The coupled decarbonization of the power and transport sectors
Walter Vergara
“…on going pathway…will lead to significant disruptions of ecosystems, society and economies…” Letter from 11,000 scientists from 84 nations Dec 2019

“..no avenues left other than full decarbonization to avert major irreversible impacts on our biosphere…” IPCC 2019 Special Report on Global Warming 1.5 °C

“…1.5°C almost Impossible” without deeper and faster Cuts…” UNEP Emissions Gap Report 2019

“…leaving an inhabitable planet to future generations is first and foremost up to us…” Pope Francis, *Laudato Si*
Coupled decarbonization of power generation and transport: Opportunity, cost and benefits

Methodology

Based on available information in the technical literature and industry data.

Baseline based on Global Change Assessment Model (GCAM v5.1.3) created and maintained by the Global Change Research Institute of the University of Maryland & Pacific Northwest Laboratory

Projected costs using the Greenhouse Gas Abatement Model (GACMO) created and managed by UNEP/DTU partnership
Region’s carbon footprint

4,143 MT CO2 e (2018)

Power and transport (2018):
67%  fossil GHG
25%  all GHG

Source: GACMO, consulted, October, 2019; CAIT, Climate Data Explorer, for fugitive emissions and bunker fuels, included as others, http://cait.wri.org and GFW for deforestation rate of 3.2 M ha of primary forest in 2018
Power sector is already low carbon and moving toward even lower GHG emissions

78 GW added (2012-2018):
51% hydro
35% unconventional renewables

Source: Based on data from ENERDATA, accessed August, 2019
Coupled decarbonization of power generation and transport

Most passengers ride buses; but motorization rate is high.
Most cargo by trucks; rail and vessels have marginal participation

Transport’s energy profile by fuel in 2018

Source: Compiled from Enerdata through GACMO.
Where do we get to under current trends?
Projected demand for power and transport sectors by mid-century under GCAM BAU scenario

**Power sector**
16.7 EJ
$1083 billion

**Transport sector**
18.0 EJ
83% gasoline & diesel

Source: As projected under GCAM BAU outputs, August 2019
Current trends are not enough to get to zero emissions by 2050

Source: As projected under GCAM BAU outputs, August 2019
Can we go zero?
The region has a world-class endowment of renewable energy resources

**SOLAR ENERGY**
- Atacama Desert
  Potential generation: 2700 GW (with 10% of area under use)
- Sonora Desert
  Potential generation: 4,940 GW (with 10% of area under use)

**HYDROPOWER ENERGY**
- All countries particularly the Andes and the Amazon basin
  Potential generation: 675 GW

**MARINE ENERGY**
- Southern Pacific Coast
  Potential generation: 200-240 GW

**GEOTHERMAL ENERGY**
- Andes Cordillera and Central American Cordillera
  Potential generation: 44 GW

**OFF-SHORE WIND ENERGY**
- The entire region has 50,000 Km of coastline
  Potential generation: 1,300 GW (Brazil)
- High southern latitudes
  Intensity: 600-1300 W/m²
- Southern Atlantic Coast
  Intensity: 100-450 W/m²
- Brazil coastal and northeastern areas
  Potential generation: 500 GW
- Guajira Peninsula
  Intensity 10 GW
- Isthm of Tehuantepec
  Potential generation: 30 GW
- Southern Atlantic Coast
  Intensity 100-450 W/m²

Endowment could meet 22 times global power demand!
The generation cost of electricity from unconventional renewables in the region is already very competitive and costs are falling fast.

Auctioned prices for wind and solar have fallen by more than 80% (2013-2019)

Source: Based on data from Nagendra S., 2017 and industry data.
Hydropower plays key role in the power sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Hydro as share of peak demand</th>
<th>Share of hydro in total generation</th>
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</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>46</td>
<td>23</td>
</tr>
<tr>
<td>Brazil</td>
<td>131</td>
<td>63</td>
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<tr>
<td>Chile</td>
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<td>Colombia</td>
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<td>Costa Rica</td>
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<td>Mexico</td>
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<td>Peru</td>
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<td>58</td>
</tr>
<tr>
<td>Uruguay</td>
<td>94</td>
<td>52</td>
</tr>
</tbody>
</table>

Grid is partially integrated but additional investments are required

National investment in T&D lines is crucial for the well-connected and flexible grid of the future

Source: CIER, 2019
The cost of electric vehicles is rapidly decreasing, and new technologies are entering the market.

85% reduction in kWh storage since 2010
EV small vehicles already outcompeting IC in the marketplace

Source: BNEF, 2019; and author’s estimates.
How would it look like?
Zero carbon pathway by 2050: key assumptions

100% of new power demand met by renewables. LCOEs below natural gas and coal.

All currently operated fossil-fuel plants will be decommissioned. Coal & oil by 2030, gas by 2040.

Gradual electrification of the transport sector. All modes for cargo and passenger transport, except air travel are gradually electrified as LCOTs outcompete IC options.

No new refineries commissioned. by 2030; existing facilities decommissioned by 2040.

No rationale for further investments in coal and gas generation.
New demand is met through a combination on renewables reflecting projected relative competitiveness

Investment: US$ 800 billion

Source: Author’s estimates
What changes?

Energy security ·
Energy efficiency.
Load balancing ·
Exposure to airborne pollution ·
Refining operations ·
Value of fossil fuel capital assets ·
Cost of power and transport services ·
Diversified renewable matrix will eliminate fossil fuel dependency, eliminate imports of oil/coal/gas and improve resilience to climate events.

