CHILE CALIFORNIA COUNCIL

CHILE-CALIFORNIA ENERGY ALLIANCE

ANNUAL REPORT

2021-2022

Thanks to our Partners

We want to give special thanks to the Ministry of Foreign Affairs and the Ministry of Energy of the Government of Chile, The California Energy Commission, Acesol, Generadoras de Chile and World Energy Council Chile for supporting our work that made everything possible.

We welcome more partners to join us in our endeavors.

BE PART OF OUR PROJECT

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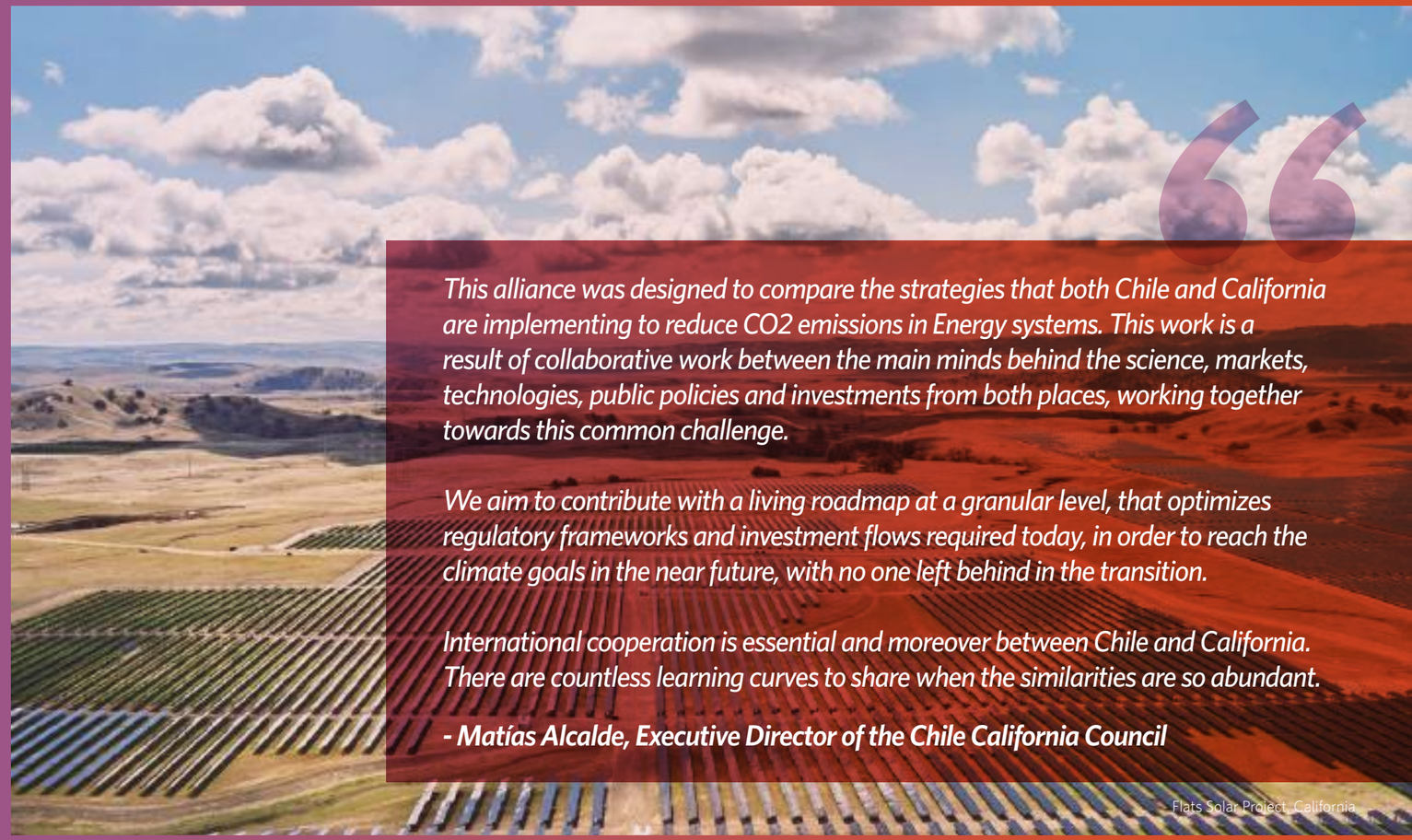


This alliance was designed to compare the strategies that both Chile and California are implementing to reduce CO2 emissions in Energy systems. This work is a result of collaborative work between the main minds behind the science, markets, technologies, public policies and investments from both places, working together towards this common challenge.

We aim to contribute with a living roadmap at a granular level, that optimizes regulatory frameworks and investment flows required today, in order to reach the climate goals in the near future, with no one left behind in the transition.

International cooperation is essential and moreover between Chile and California. There are countless learning curves to share when the similarities are so abundant.

- Matías Alcalde, Executive Director of the Chile California Council

Flats Solar Project, California

The Energy Alliance

01

We are on the cusp of irreparable damage to our planet due to GHG emissions being emitted from multiple sources.

Energy is the industrial sector responsible for about 60% of the GHG emissions in the world. However, it is the area with more opportunities to address decarbonization and chart the path to the true zero-carbon energy mix.

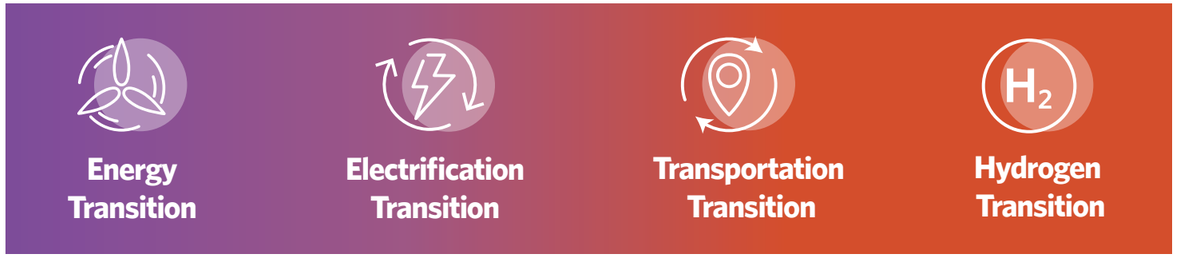
Climate change is an urgent matter that our society and economy need to address holistically. There are untapped opportunities to mitigate climate change and accelerate carbon neutrality by using policy, incorporating market dynamics, and including society. This Energy Alliance between Chile and California pretends to be a toolkit of challenges, opportunities, and lessons learned for each Transhemispheric Twin to reach carbon neutrality goals.

Chile and California share unique similarities, yet the development level is dissimilar in that both can collaborate effectively towards accomplishing their goals. The learnings of the Energy Alliance, the first of multiple initiatives going forward, apply to these particular geographies and many regions in the world. This Energy Alliance sets a precedent of collaboration to develop and implement effective solutions.

This initiative started in 2021, catalyzed by the Chile-California Council, as one of many exchanges between public and private organizations and individuals to help our geographies prosper sustainably.

This first Energy Alliance exchange consisted of four virtual sessions with experts from recognized institutions, academic boards, and individuals. These sessions allowed participants to concentrate on takeaways, learning, and interchange of knowledge, focusing on tackling pieces of the pie and generating tangible next steps and recommendations in each session.

The topics covered were:



The sessions were divided into three main blocks: (i) context on the challenges and opportunities for each transition in Chile and California, (ii) three simultaneous group discussions, and (iii) an open floor dialogue with findings and takeaways from group discussions. In each session, participants were individually assigned in advance to one of the following group breakouts:

- Addressing with Strategy & Principles
- Adopting Best Practices
- Thinking the Future Economy

The Chile-California Council wants to thank the Chilean Ministry of Energy as one of the main propellers of this initiative and our sponsors: ACESOL, Generadoras de Chile, and the World Energy Council. Special thanks to the California Energy Commission for their unrestricted support and collaboration. Finally, we want to thank each participant of these sessions. We are very grateful for having interacted with each of you and for your tremendous contribution and generosity in building this Energy Alliance.

