Ministerio de Energía

Gobierno de Chile

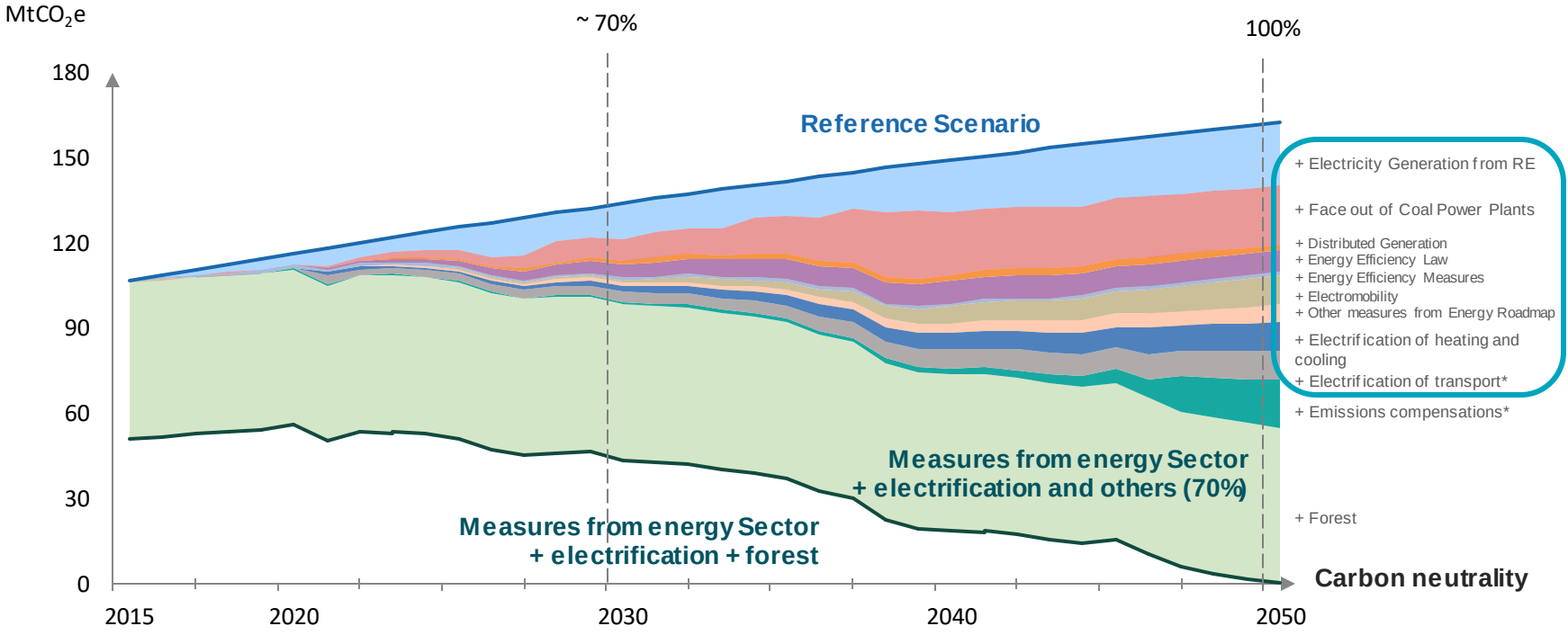
Flexibility on the Chilean Power System

Ministry of Energy

July 2019

Our vision about the future

Carbon neutral by 2050



Source: Environmental and Climate Change Division, Ministry of Energy, Chile

Note: *Measures that need to be studied for a proper quantification.

Some challenges about decarbonize

- ✓ Renewable energy integration.
- ✓ Face out of coal power plants.
- ✓ Distributed generation.
- ✓ Energy efficiency.
- ✓ Electromobility.
- ✓ Electrification of other consumptions.

- ❖ Variability.
- ❖ Uncertainty.
- ❖ Decentralization.
- ❖ Diversification.

A flexible energy sector is required

Context

What we understand as flexibility?

There isn't a unique definition of flexibility:

- *"It is the ability of a power system to reliably and cost-effectively manage the variability and uncertainty of supply and demand across all relevant timescales."*

  Status of Power System Transformation, IEA

- *"(…) the ability of the system to adjust rapidly to changing conditions, such as shocks to demand or supply."*