Source: based on data from ENERDATA consulted September 2019
**Energy efficiency**
Electrification of transport will reduce energy consumption with savings of 12 EJ/year by 2050

But, electrification of transport will increase power demand by 33%

Requiring 327 GW
US$ 214 billIons

Source: author’s estimates
Load balancing

Demand management could reduce net impacts through “valley filling” (estimated 10 GW regionally by 2050)

Source: author’s estimates
Exposure to airborne pollution

Electrification of transport in a fully renewable energy matrix will eliminate its contribution to airborne pollutants including PM, NOx, VOCs

Reduce morbidity and mortality


Source: WHO Standard for PM10: not to exceed 20 μg/m3 annual mean
Impact on fossil fuel assets

In 2018:
· Installed capacity of 172 GW of thermal power plants.
· Installed refinery capacity of 7.7 BBPD (optimized for production of transport fuels)

Estimated value of stranded assets:
· US$ 80 billion (2018) power plants
· US$ 10.5 billion (2018) refineries

Projected LCOES for the power sector
LCOEs for wind already outcompete gas (and coal). Projections through GACMO indicate further competitive advantage for wind and solar

Annual savings: $222 billion

Source: As projected under GCAM BAU outputs, August 2019
Projected LCOTs for the transport sector

LCOTs projection through GACMO indicates significant gains for all electric modes outcompeting internal combustion options

Annual savings
Passenger: $381 billion
Cargo: $41 billion

Source: As projected under GCAM BAU outputs, August 2019
Coupled decarbonization results in substantial economic benefits.

- **Annual savings linked to the coupled transition by 2050:**
  - **621 US$ billion**

- **Accumulated capital savings for provision of power and transport services by 2050:**
  - **386 US$ billion**

- **Value of stranded fossil fuel capital assets by 2050:**
  - **90 US$ billion**
Coupled decarbonization generates jobs
Jobs (millions) generated by 2050

- **INDUSTRY**
  - Hydro run of river
  - Wind Energy
  - Solar PV
  - Geothermal
  - Solar CSP
  - Job losses in fossil-fuel based power generation
  - Heavy duty vehicle*
  - Light vehicle
  - Grid modernization**

**MILLIONS**

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**TOTAL**
- 17.13 Construction (Job years***)
- 10.83 Manufacturing (Job years)
- 7.7 Operation and maintenance (jobs)
Summary of elements of a macro policy agenda

A well-constructed enabling environment, with clear, consistent and robust policy frameworks, will be critical to attract investment flows towards a coupled transition

<table>
<thead>
<tr>
<th>Goal</th>
<th>Policy</th>
<th>Instrument</th>
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<tbody>
<tr>
<td>Reduce losses in stranded assets</td>
<td>Discourage investment in fossil capital assets</td>
<td>Decarbonization policy Sunset provisions to encourage early retirement</td>
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<tr>
<td>Modernize grid</td>
<td>Encourage investments in modern transmission and distribution infrastructure</td>
<td>Clear regulations on demand management and storage Regional power exchange market</td>
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<tr>
<td>Internalize health and climate costs of transport emissions</td>
<td>Enable allocation of costs</td>
<td>Fiscal measures to pass costs to emitters</td>
</tr>
<tr>
<td>Encourage level playing field for new technologies</td>
<td>Open competition with fossil fuels Removal of policy barriers</td>
<td>Eliminate subsidies and rents</td>
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<tr>
<td>Encourage innovation</td>
<td>Promote R&amp;D in zero carbon technologies</td>
<td>Fiscal and regulatory measures to encourage investments in R&amp;D</td>
</tr>
<tr>
<td>EV deployment</td>
<td>Promote electric transport adoption</td>
<td>Standards, electric tariff incentives, non-fiscal incentives, EV targets</td>
</tr>
</tbody>
</table>
Examples of policies to support the transition
The decarbonization pathway towards 2050

**Carbon pricing**
Mexico · Chile · Colombia
Carbon pricing based on “a polluter pays principle” can generate funds to support the transition

**Renewable Energy auctions**
Colombia
Will be incorporating 2250 MW to the electrical system - equivalent to an investment of US$ 2,000 million

**Electric Buses**
**Business & Government alliance in Chile**
Procurement plan that included technical and business model innovations to keep the total cost of electric buses close to that of an internal combustion bus to enable purchase without using subsidies

**Regulation updates for DG deployment**
Brazil · Chile · Mexico
Allow net metering for larger installation capacities to stimulate the deployment of rooftop PVs
Elements of a coupled transition - new business & enterprise opportunities
### Examples of business models

### Energy distribution company in Panama
**ENSA**
This company offers solar PV panels installation and monitoring while providing financing through the electric bill.

### Private sector initiative in Barbados
**Megapower**
The company pioneered introduction of EVs through the roll out of a network of public charging stations powered by renewable energy.

### Utilities, Automakers, oil & private companies

### Charging infrastructure

#### Distributed Solar Generation Finance
**Mexico**
Catalysing financing for Commercial & Industrial (C&I) end-users by structuring a solar-customised financial scheme (USD$60 million) via commercial banks.

#### Different players involved in the deployment of charging infrastructure in different countries. Examples: BMW in Mexico and Brazil, La Casa de las Baterías in Panama, YPF in Argentina and Terpel in Colombia, Enel & Engie in Chile.
A just transition

The transition must:

· Minimize disruption for workers and communities reliant on unsustainable industries and energy sources

· Address social and economic inequalities

· Focus on bringing everyone to the table
Can do

“Substantial capital and economic savings without impact on access or quality of services”

Walter Vergara