Participants:

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Gabriel Guggisberg
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Roberto Araos
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Nicolás Westenenk
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Alana Sanchez
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Héctor de la Torre
California Air Resources Board

Ignacio Fernández
Southern California Edison

Brian Goldstein
Energy Independence Now

Juan Carlos Olmedo
Coordinador Eléctrico Nacional

Fritz Foo
California Energy Commission

Trinidad Castro
World Energy Council Chile

Juan Silva
Chile California Council (2020-2021)

Session 1: **Energy Transition**

On May 19, 2021, the Chile-California Council and the Ministry of Energy of Chile held the first working group discussion regarding Energy Transition. This session helped draw a common ground of current challenges, opportunities, and goals that both Chile and California have.

The session started with a presentation of the Chilean Government's plan for decarbonization and was exposed by Gabriel Prudencio, former Head of the Sustainable Energy Division at the Ministry of Energy of Chile, followed by CEC's plan for decarbonization presented by Commissioner Andrew McAllister.

The main highlights for this Energy Transition session were three:

1. Collaboration for a fast and successful path to the energy transition.
2. Genuine society commitment by involving communities early in the process.
3. Strengthened institutional relationships for value-driven projects development.

This session ignited a concrete collaboration agenda by identifying incentives, strategies, technologies, and areas for long-term investments required for a successful transition to clean energy. Chile and California have tremendous similarities, yet strategies, approaches, and scales are different.

Antofagasta, Chile

02

Energy Transition in Chile

Gabriel Prudencio
Former Head of Sustainable Energy, Ministry of Energy of Chile (2018-2022)

Chile is currently on the path towards carbon neutrality by 2050 under the Paris Agreement and the Sustainable Development Goals. Chile has deployed different strategies that focus on the most polluting industry. The energy sector is responsible for 78% of the GHG emissions in the country; 32% comes from the electricity sector, and for that reason, decarbonizing the electricity grid is an excellent opportunity to fight climate change.

The Fair Energy Transition Strategy has been developed to promote a transition that includes everyone and reduces the social effects. This strategy will focus on fair and equitable social and environmental development with a strong focus on fostering new green employment that will enhance the quality of people's lives and improve the environmental conditions in those areas where energy infrastructure is placed. The development of this strategy contemplates the participation of diverse social actors, local governments, union representatives, private companies, nonprofits, and local organizations.

There are four central pillars to address carbon intensity reduction on the grid: Coal phase-out and increase of renewable energy, energy efficiency, green hydrogen, and electric mobility.

Chile released the Zero Carbon Energy agreement in 2019. It is an agreement between the Ministry of Energy and electricity generation companies that stipulates the coal phase-out by 2024 with the closure of eight thermoelectric power plants. It also mandates all new coal projects be developed with carbon capture and storage.

The Chilean Ministry of Energy has published the first energy efficiency law, crucial to reaching carbon neutrality. Chile will achieve almost 40% of the decarbonization target by implementing energy efficiency measures. It is expected that by 2030, the application of these measures will reduce energy intensity by 10% and 28.6 million tonnes of CO2.

Cerro Dominador, Chile

Energy Transition in California

Andrew McAllister
Commissioner at California Energy Commission

California has committed to carbon neutrality by 2045, under six main driving pillars:

1. Transportation
2. Industrial
3. Building Decarbonization
4. Load Flexibility
5. Energy Efficiency
6. Research & Innovation

These drivers have been an essential part of California's efficiency strategy in the long run. GHG emissions per GDP in California have felt almost half in the last 20 years. The role of public entities has been a significant driver of pushing and deploying new, more efficient technologies, which has resulted in a diversified energy portfolio.

However, there is still a long road ahead for carbon neutrality. California needs to triple the current solar and wind build rate while increasing the energy storage build rate by eight times to reach the 2045 goal.

The State needs to continue supporting technological development in storage technologies that have already provided significant reductions in the price of batteries and faster-charging speeds. In addition, California has to continue developing carbon capture technologies on existing gas plants, hydrogen technologies, and other sources of emission-free technologies.

By 2019, 63% of the energy produced was carbon-free, including hydro and nuclear (not considered renewables). More recently, in March 2021, the entire energy matrix of California reached virtually 100% carbon-free generation (for a couple of hours) as a pilot testing program.

Among the short- and medium-term challenges is investing heavily in the clean energy transition, energy efficiency, and climate response.

In energy efficiency, California has the most aggressive Energy code in the country, setting the requirements for the market to accomplish milestones in 3, 6, and 9 years. Building these energy codes has been key to making the go-to-market faster and more visible new developments.

Stateline Solar Farm, California

Addressing with Strategy and Principles:

System planning in the context of a massive insertion of renewables energies.

San Francisco, California

Aura Rearte
ACESOL

Matias Alcalde
Chile California Council

Nicolas Westenenk
Generadoras de Chile

Carlos Barria
Ministry of Energy of Chile (2019-2022)

Ignacio Fernandez
Southern California Edison

Alana Sanchez
California Energy Commission

Regarding system planning, participants of this group session discussed the challenges and opportunities for each geography, finding essential takeaways applicable to both. Decarbonization has to be covered from a holistic and consistent transition approach starting from system-level improvements for scaling and considering network reliability while providing equitable access to renewable resources.

This group concluded the following high-level recommendations to tackle system planning:

- **Improve permitting and processes**, allowing for a more significant number, more varied portfolio of renewable projects in the long term
- **Accelerate the demand side** by promoting electric mobility, electrifying firewood heating, incentivizing flexible rates, etc
- **Secure electric system resiliency** capable of overcoming weather issues and peak periods. **Improve transmission** to avoid bottlenecks in the grid and fully tap on renewable sources, and at the same time address deficiencies in certain communities
- **Secure equitable access** to renewable energy generation and storage
- **Improve the design and use of storage** capacity to address flexible demands and secure utilization of renewable sources
- **Avoid fossil fuel sources by improving cost parity** (e.g., green hydrogen's technological advances)
- **Assess technical needs for a grid-based on renewable sources** (e.g., storage, transmission and distribution network enhancements, data and management)

An important takeaway from the working group discussion is that Chile has a lagged strategy in energy transition compared to California. Firewood heating is still predominantly in, specially in central and southern regions of Chile, while there is still some progress to make in grid resiliency and permitting. The role of public entities in California's energy system emphasizes how to make state-wide system improvements focusing on equitable access to renewable technologies, which need to be incorporated into Chile's decarbonization strategy.

Adopting Best Practices:

Creation of new jobs, transfer of skills and consensus-building mechanism for the carbon neutrality process.

Javiera Aldunate
Ministry of Energy of Chile (2019-2022)

Juan Silva
Chile California Council (2020-2021)

Santiago Vicuña
Ministry of Energy of Chile (2018-2022)

Commissioner Andrew McAllister
California Energy Commission

Merrian Borgeson
Natural Resources Defense Council

Community involvement is critical for a successful implementation of an energy transition strategy. The participants discussed many learnings from both Chile and California on working with communities and developing the platform for a proper resiliency of stakeholders towards an energy transition.

There have been conflicts with communities and local governments in the past. An avenue to impede such kinds of disputes is collaborating with stakeholders and communicating early about the benefits and consequences new project developments will have for them. It is crucial to address the detrimental sentiment of smaller communities when new nearby developments don't produce direct benefits for them and "only costs" (e.g., potential noises, trucks destroying roads, new infrastructure changing landscape, etc.)

In terms of jobs, the decarbonization strategy has to promote the creation and transfer of skills and capabilities from older technologies to new ones. It is important to determine the needs, timeline, and investments required to build labor force capabilities for a smooth phase-out of fossil fuels to adopt renewable energy successfully.

- **Prevent potential social misconnections** and impede political conflicts by planning ahead and communicating early
- **Promote the creation and transfer of skills and capabilities** to address the energy transition
- **Assess requirements for a fossil fuels' phase-out** to a highly successful renewable adoption
- **Promote mutually beneficial associations with local communities** through established governance models and effective community participation
- **Strengthen the relationships between central, regional, and local governments**, through consensus-building programs and exchanges between Chile and California

Thinking the Future Economy:

New Technologies, innovations, designs and prototypes for power generation for the next 30 years

Trinidad Castro
WEC Chile

Rafael Friedmann
Chile California Council

Gabriel Prudencio
Ministry of Energy of Chile (2018-2022)

Max Correa
Ministry of Energy of Chile (2020-2022)

Roberto Araos
Ministry of Foreign Affairs of Chile

Marcela Angulo
Chile California Council - U. Concepcion

Fritz Foo
California Energy Commission

Chile and California can create an ecosystem of thoughtful collaboration in technology, specially in areas mutually beneficial such as storage, hydrogen, and energy efficiency.

