

Workshop Proceedings

Long-term Scenarios for the Clean Energy Transition in Latin America

Clean Energy Ministerial Campaign “Long-term Energy Scenarios for Clean Energy Transition”

Date: 25-26 February 2019

Place: Ministry of Mines and Energy Auditorium, Brasilia, Brazil



Event background

The climate objectives of the 2015 Paris Agreement require a global transformation in the energy sector. United Nations Sustainable Development Goals similarly call for a shift to clean energy, mainly based on renewable sources and technologies. In parallel, accelerating innovations over the past decade have changed the ways that energy is generated, distributed and used, as well as how the system operates and links with broader infrastructure. Launched at the 9th Clean Energy Ministerial (CEM) in May 2018, the Long-term Energy Scenarios (LTES) campaign aims to explore these challenges, in which IRENA is the operating agent. The CEM LTES campaign is supported by 11 CEM-member countries, among them Chile, Brazil and Mexico.

Long-term energy scenarios are a vital tool that allows assessing the complexities of the energy system described above in an integrated manner and explore the alternatives to meet national goals in terms of energy supply, decarbonisation and economic growth. However, the use of long-term energy scenarios for policymaking is often met with concerns around the reliability of the projections, mainly due to the inherent limitations that available quantitative

techno-economic tools (models) have when representing the expected technological, social, political and economic disruptions associated with a clean energy transition.

In this context and under the Clean Energy Ministerial Long-term energy scenarios campaign (CEM LTES), IRENA together with Brazil's Energy Research Company (Empresa de Pesquisa Energetica, EPE) organized a workshop to discuss regional and international best practices from governments, public utilities, and academia, in the use and improvement of long-term energy scenario planning, as well as on issues regarding capacity building. The two-day workshop gathered about 80 for energy planning practitioners and modellers primarily from the government sector.

This workshop also built on the discussions from the previous IRENA workshop: "Exchanging best practices to incorporate variable renewable energy into long-term energy/power sector planning in South America" held on August 28th – 31st 2017, in Buenos Aires, Argentina.

Meeting objectives

The primary objective of the workshop was to exchange best practices in long-term energy scenario planning in the specific context of the clean energy transition. Participants were expected to encounter novel, cutting-edge approaches, and emerge with new ideas that could be applied in their national and/or regional long-term energy scenarios development process.

More specifically, the discussion around best practices in long-term energy scenario planning would focus on the following inter-related themes of IRENA's CEM LTES campaign:

- » **Use of Long-term energy scenarios (LTES) for decision making:** how scenarios can be better used and become more relevant for policy making or investment planning under a high degree of uncertainty?
- » **Development and improvement of the LTES for the clean energy transition:** how scenarios can be improved to reflect the drivers for the clean energy transition? What are the essential elements to be included in the LTES?
- » **Approaches to building capacity for model-based scenario development:** where and how to develop capacity building for better scenario use/development?

The agenda of the event can be accessed [here](#).

Summary of the discussion

DAY 1 – 25 February 2019

Opening

Revie Barros, Secretary of Planning, MME

- Brazil is pushing for solar and wind.
- This event is timely in assessing the long-term in Brazil and Latin America. Focus on regional integration.
- Not only focusing on scenarios, but also in the methodologies.
- Suggest alternatives to plan the system and supply consumers and have a secure energy supply.
- We should also focus on capacity building on tools
- This is a high-level panel, so he expects good outcomes.

Ubiratan Castellano, Director of Energy Studies

- Overall thanks to IRENA, EPE, OLADE, fellow institutions and Latin American delegates.
- Mentions the three pillars that the LTES campaign assesses:
 - Use. It is timely for Brazil; the country is trying to assess what opportunities there are for Brazil to use its energy resources and how to better use scenarios for energy planning.
 - Development. Brazil wants to see how to handle uncertainties and the behaviour of different stakeholders in scenarios and how to include these in methodology.
 - Capacity building. MME wants to focus on two targets: how to use scenarios and how to produce scenarios; this would be of interest to other countries in LAC.
- The Ministry and EPE are working jointly. MME establishes targets and guidelines. EPE takes in these targets to produced studies. The 10-year plan, energy balance, national energy plan.

Thiago Barral, EPE President

- Thanks IRENA for the effort and MME for giving the space.
- The 10-year plan is a consolidated piece of work, but the long-term energy plan has still needed in terms of methodologies and the process itself. The MME has open the process of building long-term energy scenarios to public consultation.
- Scenarios are to show what is possible and what are the alternatives. Question is how to deal with many scenarios? What do we need to do now to achieve the long-term goal?

- Mentions the CEM. 26 countries and the European Union. The right place for exchanging experiences and this is the 2nd workshop done in Brazil. November CEM days, and February LTES.

