

ORGANIZA:



UNIVERSIDAD  
SERGIO ARBOLEDA



# CONGRESO COLOMBIANO Y CONFERENCIA INTERNACIONAL

CALIDAD DEL AIRE Y SALUD PÚBLICA - CASAP  
**PERSPECTIVAS POSPANDEMIA**

EVENTO ONLINE

**3 al 5**

**DE NOVIEMBRE**

BOGOTÁ, COLOMBIA  
2021



# Which Energy Resources for the Futur of Colombia? Impact on Atmospheric Emissions

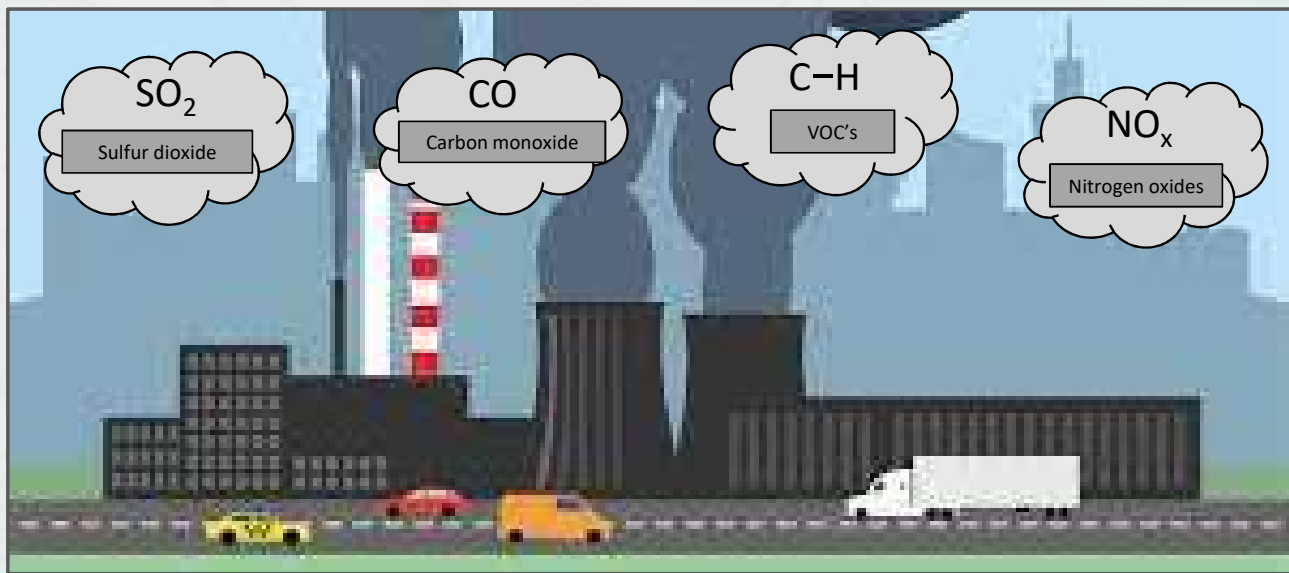
*Clappier Alain*

Université

de Strasbourg

# Pollutant emissions and energy consumption

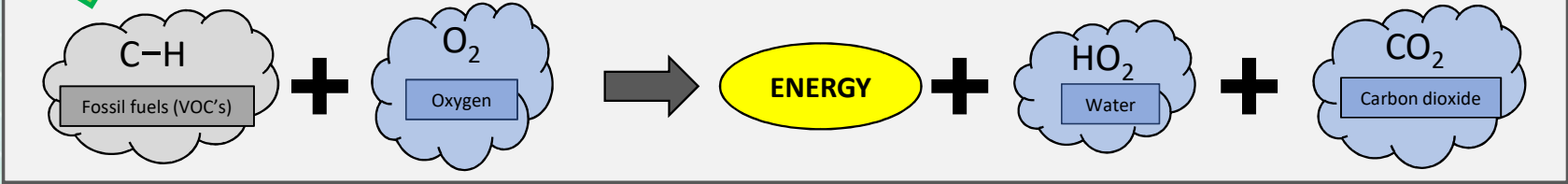
**Air Quality**



**Energy Resources**



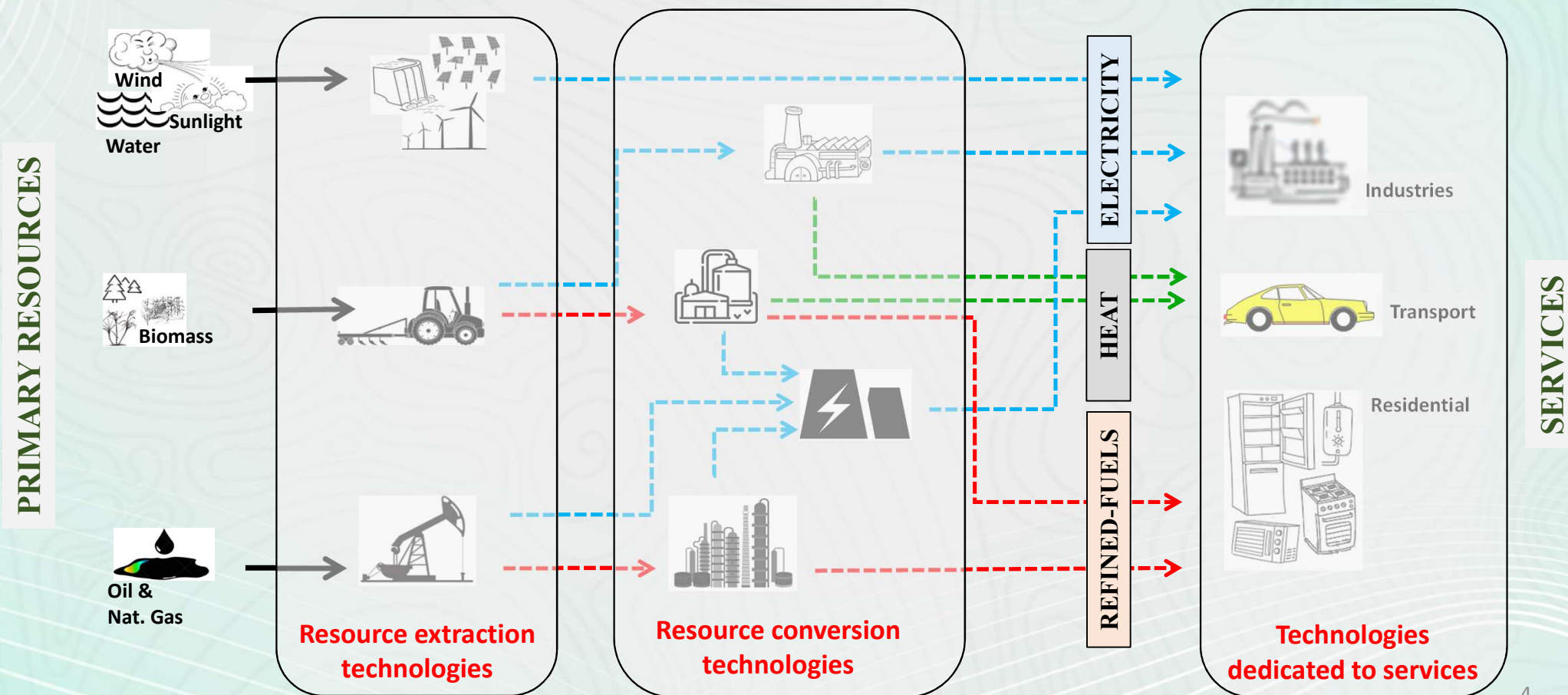
**Combustion**



**Climate Change**

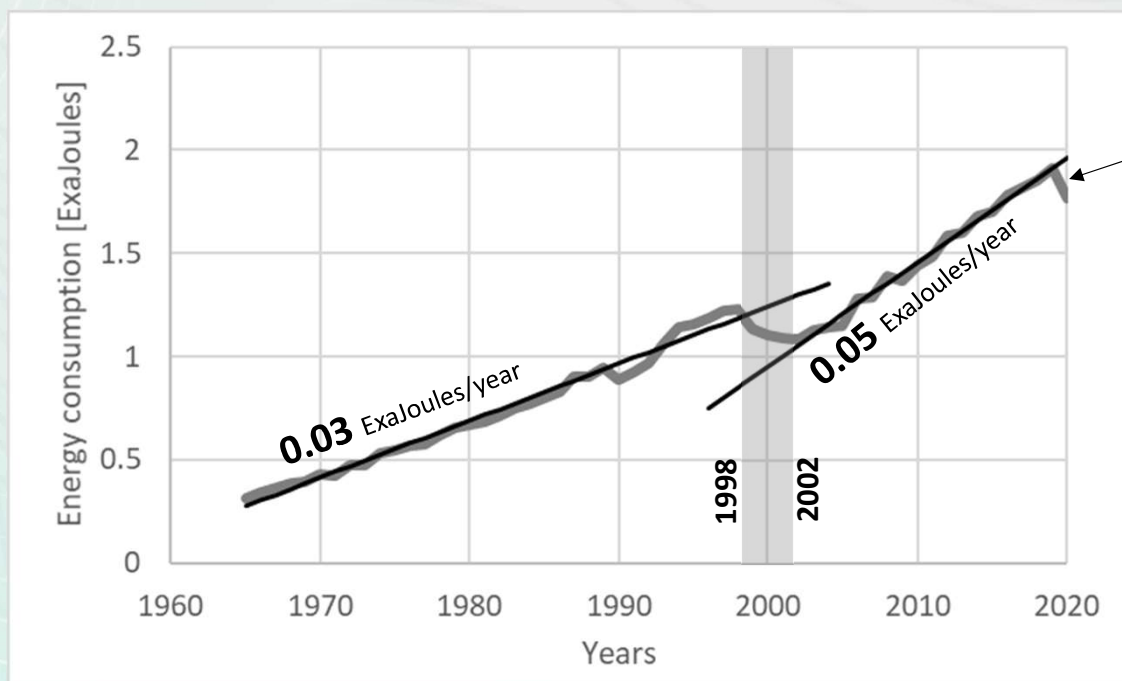


