



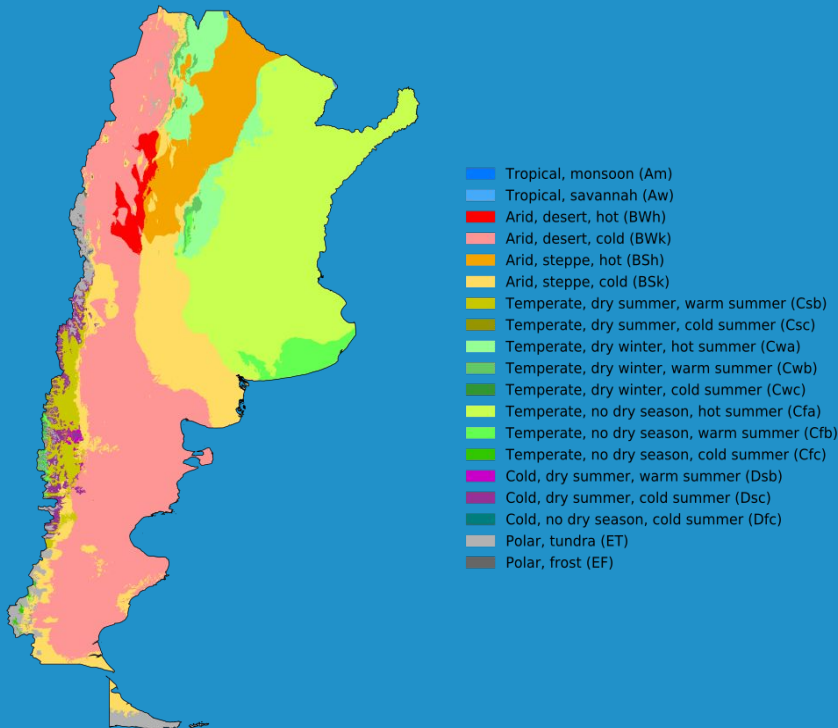
Energy: Argentina

Lisa Luchford & Clark Johnson

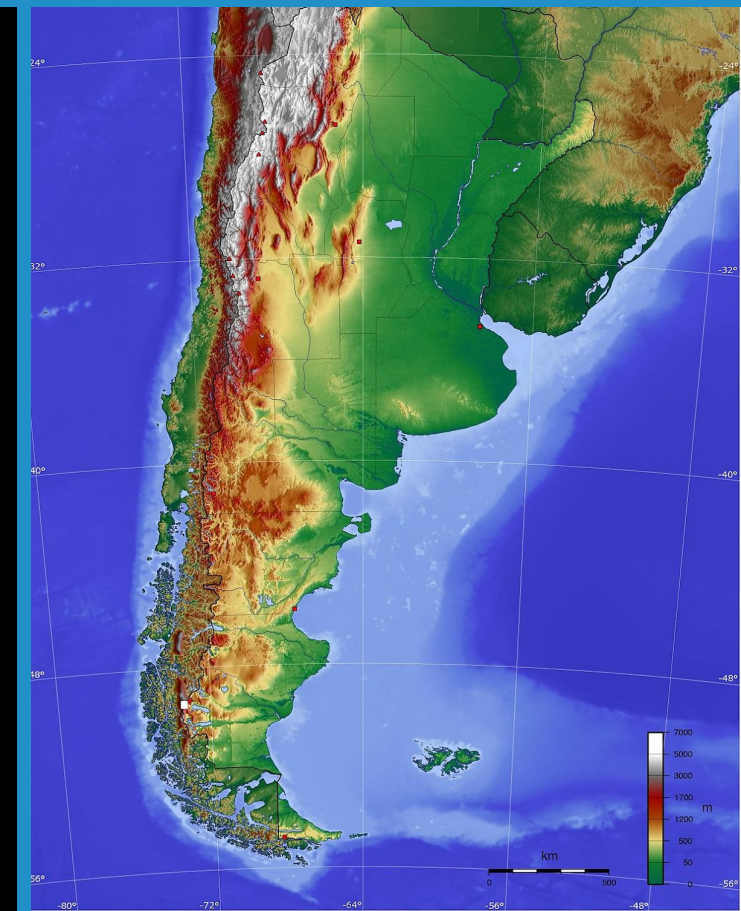
Country Overview



Köppen-Geiger climate classification map for Argentina (1980-2016)



- Area: 1.074 million mi²
- 8th largest country
- Population: 44.49 million
- produces more grain than any other country in Latin America
- 2nd in cattle raising
- Receipts from tourism 2nd in Latin America
 - 1st = Mexico
- Climate varies depending on the region
- Andes Mountains



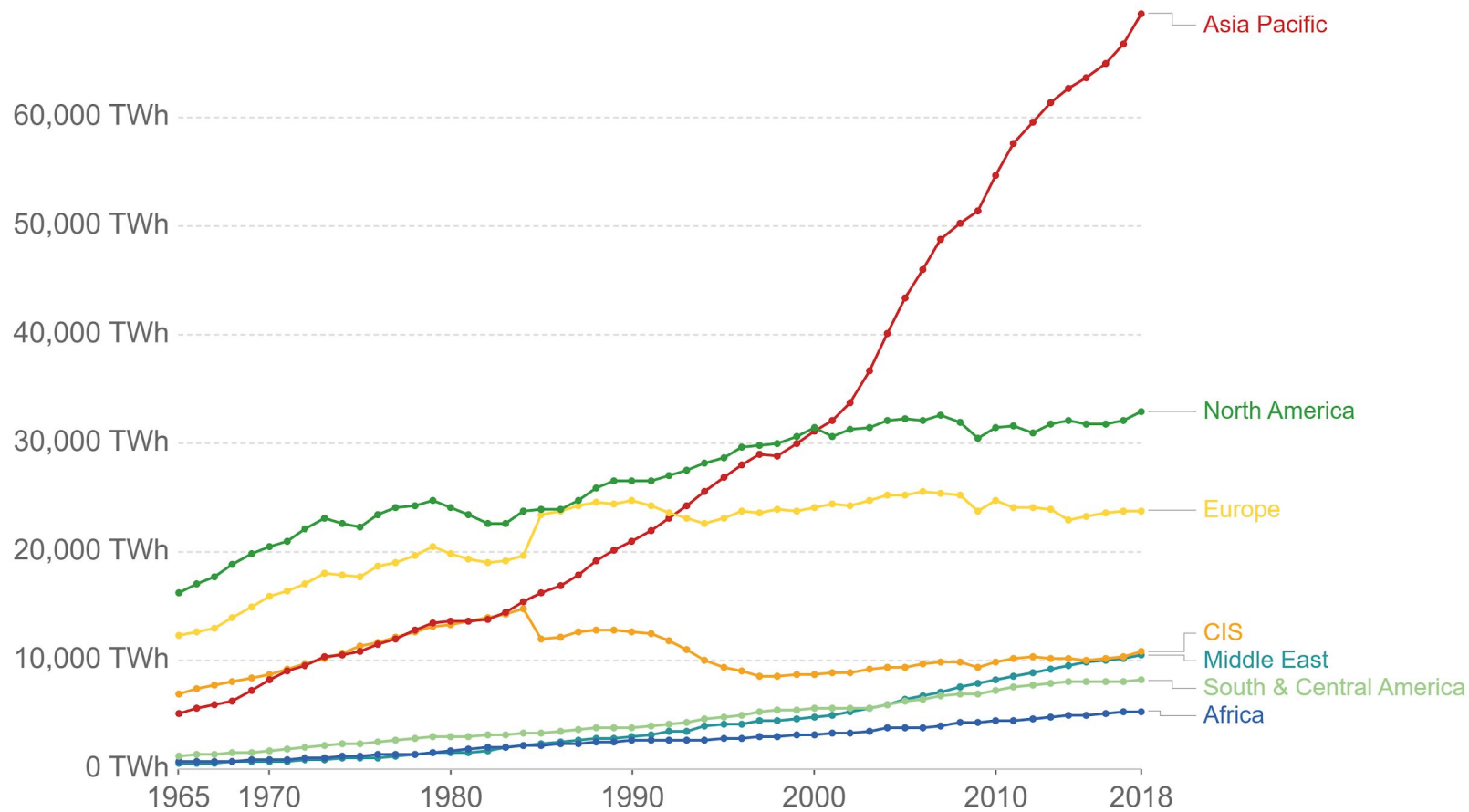


Energy Overview

Primary energy consumption by world region, 1965 to 2018

Our World
in Data

Primary energy consumption is measured in terawatt-hours (TWh). Note that this data includes only commercially-traded fuels (coal, oil, gas), nuclear and modern renewables used in electricity production. As such, it does not include traditional biomass sources.



Source: BP Statistical Review of World Energy (2019)