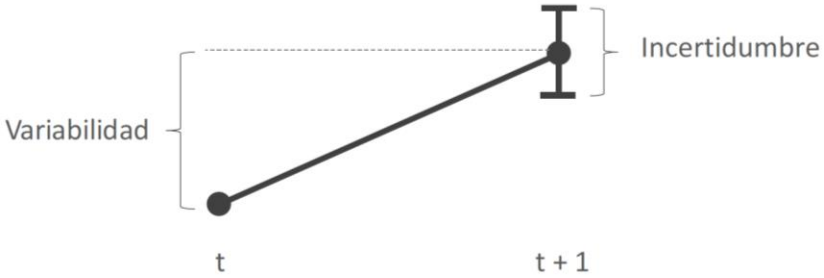
  The Making Flexibility Pay: An Emerging Challenge in European Power Market Design, NERA

- *"(…) the ability of a power system to cope with variability and uncertainty in both generation and demand, while maintaining a satisfactory level of reliability at a reasonable cost, over different time horizons."*

  Evaluating and Planning Flexibility in Sustainable Power Systems, several authors from IEEE

Context
What we understand as flexibility?

"Ability of an electric system to respond to variability and uncertainty of supply and demand, in a secure and efficient manner, across all time scales"



Seconds
Shocks and failures

Minutes
Changes in load and generation

Hours
Ramps

Days
Availability of primary resources

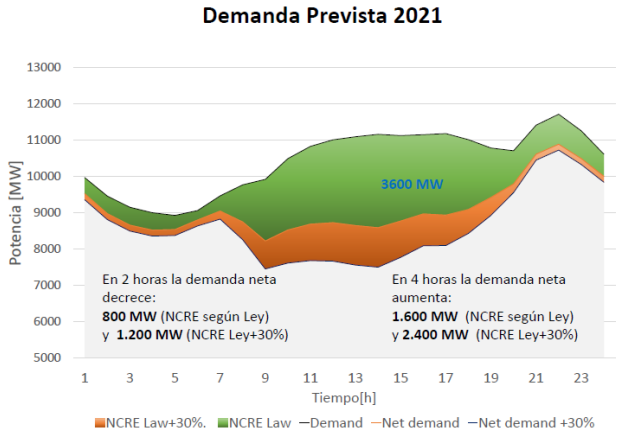
Months/Years
Availability of manageable resources

Time scale

Context

Which are the symtoms of flexibility requirements?

- ✓ Frequent operation at minimum capacity of generation units.
- ✓ Frequent starts and stops of generation units.
- ✓ Higher requirements of balance ancillary services.
- ✓ Higher ramping requirements to keep balance between load and generation.



Source: National Electric Coordinator (ISO), 2019

Context
How flexible is the Chilean system?

- Flexibility metric for the energy offer, considering minimum output power and ramping capacity (1).

$$flex(i) = \frac{\frac{1}{2}[P_{max}(i) - P_{min}(i)] + \frac{1}{2}[Ramp(i)]}{P_{max}(i)}$$

$$FLEX_{system} = \sum_{i \in A} [\frac{P_{max}(i)}{\sum_{i \in A} P_{max}(i)} \cdot flex(i)]$$