In **storage**, Chile and California need to explore new mechanisms for pump, battery, or other forms that provide the grid with enough flexibility to absorb peaks and maximize the system's economic efficiency.

The peak power demand during evening hours when the sun is down, and the wind blows with less intensity is supplied by some non-polluting sources (hydro and nuclear) and highly-polluting non-renewable sources. A sound storage system will minimize GHG emissions while being a green substitute for polluting energy generation.

In **hydrogen**, Chile and California have made it an essential part of their strategy for their zero-carbon emission objectives by 2050 and 2045, respectively. While Chile plans to export hydrogen overseas at scale, California is leading the leap in hydrogen transportation, a yet-to-be-explored venture for Chile.

The most significant impact of collaborating in hydrogen could be seen on the demand side by creating a base of common knowledge and assessing how and when hydrogen can be the preferred choice in the transportation, industrial, and agricultural sectors. Please refer to Session #4: Hydrogen Transition to dive deeper into these takeaways.

Energy efficiency is another avenue of collaboration to explore strategies, innovations, technologies, policies, incentives, and business models to enable efficiency in the deployment of the energy transition. Please refer to Sessions #2 and #3 for the takeaways in Electrification Transition and Electromobility.

Session Takeaways:

California is one of the biggest economies. It has more resources and is a better platform to promote technological development. The State's public commissions and entities have a significant say in policy and regulations, incentives and strategy, being more hands-on to push the market in the desired direction.

On the other hand, Chile is a smaller market with lots of potential and great institutionality to collaborate effectively with private-public practices. Chile has innovation but also is an excellent location for testing new technologies.

Regulation and planning are central areas for collaboration. California and Chile have similar regulatory instruments (the IPER and IRP in California are equivalent to Energia 2050 and MAPS in Chile). It is possible to bridge interagency coordination for more agile public processes and more flexible regulation and institutions capable of adapting to changes and new technologies in a dynamic and fast-paced fashion.

Community-centered strategies are critical for the successful transition. Early dialogues with communities about specific needs and how they can benefit and be challenged by potential energy projects. There is a need to find the right balance between permitting planning and environmental justice to foster renewables without the detriment of historically disadvantaged communities.

Spanish
Webinar &
Executive Summary

English
Webinar &
Executive Summary

San Francisco, California

03

Session 2: **Electrification Transition**

On June 16, 2021, the Chile-California Council and the Ministry of Energy of Chile held the second working group discussion regarding Electrification Transition to reach decarbonization goals for respective geographies.

The session started with a presentation of the Chilean Government's plan for Electrification exposed by Alex Santander, Head of Energy Planning and New Technologies at the Ministry of Energy, followed by CEC's plan for Electrification, presented by Alana Sanchez, International Relations Senior Advisor at the California Energy Commission.

Both geographies share enormous similarities, and there is a large room for collaboration and knowledge sharing on this topic. There is a massive need to finance Electrification, and both geographies are tackling the same avenues. California is incorporating an equitable access electrification transition standpoint currently not prioritized in Chile. The latter, however, has yet the challenge of moving away from firewood heating and other pollutant sources of Electrification.

Electrification Transition in Chile

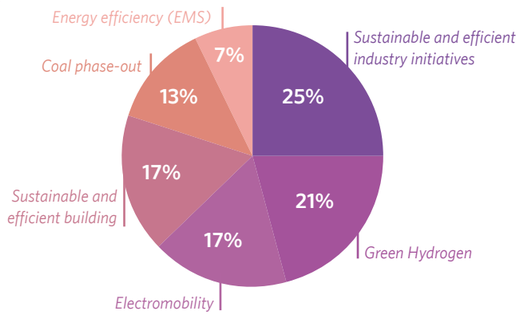
Alex Santander
Head of Energy Planning and New Technologies
Ministry of Energy of Chile

Chile has established a long-term energy planning strategy measuring and forecasting energy future demand and supply projections based on inputs from a broad bottom-up citizen and stakeholders' collaborative participation. Between 2020 and 2050, energy demand will increase by a factor of 1.3, primarily boosted by electricity demand (one of all energy carriers), which will increase 2.75 times.

Electrification represents almost 80% of the GHG emissions reduction goal for carbon neutrality by 2050. Within this metric, there are six main areas for GHG emissions reduction: 25% coming from sustainable and efficient industry initiatives, 21% from green hydrogen, 17% from electromobility, 17% from a sustainable and efficient building, 13% from coal phase-out, and finally, 7% from energy efficiency (EMS). For example, the electricity sector in Chile represents 32% of total GHG emissions, being an area of great opportunity for environmental and climate actions.

Electrification represents almost 80% of the GHG emissions reduction goal in Chile

Main areas for GHG emission reduction goals in Electrification



Electricity will grow from <25% of the current total energy demand to almost 50% by 2050. Carbon neutrality and coal phase-out goals have accelerated the pace of Electrification. Chile is putting a lot of effort and focus on electric heating, electromobility, and green hydrogen production.

The Ministry of Energy has already started with focalized programs in electrification promotion, like:

- "Ponle Energía a tu Empresa" */ energize your company,* for commercial self-consumption
- "Mi Taxi Electrico" */ my e-Taxi*
- "Recambia tu calor" */ change your heat*, to propel residential electric heating
- "Casa Solar" */ solar house*, for residential PV implementation

Firewood heating is still predominant in certain parts of the Country as it is used for heating. The use of wood as fuel is a short-term focus area to solve. However, there are some challenges. Firewood is one of the cheapest fuels in the Country as it is largely available in the center-south of the Country. On top of that, electric systems in certain rural areas have poor quality. This makes it difficult to replace firewood with Electrification initiatives. There are also cultural and accessibility issues to tackle fuelwood easily.

Moving towards Electrification represents an excellent opportunity for Chile. However, there are multiple challenges and questions to address for a successful transition in the long term. For example:

- How to make an efficient energy pricing to avoid inequalities in clean energy access
- How to improve the quality of services and decrease energy poverty to ensure cleaner energy is available for all
- What's the mix between utility-scale and distributed renewable projects needed to make Electrification a reality
- How to make transmission, distribution, and storage systems resilient and reliable
- What role the government must play to be an enabler of new technologies and ensure broad energy access

Electrification Transition in California

Alana Sanchez
International Relations
Senior Advisor California Energy Commission

California works synergically with other states to achieve clean electricity goals. Shared goals and efforts between neighbor states make possible a more resilient, affordable, and environmentally sustainable electricity system.

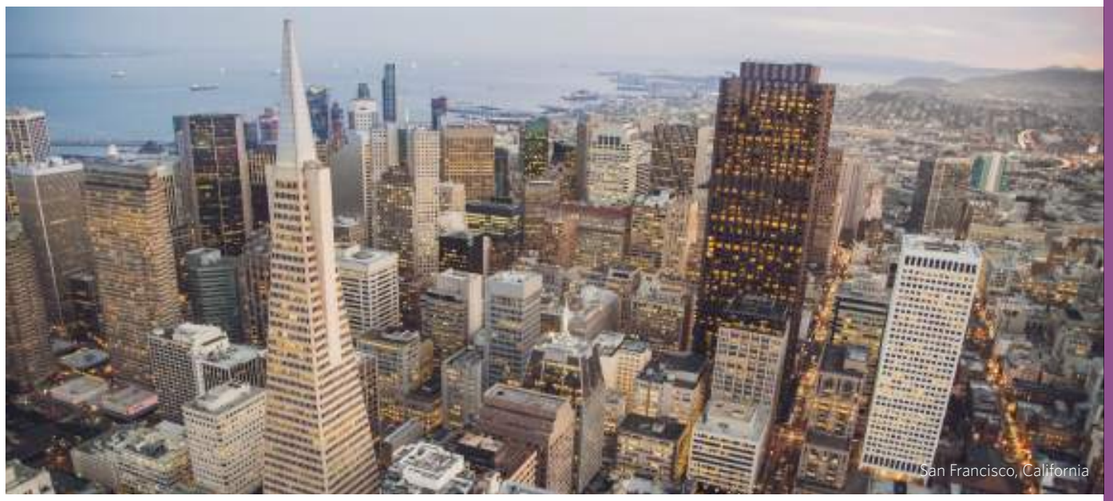
Senate Bill 100, which is officially titled "The 100% Clean Energy Act of 2018", is a central part of California's improvement goals of the energy system. It first sets the goal of powering all retail electricity sold in California and State agencies' electricity needs with renewable, zero-carbon resources by 2045. It also updates the State's Renewables Portfolio Standard to ensure that by 2030 at least 60% of California's electricity comes from renewable resources, compared to the 50% by 2030 goal set before. Under Senate Bill 100, the Energy Commission, Public Utilities Commission, and Air Resources must work together to enable a 100% clean electricity supply, tracking and reporting progress every four years.