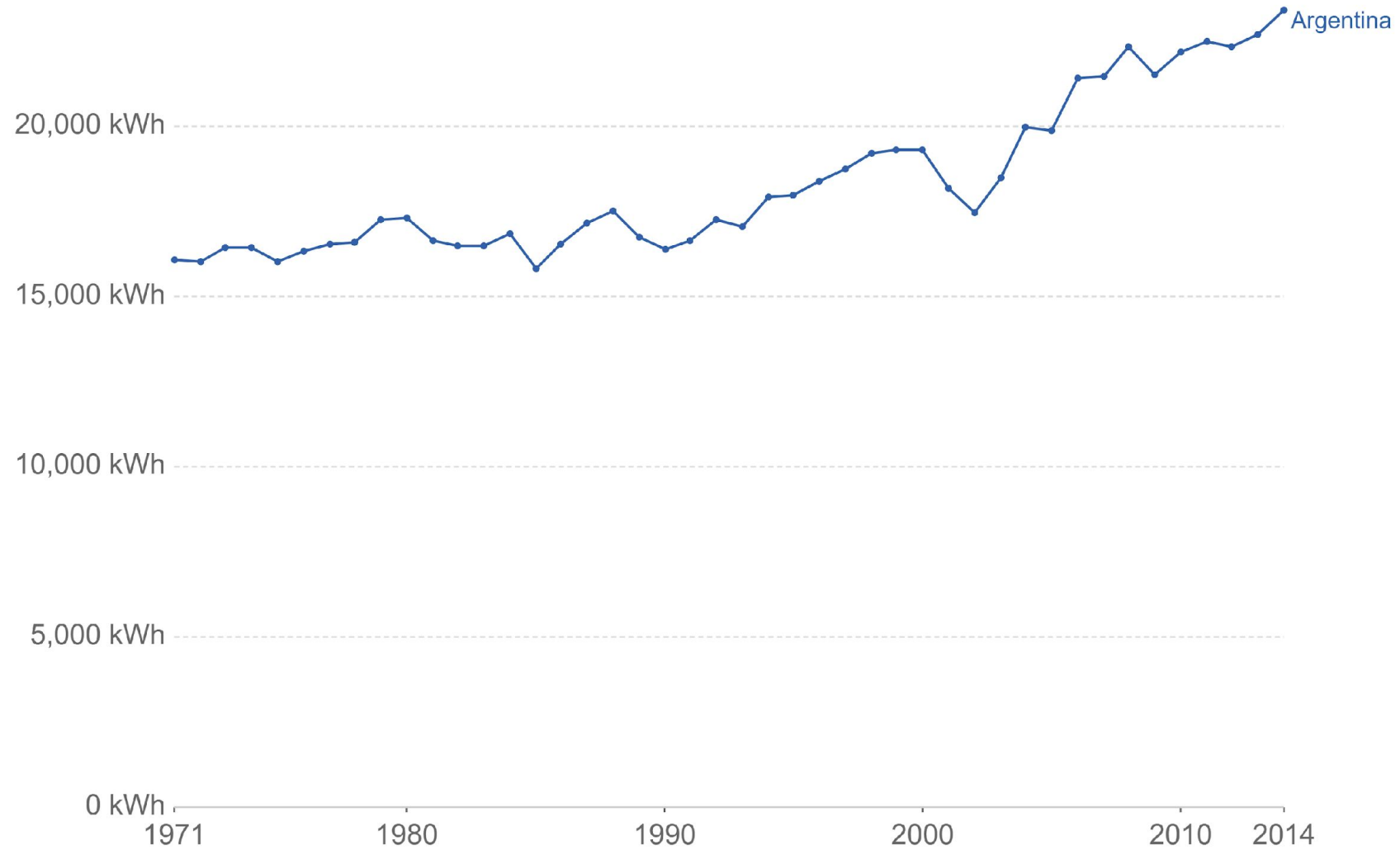
OurWorldInData.org/energy-production-and-changing-energy-sources/ • CC BY

Energy By Region

Energy use per capita, 1971 to 2014

Our World
in Data

Annual average per capita energy consumption is measured in kilowatt-hours per person per year.



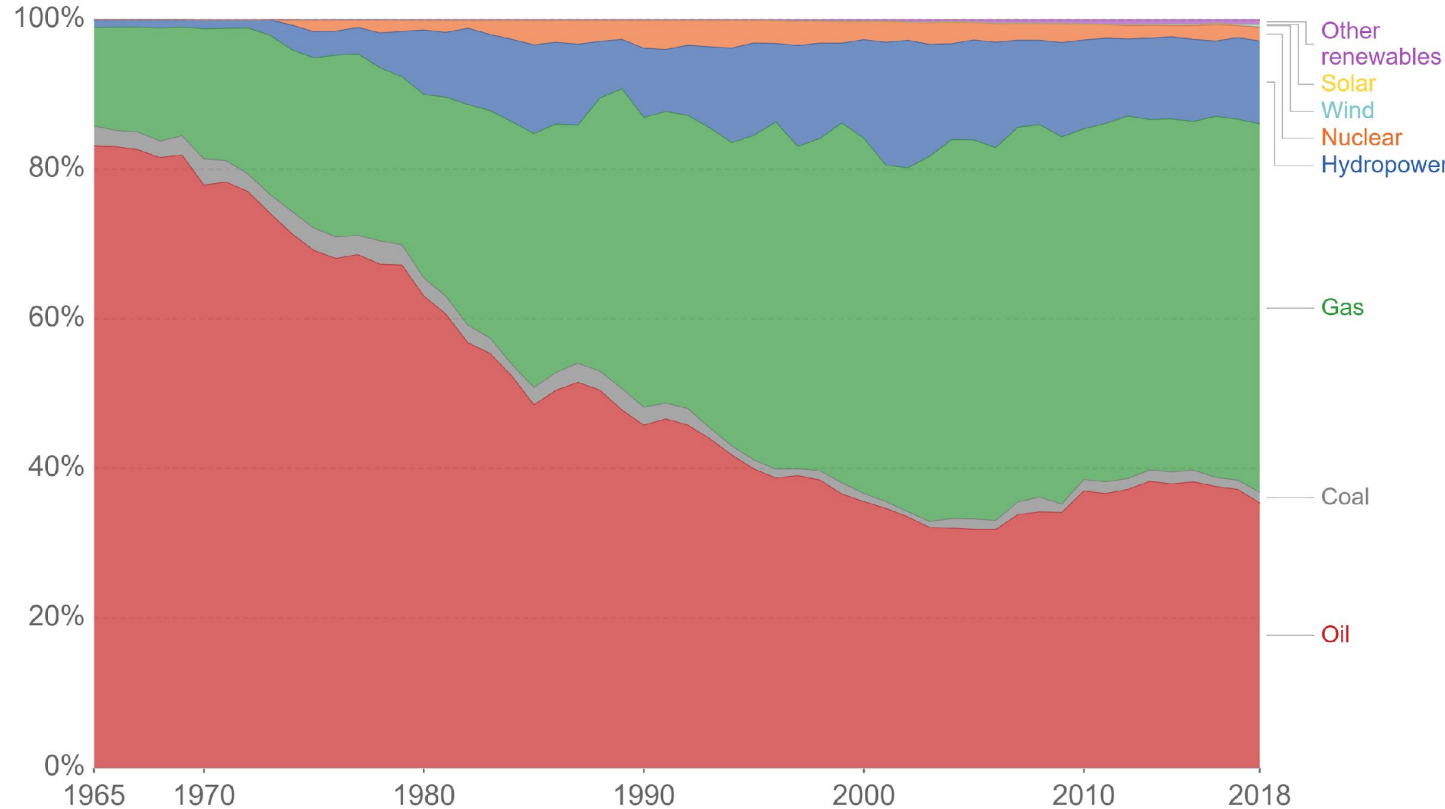
Source: International Energy Agency (IEA) via The World Bank

OurWorldInData.org/energy • CC BY

Energy consumption by source, Argentina, 1965 to 2018

Energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.

Our World
in Data



Source: BP Statistical Review of World Energy (2019)

Note: 'Other renewables' includes geothermal, biomass and waste energy.

OurWorldInData.org/energy • CC BY

- Oil consumption has gone down from >80% to <40%
- Out of all types of renewable energy hydropower has increased the most