# Resources, Services and Technologies



# Evolution of the Energy Demand

Energy demand is increasing in Colombia



Covid 19



## Evolution of the Energy Demand

Electric technologies are disrupting the transportation sector.

### 90% of new cars sold in Norway are now electric or plug-in hybrids

The goal is to get to 100% EV sales by 2025.



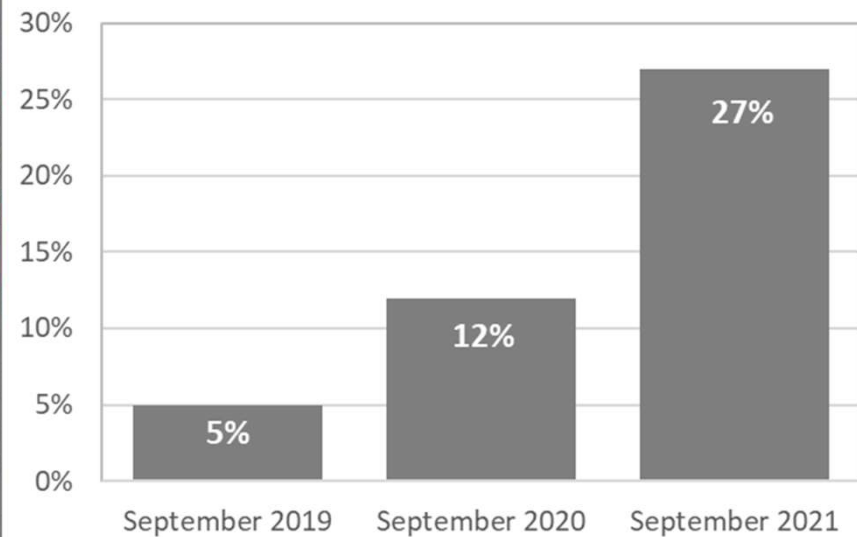
[Photo: bruev/Stock]

### Tesla Model 3 Was The Top Selling Model In Europe In September

It's the first time ever when an all-electric car is also the best selling car in a month.

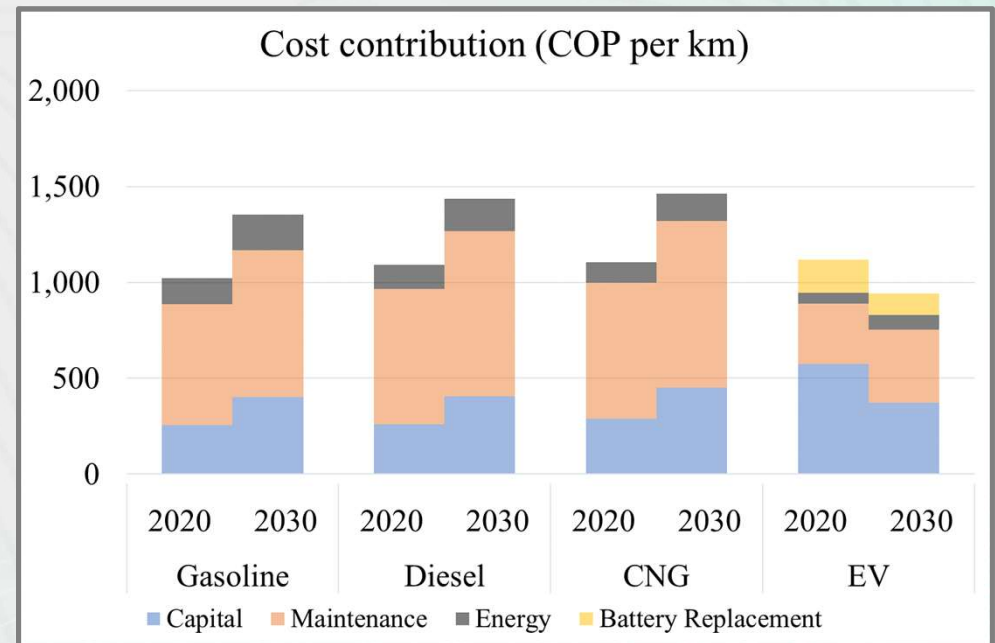
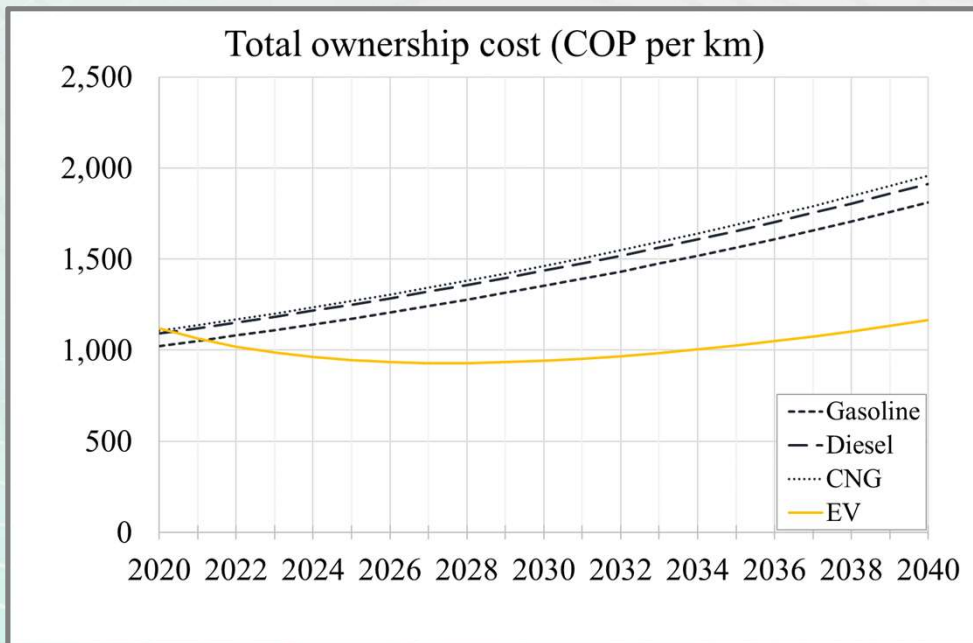