Asami Miketa, IRENA

- IRENA's work on long-term energy scenarios.
 - RE should be better represented in mainstream energy planning.
 - Bring RE into the level-playing field.
 - Use of scenarios (raise the ambition of RE deployment – REmap). Development (AVRIL, Flextool). Capacity building (Africa, but also cooperation with UNDESA and IAEA).
- CEM Campaign
 - DE and DK, proposed the launch of campaign LTES in 2018.
 - The advantage of this group is that it has access to the Ministerial meeting.
 - Although CEM LTES is for a limited number of countries, IRENA's ETS-Net will broaden the number of countries.
 - We have been cooperating with UNECLAC, OLADE and IADB.
- Summary of CEM LTES campaign activities and collection of insights for use, development and capacity building. Workshop overview.
- The distinction between "use" of scenarios and the "use" of modelling tools. It is not the same process, but it is interlinked. The focus of the CEM LTES campaign is the government teams that use and/or develop scenarios.
- Expected outcomes:
 - Facilitate the exchange of experiences and mutual learning
 - Identify key lessons learnt (and remaining challenges) on three key themes of the LTES campaign
 - Learn from key subject experts from academia
 - Discuss future regional cooperation opportunities

Sharing country experience

Emilio Matsuyama, EPE

- Experience around the national energy plan 2030 (PNE 2030)
- EPE created in 2004, started in 2005. Federal institution linked to MME. Develop studies/statistics to support energy policymaking.
- Highly qualified staff (2/3 with masters).
- Why long-term scenarios. Create a coherent vision to have a dynamic and resilient and comprehensive strategy. Raise awareness of risks.
- PNE 2030
 - Pioneer study. Before this published no official study about long term. Took about 1.5 years to build (2005-2007). Fundamental to consolidate energy planning in the government and EPE as a producer of quality studies.
 - Eight public consultations/workshops to capture civil society and included comments on PNE. 50 experts at EPE.

- It has two volumes on specific terms. They focused on 4 qualitative/quantitative scenarios for demand. For these scenarios, they obtained 1 scenario for supply, because they realised there is a fragmented vision of the future. They used sectoral models (power, oil, biofuels). They focused on complementarity and fuel switching. They did a sensitivity analysis to assess uncertainty. The outcome was 13 guidelines to support policymaking:
 - Maintain hydropower as key for electricity expansion
 - Participation of natural gas and nuclear.
 - Energy efficiency and another RES.
- Long-term recommendations: they had some side benefits from working with scenarios
 - A change in working in an integrated matter. (within EPE and beyond). When creating scenarios, they realised the level of investments needed, which called for feedback on the economic sides of assumptions. How will Brazil grow? Economic scenarios as inputs for energy scenarios; this takes relevance when analysing a low carbon economy, which has profound implications for the economy.
 - Socio-environmental analysis moved from power to cross-cutting.
 - Working with scenarios allowed for spin-offs to support other sectors. E.g. Climate change strategy and NDC. Was discussed in 2007 support the Paris Agreement position of Brazil.
 - Other government offices saw the importance of having a long-term vision. To see the Brazilian economy.
- Lessons learned about the VALUE of LTES
 - Legitimacy: they must be led by an institution that appears to be equidistant to all stakeholders involved in the energy sector.
 - Credibility: update assumptions
 - Importance/relevance: are we making the correct questions?
- Critique to the PNE 2030: the link between scenarios and policy maker is still missing.
- The number of scenarios should be linked to the number of questions and the strategy that is being studied.
- Should we do more scenarios or more sensitivity scenario? To assess this, we need to ask the question? Does changing this parameter change the underlying assumptions and coherence of the scenario. When to do a new scenario? When the future changes in a structural way, you must do another scenario. When the PNE 2030 was developed, decarbonisation, digitalisation and decentralisation were not a big issue. But now it is unthinkable of having a scenario that does not consider this. Also, when the policy sector changes with changes in government, this will have long-term implications.
- "Scenarios do not control the future", but they help us to see a fraction of the what the future could look like. It is essential to gather experts that can give

you an idea. However, the message for the policymaker must know that the scenario is not the future.

Alex Santander, Ministry of Energy Chile

- We started to ask ourselves what was the pathway that the energy sector would take in the long-term. Not having a long-term vision made it difficult for investments to be defined or directed.
- Chile had had a renewable power generation matrix traditionally. However, this was overturned when natural gas entered the mix. Now the majority is natural gas, which is secure but high emitting. Now efforts to go back to the renewable past.
- Chile has a law (2017) that establishes the long-term energy planning must be carried out by the Ministry (minimum 30 years). It has to be a participatory process. Energy planning must be updated every 5 years.
- The planning process gave its results of scenarios in 2018.
- Inputs for energy planning:
 - Cost projections, fossil fuel projections, power demand, RE potential, distribution generation, EV projections, EE projections, heating and cooling projections, energy exchange.
 - Economic growth depends significantly on copper production
 - Exogenous sources for technology prices.
 - Targets for EV: 100% buses and 40% cars by 2050.
- Scenario building: long-term scenario planning raised much public interest. They did five scenarios and called experts to workshops. Used Delphi method. 40 stakeholders.