Energy Consumption By Source

Argentina

2017 primary energy data in quadrillion Btu



Total Energy: Production 3.157 Consumption 3.868



Coal

Production

0.001

Consumption

0.033



Dry natural gas

Production

1.51

Consumption

1.81



Petroleum & other liquids

Production

1.191

Consumption

1.537



Nuclear, renewables, & other

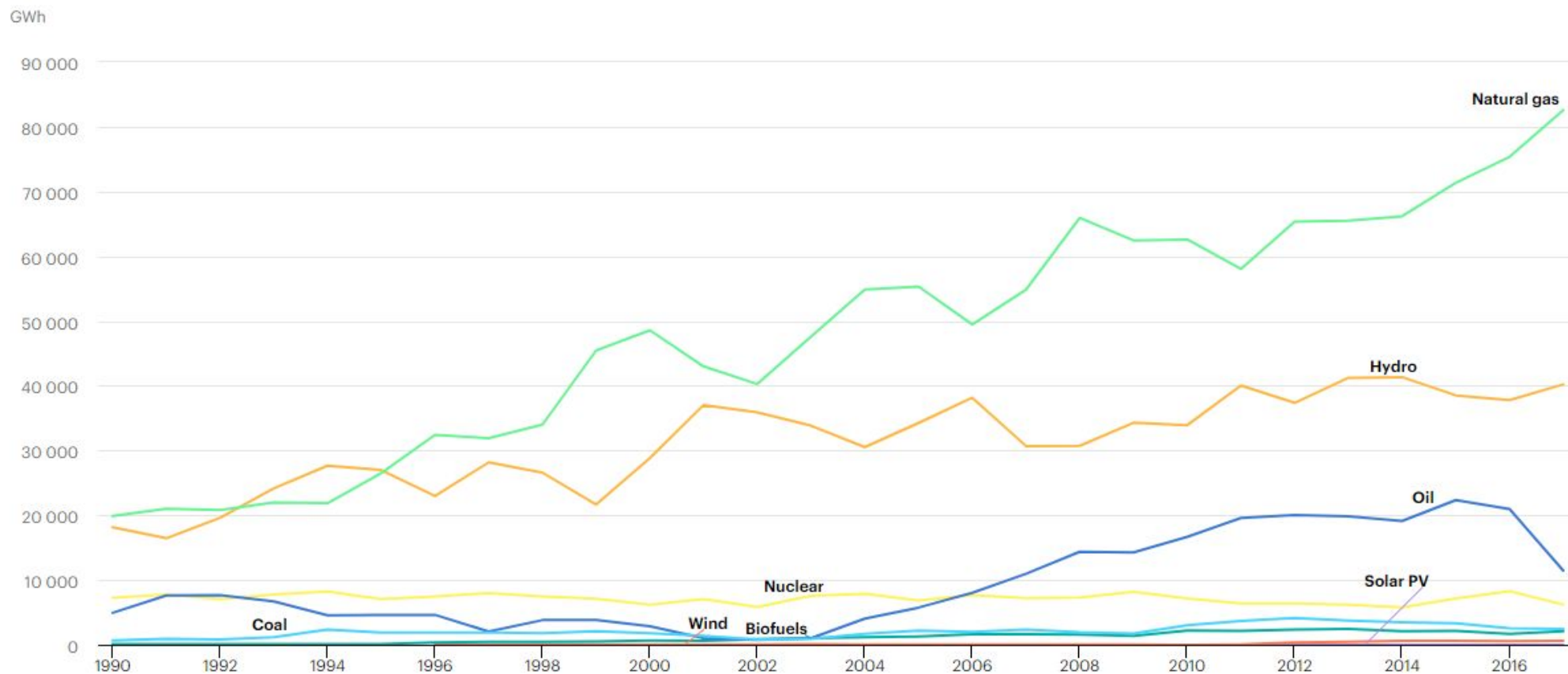
Production

0.455

Consumption

0.487

Electricity generation by source, Argentina 1990-2017





Fossil Fuels

Coal

COAL RESERVES

551,155,000 tons

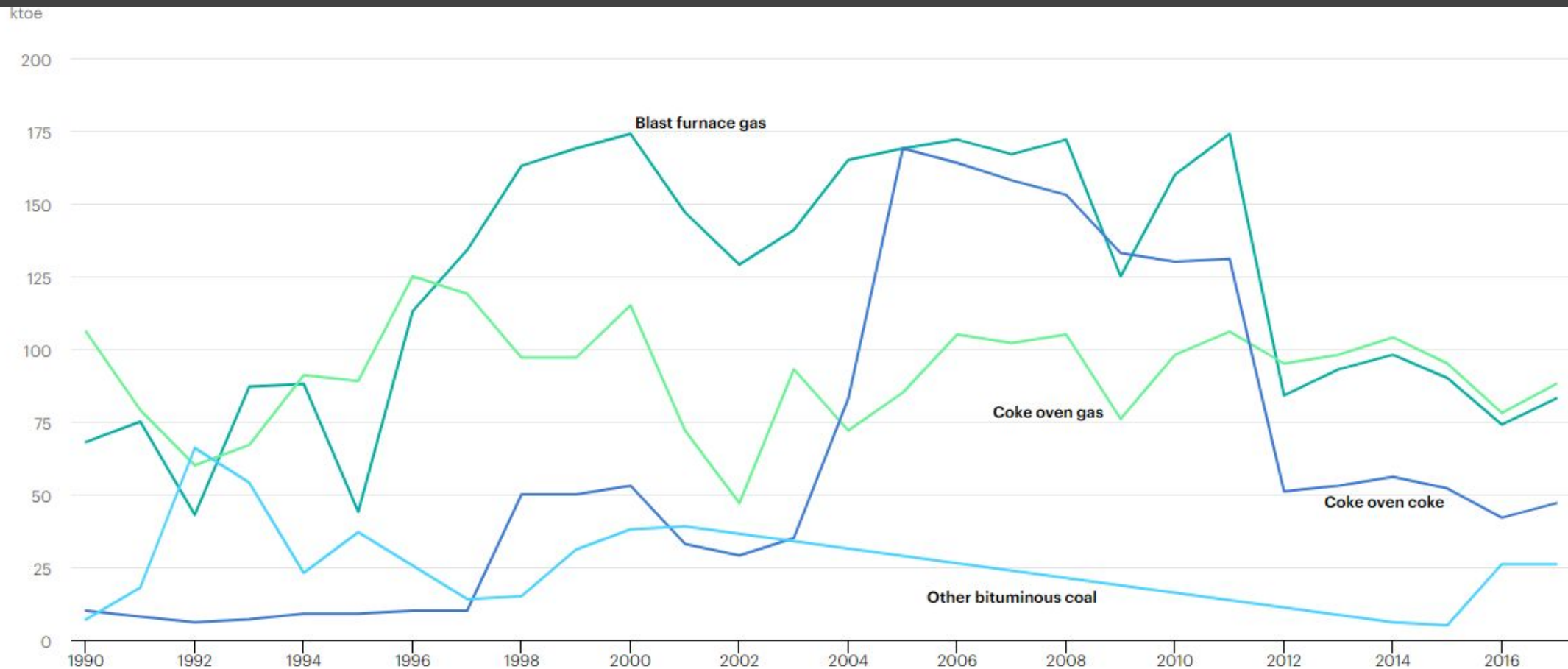
Global Rank: **39th** | Share of World: **0.05 %**

393 years of Coal left
(at current consumption levels)

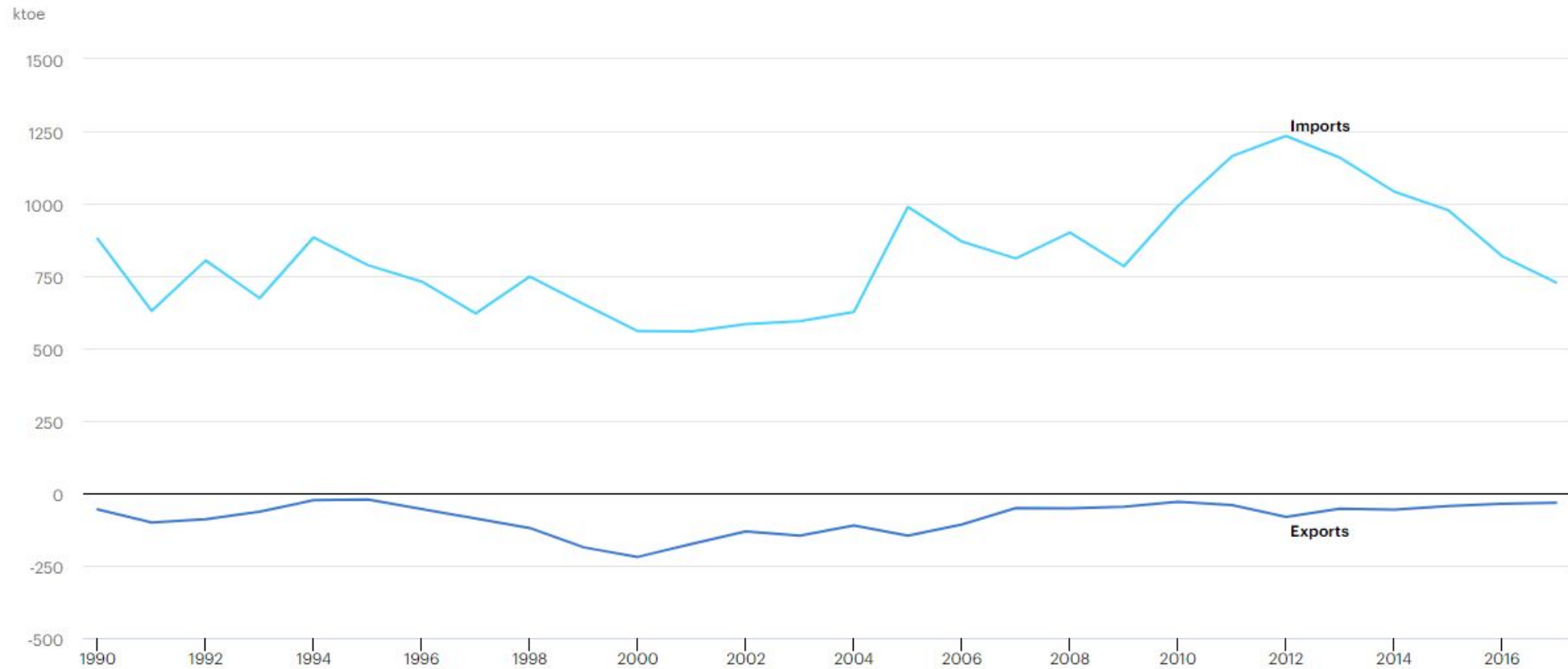
- Argentina has proven reserves equivalent to 392.7 times its annual consumption
- <https://www.worldometers.info/coal/argentina-coal/>

Coal Final Consumption By Type

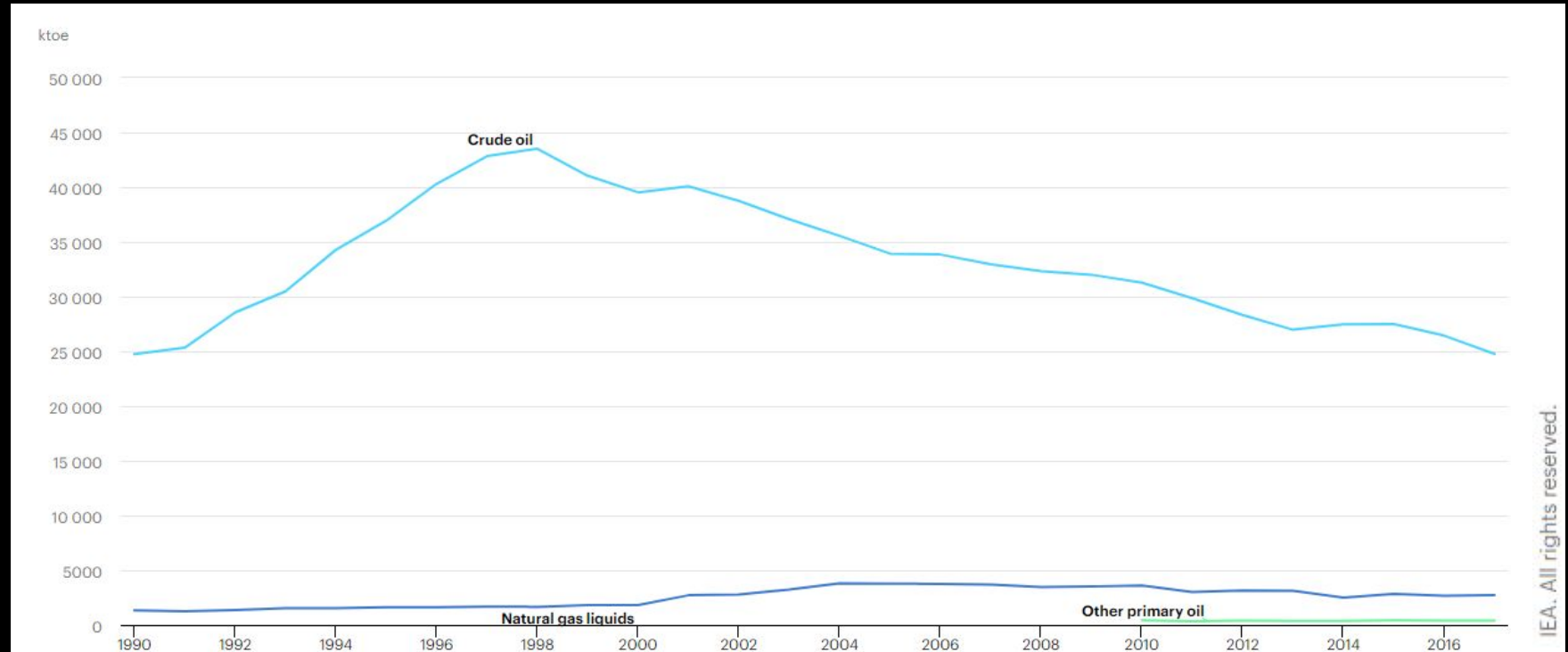
- Coal is mainly used as:
 - Blast furnace gas
 - Coke oven gas
 - Coke oven coke



