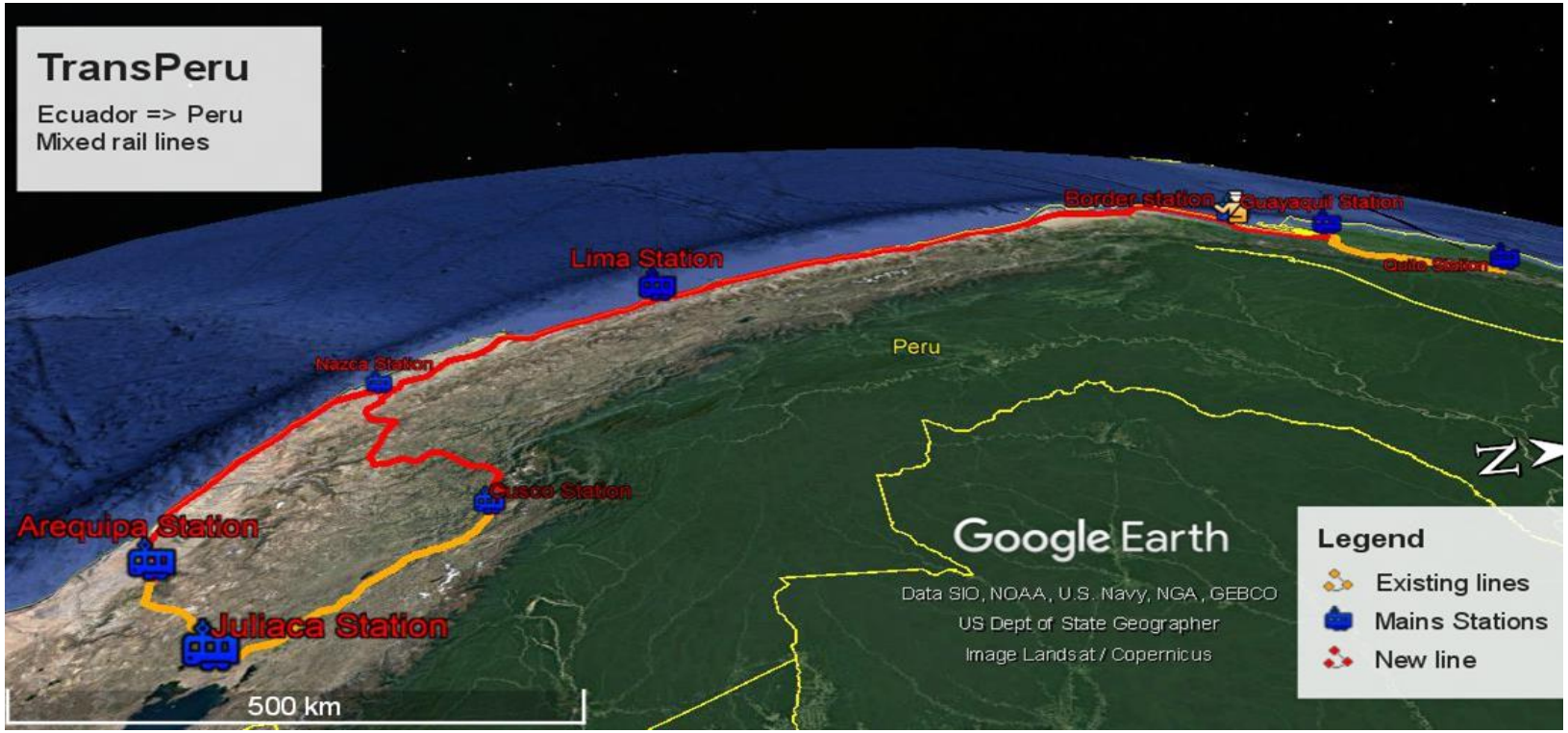
Bridging Transport Gap by Train of Thought