### Percentage of EV Cars Sals in Europe-26



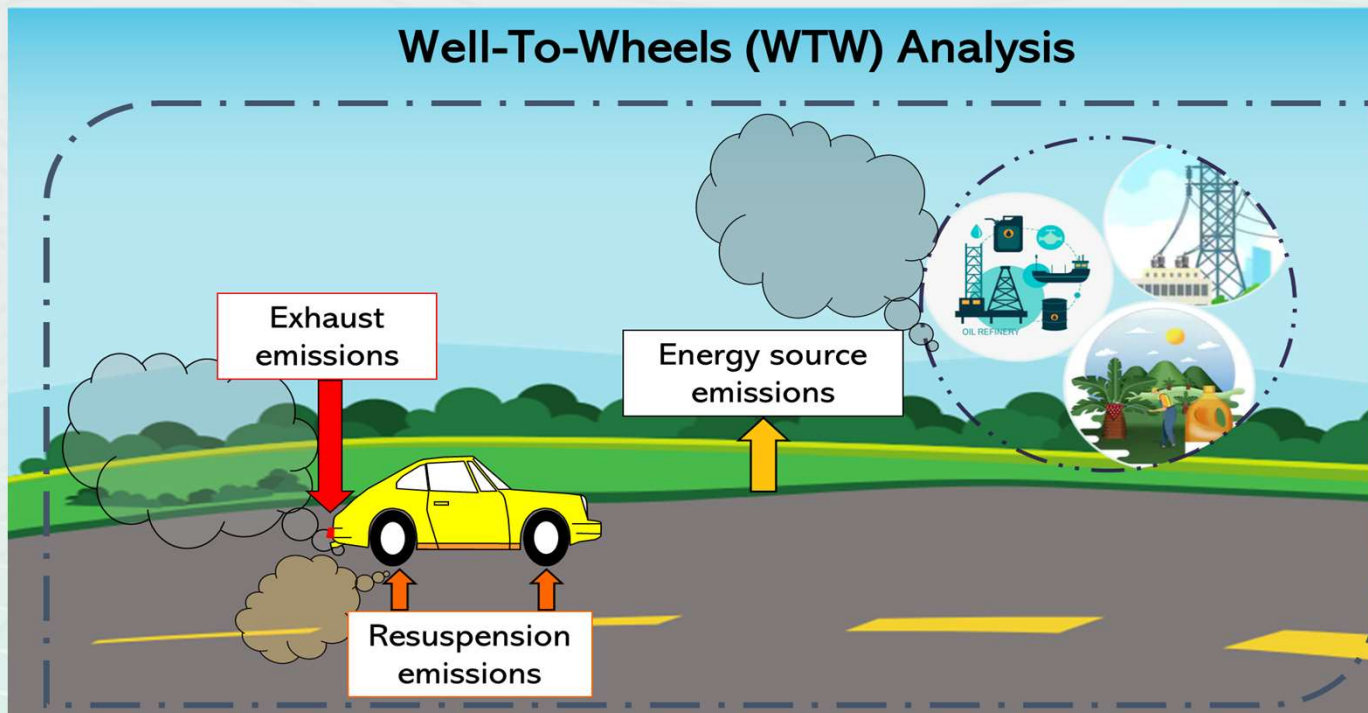
## Evolution of the Energy Demand

Electric vehicles become the cheapest



## Evolution of the Energy Demand

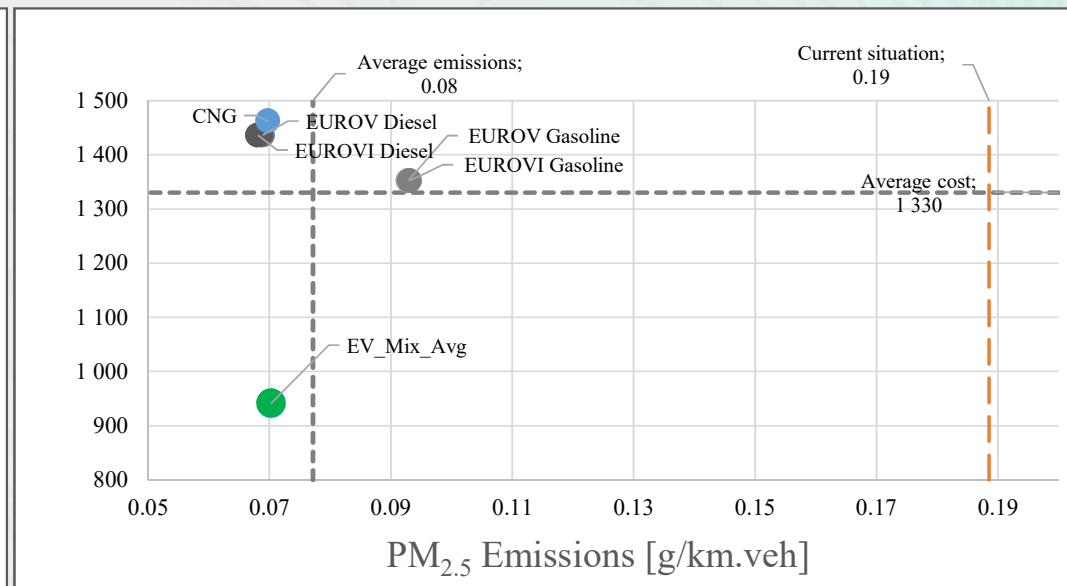
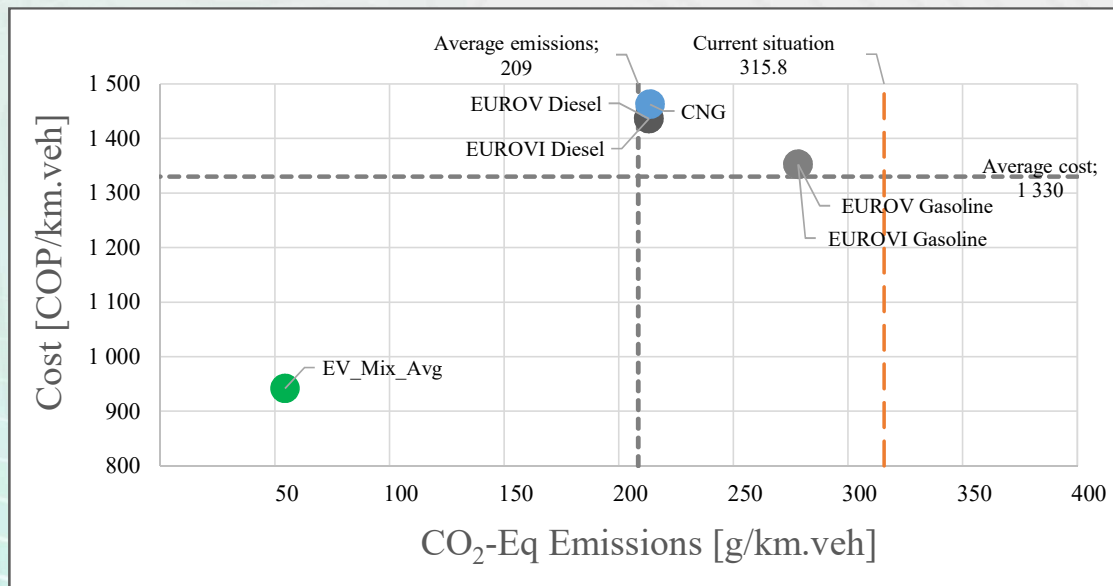
Well to wheel emissions





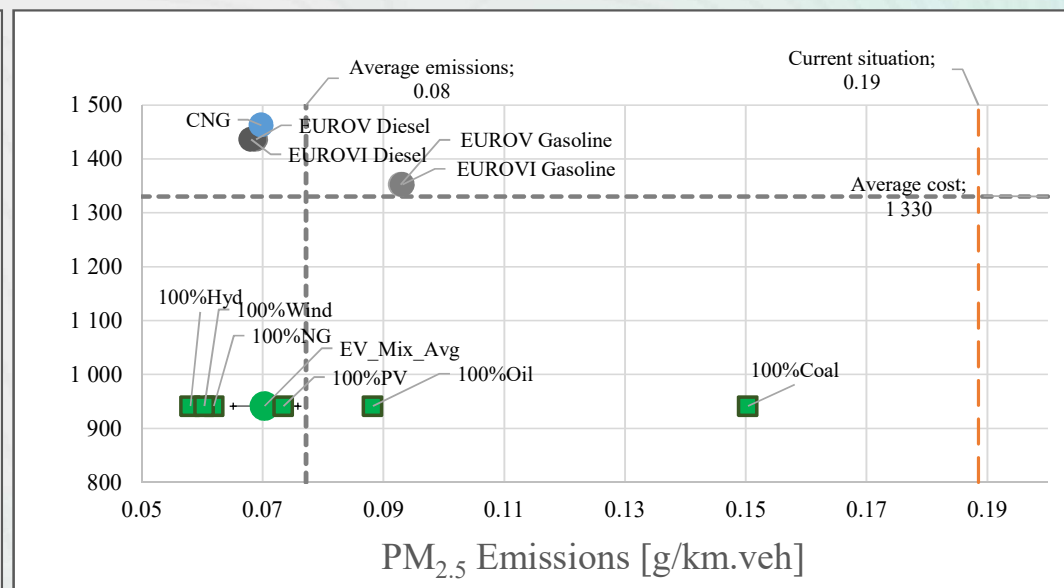
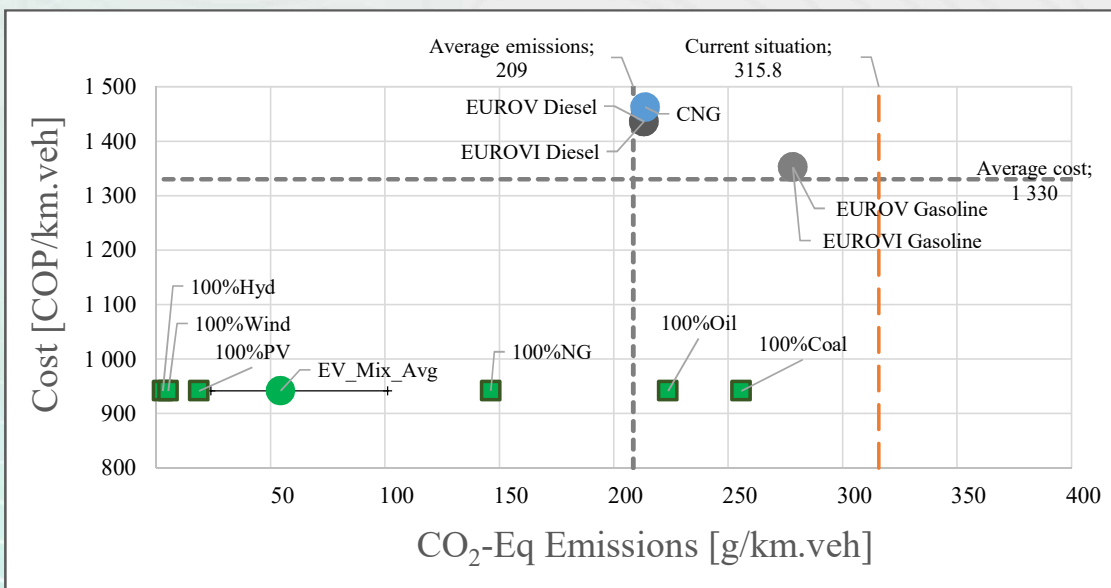
## Evolution of the Energy Demand