Electrification is a major component to meet California's 2045 net zero GHG emissions goal. As such, multiple state-wide initiatives have started on many fronts. In terms of mobility, all new cars and passenger trucks sold in California must be zero-emission by 2035. Furthermore, the electricity powering the zero-emission transportation must also be carbon-free. For example, on the building side, California is incentivizing electricity use over natural gas for heating.

California is working on leveling up efficiency standards of appliances and buildings to offset new power generation needs and reduce customer bills for the system itself. This initiative is also working on gaining load flexibility to take advantage of solar and wind power generation, higher in the middle of the day, by gradually shifting electricity demand times.

California has adopted the urgency of acting now towards 100% clean energy because of the immense opportunity that represents. Full clean energy would reduce smog-related deaths and illnesses that today affect a population of about 23 million. Disadvantaged and low-income communities throughout the State, historically suffering from poor air quality and infrastructure access, will reap the highest health benefits from clean energy.

Senate Bill 100 will boost the capacity to generate and store clean electricity, driving the creation of thousands of new high-quality, green energy jobs.


San Francisco, California

Addressing with Strategy and Principles:

Electrification in the context of a massive insertion of renewables energies.

Hydrogen Refueling Station, California

Trinidad Castro
WEC Chile

Matias Alcalde
Chile California Council

Gabriel Prudencio
Ministry of Energy of Chile (2018-2022)

Hector De la Torre
California Air Resources Group

Juan Pablo Carvallo
UC Berkeley

Benjamin Maluenda
Ministry of Energy of Chile (2019-2021)

From the technology side, there is still the chicken-or-the-egg paradox for some of them, in which both the supply and demand applications still don't exist or aren't widely available—for example, hydrogen electrolysis infrastructure, long-duration storage, and hybrid power plants. Pricing mechanisms and market designs are essential for the profitable implementation and adoption of technologies. Chile still needs certain policies to drive specific technological developments. For example, California is banning new fossil-fuel pick-up trucks starting from 2035, but still, there is no substitute yet.

Strict milestones *(sticks)* are often unpopular or harder to support by different stakeholders. However, they allow for better system planning, factoring in the accelerated adoption of new technologies. For example, banning fossil fuels for certain vehicles can reduce incentives and predict higher adoption of other technologies. On the other hand, rebates and price reduction incentives *(carrots)* become important for securing equitable adoption and gaining traction of new technologies. In order to make electrification happen, policies need to have both sticks and carrots to ensure the adoption pace will be enough for meeting carbon-reduction goals and give system-wide certainty.

Still, system planning is a big challenge. There's uncertainty in predicting and understanding the different ways zero-carbon technologies will fit as we progress and what levels of adoption they will have across various end-uses. If adoption were to happen too fast, then there might not be enough supply; on the contrary, too slow, then there might be stranded investment. An example of the challenges that the electrification transition represents are how transportation and power systems can be integrated into planning as stakeholders need to understand where the charging infrastructure has to be developed, who should own it, at what pace, etc.

Adopting Best Practices:

Integrating demand and supply planning for the transition, ensuring system resiliency and economies of scale.

Juan Silva
Chile California Council (2020-2021)

Alex Santander
Ministry of Energy of Chile

Roberto Araos
Ministry of Foreign Affairs of Chile

Ignacio Fernandez
Southern California Edison

Aura Rearte
ACESOL

Alana Sanchez
California Energy Commission

Teresita Vial
ACESOL

Marcela Angulo
Chile California Council - U. Concepcion

Although Chile and California face similarities in disaster prevention and management, California has higher potential risks of wildfires affecting transmission lines. Both geographies have been collaborating to address system resilience based on knowledge creation and better system capabilities.

It's urgent to focus on policies and infrastructure projects aiming to address current and potential issues and ensure adequate and timely investments in utilities. While Chile uses natural gas for coal phase-out, California uses storage to reduce natural gas usage.

Storage in California is an example of system-wide infrastructure planning. Storage implementation has three main layers:

- Utility-scale, extensive battery infrastructure close to transmission substations
- Distributed-scale, minor infrastructure to assist communities when the local grid is affected
- Behind-the-meter, in-house onsite storage for optimized energy use (e.g., EVs). In-house batteries are still expensive, and only wealthy households can afford them

California has also been widely successful regarding specific pricing policy implementation, such as the carbon's cap-and-trade mechanism and low-carbon fuel standard. More carbon-intensive fuels compensate for less carbon-intensive fuels or projects in this zero-sum approach. Chile, in particular, needs to revisit the current pricing schemes as the carbon tax in the country could be out of the chart ($5 p-TonC), and the fact that renewable energy projects pay around 38% of the tax is contradictory.

Equity and environmental justice are taking center stage in California's agenda as the State is kicking off the scoping plan update. California is currently reviewing the progress of climate goals for 2030 and 2045 and expects to revise the planning by the end of 2022.

Thinking the Future Economy:

Rafael Friedmann
Chile California Council

Javiera Aldunate
Ministry of Energy of Chile (2019-2022)

Nicolás Westenenk
Generadoras de Chile

Sebastian Gonzalez
ACESOL

Merrian Borgeson
Natural Resources Defense Council

Anna Ferera
California Energy Commission

Chile and California must finance massive incorporation of electrification infrastructure to address electromobility, housing appliances (current and new), and other end-user applications. There are many identified opportunities to continue collaborating in best practices, knowledge sharing, and cross-learning.

There is a need to address firewood replacement and change users' behavior by giving them access to new technologies to experience the benefits first-hand. It is critical to communicate properly de opportunity for the household economics and the health benefits for end-users.

Chile lacks a robust electrification long-term plan. It is urgent to create an all-hands project including current players and future entrants to allow customers to choose their electric provider.

It is key to co-develop policies and market mechanisms/rules that enable consumers to favor electrification to turn them into "prosumers." The end goal is to make homes generate for self-use and sale to others or generate the capabilities to make end-users modify their demand to align with the grid.

Session Takeaways:

This session closed with a collaborative discussion regarding best practices and resources. For example:

- California opened a proposal for grid planning for electrification, which process can be replicated in Chile
- The State of Maine has created an exciting heat pump technology that could be added to storage planning in both Chile and California
- Attendees extended the conversation with some experts to understand optimized ways for electrification transitions
- Attendees discussed the importance of adding labor unions and other stakeholders for a better transition to the green economy
- Information was requested on how California's building codes have adapted to EVs and other electrification end-uses

In general, this session motivated broader offline roundtable discussions in many areas of electrification transition for both Chile and California.

Spanish
Webinar & Executive Summary

English
Webinar & Executive Summary

Session 3: **Transportation Transition**

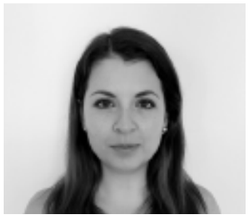
On July 21, 2021, the Chile-California Council and the Ministry of Energy of Chile held the third working group discussion regarding Transportation Transition and Electromobility to reach decarbonization goals for respective geographies. This session helped draw a joint base of current challenges, opportunities, and goals that both Chile and California have.

The session started with a presentation of the Chilean Ministry of Energy's plan for Transportation exposed by Daniela Soler, former Head of the Efficient Transportation Unit, followed by CEC's plan for transportation transition presented by Patricia Monahan, Commissioner at the California Energy Commission.

The main highlight of the session incorporated the necessity to coordinate among stakeholders to break down technical, political, and social barriers to make electromobility happen. Optimized pricing strategies including tax schemes, variable electricity rates, and incentives were also an important part of the discussion to make funding available for more projects promoting the use of zero-emission vehicles and helping to bridge the gap of electromobility access and equity.

