit commitment without tender

- Last day unit commitment
- Technical parameters
- Water mid-term costs¹
- Expected generation and load profiles
- Ancillary services bids
- Audited costs

¹ Water usage is affected by tender so water costs are not exactly what they would be in an operation without tender.



Adjudicated bid prices in different phases

The price of the offers in the market reopening phase (fourth phase) have been lower because a large part of the costs are calculated by Chilean ISO according to audited costs outside the offer price.



Evolution of ancillary services side payment costs

Side payments associated to the ancillary services tender are higher in the second phase compared to the fourth phase. In the fourth phases the opportunity costs and variable cost over spot price side payments were higher in 2021. However, the cost increases were affected by the increase on spot prices.



energy & sustainability

Decoupling of the system due VRE integration affects ancillary services market

The decoupling of systems due to transmission congestion will change levels of competition in the ancillary services market; the level of competition in each subsystem should be carefully evaluated.



inodú

Inflexibilities in the allocation process of ancillary services constraint the flexibility of flexible assets

When reservoirs provide frequency regulation services their operations are restricted and their capacity to provide flexibility to supply variability of the net-load can be affected. Hence, leading to the dispatch of more flexible thermal units.



energy & sustainability

The performance metrics used to evaluate the provision of ancillary services are an important factor in the ancillary service market design

Some units providing Secondary Frequency Control (SFC) up and down are not responding adequately to provide the reserves they have been requested, showing that there are challenges with how response performance is being considered in the reserve allocation and payment process.



inodú

Opportunity of renewable resources participation in ancillary services market

Renewable resources can be adapted to provide part of the ancillary services requirements through power inverters, allowing other flexible resources to fulfill other functions required by the system.



Upstream and downstream SFC adjudication (MW)



energy & sustainability



Standard for Interconnection and Interoperability of Inverter-Based Resources 19 Interconnecting with Associated Transmission Systems, WSPI-P of IEEE, P2800[™]/D6.0, March 2021

- 1. Chilean system and regulation
- 2. Scope of study
- 3. New tender development methodology
- 4. Analysis of new tender implementation
- 5. Conclusions

Learned lessons

- 1. The whole system structure should be considered when designing the ancillary services market.
- 2. The structure of the operation and dispatch programming process is key in the design and operation of ancillary services market.
- 3. The definition of performance metrics plays a relevant role in adequately implementing ancillary services markets.
- 4. Renewable resources integration will change the dynamics of ancillary services market:
 - a) The system structure and operations will change
 - b) Inverter based technologies can increase the participation of renewables resources on ancillary services market



ASSESSING THE PERFORMANCE OF A NEW TENDER FOR FREQUENCY REGULATION SERVICES IN CHILE

Lucas Neira, Donny Holaschutz, Jorge Moreno, Joaquin de la Barra, Elizabeth Paduro, Altamiro Pina

Prepared for:



8th May 2021