Questions:

- To Alex: Why didn't you consider wind offshore
 - It was a political decision to consider only on-shore. Lack of experience and sea bed not good for off-shore. However, we considered now tidal wave and hydrogen as new technologies.
- To Alex: The parameters are from models. Do the models you use allow for disruptive cases?
 - We consider sensitivities to assess disruptions of the trends.
 - However, given that the scenarios are the fruit of a consensus, this pushes the scenarios back to the general trend.
- To Alex: Chile had a polarisation: Large hydro + transmission issues, and interruptions of gas exchange with Argentina. How did these issues pollute the building of long-term scenarios?
 - Hydro was considered within environmental issues. So, the costs for large hydro have a fine, that considers the retributions to the communities.
 - Power expansion is moving in a least-cost manner towards solar PV and wind. So, it is moving without much pressure away from traditional sources such as hydro, coal and gas. They will start a phase-out of coal, which will bring new implications for scenario building.

- Regarding exchanges with Argentina, we consider these with sensitivity analysis. We also consider resilience studies to shocks in a lack of supply of gas.
- To Emilio: Are our CEO's and investor ready to use scenarios? And how to improve scenarios so they can use them.
 - Considering the number of investments that are happening in Brazil, it is inevitable that investors want to use scenarios.
 - Investors must start with at least minimal consideration about the economy to make investments. Making investing decisions in Brazil is very hard now, even more, considering possible technological disruptions.
 - The first thing investors think about is short-term; once that is secured, they start looking ahead. That was our experience when we built the PNE. When we asked investors for their opinion 20 years ahead, they didn't have a deep understanding of where they were headed. Investors wanted answers for the short-term.
- To Emilio: How can you measure the assess and the credibility and legitimacy of a scenario? Is credibility a recipe for conservatism? How do you see those disruptive elements are consistent with the credibility of scenarios?
 - Credibility, for us, is that people see the leader of scenario building is equidistant to all stakeholders. Moreover, you are approachable. If EPE is part of the conversations of a particular sector, it means that EPE has credibility.
 - The methodology must be continuously scrutinised by the public, as well as assumptions. Some sector doesn't agree, but they understand where the assumptions are coming from.
- To Emilio: Do you consider strategies to change demand behaviour in the scenarios?
 - Energy efficiency is a big discussion — both on supply and demand. For example, EV has EE issues both on supply and demand.
 - In our model, prices are not driving the model because this still has not been solved in Brazil with robust CGE models.
 - Alex: Chile uses LEAP to project demand and trends. However, they do not do it integrated: transport, residential and mining. Know they are trying to go for an optimisation model for the whole energy sector to see how these interact. We also want to see how all sector cons tribute for decarbonisation.

Ezequiel Mladineo, Ministerio de Energia, Argentina

- They have currently 4% of RES in power, but contracts will allow for 17.5% in 2021.
- Argentina has created a series of hedges to RES investment, so problems with the economy do not affect the investors. There is a trust fund (FODER) backed by sovereign guarantees. Also, there is a WB guarantee.
- They must, by law, allow all RES technologies: wind, P, biomass and small hydro. Also, there must be a geographical distribution.

- Planned for large renewable projects but soon ran out of HV transmission capacity. Created a new programme to foster smaller capacities connecting directly to MV transmission lines and the distribution companies.

Martin Cordovez, Instituto de Investigación Geológica Energética, Ecuador

- In 2018 there was a fusion of the Ministry of Electricity, Ministry of Hydrocarbons and Ministry of Mines to have only one big Ministry of Energy and non-renewable energy resources.
- The IIGE, is responsible for the Energy Balance, but the power regulator and the hydrocarbon regulator oversee building power and oil scenarios, respectively.
- Scenario process starts for historic information and defining exogenous and endogenous variables, this leads to the BAU scenario. Key to have useful basic information, and proper coordination with the sector providing this information.
- What are the challenges to improving scenarios?
 - Not only focus on fuel switching but technology switching.
 - Not only focus on energy efficiency but distributed generation
 - How to tackle subsidies?
- We have developed an MCA to select places for wind and solar farms (zoning).
- Still to develop:
 - Final Energy uses -> no data.
 - End-use Energy balance.
 - Urban PV and wind resources.
 - Other models that can be linked to the energy models.