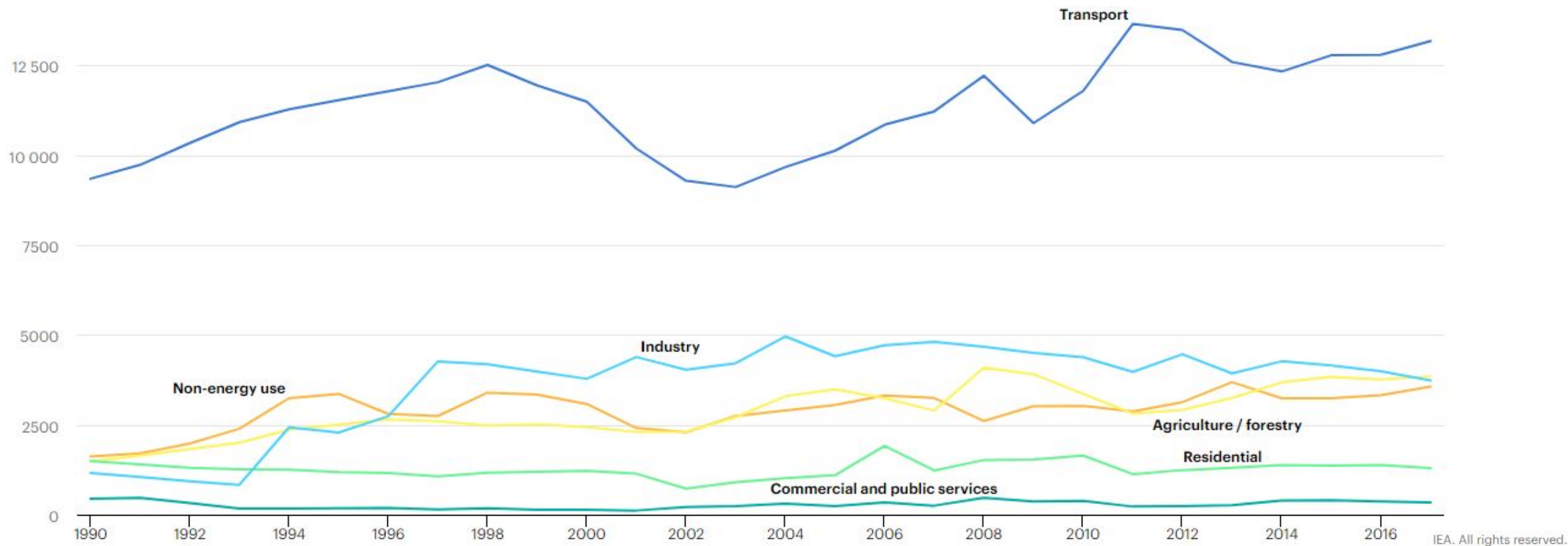
Coal Imports vs. Exports



Oil Production 1990-2017



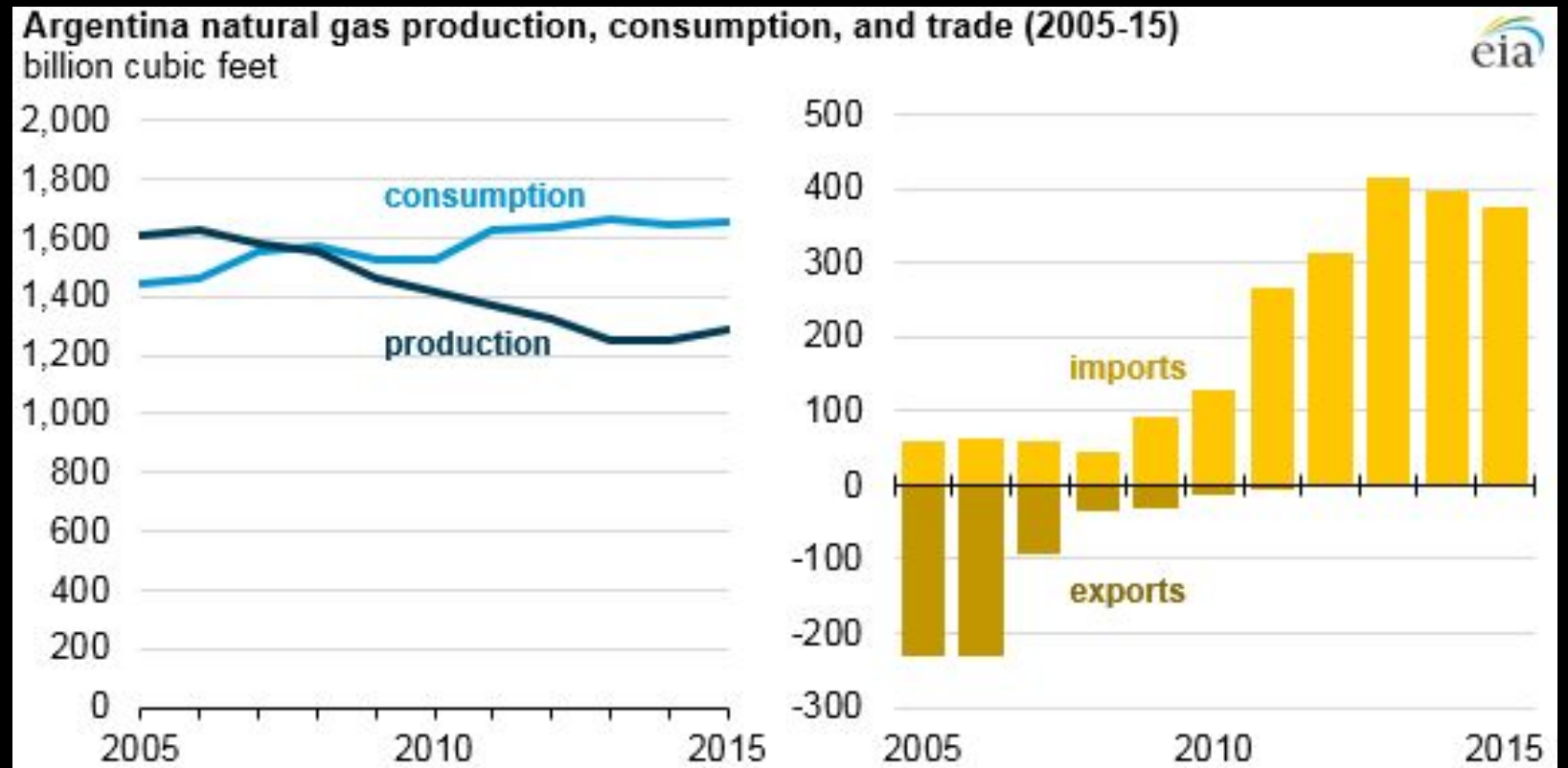
- Crude oil production peaked around 1998 and has been declining since
- Decline due to lack of sufficient investment in exploration and development (EIA, 2017)
- Shale oil production from unconventional fields has increased
 - higher drilling efficiency
- Vaca Muerta formation: ~60% of 27 billion barrels of technically recoverable shale oil reserves
 - fourth-largest shale oil reserves in the world



Oil Products Consumption By Sector

- The transport sector uses much of the oil produced (~ 13,000 ktoe)
- The rest of the sectors consume less than 5000 ktoe
- Oil is the primary fuel used in the transportation sector and represents 36% of total primary energy consumption (EIA, 2017)

Natural Gas

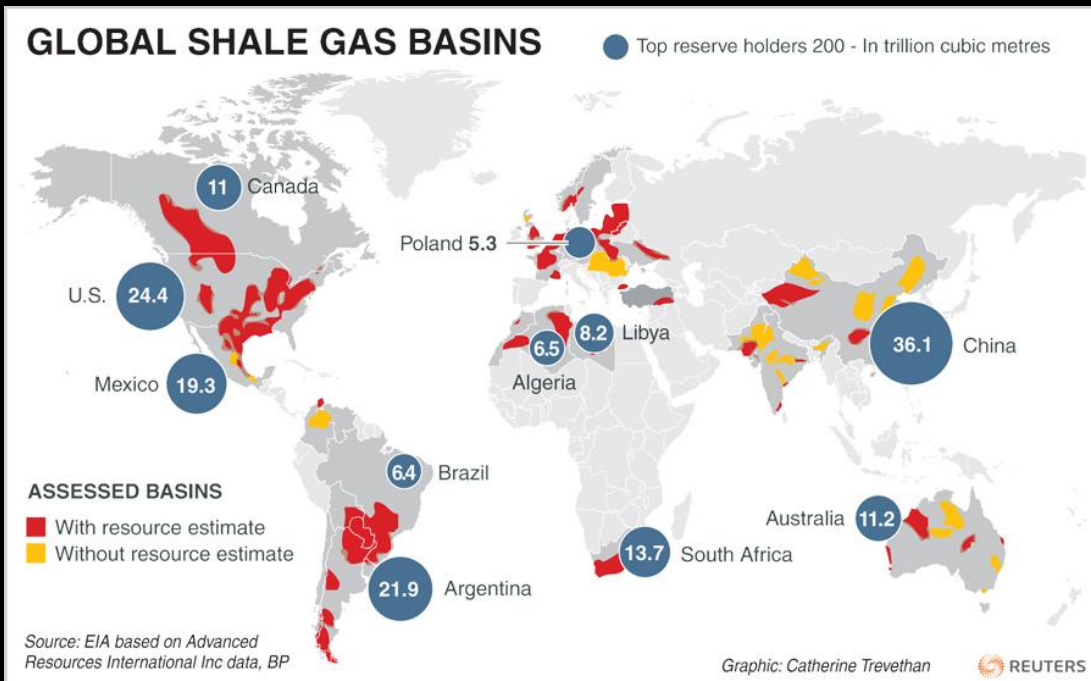


- Natural gas represented 52% of total primary energy consumption in 2015 (EIA, 2017)
- Graphs from:
<https://www.eia.gov/todayinenergy/detail.php?id=29912>