California

04



Daniela Soler
Head of Efficient Transportation
Ministry of Energy of Chile (2019-2022)

Transportation Transition in Chile

Transportation accounts for 24% of the GHG emissions in the energy sector in Chile

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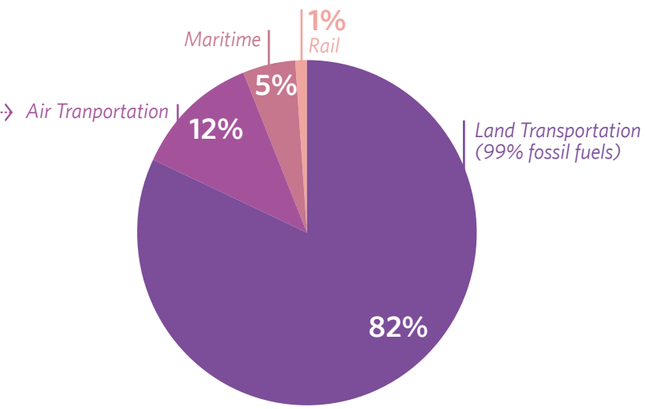

Transportation is one of Chile's four central action pillars to achieve carbon neutrality by 2050. In 2020, 3 million electric vehicles (EVs) were sold worldwide, representing 4.6% of total car sales primarily in geographies like China, Europe, and the United States. It is expected that EV sales will reach 12% of total car sales by 2030.

In 2017, Chile developed a National Electromobility Strategy, which is currently being updated to incorporate more aggressive targets towards accelerating carbon neutrality. Chile has 1,970 EVs and 263 public charges, making Chile the #2 among countries with most public chargers per EV as reported in the Global EV outlook (GEVO) presented by the International Energy Agency (IEA). Among the policies in place, it is the law 21,305 of Energy Efficiency enforced since February 13th, 2021, stating the following:

- Establishment of energy efficiency standards for vehicles
- Regulation of interoperability of EV charging infrastructure
- Accelerated depreciation for company-owned EVs, boosting importers to bring a wider variety of ZEVs

In addition, Chile has made progress in establishing new incentives to high-intensity use fleets, such as public transportation, taxis, and commercial fleets. In addition, the country has already started replacing conventional buses with electric with positive results and expects to extend electromobility learnings to other cities.

The Ministry of Transportation provides $9,400 per vehicle to electric shared-ride units ("colectivos"), while the Ministry of Energy subsidizes $10,700 per vehicle plus home charger to conventional taxis. In commercial fleets, the government provides incentives to those companies integrating electric fleets into their business models.

Among the electromobility enablers, Chile has made progress in the following areas:

- Safety & Operations: specific regulation for drives and EVs, plus securing interoperability of charging infrastructure
- Ecosystem enhancement: (i) Electromobility platform, allowing updated metrics and information regarding the ecosystem, (ii) EcoCarga App, an online map indicating current and coming charging stations, and (iii) Networking events to promote public-private collaboration
- Human development: research gaps and skills needed to create new job profiles and enable electromobility from the human capital side

Transportation Transition in California

Patricia Monahan
Commissioner
California Energy Commission

From a GHG emissions standpoint, transportation is the greatest and increasing source in California; also, it is a significant driver of harmful air pollution. Transportation represents more than half of total GHG emissions in the state.

One of the biggest challenges in California is to let everyone stand to benefit from the transition to ZEVs. Residents that live in disadvantaged and low-income communities are exposed to a high level of toxic diesel particulate matter due to the proximity to corridors of medium and heavy-duty vehicles. Unfortunately, UPOC communities are the ones most affected by these pollutants.

Governor Newsom has established that by 2035 all new passenger vehicles sales will be 100% ZEV, and all medium and heavy-duty vehicles, including drayage, off-road, and equipment vehicles, will be 100% ZEV by 2045. However, the state has made significant progress in Electromobility so far. By 2025 the state expects to [sell over 1.5 million] EVs, install 250,000 charges and own 200 public hydrogen refueling stations. This goal will increase 3x+ for over 5 million EVs sold by 2030. California is the first in the world to rule that all truck sales by 2045 be zero emissions.

California has driven incentives by regulating vehicle emissions for a long time. The low carbon fuel policy has effectively driven investment into zero-emission transportation. California leads the US in EV sales. Although representing 10% of the total car market, half of all EV sales in the US come from California. California is #2 in the EV market, only after China. Currently, 14 manufacturers are designing and building cars, buses, motorcycles, and trucks in the state. Tesla is the #1 seller and the reason why California is #1 in ZEV exports.

The state wants to continue fostering innovation in ZEV. As such, the CEC's 2021-22 budget prioritizes funding for ZEV infrastructure, related workforce development, and manufacturing. A budget of $1.2 billion in 3 years for ZEV infrastructure and manufacturing grants it's the biggest budget ever for ZEV transportation and is broken down as follows:

- $250 million for zero-emission drayage trucks
- $25 million to drayage trucks and infrastructure research
- $90 million for transit buses
- $50 million for school buses
- $250 million for ZEV manufacturing grants
- $500 million for ZEV infrastructure


San Francisco, California

Addressing with Strategy and Principles:

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Chile requires policies to make new buildings have EV infrastructure built-in, and developers include EV charging stations in their affordable housing projects. In addition, the country needs to work at the municipal/district level to ensure EV infrastructure is considered in their urban planning as part of the transportation budget. California, for example, is assessing how to allow utilities and eventually CAISO to control the charging of EVs from a system capacity perspective.

EV adoption implies a highly-flexible storage capacity thanks to cars absorbing the free solar energy in the middle of the day. EV storage is a significant driver to reduce low/high peak demand hours. However, it is unclear how much stress EVs can put on the grid, potentially affecting local utility investment needs. It is important to address the transportation transition from a well incentivized urban planning and programming.

From public transportation, it is necessary to bring a business model or solution that matches and improves the existing model without applying too much pressure on it. It is key to understand the lessons from where electric buses were deployed and roll-out improvements nationwide. However, significant work in education is needed to increase the adoption of public transportation and EV adoption in general, including convincing bus operators to shift away from diesel. The US public transportation is essential from an equitable transportation access standpoint. For example, going from hotel to airport in Houston is just $1.75, while a taxi would be $50. Even though Public transportation could be the biggest switching driver to electric mobility, there are still major challenges:

- Due to the pandemic, car purchases increased by 30% because people were afraid of getting infected by using public transportation. Still, a pilot project to promote electric taxis is planned for 2022
- Public transportation has been built with a transportation efficiency focus producing a mismatch between system design and user-needs
- Many families live far from public transportation or in places with low frequency. Higher coverage or other transportation mechanisms would reduce current public commuting time, currently 3-4x the time in a private car
- At the energy system level, there are limitations at the transmission level that requires an urgent collaboration between the CNE (the National Energy Commission), Chile's Sustainable Energy Agency, and other stakeholders

Chile has the opportunity to complement these sources of transportation transition by (i) expanding the subway, which is one of the preferred commuting alternatives because it runs on time and is highly efficient, and (ii) incorporating electric trains. Regarding the latter, Chile used to have many miles of rails 20 years ago. Given Chile's geography and low EV adoption rate, an electric train could be an efficient alternative to drive electric mobility while avoiding planes and cars. Finally, Chile also requires more distributed energy generation (DG), which is an essential factor in promoting electric transportation, in which hydrogen could also be incorporated.

As a final note on planning and principles, the group went over incentives currently in the opposite direction of transitioning to electric transportation. First, fossil fuels and petrol have been subsidized (specially in the US), while countries and states favor EVs subsidies. US taxes paid for highways, promoting and making it easy for people to adopt and use fossil fuels. California is now subsidizing EVs, but there is room to reduce and/or eliminate fossil fuel subsidies.

Urban planning and advocacy to reduce the need for physical transportation, promote public transportation and vehicle sharing, remote work, pedestrians, bicycles and other green solutions.

Adopting Best Practices:

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Equity in access to participate in the transportation transition

In California, the CEC has been working on detecting the most affected communities by GHG emissions and other pollution. The results show that communities living in or close to areas with high transportation levels (e.g., industrial areas close to ports, highways, and railroads) are primarily communities of color (or POC) and lower-income levels. This effort has been a critical driver to continue pushing for higher zero-emission vehicle adoption. The CEC works with NGOs and communities to find out needs and potential solutions to address them, focusing on providing grants to high unemployment or disproportionately polluted communities. As such, the CEC currently funds zero-emission school buses.