Daniel Puentes, Viceministerio de Minas y Energía

- Energy scenarios for Paraguay published for 2013-2040. They out-sourced to Fundación Bariloche. Final energy balance is done within the ministry, but end-use energy balances is a challenge.
- The greatest challenge for planners is to articulate with other plans that the government is producing.
- The National Growth Plan asks for growth in 60% of RES and reduction in 20% of fossil fuels. Also, promote the use of biomass.
- Working on a scenario project 2015-2050 with IAEA. They used LEAP previously and now they are working with IAEA. They are doing a subregion approach with Brazil, Argentina, Uruguay and Paraguay ("Cruz del sur"). The objectives of these projects are:
 - NDC.
 - SDG
 - Mobility
- Future Actions:
 - Work in an Energy Agenda. Update the Energy policy for 2040
 - Update scenario up to 2050.
 - Update useful and final energy balances.

Vittorio Scopelli, Ministry of Energy, Uruguay

- Connected with Argentina for the last 40 years with 2000MW capacity. Since 2001 with Brazil (500 MW).
- Uruguay has 95% of RES in the power matrix.
- The utility UTE used to do the planning. However, now it is the responsibility of the Ministry of Energy, since 2006.
- The energy plan is indicative and not normative.
- Most important variables are:
 - Annual hydrology that sets the energy price for the next year.
 - Oil and gas prices, Uruguay does not have any.
 - Demand: that shows when to do system expansion.
- Developed a multi-party state policy in 2010; this gives security to investors because it does not depend on who wins the elections.
- Energy planning objectives are the least-cost expansion and the security of supply.
- How to improve the scenario process:
 - Make the energy plan public, this would help investors.
 - Improve the utility of energy planning within the context of national problematic
 - Economic assessment of energy-intensive projects
 - Tariffs, scenarios show a surplus of power, what is going to be done with that excess?
 - Cost of security of supply.
 - Development of grid and other investments.
- Recommendations:
 - Participatory process and discussion with stakeholders. This creates trust in the ministry and the plan.
 - Exchange the experiences in the region.

Questions:

- To all: How do you consider cross-border energy exchanges. Do you consider a need for such a study?
- To all: How are the international options being included. What happens when the Itaipú contract runs out? Paraguay could use domestically all the power that it currently exports to Brazil. Likewise, the exchanges of natural gas between Chile and Argentina.
 - Brazil: The Itaipú contract will not close. It continues but needs to be renegotiated.
 - Argentina: We haven't had any issues with Uruguay, Chile and Brazil.
 - Ecuador: We have power exchanges with Colombia and Peru. We have included in our scenario's further energy exchanges. We have even considered exporting to Chile, through Peru. However, we have realised that this depends on each country's ability to comply with national infrastructure for exchanges.
 - Paraguay: Last January (2018), the IAEA started a project that has the objective of building sub-regional energy scenarios: Argentina, Brazil, Paraguay and

- Uruguay. The project's name is 'Cruz del Sur'. In March 2019, there will be a workshop in Rio to see the progress of this project.
- Uruguay: We do not take into consideration international exchanges in the long-term. We do sensitivity analysis.
 - Brazil: in LAC, we have a strong focus on energy security and self-sufficiency. What is missing is strong evidence of on-going international exchange projects.
 - To all: How is the regulatory framework of the countries considered in long-term energy scenarios. The country is currently undergoing reforms in law and regulation, and this positively impacts long-term assumptions.
 - Argentina: We consider the 20% by 2030 target of renewables that the law prescribes. This value was determined by the system operator, through sensitivity analysis (min and max demand, min and max supply) with multiple scenarios. 20% seemed like a rational value.
 - Ecuador: Traditionally, the State was the sole investor in generation, transmission and distribution. However, now the sector is opening, and this changes the scenarios regarding the projects that the government had considered. Also, if we are considering a future with distributed generation, we need to change the law and policies to allow for this. Scenarios must reflect this change.
 - Argentina: NDCs are influencing how we are developing scenarios. NDC compliance will shift us away from what we consider to be the least-cost/optimum expansion plan.

TECHNICAL SESSION 1 – USE OF LONG-TERM ENERGY SCENARIOS FOR DECISION MAKING

Pablo Carvajal, IRENA

- The use of scenarios is many times separate from the development.
- Mention 5 fundamental issues that have appeared in the use of LTES:
 1. Effective policy making vs a full range of exploratory scenarios.
 2. Centralized planning vs participatory process
 3. Nature of scenarios: types according to organization and purpose.
 4. Communication to policy makers: transparency, inter-comparability and diversity of assumptions.
 5. Coordination of scenario planning.
- Examples for coordination of scenario planning in Canada.
- Examples UK and DE on stakeholder engagement.