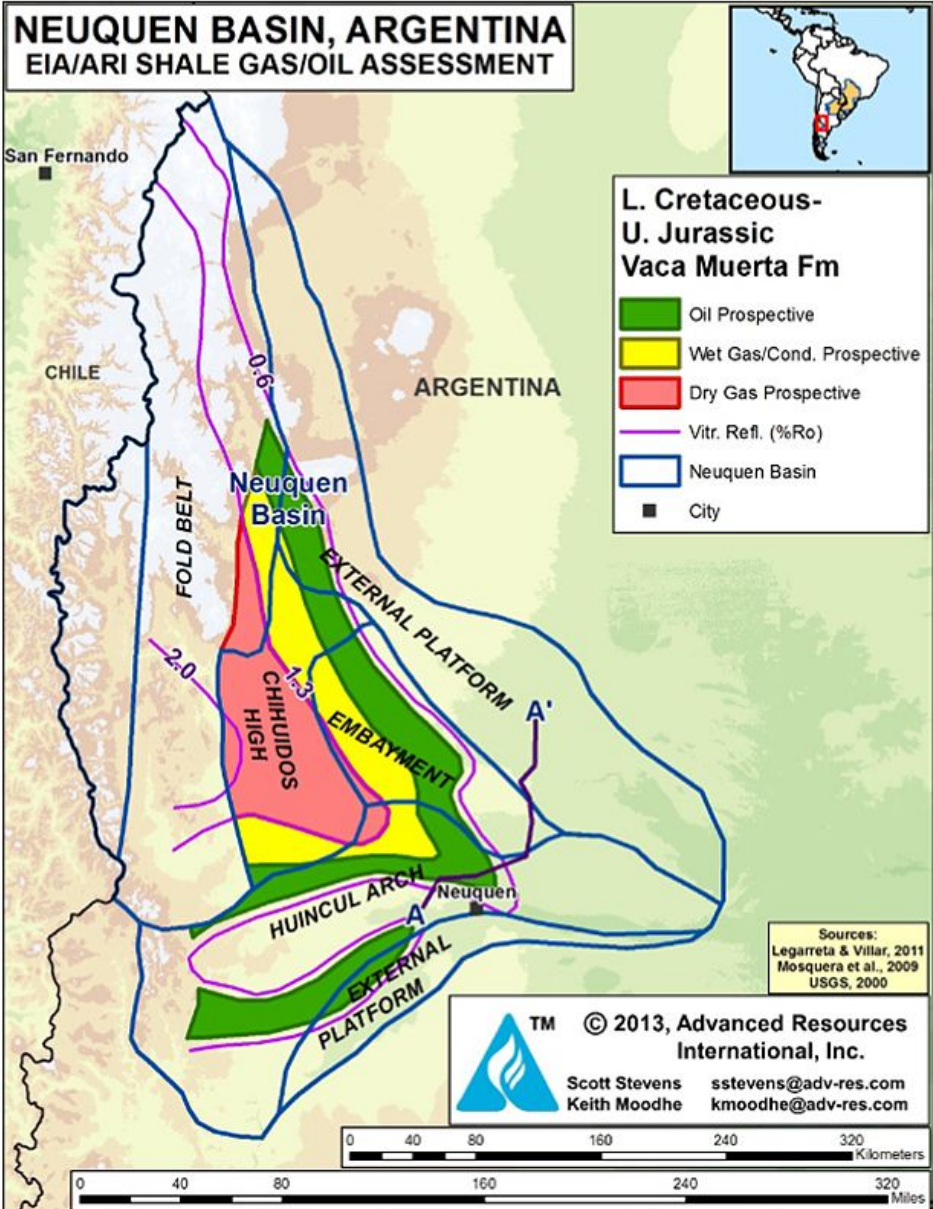


Natural Gas

- Largest natural gas-producing basins: Neuquén, Austral, and Noroeste
 - ~85% of Argentina's natural gas production (EIA, 2017)
- Argentina has 18,598 miles of natural gas pipelines
- Most imports come from Bolivia (via pipeline)
 - 2014: imported 203 Billion cubic feet (Bcf)
- Although Argentina is a net importer of natural gas, it continues to export natural gas to its neighbors — largely Chile and, to a lesser extent, Uruguay (EIA, 2017)



NEUQUEN BASIN, ARGENTINA EIA/ARI SHALE GAS/OIL ASSESSMENT

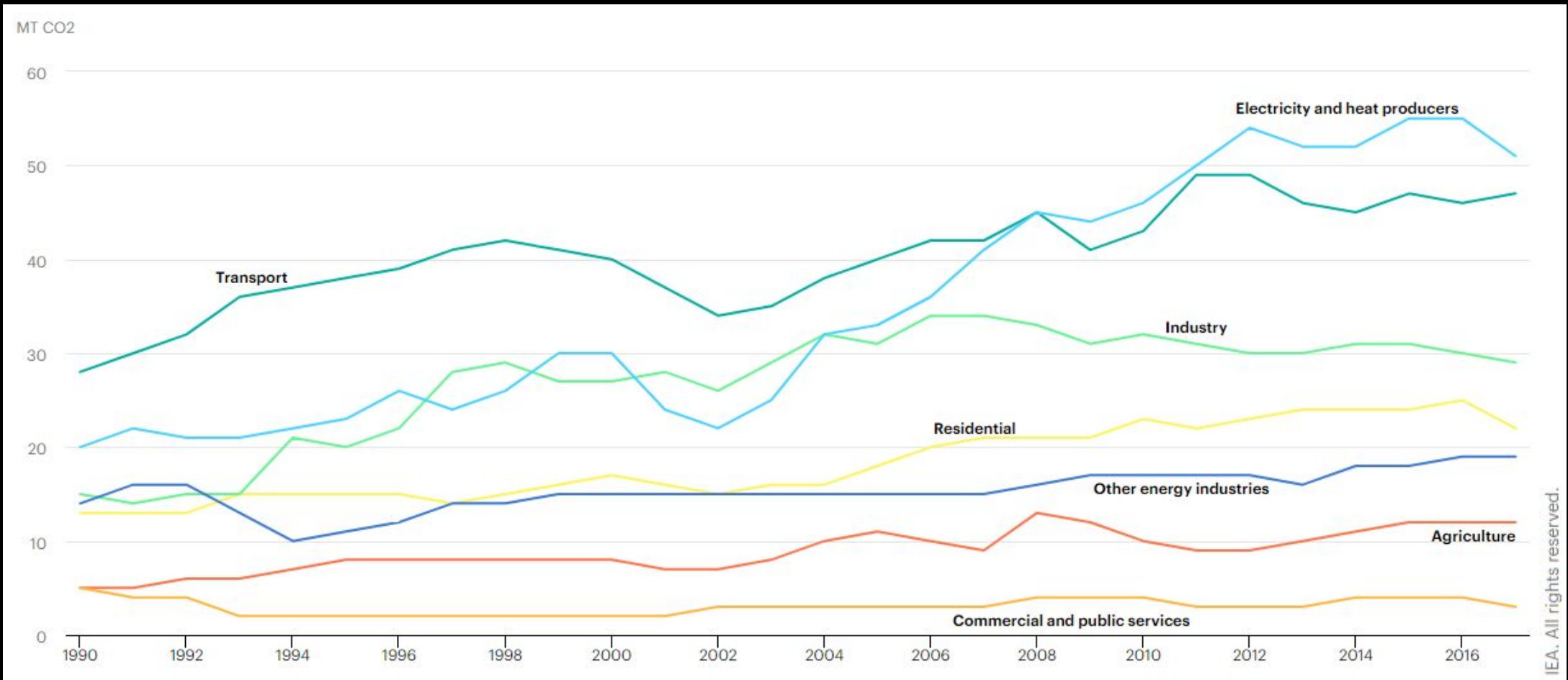


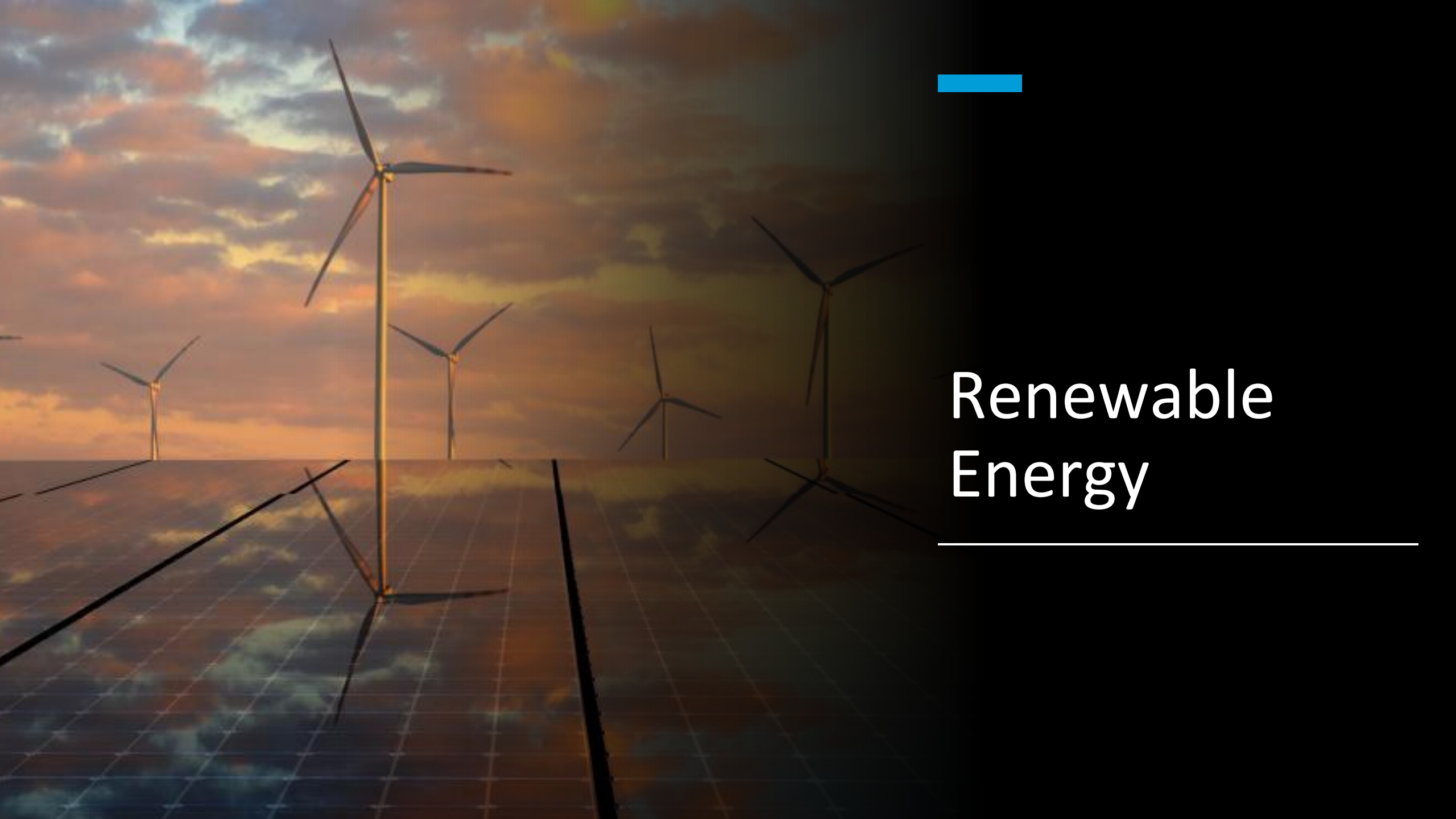
Source: EIA, Advanced Resources International