The cost of ZEV remains high. Interdisciplinary work for addressing GHG emissions in transportation is key. The CEC works closely with leaders in the energy sector, the California Governor's offices, the California State Transportation Agency, among others, to bring new ideas and recommendations to set up zero-emission corridors, alternative ways to travel, additional bike lanes, etc.

In Chile, incentives to promote ZEVs are very few (as explained earlier in this session). However, the new energy efficiency standard for vehicles is expected to continue promoting the adoption of ZEVs in Chile. It will increase imports of ZEVs or EVs from a wider variety of manufacturers. So far, the electrification of public transportation has shown positive results in the passenger experience by providing a carbon-free transportation source.

The government does not currently subsidize the charging infrastructure. Discussions with building developers about adding electrical chargers in new developments have not yielded a positive outcome as it increases construction costs. Similarly, in California, the feasibility of installing an EV charger in existing multifamily housing is very low because it is not clear who should pay for that investment. In Chile, annual car registration fees paid to local governments/municipalities could be a source of funding to finance public electric chargers. The Ministry of Energy is currently working on tools and expertise to create sustainable budgets for EV charging programs in local municipalities.

As part of the discussion, the group covered challenges and opportunities from an equity standpoint. The following is a summary of some of the topics:

- Minimize carbon footprint of "moving" by a holistic approach to transportation - (i) reducing miles traveled, (ii) understanding coverage needs, (iii) promoting bike lanes, (iv) promoting telecommuting, (v) promoting ZEVs use on fleets and general services
- Tax high-polluting vehicles to shift incentives - (i) raising taxes of internal combustion effectively promotes EV adoption and secures a market for new technology adoption, (ii) using low carbon standards, cap, and trade, or vehicle registration fees would add funds that could be reinvested in underserved areas/communities
- Low rolling resistance tires testing and implementation - California is currently looking at this technology that can be useful in Chile too
- Rule incorporation of electric chargers in a new residential unit in Chile and existing multifamily housing in California
- Create market confidence and maturity by providing early-adopters with rebates and incentives, even if they can afford EVs without them

Thinking the Future Economy:

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Menlo Energy Economics

Juan Carlos Olmedo
Coordinador Electrico

Chile is still far from making electro-mobility happen at scale. There is still a long road ahead to promote and accelerate regulations, incentives, and optimization avenues to make electro-mobility happen. However, if a plan is deployed in an optimized fashion with proper technologies, electrification in transportation could benefit the whole electric system.

Another flag raised is the need for more synchronization. Chile has many renewable generation facilities connected to the grid that are working without synchronization that would help to absorb an electrification transition more effectively while also bringing down energy spot prices. On top of that, it would be valuable to the system to incorporate inverters with synthetic inertia capability into new renewables entering the grid.

There is a long way to go to make EVs competitive in the Chilean market, from charging infrastructure to solving the chicken-and-the-egg dilemma. Then, attempt to create mass adoption to eventually use EVs as an alternative for storage.

Connecting the discussion:

Zero-emission transportation is happening from the technology standpoint, but there has to be greater coordination between regulators, stakeholders, and users to make it happen. It is necessary to have clear and secure regulations, reasonable electricity rates to incentivize people, and to be beneficial to the grid, integrating EVs within the grid planning. It is highly beneficial to incorporate EVs at scale on the streets. The following are some examples of the opportunities that would accelerate the implementation of ZEVs:

- Variable electricity rates reduce overall system costs as demand shifts to renewable and cheaper energy production
- EVs as dynamic devices can provide a source of storage for the distribution system (eventually for the transmission system), providing a massive opportunity to bridge mismatch of energy use at different levels
- Local and regional governments are key stakeholders in EV adoption as they need to be convinced everything should and will be electrified. This collaborative work will be relevant for the next 5-10 years

Chile is updating its national strategy for EVs, which was originally launched in 2017 via a participatory process with players and stakeholders. This roadmap will create the pillars on accelerating the transition to EVs.

During California’s wildfire crisis in 2020, Fire Management offices coordinated with electric utilities and Tesla HQs in an attempt to control EVs charging. Tesla owners received a request to avoid charging their cars during certain day hours. This public-private collaboration is an example that could strengthen throughout the years and generate massive opportunities by 2030 when there will be 5 million EVs.

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Session 4: Green Hydrogen Transition

On August 18th, 2021, the Chile-California Council and the Ministry of Energy of Chile held the third working group discussion regarding Green Hydrogen incorporation as a source of energy towards a sustainable, zero-emission system.

The session started with a presentation of the Chilean Ministry of Energy's Green Hydrogen plan exposed by Max Correa, former Head of Fuels and New Energy Division, followed by CEC's Green Hydrogen plan presented by Karen Douglas, Commissioner at the California Energy Commission.

Hydrogen technology is far from solved, and there is still a long road to making hydrogen feasible and economically viable for multiple applications. It is key to understand that new technologies' development cannot deviate from the carbon neutrality goal for California and Chile in 2045 and 2050, respectively.

Stakeholders need to assess and deeply understand the different use cases for demand generation and supply investment before moving forward with significant incentives that would eventually have insufficient off-takers. Hydrogen is a massive opportunity for California and Chile, which has also attached high responsibility on its deployment

Max Correa
Former Head of Fuels and New Energy Division Ministry of Energy of Chile (2020-2022)

Green Hydrogen Strategy in Chile

The hydrogen strategy of Chile is an essential part of the energy transition for climate action. The Chilean government is committed to fighting climate change and hydrogen, specially green, is part of the larger carbon neutrality plan.

Chile has significant challenges in the distribution, transmission, storage, and efficiency of the whole energy system. The country is phasing out coal-fired power plants that account for 40% of the electricity grid. Coal phase-out would likely be faster than the current 2040 goal. Chile is making progress. In 2021 alone, solar and wind capacity expanded 6GW, doubling the power capacity developed in the previous ten years. The country's potential is about 800 GW of renewable electric potential, equivalent to 70x current demand.

Chile benefits from high-quality renewable energy generation: solar power at a high capacity factor in the north (37%) and strong winds in southern Patagonia (capacity factor of 70-75% onshore). Access to high-quality renewables is charting the path to produce green hydrogen for export, fueling Chile's economy and helping the rest of the world transition to clean energy. The goal is to make green hydrogen responsible for 20-28% of the carbon emissions reduction. Clean hydrogen can offer as many economic benefits and value creation as the mining industry provides to the country. If done correctly, it will have fewer externalities and build human capital and local value.

Green hydrogen production will be competitive with fossil fuel prices if it reaches a cost of $2/kg. Chile's goal is to leverage energy development and go even below to reach $0.95-1.05/kg by 2030. Unfortunately, Chile is far from large economies that will demand hydrogen, but it can compensate for the cheaper generation costs and the economy of scale in the long run. Chile has set the ambitious goal of having an electrolysis capacity of 5 GW by 2025, implying adding up to 7.5 GW of renewable power capacity.

Chile has accelerated the deployment of green hydrogen in 6 prioritized applications: oil refineries, ammonia, mining haul trucks, heavy-duty trucking, long-range buses, and blending hydrogen into the gas grids (up to 20%). With that in mind, the country has achieved the following milestones:

- $50 million in the first green hydrogen projects' financing call, which includes ~10 MW of electrolysis capacity
- $265 million funding for a Clean Technologies Institute, which is an open innovation platform for clean energy and mining technologies
- International outreach, signing a Memorandum of Understanding (MoU) with Singapore and the Port of Rotterdam
- Fast track piloting, streamlining approval processes to pilot initiatives in tech production, mining, and transportation
- An energy efficiency law, which includes new standards for vehicles

The Ministry of Energy is already working towards making this happen, with experts working on (i) Regulations and Permitting, (ii) Coordinating domestic and international alliances, (iii) Financing and adding incentives to accelerate cost-competitiveness of green hydrogen, (iv) developing adequate infrastructure, and (v) increasing research and development of green projects deployment.

Green Hydrogen Strategy in California

In addition to the California law calling for 100% clean energy and retail sales by 2045, the Governor issued an executive order calling for 100% ZEV by 2035. Although the potential role of hydrogen and the strategies to scale the market have been revisited many times, most of California's early success with the integration of hydrogen has been in the transportation sector.

Green hydrogen is an alternative that could replace or complement the uses of fossil gas in the electric system. The CEC is actively looking for other options to increase efficiency and build up economies of scale in the generation, storage, and conversion of green hydrogen to fully enable the advantages of the renewable power that the State has been producing very effectively.