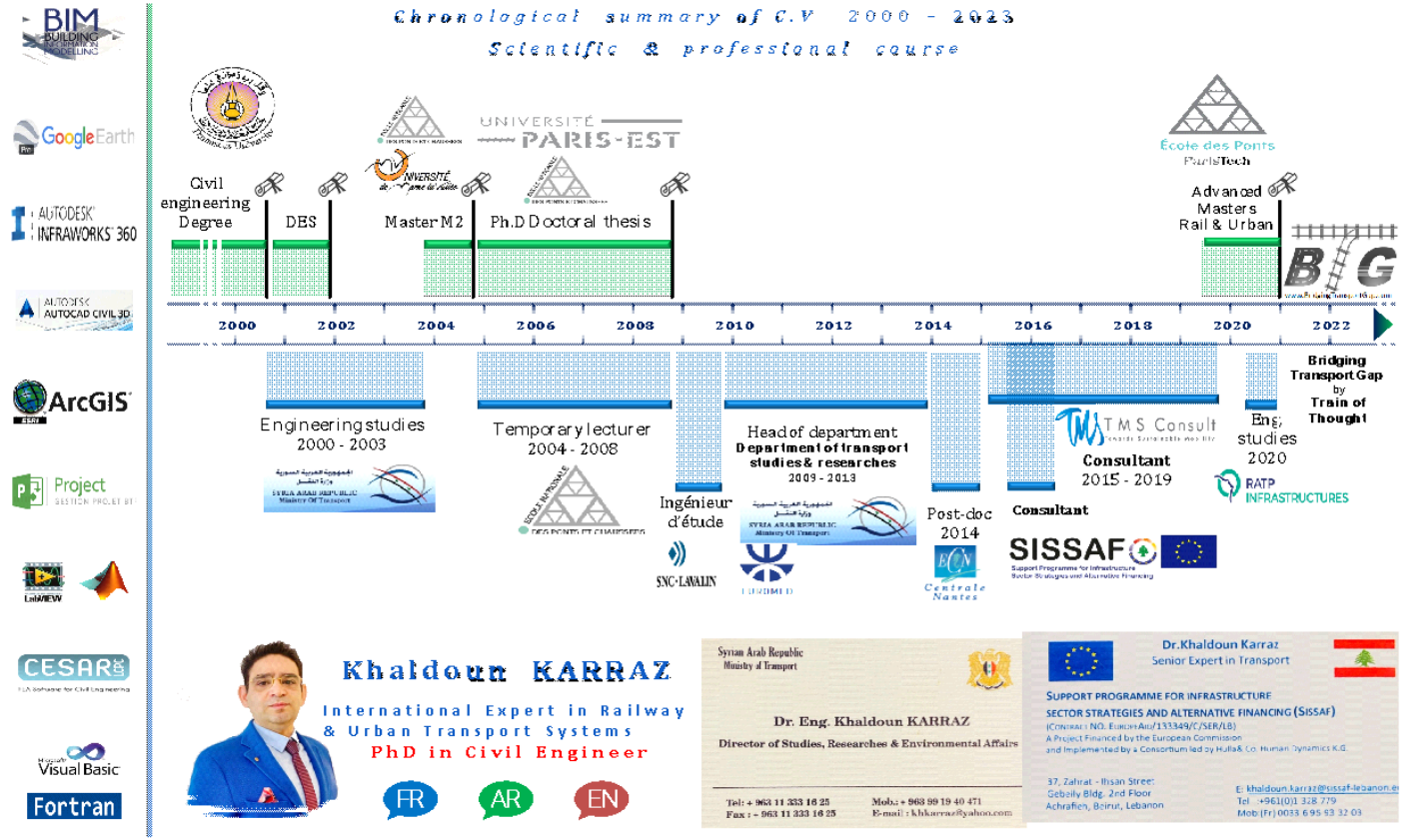
University of East London

# Designing & Creating a Mixed Railway Connection Between Ecuador and Peru by BIM