Natural Gas

- Proven natural gas reserves: ~11.1 trillion cubic feet (Tcf) in December 2016
- Argentina has world's second largest shale gas reserves
 - Vaca Muerta (dead cow in Spanish) in the Neuquen Basin (~308 Tcf of dry, wet, and associated shale gas resources)
 - Geologic formation of Late Jurassic to Early Cretaceous age

CO₂ Emissions By Sector





Renewable
Energy



Hydroelectric



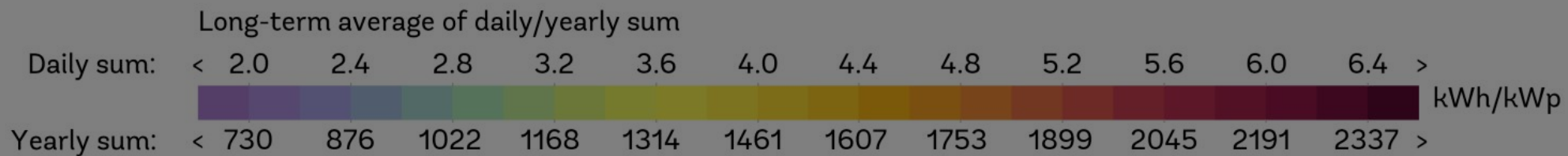
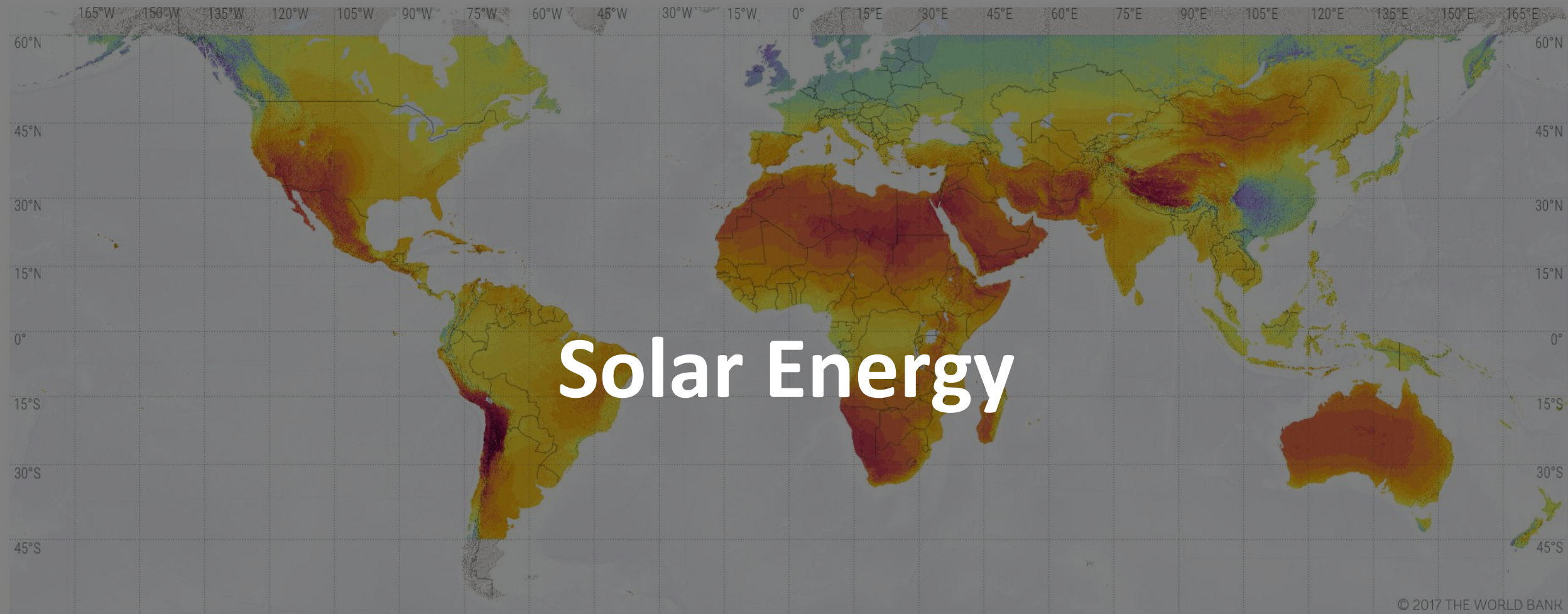
- 10790 MW Installed Capacity
- 28% of current energy
- Estimated 169,000 GWh/year, 130,000 GWh/year feasible
- 35 Hydro Plant of at least 10 MW
- 16 Multipurpose hydro plants
- Yacyretá Dam
 - Largest in Argentina
 - 808 Meters Long
 - 3100 MW Max Output
 - Cost more than \$11 Billion
 - Shared with Paraguay



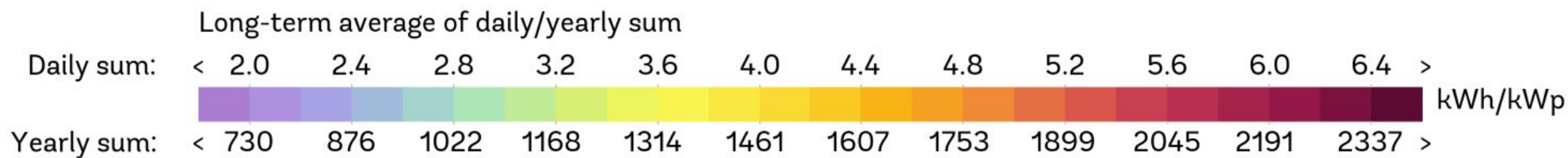
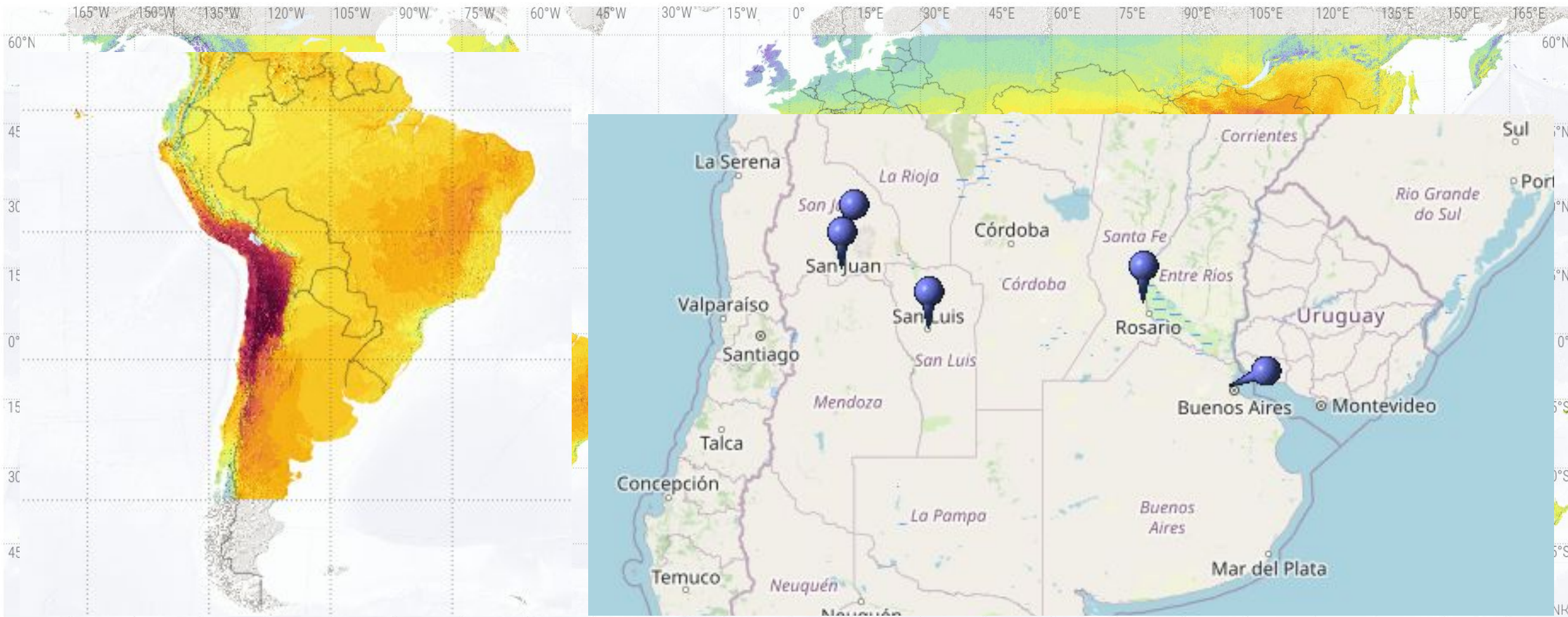
Hydraulic Energy

Figure from:
<http://www.geni.org/globalenergy/library/energy-issues/argentina/index.shtml>