California has detected a large room for potential partnerships to continue researching, developing, and deploying new technologies for the electricity sector and industrial decarbonization. Green hydrogen can provide firm, dispatchable, and zero-carbon generation to support the grid when renewables are not producing enough electricity. However, the State is expecting to add more funds for research and development of hydrogen technologies that include, among others, more efficient electrolysis and more efficient storage systems.

Supply scalability is one of green hydrogen's deployment constraints. Resolving how fast the supply can scale will be critical to exploring different niches. Developing an ecosystem around green hydrogen is essential for efficient production and scalability. California is a significant renewable energy producer making it feasible to co-locate green hydrogen facilities close to photovoltaic and wind facilities.

More recently, the CEC hosted an international workshop to explore the status of green hydrogen and its potential role in California, including presenters from Germany and Denmark, the US Department of Energy, Los Angeles Department of Water and Power, and other California representatives.

Karen Douglas
Commissioner
California Energy Commission

Addressing with Strategy and Principles:

Nicolas Westenenk
Generadoras de Chile

Matias Alcalde
Chile California Council

Max Correa
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Fereidoon Sioshansi
Menlo Energy Economics

There are two main challenges in green hydrogen deployment at scale. First, there is the causality dilemma between supply and demand: how to incentivize more supply to foster more demand (or the other way around)? And second, how to make green hydrogen production affordable by lowering the costs as much as possible so that they can replace fossil fuels in more energy-intensive uses.

It is key to put the efforts to scale up low-hanging fruit on the demand side and, as such, secure visibility on the supply side. Demand is uncertain because there is a gap of knowledge regarding the cost of production versus other energy sources. A solid regulatory and political framework would be key to setting long-term rules that later foster stability for new developments and investments. On the other hand, demand can be generated internationally, potentially making green hydrogen exports sufficiently high and more secure investment in the supply side.

If possible, certification of green hydrogen produced from renewable sources can promote off-takers to pay a green premium, which will accelerate adoption and incentivize investment in the supply side. About this premium, a carbon tax represents an excellent opportunity for Chile, which both (green certification and carbon tax) governmental involvement in setting up the rules.

Adopting Best Practices:

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Merrian Borgeson
Natural Resources Defense Council

Hydrogen and biomethane cannot distract the whole electrification transition panorama. It is necessary to ensure that the conversation of new fuels and technologies are pieces of the larger decarbonization puzzle.

Investing in large-scale facilities early on without knowing how much hydrogen could scale up and how quickly could represent a problem for investors and stakeholders. For instance, there is significant concern about gas companies encouraging hydrogen pipes and other infrastructure investments when there is no certainty whether such infrastructure will be finally needed or not.

Before exporting green hydrogen, there is the need to scale up renewables and interconnect them to be available for multiple uses. For example, it is better to use electricity in certain end-use fuel applications rather than hydrogen. It takes around 5x more energy to heat a building with hydrogen than directly with electricity using heating pumps.

It is important to distinguish between green hydrogen production using electrolysis from renewable sources of energy and the existing steam methane reformation process currently available in California. The State has both technologies and risks that specific incentives favoring steam methane reformation could be detrimental to electrolysis development pace.

Thinking the Future Economy:

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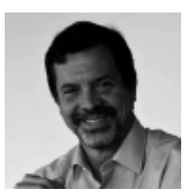

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The potential role of hydrogen in the energy system is way more significant than transportation. It has different use cases in the overall energy system for either storage, industrial decarbonization, and disaster resiliency, making hydrogen attractive and worthwhile studying applications and market opportunities. For instance, 80-85% of the stock of combustion gas turbines across the US could be replaced with hydrogen because of the presence of salt caverns that can efficiently store hydrogen for long periods, potentially compensating for long stretches of variability in solar and wind energy generation. There is a significant need to research hydrogen use cases and find ways to help policymakers prioritize uses.

California is ahead of every other state in hydrogen adoption, primarily in transportation. However, its current phase of adoption indicates that it continues to be an under development technology, with only a few producers, a low number of refuel pumps, and even a low volume of hydrogen available. The regulatory community in California recognizes that currently, there is no single technology that would be the silver bullet, and most likely, they would coexist. For example, pick-up trucks and SUVs are better suited for hydrogen, lighter and smaller commuter vehicles may not. Locomotive and heavy-duty trucks manufacturers are also bullish about the technology as a possible transition from fuel.

The US Department of Energy announced a program to bring down hydrogen production costs to $1/kg by 2030, making hydrogen competitive versus other fossil fuels and affordable for different applications. Eventually, a fossil fuel penalty would force the transition into new technologies.

Hyundai was the first company to announce large-scale production in 2000. The company made 1500 H2-powered trucks, and all of them went to Switzerland because of a combination of local incentives and disincentives.

California's current hydrogen supply network has to scale to achieve the State goals for medium and heavy-duty trucks by 2045. More stations would eventually enable an open car market for both technologies (batteries, currently predominant, and fuel cell). The CEC funded a program with Hyundai for heavy-duty H2-fueled trucks. The goal is to transport products from the Port of Oakland to other parts of California. The plan includes three high-capacity H2 pumping stations. However, initiatives like this have to be replicated across the state to make hydrogen accessible for zero-emission vehicles.

Session takeaways:

Hydrogen represents an untapped opportunity for both geographies. Although California has advanced significantly on the transportation side, Chile is still on time to adopt lessons learned and work towards making hydrogen transition beneficial for the whole country. Among the tasks for enabling hydrogen in both Chile and California are:

- Understanding of different uses and technologies available can allow better matching between market applications and production
- Investing in extensive hydrogen infrastructure could be detrimental for cost-effective deployment of the plan
- Defining standards for green hydrogen and renewable production certification could be an enabler of green premiums
- Collaborating between science, industry, and policymakers to understand possible use cases and innovation gaps

Chile, in particular, has the challenge of focusing first on internal policies for decarbonizing the economy, displacement of coal power plants, and strengthening the interconnection of the central and north electric system before fully enabling hydrogen production at scale.

Although hydrogen will never be less expensive than the cost of electricity used to produce it. Hydrogen represents an immense renewable energy storage opportunity in the long-term.

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Roadmap Integration and Next Steps

The following chapter presents tables that integrate the main objectives, goals and next steps of each of the working sessions, systematized according to the following planning categories:

1. System & Infrastructure Design
2. Market, Demand & Equitable Access
3. New Technologies, Research and Development
4. Community & Labor (skills and capabilities)
5. Regulatory Framework

Atacama, Chile

06

1. Systems & Infraestructure Design

	High-level Challenges	Macro Goals	Heads-Up for the following Sessions
Session 1: **Energy Transition**	Secure system resiliency	• Grid readiness for weather issues and natural disasters • Improve peak load management	• 3-5y plan for risk/mitigation assessment of the electric grid • Map network needs and develop enhancement plan • Create a live data repository for grid management • Detailed investment case for system strenghtening • All-hands with stakeholders and accelerate design of public tenders
	Solve technical needs on the grid	• Make storage capacity available • Enhance transmission and distribution networks • Data management for better performance	
	Improve Transmission	• Avoid bottlenecks on the grid • Address deficiencies in certain communities	
Session 2: **Electrification Transition**	Secure system resiliency	• Grid readiness for weather issues and natural disasters	• Develop a detailed short/long-term storage plan • Develop a utility scale, distributed scale and behind-the-meter storage program • Create a live data repository for distributed power management • Detailed investment case for storage
	Assess system-wide storage capabilities	• Provide a storage program to ensure optimized use of renewable energy	
	Collaborate between stakeholders for infrastructure planning	• Ensure timely investment in infrastructure	
Session 3: **Transportation Transition**	Enable a more flexible and synchronized grid	• Bring down energy prices for cost-competitiveness • Support massive incorporation of EVs into the system	• Assess current distributed generation capacity and create a plan to address forecasted demand • Develop a plan for a publicly available charging infrastructure network • Develop a public transportation adoption plan with focus on longer hauls and underserved communities
	Develop the charging infrastructure	• Enable distributed generation to support electromobility • Make a charging network available to increase convenience	
	Improve public transportation infrastructure	• Increase demand to reduce miles driven • Allow access to underserved communities	
Session 4: **Green Hydrogen Transition**	Assess technical needs on the grid	• Ensure incorporation of renewable energy in a timely manner	• Appraise impact of hyrogen production-cycle at scale in other industries: gas pipeline, reverse osmosis, agro, etc • Forecast hydrogen demand, hydrogen supply and renewable power need
	Assess ancilliary investment for hydrogen at scale	• Review if gas pipeline investments are needed or not • Understand what other industries would be affected	
	Design for cost-effective production in the long-term	• Make hydrogen cost-competitive over fossil fuels • Scale renewable to ensure cost-effectiveness	