Flexibility Level(1)	FLEXsystem
High	0,63
Medium	0,48
Low	0,43

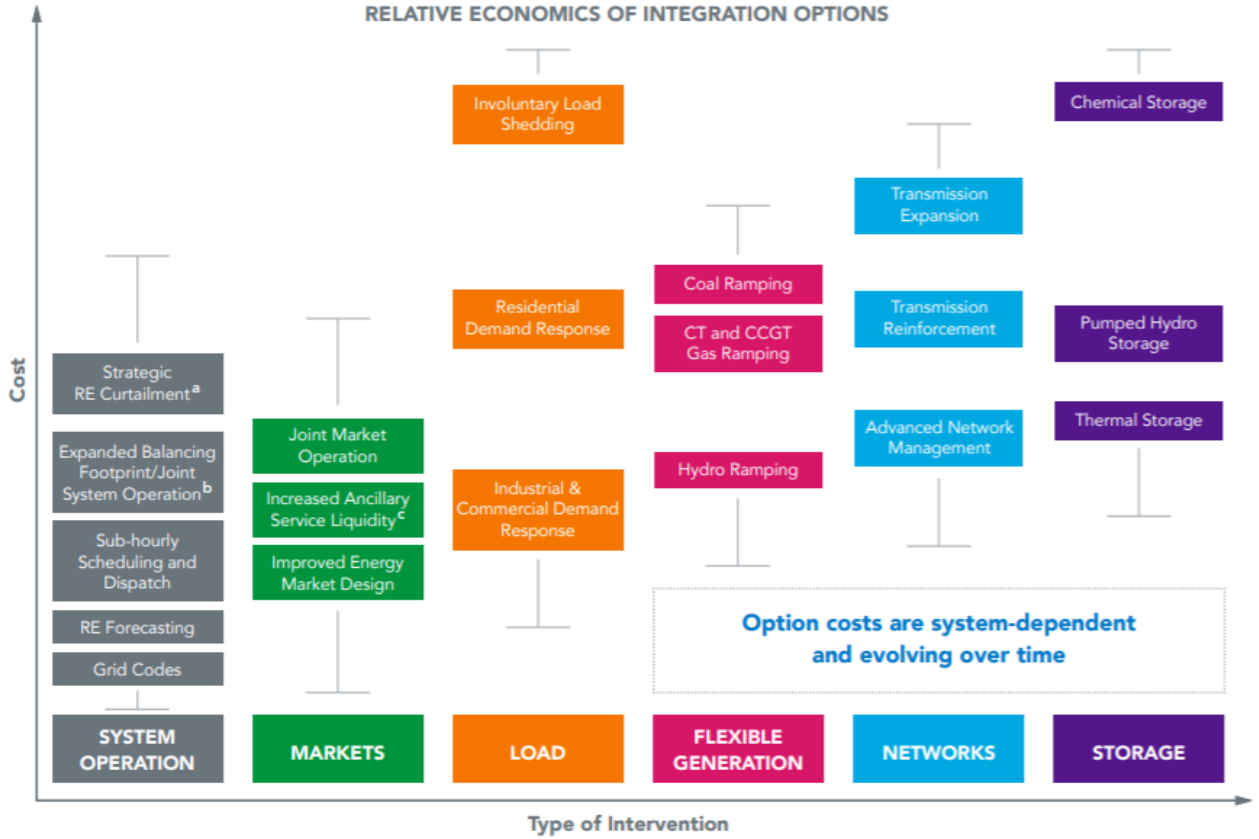
Case	FLEXsystem
Chile 2018	0,679

- It must be considered that part of this flexibility comes from hydroelectric capacity, which availability relies on hydrological conditions.

(1): Juan Ma et al., Exploring the Use of Flexibility Indices in Low Carbon Power Systems, IEEE, 2012.

Context

How can we improve our flexibility?



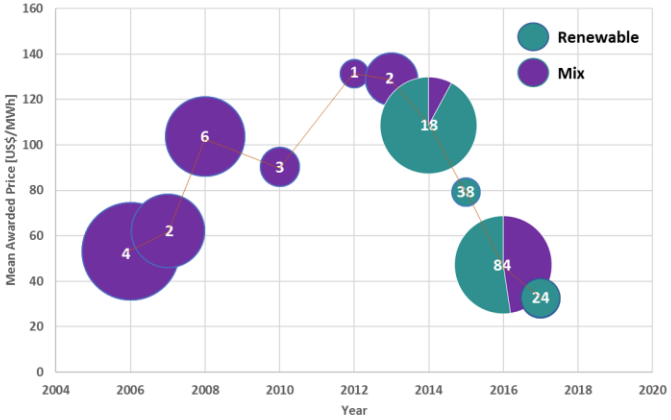
Source: NREL, 2014

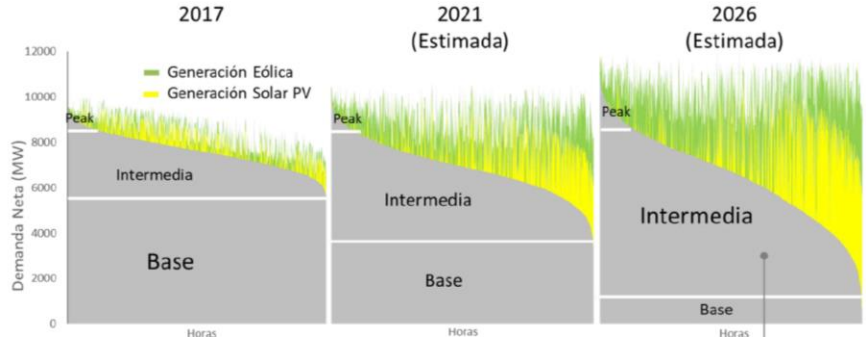
Challenges

How much flexibility we will need in the future?

- Variable renewables energy have proven to be one of the most efficient solutions.

- There is a new requirement in the energy market: balance variable generation with the demand.





The rise of the middle market

Challenges

Which role plays geothermal resources on flexibility?

- Geothermal technology uses a steam turbine, which provides inercy and frequency control like other thermal technologies.
- Doesn't have the limitations of a thermal boiler.

Item (1)	General value range
Minimum operating power (as % of Pmax)	20% – 25%
Ramp-up capacity (in %P/min)	1% - 5,3% /min
Ramp-down capacity (in %P/min)	2,8% - 5% /min
Minimum operating time, after synchronization (hours)	No limitation.
Minimum downtime, after desynchronization (hours)	Not applicable.