The introduction of electric vehicles will lead to a decrease in CO<sub>2</sub> emissions, but not in PM<sub>2.5</sub>.



# Evolution of the Energy Demand

Emissions resulting from the use of electric vehicles depend on the electricity generation mix.

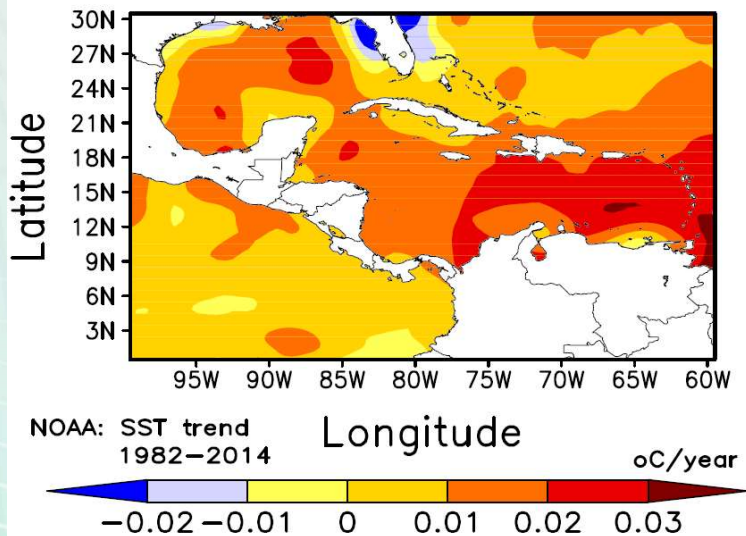


For more information, see: Yohen Cuellar Alvarez scheduled on November 4, at 14:30 in Salón 1.

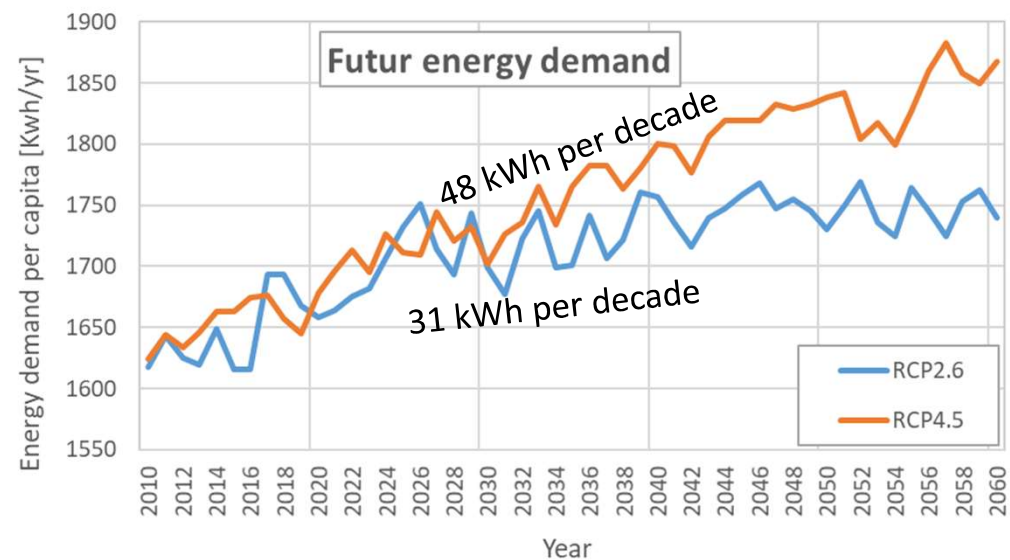
## Evolution of the Energy Demand

Climate change will lead to temperature elevations and an increase of energy consumption in the residential sector (air conditioning).

Sea surface temperature trend between 1980 to 2013 in Carribean region



Energy trend between 2010 to 2060 in Carribean region



Moises E. Angeles et al.: Impacts of climate change on building energy demands in the intra-Americas region, Theor Appl Climatol (2018) 133:59–72

## Evolution of the Energy Demand

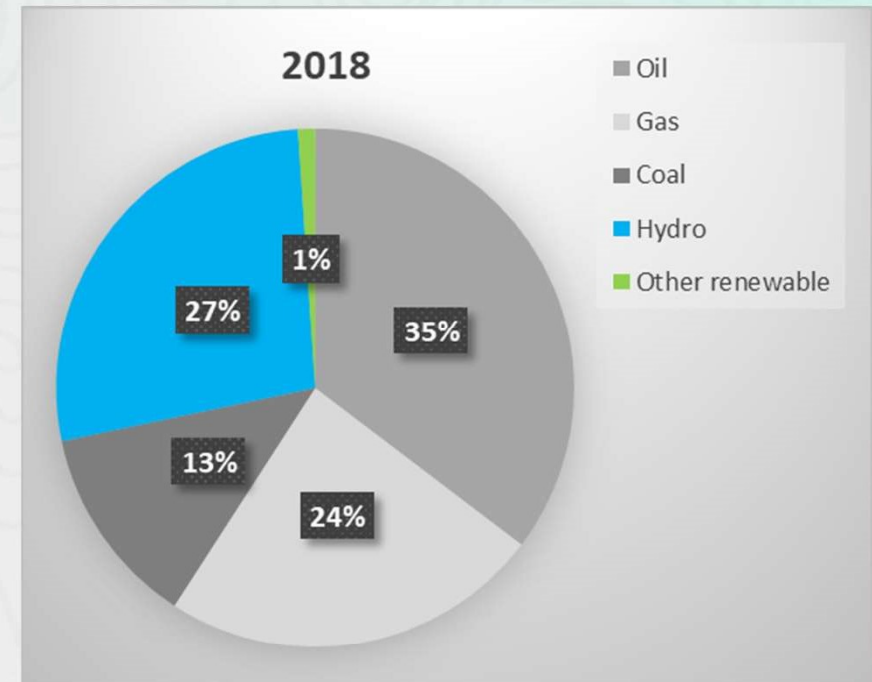
In the future, Colombian energy demand will continue to increase especially the electric demand of the transport and residential sectors.

*How will it possible to supply it?*



## Colombian Energy Mix: Strengths and Weaknesses

Colombia is fully energy independent but...