Follow Up Trough 2022

2. Market, Demand & Equitable Access

	High-level Challenges	Macro Goals	Heads-Up for the following Sessions
Session 1: **Energy Transition**	Secure equitable access	• Expanded access to renewable energy • Brige equity gap in green generation and storage	• **Develop plan to expand green generation off-takers** • **Milestones definition for fuel wood phase-out** • **Develop detailed plan for electro-mobility infrastructure** • **Originate electro-mobility testing capabilities** • **Propose a comprehensive review of power rates in accordance to forcasted market needs**
	Accelerate the demand side	• Electrify Firewood • Promote electro mobility • Flexible power rates to enhance demand	
Session 2: **Electrification Transition**	Secure equitable access	• Equitable access to storage capacity, ZEVs, residential PVs, etc	• **Learn lessons for massive adoption of storage, ZEVs, PVs, etc** • **Co-develop a charging infrastructure plan, ensuring system level performance**
	Collaborate for a sustainable deployment of electrification	• Integrate stakeholders in planning to deploy electrification and charging infrastructure in a sustainable way	
Session 3: **Transportation Transition**	Secure equitable access	• Grant access to charging stations and storage capabilties in underserved communities	• **Propose public-private alternatives to incorporate charging and storage capabilities in underserved communities** • **Map transportation needs and increase coverage** • **Work on a plan to promote ZEV use on commercial fleet** • **Measure rebate and subsidy plans to accelerate ZEV adoption**
	Tackle transportation infrastructure in an hollistic approach	• Reduce miles/km traveled • Increase coverage subject to end-users needs • Promote ZEV use on fleets and general services • Generate subsidies and rebates to accelerate adoption	
Session 4: **Green Hydrogen Transition**	Accelerate the demand side	• Co-existance of technologies to transition from fuel • Address medium and heavy-duty transportation	• **Map potential substitutes to green hydrogen** • **Map other potentital use cases for hydrogen in transportation and industrial applications** • **Appraise R&D needs to develop hydrogen storage capacity**
	Assess end-uses beyond transporation	• Generate a storage capacity based on hydrogen • Address industrial decarbonization • Secure hydrogen supply subject to end-uses	

Follow Up Trough 2022

3. New Technologies, Research and Development

	High-level Challenges	Macro Goals	Heads-Up for the following Sessions
Session 1: **Energy Transition**	Develop new technologies	• Phase-out of fossil fuels and pollutan sources of power • Cost parity improvement vs fossil fuels	• Track fossil fuels phase-out performance • Understand capital allocation to R&D and propose incentives • Rule milestones and incentives to improve energy standards • Propose incentive scheme to energy efficient use cases • Forecast demand flexibility needs • Appraise yearly storage need until decabornization goal
	Enhance energy efficiency	• Improve energy standards • Efficient and innovative end uses	
	Assess, design and build storage capacity	• Address demand flexibility • Secure utilization of renewable sources	
Session 2: **Electrification Transition**	Develop new technologies	• Match new developments with end uses • Electrify firewood in the short-term	• Measure impact of turning customers into prosumers and create plan accordingly in PVs and ZEVs • Measure new potential demands and forecast new markets • Create a detailed electrification milestone plan
	Enhance energy efficiency	• Turn customers into 'prosumers' • Align end-user demand with the grid	
	Bridge the causality dilemmna (chicken or the egg)	• Create demand of new technologies • Accelerate adoption by creating milestones and incentives	
Session 3: **Transportation Transition**	Develop new technologies	• Add new low/zero carbon emission alternatives to the pool (e.g. low rolling resistance tires, fuel cell, etc)	• Create test capabilities for new technologies aiming to reduce carbon emmissions • Create live data capabilities to use EVs as storage devices • Develop a plan for business adoption of EVs
	Enable EVs as storage solution	• Generate a highly flexible storage capacity • Create a network resilient capability due to charging flexibility	
	Go beyond light-weight, residential vehicles	• Incorporate companies' fleet and general services to increase adoption	
Session 4: **Green Hydrogen Transition**	Develop new technologies	• Make electrolysis more efficient • Increase storage capacity and uses of hydrogen • Add new applications	• Map patents, scientist, private players, etc, developing electrolysis mechanisms • Propose a subsidy for R&D in Hydrogen and Electrolysis • Create plan to test new electrolysis technologies in Chile/California
	Bridge the causality dilemmna (chicken or the egg)	• Create demand of new technologies • Accelerate adoption by creating milestones and incentives	
	Make hydrogen production efficient	• Reach the production cost $1/kg to become competitive over other fuel alternatives	

Follow Up Trough 2022

4. Community & Labor (skills and capabilities)

	High-level Challenges	Macro Goals	Heads-Up for the following Sessions
Session 1: **Energy Transition**	Collaborate with communities and local governments	• Engage communities early to promote developments • Avoid conflict in decarbonization plan • Strenghten relationships by consensus-building	• **Learn approaches for community risk management** • **Measure impact of phasing-out technologies in employment and skills and create a mitigation plan**
	Transfer skills from older technologies to new ones	• Engage communities to address new technologies • Ensure transfer of skills from older technologies	
Session 2: **Electrification Transition**	Collaborate with communities and local governments	• Engage households in the electrification transition	• **Map electrification penetration accross the geography** • **Size investment needs to address electrification in underserved communities**
	Poverty reduction and access improvement	• Ensure access to electrification to underserved communities	
Session 3: **Transportation Transition**	Poverty reduction and access improvement	• Allow for subway extension, telecommuting alternatives, train development, etc	• **Measure impact and financial cost of expanding the subway** • **Measure productivity impact of telecommunting** • **Appraise new transportation capabilities (e.g. train)**
	Convert local governments in promoters of electromobility	• Increase awareness of ZEV development and adoption • Build the charging network	
Session 4: **Green Hydrogen Transition**	Collaborate between science, industry, and policymakers	• Understand possible use cases • Increase awareness and adopt securely • Make progress in a timely fashion without deviating more urgent goals in decarbonization	• **Engage academic and science boards for new use cases of hydrogen** • **Map funding alternatives to new technology developments**

Follow Up Trough 2022

5. Regulatory Framework

	High-level Challenges	Macro Goals	Heads-Up for the following Sessions
Session 1: **Energy Transition**	Improve permitting and processes	• Diversify renewable sources • Expand system capacity	• **Review permitting processes to detect improvements** • **Proposal of all-hands consensus-building instances with stakeholders**
	Promote stakeholders' collaboration	• Share knowledge between differente stakeholders • Engage hollistically towards fighting climate change	
Session 2: **Electrification Transition**	Pricing regulation to favor transition	• Incentivize demand flexibility • Push for adoption of new technologies	• **Assess pricing regulation to incentivice demand flexibility** • **Review current policies to ensure a timely deployment of technologies** • **Map and propose electrification incentive schemes** • **Revisit carbon tax regulation in Chile**
	Improve standards	• Accelerate deployment of technologies under improved efficiency standards	
	Chilean carbon tax regulation to favor transition	• Allocate incentives in the proper direction • Generate incentives to deploy green projects	
Session 3: **Transportation Transition**	Assess pricing regulation to favor transition	• Favor early-adoption with subsidies and rebates • Enable a comprehensive charging station with subsidies	• **Propose a set of subsidies and rebates to increase adoption based on learnings from other geographies** • **Benchmark rules and milestone of other geographies regarding storage and charging in new buildings and multifamily housing**
	Review and improve standards	• Enforce redisidential charging stations in new buildings and multifamily housing	
Session 4: **Green Hydrogen Transition**	'Green' certification formulae	• Allow for charging a green premium and enhanced shift to green sources	• **Formulate a green certification for pricing purposes** • **Assess and improve regulatory framework to attract investment**
	Ensure a solid regulatory and political framework	• Attract diversified development of projects and end uses	

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