Elaine Marcia, IPEA, Brazil

- Fundamental for building scenarios: we want to find information about the future.
- Characteristics of the future:
 - Multiple and uncertain
 - Impossible to predict
 - Improbable

- Influence by environment forces
- Change in current conditions
- Scenarios are the best tool to explore the future, however, we do not build scenarios hoping to forecast what is going to happen.
- Why is it so hard to have clean energy transition scenarios?
 - The paradigm is not consolidated: it's a transition.
 - Many technologies are not fully developed. Examples are given.
 - The unusual could appear anytime.
- Energy is more strategic than water. If you have energy, you can reach, treat and reach water resources. Without energy you cannot do any of this.
- Many of the problems that we have today are because we didn't develop long-term visions in the past.
- However, people rarely use the whole range of scenarios that they develop. Picking one scenario out of four, for example, leaves out other characteristics of what had been thought. This can cause a strategic risk -> incorrect use of scenarios due to low credibility and therefore wrong decisions.
- Policymakers like having numbers. Having only qualitative scenarios has credibility issues.
- How to improve scenarios:
 - Need to train the people using scenarios, i.e. policymakers.
 - Participatory process
 - Contingency plans – have worst case scenarios.

Questions:

- To Elaine: You mentioned the importance of capacity building in the government. Do you have any experience building this capacity?
 - We have made a great effort to build capacities. We had a project called Brazil 2035, in which stakeholders had a chance to understand how scenarios work.
 - We are limited by the people that are willing to teach how to use scenarios.
- To Elaine: How do you see the transition between the educational process of understanding scenarios and reaching the actual decision makers.
 - Education is long-term. The issues that we need to start, and we don't.
 - One thing we have done to reach the minds of executives is to make them start thinking about uncertainties; this helps the executive to understand the importance of scenarios.
 - An additional strategy is to engage with the policymakers, make them many questions. Make mid-project presentations/initial results.
 - Include scenario analysis in university programmes.

Ubiratan Castellanos, Director of Information and Energy studies, MME

- Energy planning in Brazil:
 - Strategic vision – 30-year horizon, National Energy Plan

- Programme vision – 10-year horizon, National Energy Expansion Plan. Energy auctions are designed based on this plan for power, transmission and biofuels.
- Monitoring – 1 to 3 years
- National Energy Balance, since 70s, from 2004 is done by EPE.
- The Secretariat of Energy Planning and Development concentrates long-term energy planning and the agencies working on energy planning. It also coordinates the elaboration of the ‘instruments’ for energy planning in Brazil i.e. Plans.
- There is a feedback loop between the MME and the EPE. EPE does studies that feed into the MME policy development. The difficulty is that studies take a long time to develop. When EPE sends the study over, many times, the assumptions and considerations for scenarios have already changed.
- There is a National Energy Policy Council that takes into consideration the studies that the Secretariat of Energy Planning and EPE are producing. However, they mostly want the conclusion and the final recommendation. If we show up with four alternatives, that is no good.
- From the PNE 2030 to the PNE 2050, there have been complexities that are being introduced.
 - Demand behaviour
 - Transport
 - Storage
- MME’s most recent advancement is to make a public consultation on the “process for energy planning”, 45 days open to the public on MME website. MME needs to “open the game”. What was consulted was:
 - Agenda for energy planning: what are the milestones for energy planning to produce a national energy plan every 4 years? Revision stages, writing up, scenario definition, etc.
 - A systemic approach to socio-economic projections.
 - Inter- and intra-sector governance.
 - How to use the results of the energy planning process
- The top priorities to improve energy planning in the MME are:
 - Capacity building

Alex Santander, Ministry of Energy, Chile

- There is an “Energy Route 2018-2022” that provided 7 Axis of action to move Chile’s energy sector towards sustainability.
- Long-term energy planning (every 5-year, 30-year horizon) is carried out by the Ministry of Energy, while Transmission planning (yearly, 20-year horizon) is carried out by the National Energy Commission.
- Long-term energy planning is seen to provide a series of ‘products. Energy scenarios for supply and demand are one product, but there is also an additional product name "development poles", which seeks to find specific regions that can develop a

resource and what the State needs to do to promote private investment in such region.

- The long-term energy planning process is a 5-year process. It must have yearly update reports on assumptions.
- 40% of Chile's power is generated from coal. An agreement has been signed for no more coal plants.

Questions:

- To all: What are the common things that policymakers look for in scenarios? What is still missing in scenarios?
 - Brazil: Given that we are in a period of significant uncertainties. We would like to have scenarios that methodologically include these — thinking that we understand all the possibilities that might come, and how to prepare for them. A scenario must help me prepare for uncertain outcomes and identify the main routes the country can take; this in a systematic way so that policymakers have more elements to decide, instead of just gambling the future of the country. They should be useful to quantify the costs of the different pathways. It must show a number.
 - Chile: we would like to see decarbonisation of the whole energy sector. How can we combine power planning (which is well developed in terms of models) with whole system energy planning? We want to see the sectoral switches in terms of energy. Be able to communicate in simple messages that can be digested by the civil society.
 - Brazil: we did a 'multi-innovation' study to assess what technologies and what trends could appear in Brazil in the following decades. It was a scenario study of innovation that helped create inputs for energy scenario modelling. This innovation study helped to identify the routes for energy technologies.