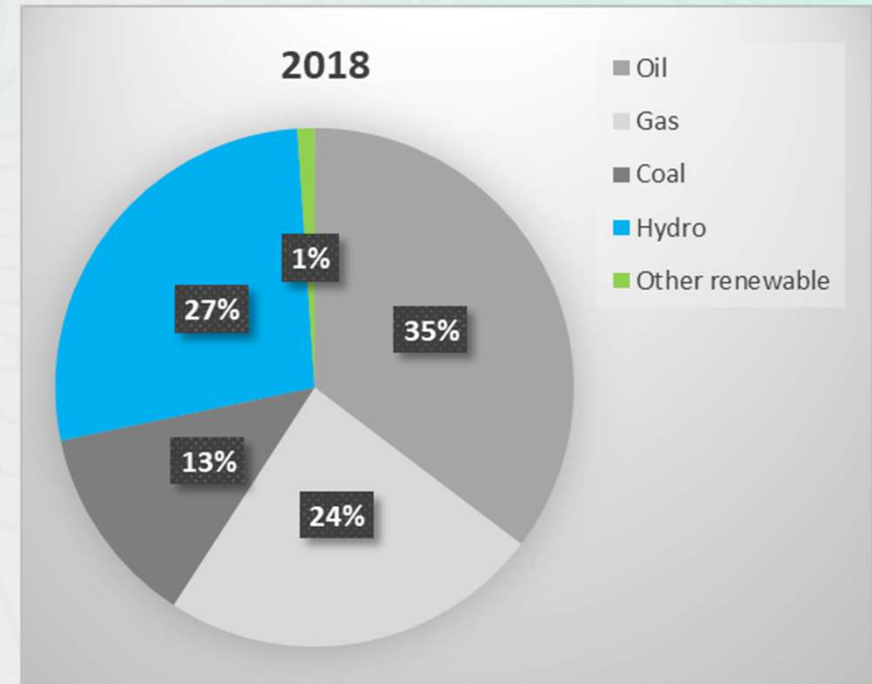
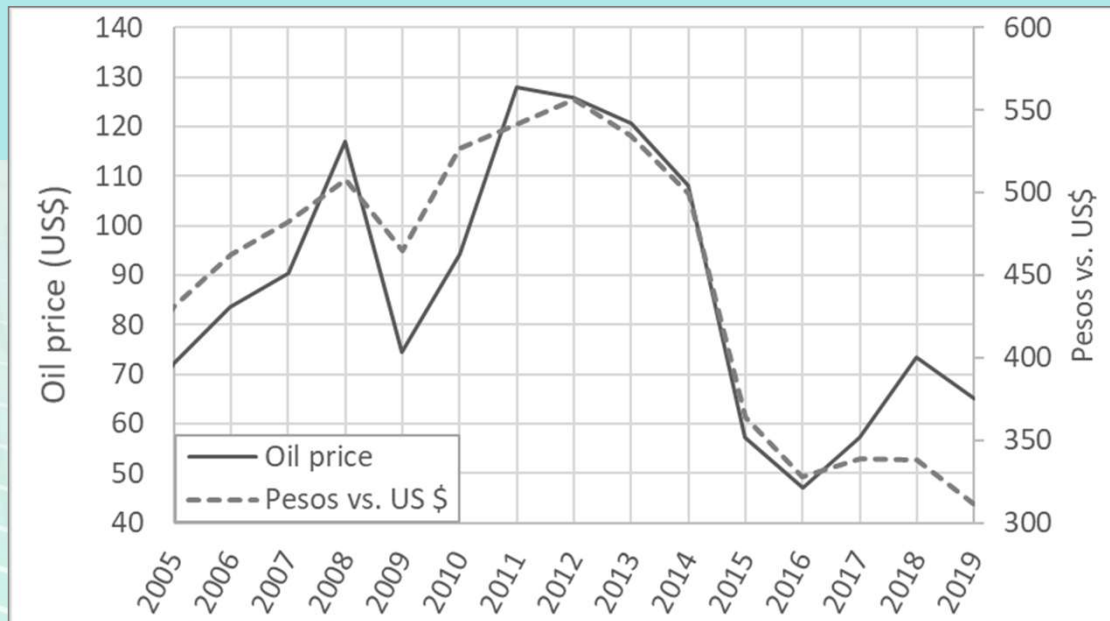


2018	Production	Consumption
<b>Oil</b> [barrels per day x 1000]	866	342
<b>Gas</b> [billion cubic meter]	12.9	13.0
<b>Coal</b> [million tonnes]	84.3	5.9

## Colombian Energy Mix: Strengths and Weaknesses

Colombia is fully energy independent but...

- the national economy depends strongly from the oil market



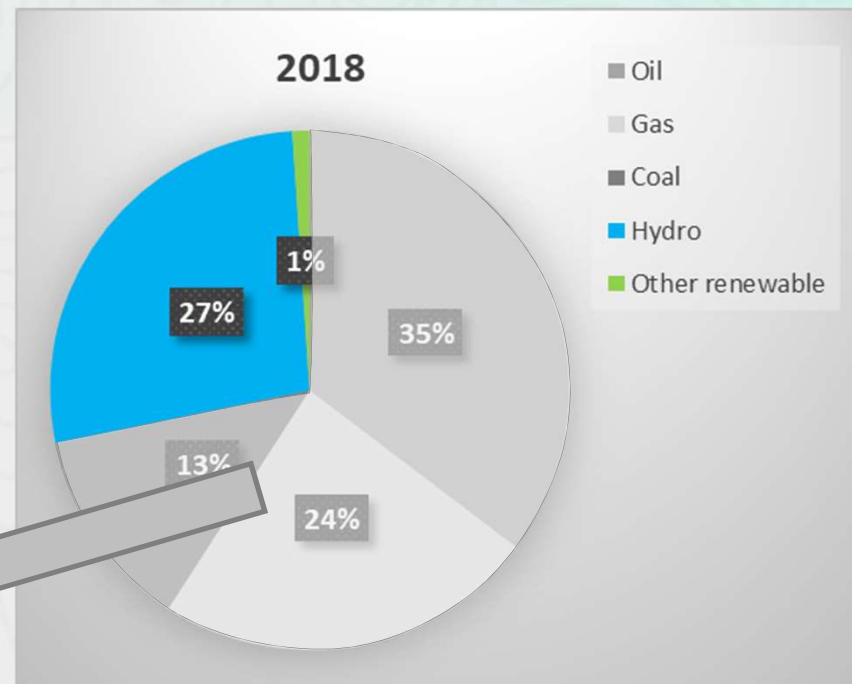
from BP Statistical Review of World Energy 2019 | 68th edition

## Colombian Energy Mix: Strengths and Weaknesses

Colombia is fully energy independent but...

- ❑ the national economy depend strongly from the oil market
- ❑ the sustainability of energy resources is weak:  
***less than 10 years of oil and gas reserves remain.***

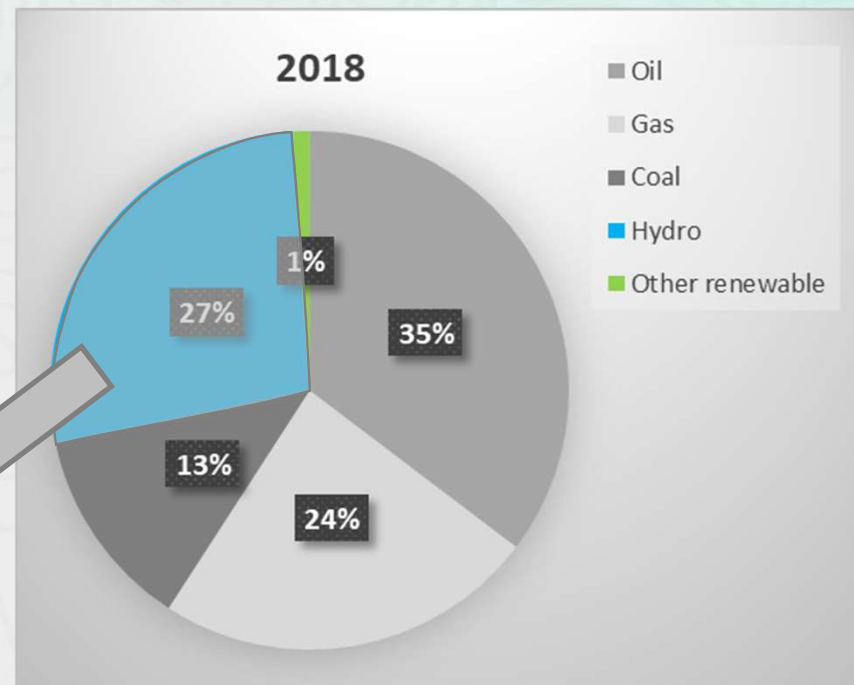
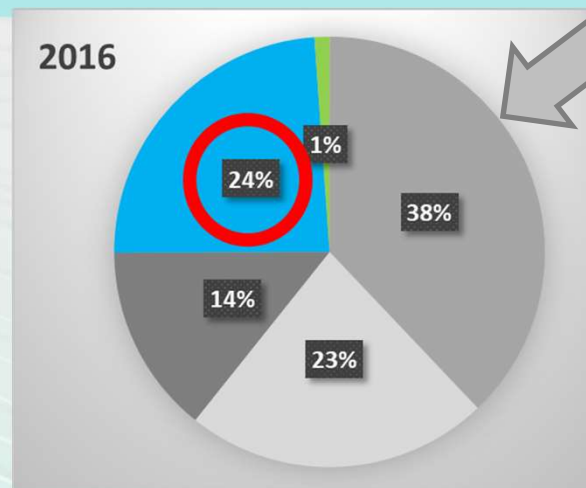
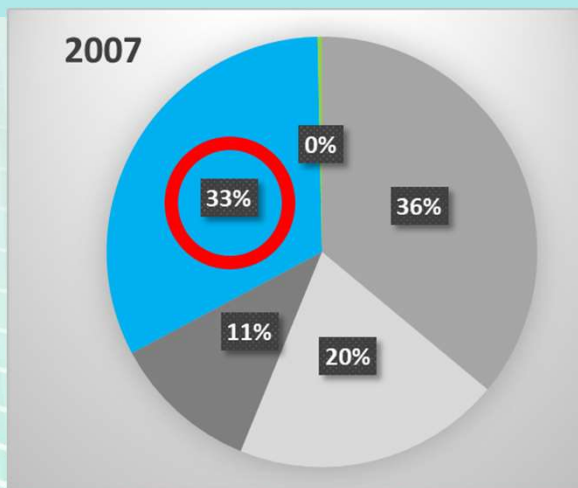
2018	Years
Oil	5.6
Gas	8.3
Coal	58



## Colombian Energy Mix: Strengths and Weaknesses

Colombia is fully energy independent but...