SOLAR RESOURCE MAP PHOTOVOLTAIC POWER POTENTIAL

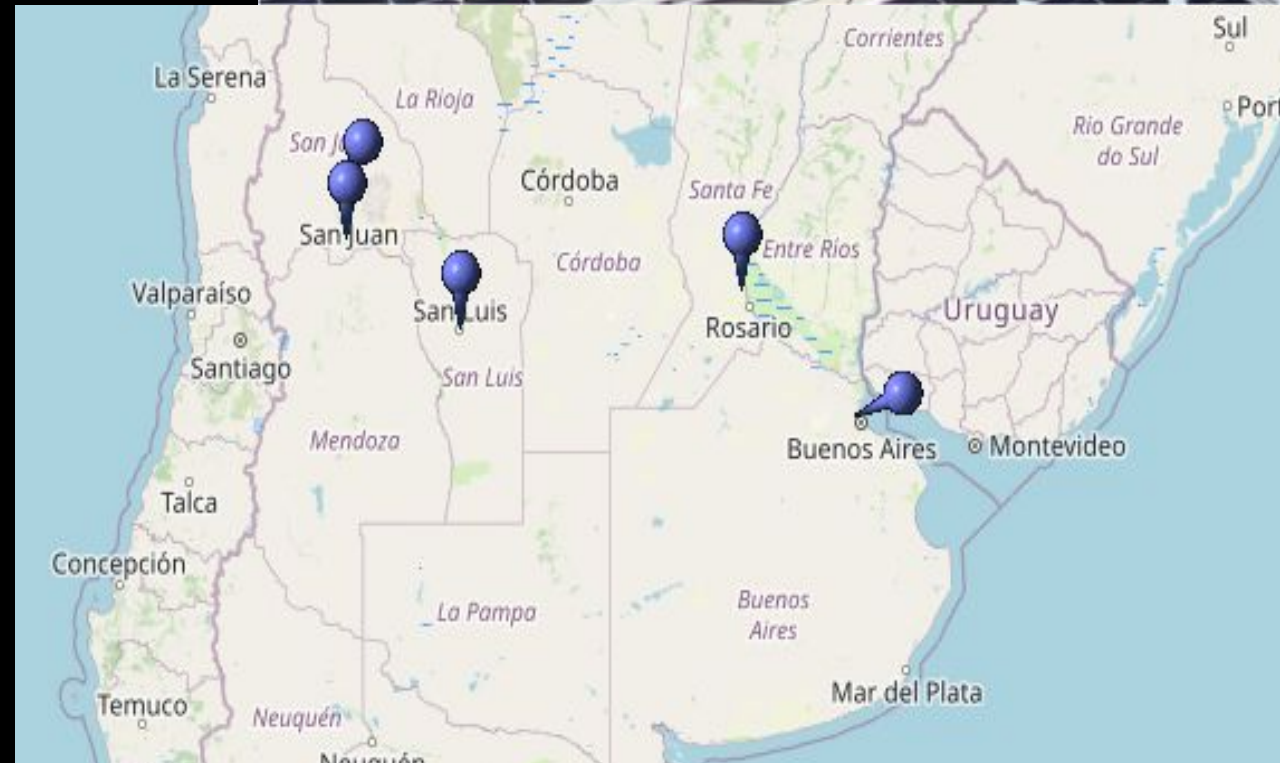


SOLAR RESOURCE MAP PHOTOVOLTAIC POWER POTENTIAL



Solar Energy

- 317 MW Installed Capacity
- .81% of current energy
- 5 Solar Power Plants
- Chimbera
 - Largest Solar Plant
 - Combined 7 MW
 - Cañada Honda, San Juan Province
 - Owned by 360 Energy SA

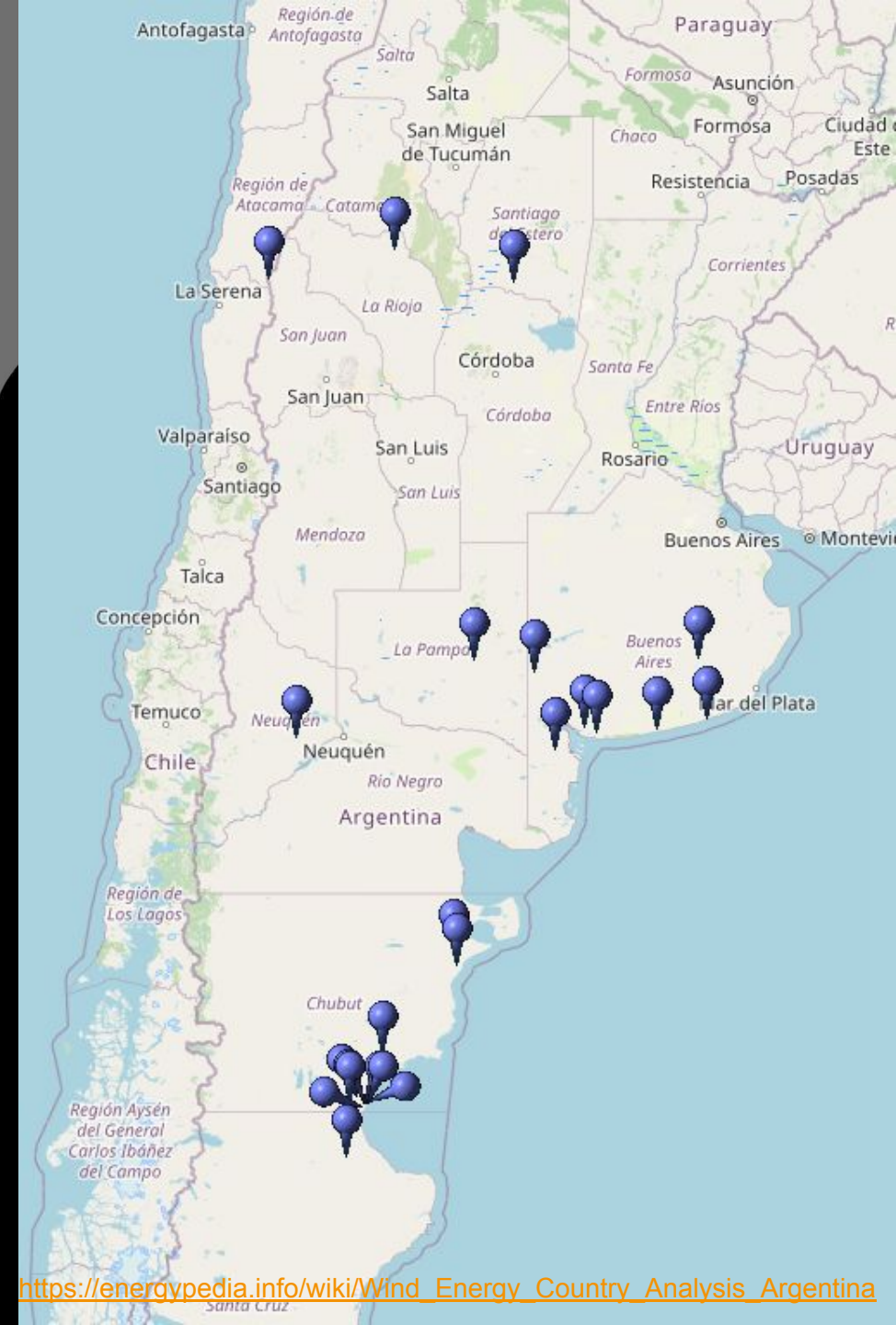
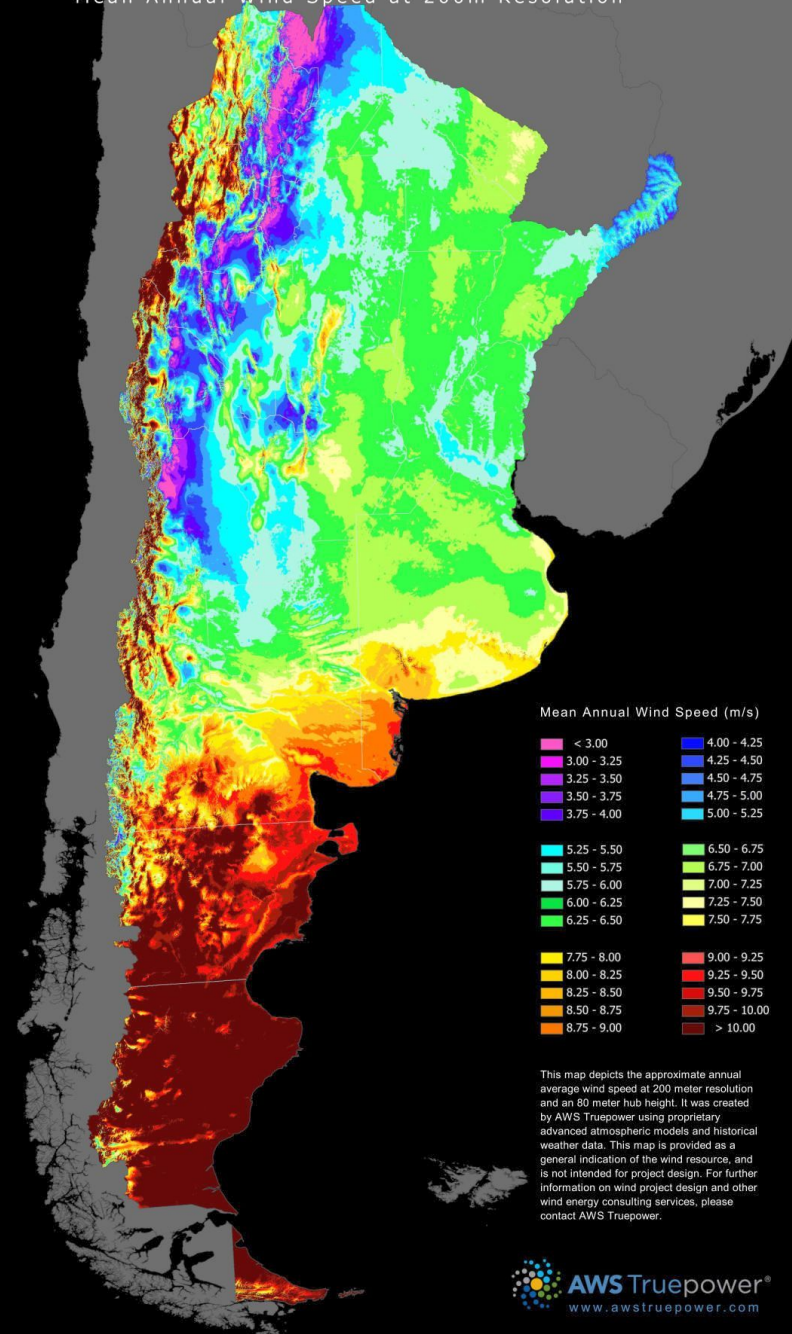


WIND RESOURCE OF ARGENTINA

Mean Annual Wind Speed at 200m Resolution

Wind Energy

- 970 MW Installed Capacity
- 18 Wind powered energy plants
- 2.5% of current energy
- 70 % of Argentina's territory is suitable for wind energy utilization
- Annual average wind speed of 6 m/s (measured at 50 meter height)
- Best sites are located in the southern part of the country, particularly in the middle and southern



Wind Energy

- Genneia's has ~40% of the wind energy share
- The Madryn Wind Farm
 - 223 MW
 - 6,000 hectares
 - Province of Chubut
 - 62 wind turbines
 - 117 meters high and 60 meter long blades
 - Supplying the equivalent of more than 330,000 homes
 - Largest wind farm in Argentina