TECHNICAL SESSION 2 – IMPROVEMENT OF LONG-TERM ENERGY SCENARIOS FOR THE CLEAN ENERGY TRANSITION

Pablo Carvajal, IRENA

- Overview of the objectives of the session: Development of scenarios.
- Examples of Finland and NREL

Camila Ferraz, EPE, Brazil

- The first step for scenario assessment is to do retrospective analysis.
- Challenges identified when developing scenarios:
 1. Scenarios are not an end itself and should not be confused with a plan.
 2. Focus on one scenario, without assessing disruptions and uncertainties.
 3. For the short-term (5 year) extrapolation maybe worthwhile, not all scenarios have to have complicated models. However, for the long-term, more complex scenarios are needed, but only if they are flexible enough to consider disruptions.

4. We have three ways of approaching the future:
 - Passive: no action at all.
 - Reactive: trying to manage all emerging issues when they happen.
 - Anticipative: use scenarios and plan.
- Lessons learned by EPE when doing the PNE 2050
 1. Definitions of scenarios methodology and governance vary significantly according to the objectives and conditions of each institution.
 2. Broad participation. Petrobras did their scenario in-house; they had stakeholders accompany the whole process of scenario building, not just to validate at the end.
 3. Exploratory scenarios. Some experience limits a priori what the scenarios need to say.
 4. Sponsors of scenario building must be involved in the whole process.
 5. Positive influence on the organisation's image.
- Last year in November, 24 employees of EPE participation in training for Construction of Prospective Scenarios. EPE will keep on doing workshops to train its employees.
- EPE identifies three stages for scenario building:
 1. First stage: sensibilisation and definition of scope.
 2. Planning: Scenario work plan.
 3. Implementation: a retrospective analysis, scenario definition, uncertainty prioritisation, scenario building and consistency/adjustment tests.
- Cross-cutting to these stages is capacity building and workshops.

Questions

- To Camila Ferris: You assigned a value to scenarios from Petrobras that I don't seem appropriate. Nobody uses those scenarios, what is relevant from Petrobras is not at the same scale as EPE's
 - It is hard to know who and how energy scenarios are used in Brazil. What we do know is that they have contacted us to ask how to improve the scenarios.

Leonam Guimarães, President, Electronuclear, Brazil

- RE and nuclear are not incompatible.
- Presented study of IEA and NEA for Projected Costs of Generating Electricity (2015), that did not consider grid enhancement, balancing, frequency control.
- Then presents the study "The Costs of Decarbonisation" from OECD and NEA.
 - This study does 8 scenarios, from Base case up to 75% VRE.
 - Considers: profile costs, balancing costs, grid costs, and should also include inertia cost.
- Study recommendations:
 - Recognise and be fair about system integration costs.
 - Encourage new investments
 - Ensure adequate capacity and flexibility.
 - Carbon pricing to decarbonise

- Policy needed for fast transition
- Presenters conclusions:
 - Nuclear power's advantage lies not in its plant-level costs, though competitive. Instead, it resides in its overall benefits to the electricity system.

Questions:

- Do you have any ideas about smaller and modular nuclear reactors?
 - Nuclear will continue to develop small modular reactor because of the US policy towards nuclear. All other nuclear energy developments are subsidiaries of US nuclear energy. The US is now looking back to nuclear and push this through.
- Brazil is growing very fast, and all technologies have space. Could you please talk about how nuclear complements VRE, given its inflexibility?
 - When I talk about complementarity, I am talking about the base load that nuclear can provide to give robustness to the system; this gives more space to VRE to deal with other variable loads. I should not have said complement, somewhat 'compensate'. Nuclear, with its low operational costs and dispatchable energy, compensates the higher integration costs to deploy VRE.

Claudia Cronenbald, WEC

- WEC is present in 10 countries in LAC, and they have done a study of energy scenarios for LAC.
- Socio-economic overview of LAC: Commodity exporting region, high urbanisation, mixed growth, high inequality.
- Energy sector drivers: innovation and productivity, geopolitical changes, focus on sustainability and CC.
- For LAC, they created three scenarios (2017)
 - Samba: market-driven
 - Tango: sustainability and policy-oriented
 - Rock: isolation.
- Emission would peak in 2030 in the Tango, and in 2040 for the Samba and Rock.
- Most significant risks for LAC: extreme climate (impact on hydropower), poor diversification of energy sources y social inequality.