- ❑ the national economy depend strongly from the oil market
- ❑ the sustainability of energy resources is weak  
*hydrological resources are affected by climate change.*





## Alternative Energy Mix in Colombia

How to move to a sustainable and environmentally friendly energy mix in Colombia?

- ❑ **Oil and Gas** : less than 10 years of reserves and it emit greenhouse gases



## Alternative Energy Mix in Colombia

How to move to a sustainable and environmentally friendly energy mix in Colombia?

- Oil and Gas : less than 10 years of reserves and it emit greenhouse gases
- Coal** : more reserves but it emit more greenhouse gases (lower energy efficiency) and other pollutants (Particulate Matter).



## Alternative Energy Mix in Colombia

How to move to a sustainable and environmentally friendly energy mix in Colombia?

- Oil and Gas : less than 10 years of reserves and it emit greenhouse gases
- Coal : more reserves but it emit more greenhouse gases (lower energy efficiency) and other pollutants (Particulate Matter).
- Hydroelectricity**: can be further developed (17 GW to 57 GW, UPME, 2018) but remain vulnerable to climate change.



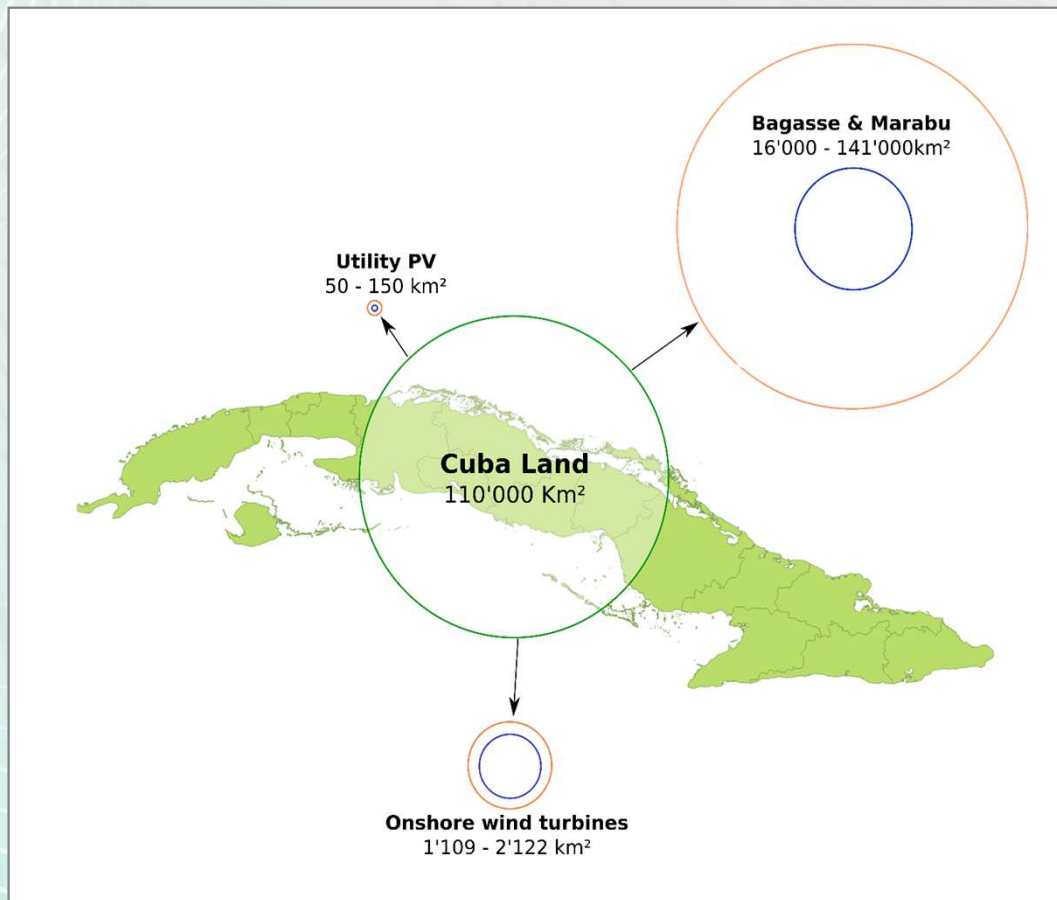
## Alternative Energy Mix in Colombia

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- Coal : more reserves but it emit more greenhouse gases (low energy efficiency) and other pollutants (Particulate Matter)
- Hydroelectricity: can be further developed (17 GW to 57 GW, UPME, 2018) but remain vulnerable to climate change.
- Biomass : ?



## Alternative Energy Mix in Colombia



Areas needed to supply 100% of the **Cuban** electricity demand (projection in 2030) with

- biomass (bagasse and Marabu wood)
- wind turbines
- PV panels

for more information see, Marco Andres Guevara scheduled, November 4, 11:00, Auditorio 2

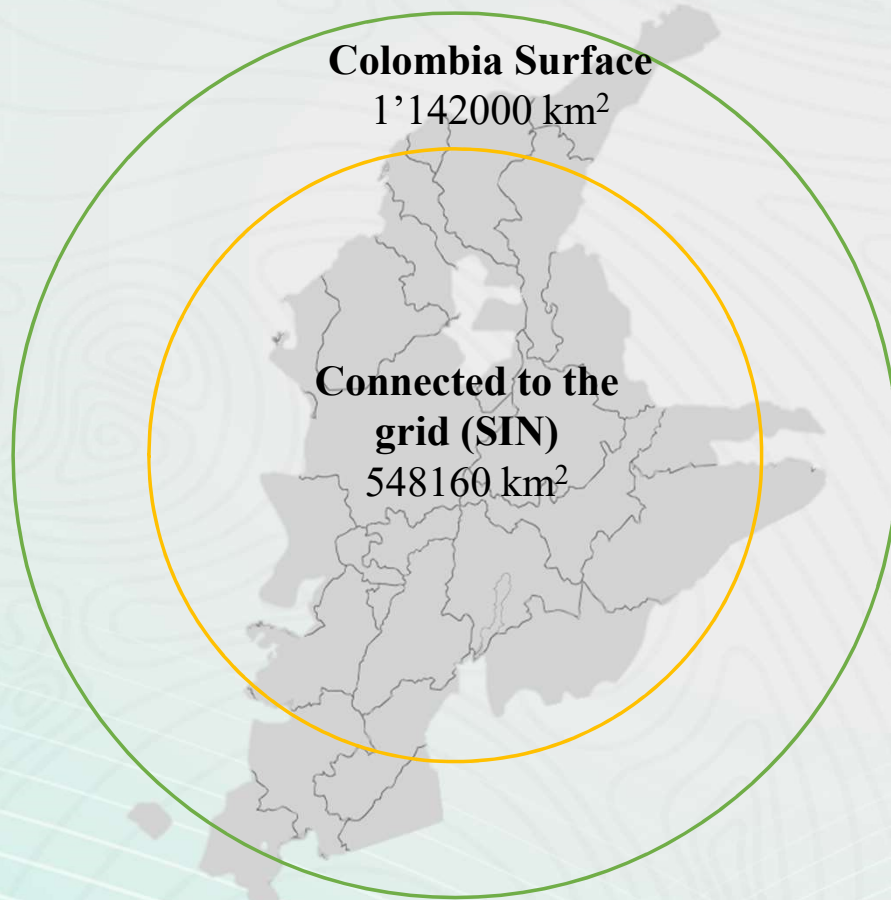
## Alternative Energy Mix in Colombia

How to move to a sustainable and environmentally friendly energy mix in Colombia?

- Oil and Gas : less than 10 years of reserves and it emit greenhouse gases
- Coal : more reserves but it emit more greenhouse gases (low energy efficiency) and other pollutants (Particulate Matter)
- Hydroelectricity: can be further developed (17 GW to 57 GW, UPME, 2018) but remain vulnerable to climate change.
- Biomass** : low energy efficiency
- Wind and solar**: ?