Nuclear Energy

Nuclear Energy

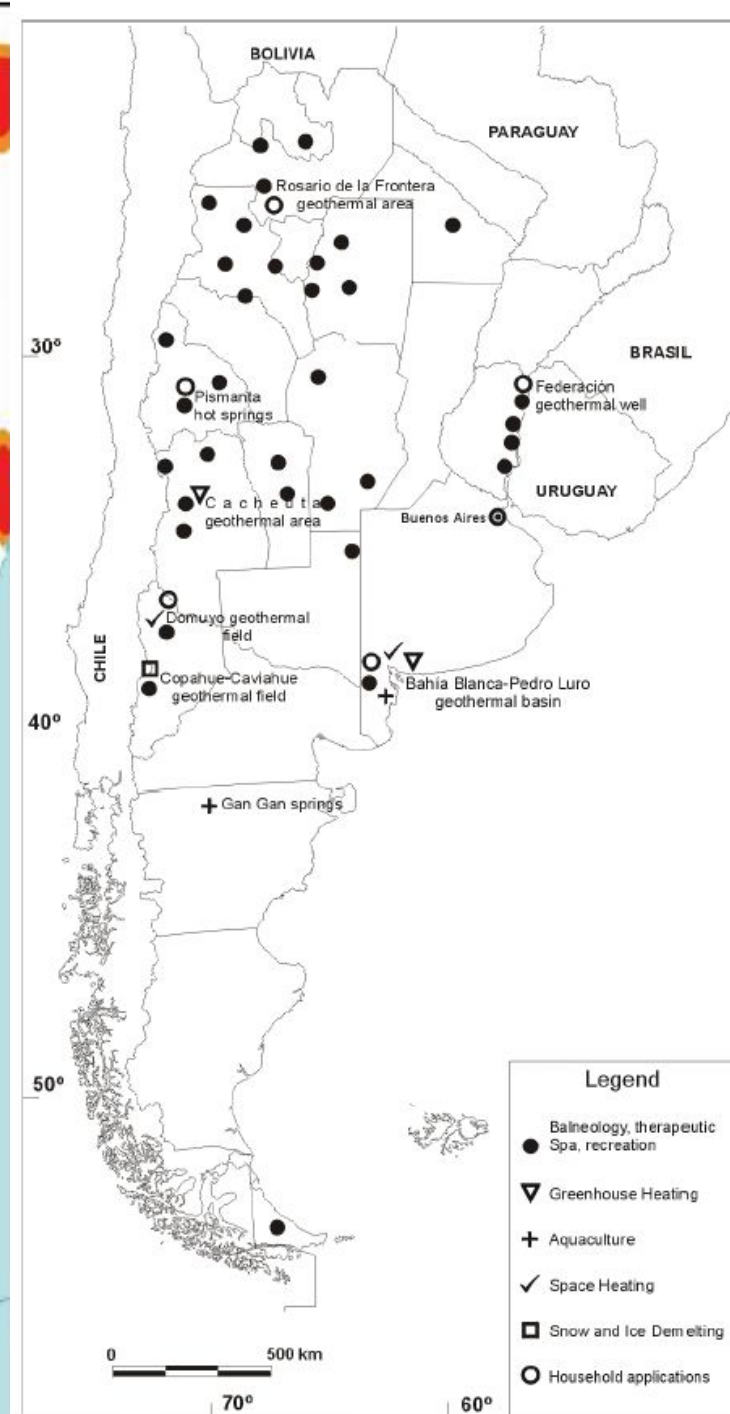
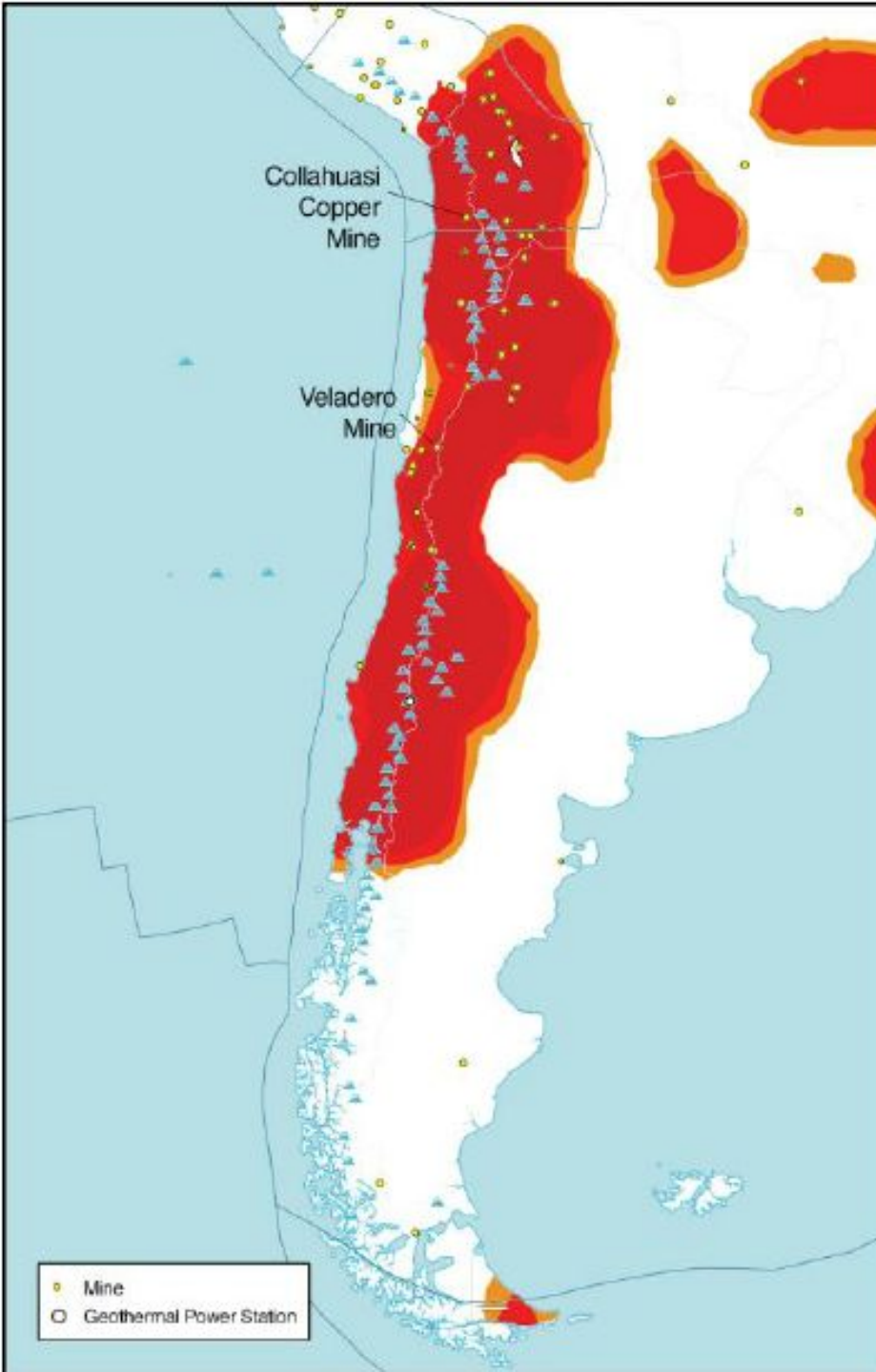
- 4.5% of current energy
- 1702 MW Installed Capacity
- 3 power plants
 - Used fuel is stored at each power plant
 - Some dry storage at Embalse.
- PHWR

Reactor	Location	Model	Net MWe	First power	Planned close
Atucha 1/Peron	Lima, Buenos Aires province	PHWR (Siemens)	340	1974	2024
Atucha 2/Kirchner	Lima, Buenos Aires province	PHWR (Siemens)	692	2014	
Embalse	Embalse, Córdoba province	PHWR (CANDU 6)	670	1983	2049
Total (3)			1702 MWe		



Geothermal

- 30 MW Installed Capability for electricity generation
- 149 MW Installed Capability for Direct Uses
 - Spas, Heating, Aquaculture, Melting, Household applications
 - Annual Output 609.4 TJ



https://www.worldenergy.org/assets/images/imported/2013/10/WER_2013_9_Geothermal.pdf
https://www.researchgate.net/figure/Mines-and-estimate-d-heat-flow-in-Peru-Chile-and-Argentina-as-given-by-Ha-mza-et-al_fig4_269395965

Biomass Energy Plants

- 8 Large Biomass Plants
 - Mix of energy and thermal production
- 260 MW Installed Capacity
- Mainly in Northern Province



The Future

- Two Wind Farms are under construction
 - Malaspina I
 - Arauco IV
 - Both 50 MW Capacity
- One Solar Farm is under construction
 - Santa Fe
 - 1.1 MW Capacity
- Three Hydroelectric Plants are under construction
 - Condor Cliff, 1,140 MW Capacity
 - La Barrancosa, 600 MW Capacity
 - El Tambolar, 75 MW Capacity
- 1 Nuclear Power Plant is under construction
 - 1000 MW Capacity
 - Hualong-1 Reactor (PWR)

References

- Technology, Energy Innovation: Policy and. “Argentina May Be the Hottest Renewable Energy Market You Haven't Heard Of. Can It Spur a Global Boom?” *Forbes*, Forbes Magazine, 15 Oct. 2019, www.forbes.com/sites/energyinnovation/2019/10/15/argentina-may-be-the-hottest-renewable-energy-market-you-havent-heard-of-can-it-spur-a-global-boom/#5d23f496eeb2.
- Ritchie, Hannah, and Max Roser. “Energy.” *Our World in Data*, 28 Mar. 2014, www.ourworldindata.org/energy.
- IEA. “Argentina - Countries & Regions.” *IEA*, 12 June 2019, www.iea.org/countries/Argentina.
- EIA. “U.S. Energy Information Administration - EIA - Independent Statistics and Analysis.” International - U.S. Energy Information Administration (EIA), Aug. 2017, www.eia.gov/international/analysis/country/ARG.
- IEA. “Data & Statistics.” *IEA*, 1 Apr. 2020, www.iea.org/data-and-statistics?country=ARGENTINA&fuel=Energy%2Bsupply&indicator=Total%2Bprimary%2Benergy%2Bsupply%2B%28TPES%29%2Bby%2Bsource.
- Donghi, Tulio Halperin, et al. “Argentina.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 20 Apr. 2020, www.britannica.com/place/Argentina.