Questions:

- To Camila: What tools do you use to validate a plan? Especially if they are indicative?
 - EPE's scenarios are indicative, not normative. Our scenarios are not to be confused with a plan. The PNE 2030 presented several scenarios that are obtained after extensive sensitivity analysis. For 2050 we include new methodologies. Monitoring scenarios and plan is not a trivial thing. How to monitor a plan that is for the long-term? What we monitor is the assumptions and their validity when we update our scenarios. In the power sector, we validate the assumptions regarding the integration of renewables, if we see the assumptions are too conservative, then we correct for more ambitious assumptions

- To Claudia: We have a hard rock scenario in LAC. Eletrobras, Petrobras, PDVSA and big energy companies that were promoting integration are now broke. All countries that have presented only talk about domestic success stories. I would like to see how Chile and Uruguay (success stories in PV and wind, respectively), could have had lower costs if we would have had more integration in LAC. I would like that the WEC assess the 'over cost' of success stories of individual countries.
 - We like to think that we make rational decisions. Moreover, now we see that the hard rock scenario is happening, albeit it not being the most rational one. We know that integration would result in economic gains. However, we have short-term policies that make success stories to appear cheaper and nicer.
- To all: If you could change one thing of how your models work, what would that be?
 - Camila Ferris: move toward multicriteria analysis and combine qualitative and quantitative analysis. Move away from cost optimisation and move towards disruptions.
 - Leonam: we are a utility. What we are missing is what I presented. Move away from LCOE of technologies and understand the system cost. We are omitting the capacity of the system to absorb larger shares of VRE. There are a series of vulnerabilities when the system is assessed as a whole
 - Claudia: we are working to include views not only from experts but also from the broader civil society, academia and NGOs. Incorporate the view of an ever-growing number of stakeholders. This is a challenge because when we build scenarios, we gather with like-minded people.
 - Camila Ferraz: no single model can include all stakeholder views. Moreover, among many views, we need many models that approach the same question from different angles.

DAY 2 - 26 February 2019

Technical session 3 – Capacity building

Rafaela Guedes, Petrobras

- Scenario planning has a long history in Petrobras, since 1986.
- Petrobras has scenarios up to 2040.
- Had to create a new design methodology and new projects management with secure backup from senior management. The process was very much inward. First, engage with different areas of the company and build an in-house multidisciplinary team. There was also a need to train people from other areas of the company so that they could contribute to the creation of scenarios.
- Scenarios must be on focus, and with a clear objective of what your industry requires, this cannot be forgotten, because it is a tool for decision making. If it is not aiding decision making, then the scenario has failed its purpose.
- The key drivers for the scenario construction came from within the company employees, through moderated workshops.

- At the end of the day, everyone “sees” oneself represented in some way in the final scenarios. The scenario must be an organic representation of the company.
- Final scenarios need top approval; if made right, management will see their questions answered.
- Final remarks:
 1. Scenarios need to answer concrete questions for the organisation’s goals
 2. Scenario training and a full set of skills are essential.
 3. Participation is the key to legitimacy.

Questions:

- To Rafaela: How are the scenarios used in the decision process in Petrobras?
 - Scenarios must be flexible enough to be resilient for changes in CEO mindset. Each CEO has a different vision for the company; we try to adjust our scenario to these ideas.
 - We carry out a sensitivity analysis with different shares of RES in Brazil.
 - Elaine: scenarios should challenge the pre-conceived views of the CEOs, not affirm their beliefs.

Medardo Cadena, OLADE

- OLADE provides several tools for energy planning: statistics, energy planning manual, energy balances, energy model (SAME), capacity building.
- OLADE has the SAME model, which is a simulation model of supply and demand. It has a user interface and allows to create reports (communication tool).
- OLADE did a study to analyse the efficacy of LAC's energy policies to reach NDC goals by 2030, and if needed, suggest more ambitious goals for the region. Resolution of the study: Brazil, Mexico, Central America, Andes, Southern cone and Caribbean. The study concludes that the current trend fails to meet the NDC goals in the region.
- OLADE carried out a study that compared global primary energy demand scenarios from 12 agencies/companies for the LAC region.
- OLADE has created the 'redLAC', a network where experts in energy planning of different countries can find and share tools, scenarios, balances, plans, etc. They will also carry out a webinar series.

Questions:

- To Medardo Cadena: Can you please differentiate between plan, planning, scenarios?
 - A plan is a product of the planning process. The plan depends on the vision of the country. Scenarios help to formalise the view with a consideration of internal and external factor that builds a consistent storyline for the future.

Bernardo Bezerra, PSR

- PSR has 60 people staff (highly qualified: 17 PhD, 31 MSc), working in over 80 countries.

- Different areas of knowledge are needed for scenario building
- PSR is studying the impact of new market designs. Moving from an “energy only” market design to a long-term multi-product market design (with other services such as frequency control). These ancillary services of energy are being included in the optimisation process.
- Energy models and scenarios should take into consideration different types of market designs and the corresponding technology development in energy for each one.
- Conclusions:
 - Challenges for model-based scenario development: higher data volume, higher coordination between generation and transmission expansion, higher spatial and time granularity.