## Wind and Solar Resources



**Colombia Surface**  
 1'142000 km<sup>2</sup>

**Connected to the grid (SIN)**  
 548160 km<sup>2</sup>

Off-grid regions (ZNI) (52% - 593840 km<sup>2</sup>)

Areas needed to supply 100% of the **Colombian** electricity demand with:

- wind turbines
- PV panels



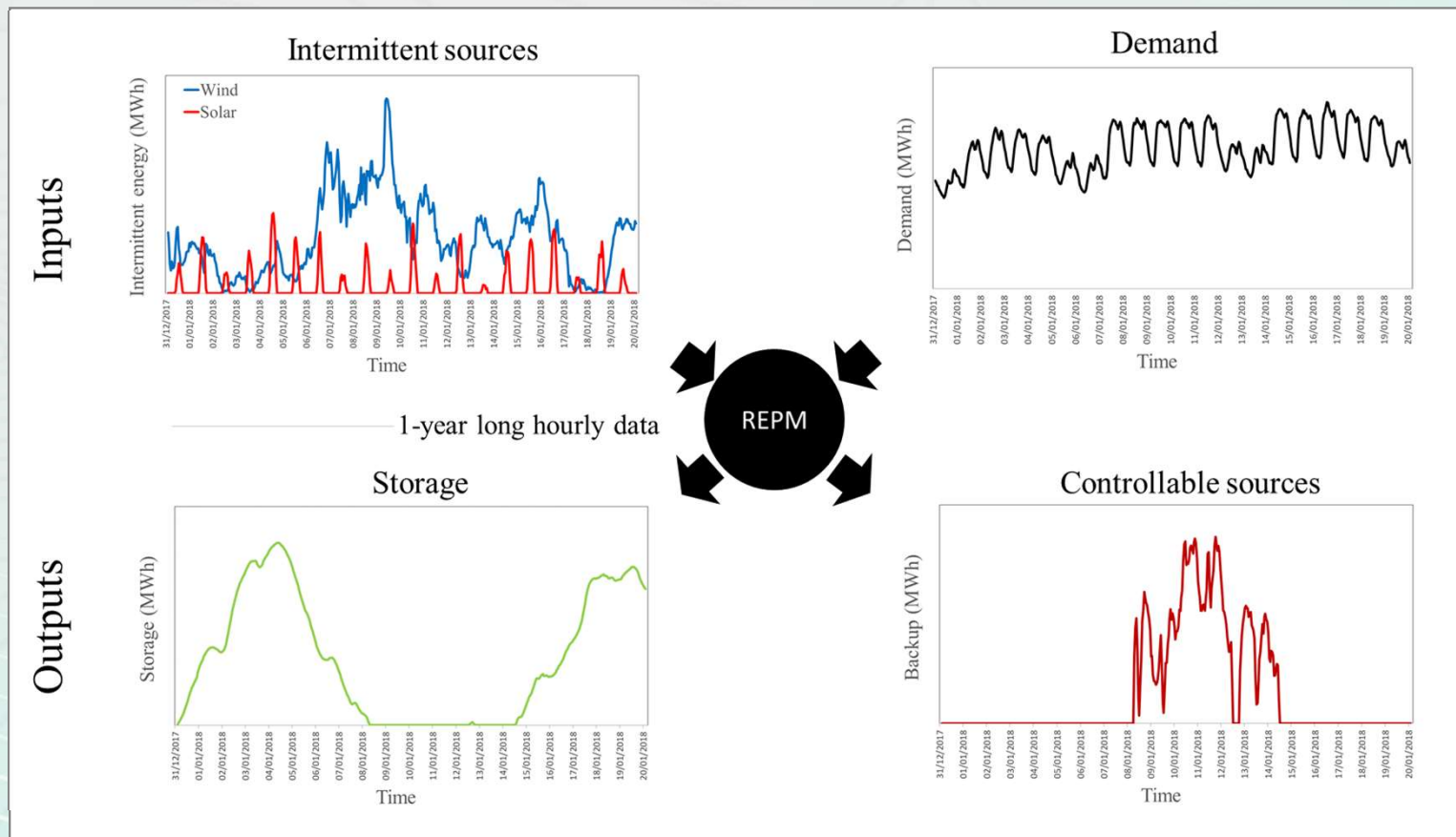
**Onshore Wind Turbines**  
 1637-6197 km<sup>2</sup>  
 (0.30% - 1.13%) of the “interconnected country surface”



**Utility Solar Photovoltaic**  
 931-1008 km<sup>2</sup>  
 (0.17% - 0.18%) of the “interconnected country surface”

# Wind and Solar Resources

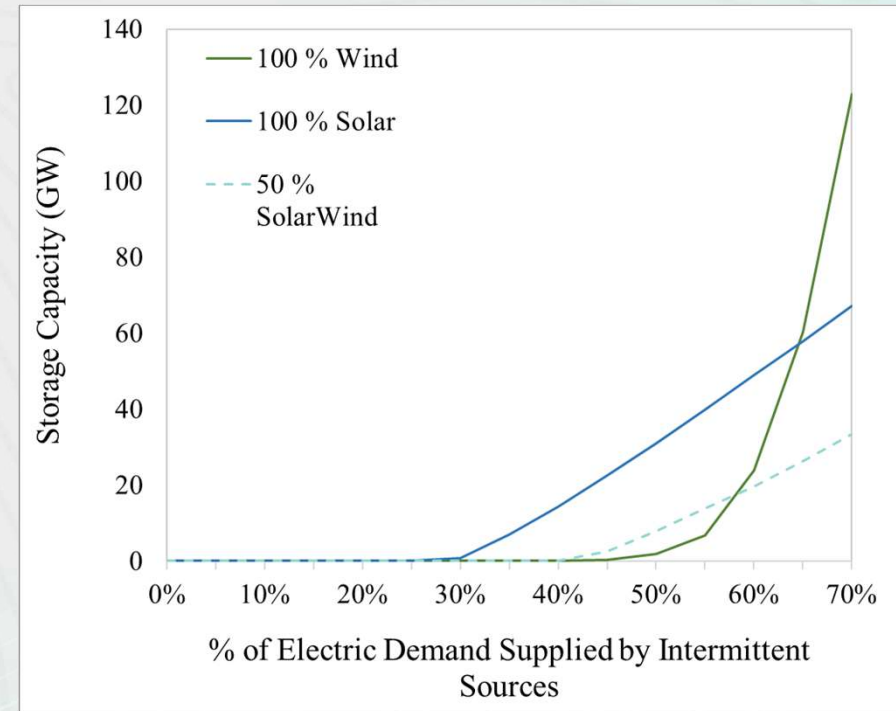
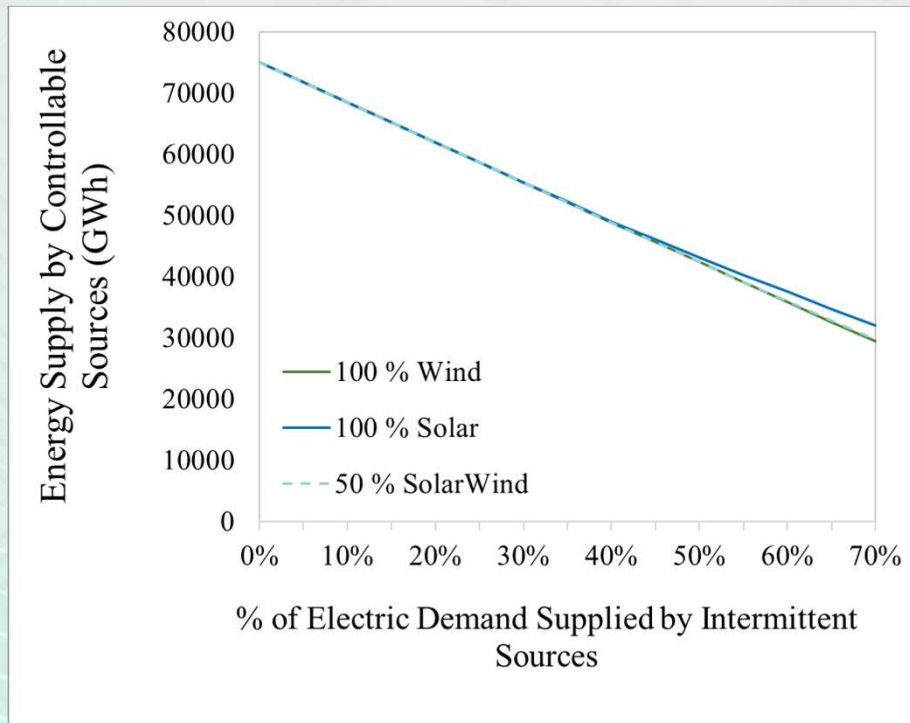
Model to estimate the storage capacity needed by the introduction of Intermittent sources into the energy mix.