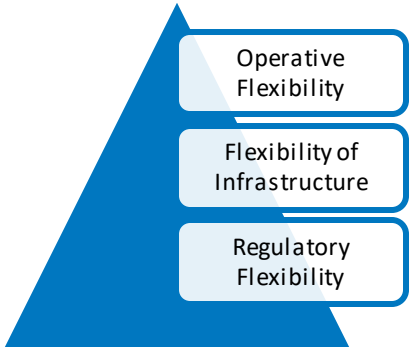
$$flex(i) = \frac{\frac{1}{2}[P_{max}(i) - P_{min}(i)] + \frac{1}{2}[Ramp(i)]}{P_{max}(i)} = 0{,}9$$

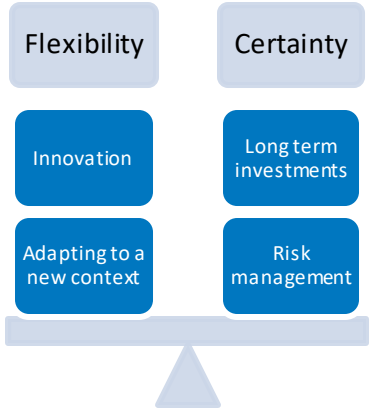
(1): Mannvit, Ability of Geothermal Power Plants to provide Ancillary Services, 2016.

Challenges

How could we get a flexible system?

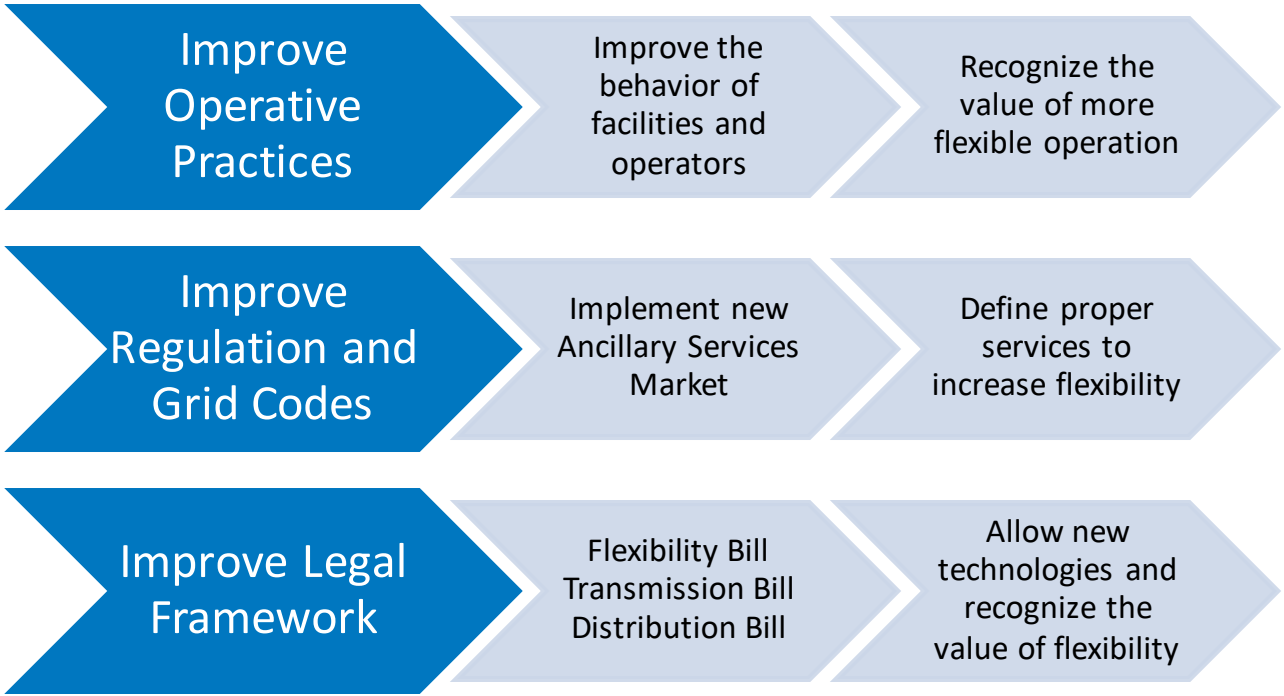
- Flexibility doesn't depend on a specific measure or technology.
- Flexibility should be considered on the regulatory framework, on the installations and also on each agent behavior.
- We must ensure a balance between flexibility and certainty that each agent get from the system.





It is necessary to define and apply a Flexibility Strategy.

Challenges
Flexibility Strategy



Secure, efficient and sustainable Electric System

Conclusion

How geothermal could be the solution to flexibility?

- There are different alternatives that can provide flexibility to the system.

It needs to be the right fit!

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Thank you