Questions: What are the particular challenges in scenario building capacity?

- OLADE: Constant political and technological changes: need to align government, privates and academia.
- PSR: Need to understand how to implement the vision in models. Investor risks, regulatory processes and market designs of the sector.

TECHNICAL SESSION 4 – ACADEMIC PERSPECTIVE ON SCENARIOS FOR THE CLEAN ENERGY TRANSITION

Alexandre Szklo, UFRJ

- For the clean energy transition, we need IAM’s. Because we need to assess the opportunities, trade-offs, benefits and interaction of multiple sectors.
- We are developing and linking models: land, water, energy and climate (CLEW Nexus).
- Brazil is the only developing country that counts with a homemade Global IAM (COFFEE), which they link to a national model (BLUES), both in MESSAGE platform.
- What’s next for tool development (IAM)?
 - Improve “satellite” models: oil refining model, petroleum production, power dispatch, etc.)
 - Improve material flows, including bio-platforms
 - Improve water balance
 - Improve shipping
 - Adaptation to global climate change (land, hydro, thermodynamic cycles, A/C demand).
 - Spatialise biomass conversion.
 - Always be modest: there is always something not thought of.

Nicolas Sbroiavaca, Fundación Bariloche

- FB has worked in 14 countries in the region, developing energy policies based on energy scenarios.
- Capacity building of 1000 professionals in the region on LEAP.

- Lessons learned:
 - Political will and social backup when developing scenarios.
 - Local stakeholders need to have the tool, know how to use it and learn about it.
 - Build a team that centralises: changes, proposals, analyses consistency, interactions among sectors.
 - Continuous capacity building in the government.
- Challenges for model-based energy planning:
 - Link energy models to have feedback with the economy and environment.
 - CC impact on energy resources (hydro)
- Good practices for communicating scenarios:
 - Map the stakeholders, their interrelations and the potential for conflict (vested interests).
 - Building capacity in governmental advisors, the people next to the policy and decision makers.
 - Short, clear and visual messages that derive from scenarios. But include error margins!
 - Politicians time does not coincide with research and technical assistance organisations time. Develop tools and scenarios that can give timely answers. Identify milestones in the country. What is the priority to decide for the country?

Joisa Dutra, FGV

- What's the situation of the Brazilian energy transition?
 - Hydro dominated system
 - Introduction of large shares of wind.
 - Climate variability impacting runoff.
 - Socio-environmental opposition to expanding hydro
- Explore the role that natural gas could have to diversify the energy matrix, but we need to assess the liberalisation of retail markets of gas to do so.
- They do a study to assess scenarios of reforming the gas industry sector from three approaches:
 - State economics and public finance.
 - Gas distribution companies (Discos, who are opposing the reform)
 - Risk management.
- Used a partial equilibrium model.

Ceres Cavalcanti, CGEE

- Technology scenarios for the power sector.
- Mapped technologies in five parts of the power chain: generation and storage, transmission, distribution, energy efficiency and system issues.
-

TECHNICAL SESSION 5 – FUTURE REGIONAL COLLABORATION AND WAY FORWARD

Ubiratan Castellano, MME

- Presents on the Forum of Regional Planners lead by UN ECLAC.
- Like the meeting minutes.

Asami Miketa, IRENA

- Presents IRENA's work on REmap, Flextool, ETS-Net

Questions:

- To Asami: What is your impression on the campaign so far?
 - We have an opportunity to witness a global debate on the use of long-term scenarios. It's an opportunity to see what countries are doing.
- To Asami: How to implement the energy transition in countries that don't want to move in that direction?
 - IRENA does not want to preach, only works with interested countries walking in the clean energy direction.
 - Within countries: different stakeholders have different opinions — example of Japan.
- To Asami and Ubiratan: How to improve the gathering and management of base information?
 - Asami: we are starting to enter the South American region, and for now, we do not support data management.
 - Ubiratan: We have much information. Olade provides much training for data management and has a platform with energy balance data for the whole region (sieLAC).
- To Asami: is there a way to benchmark countries in the region, as to identify the ones that are lagging in terms of energy planning?
 - We haven't targeted LAC countries, but we have done so in West Africa.

Closing

Thiago Barral, EPE

- We have had very heterogeneous presentations or real applications. It is good also to see other countries in the region willing to join efforts in improving long-term energy planning.
- EPE has a firm commitment to keep working with the MME and LTES.

Asami Miketa, IRENA

- We thank Brazil and Chile, our LTES members.
- We are happy to help share Brazil's experience to the world.
- Exchanging best practices of different countries, good to see perspectives from other countries.
- Need to synthesise the outcomes of the meeting.