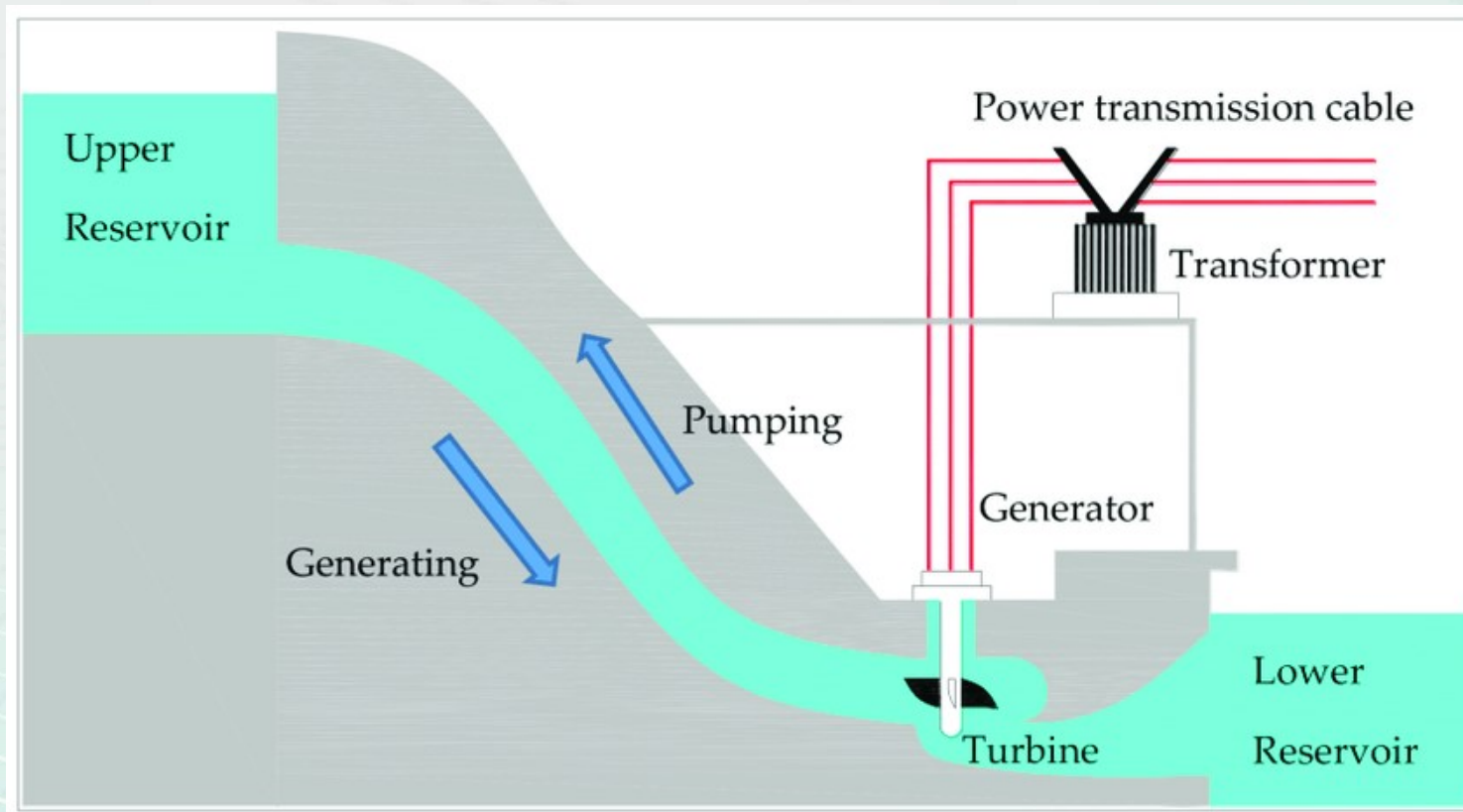
## Wind and Solar Resources

Introduction of Intermittent sources into the energy mix does need important storage capacity



## Wind and Solar Resources

Pumped-storage hydroelectricity can be used to complete intermittent sources.



## Conclusions

- Solar and wind energy are options worth considering in Colombia.
- Further study to compare production costs is needed.



**Gracias**

# TITULO TITULO

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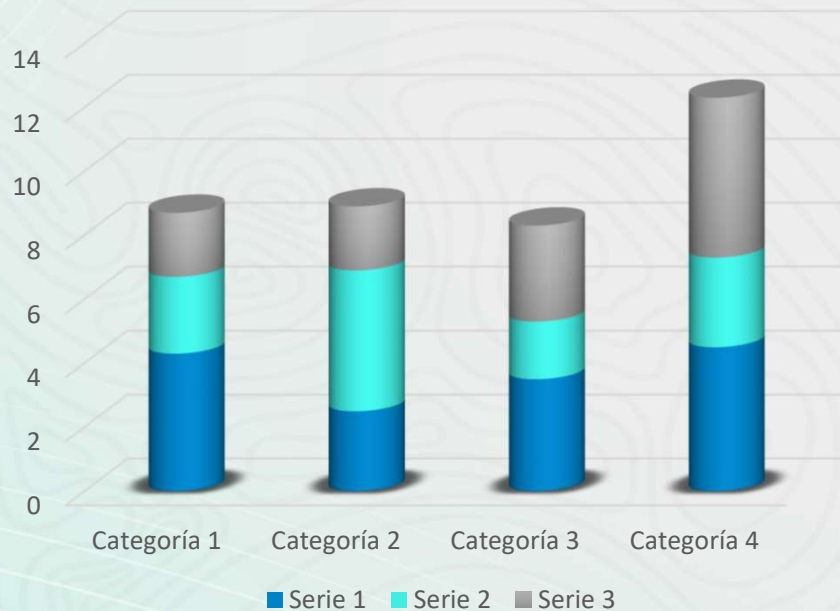




## TITULO TITULO

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ullamcorper aliqua.**





## Electric cars rise to record 54% market share in Norway

Nordic country becomes first in the world where electric car sales outstrip those powered by other means



Battery electric vehicles (BEVs) made up 54.3% of all new cars sold in the Nordic country in 2020, a global record, up from 42.4% in 2019 and from a mere 1% of the overall market a decade ago, the Norwegian Road Federation (OFV) said.

▲ Norway exempts fully electric vehicles from taxes imposed on those relying on fossil fuels. Photograph: Jonathan Nackstrand/AFP/Getty Images

## Energy Demand

port technolog

## 90% of new cars sold in Norway are now electric or plug-in hybrids

The goal is to get to 100% EV sales by 2025.



[Photo: bruev/iStock]

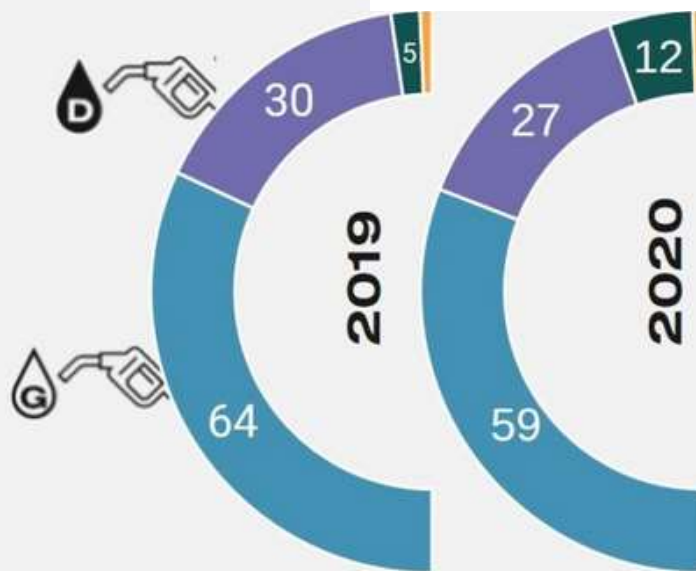
Europe 2021. Tesla Model 3 cc  
the market crown in September

# EV revolution hits new milestone as Tesla Model 3 becomes Europe's best-selling car in September

27 October 2021



The Tesla Model 3.



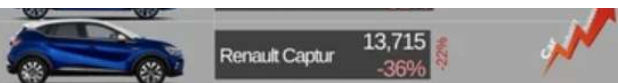
Europe-26 New Car Regs.  
by Fuel Type (%)



**September**



Europe best-selling cars in September 2021 within 44 markets in the continent, from Portugal to Russia. The Tesla Model 3 is the best selling car of September, reaching the top of the ranking for number of sales for the first time in the continent.



ep 20  
58%  
ew  
0%  
10%  
ew  
3%  
ew  
ew  
19%  
ew  
bourg