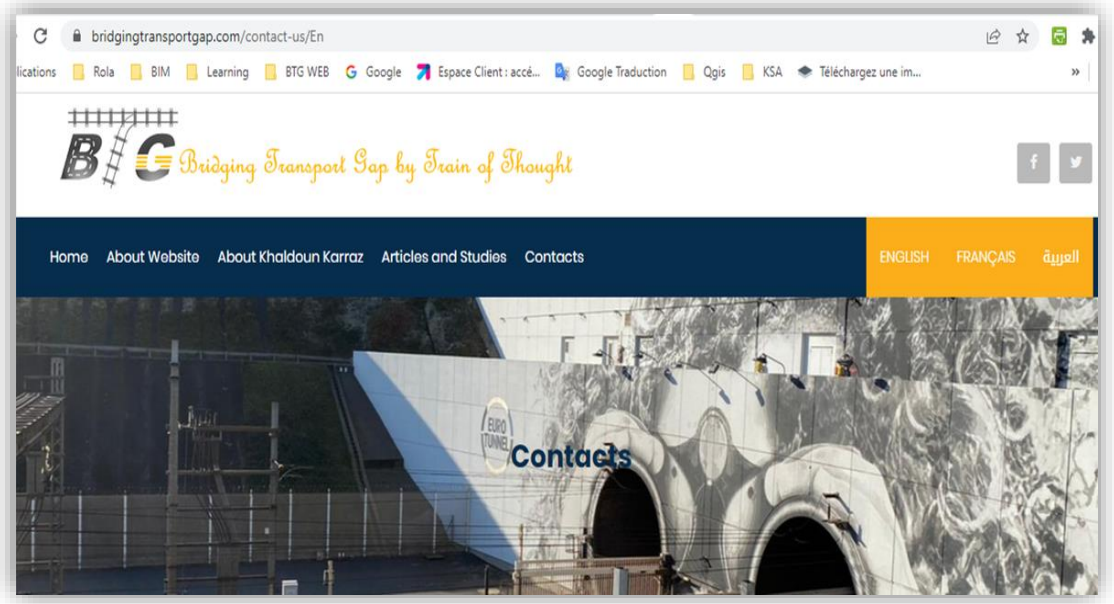



Dr. Khaldoun Karraz

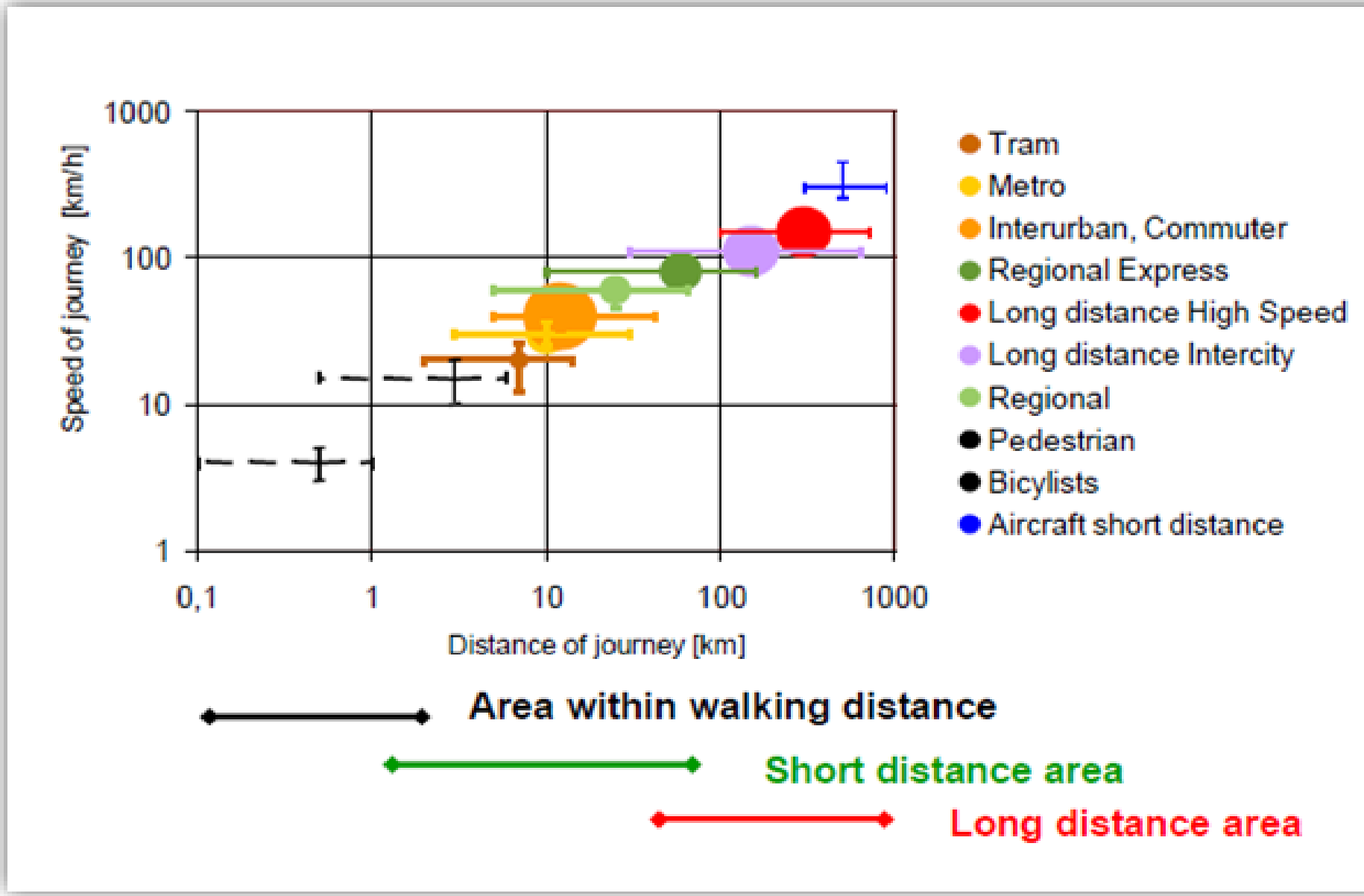
# About Me




www.bridgingtransportgap.com



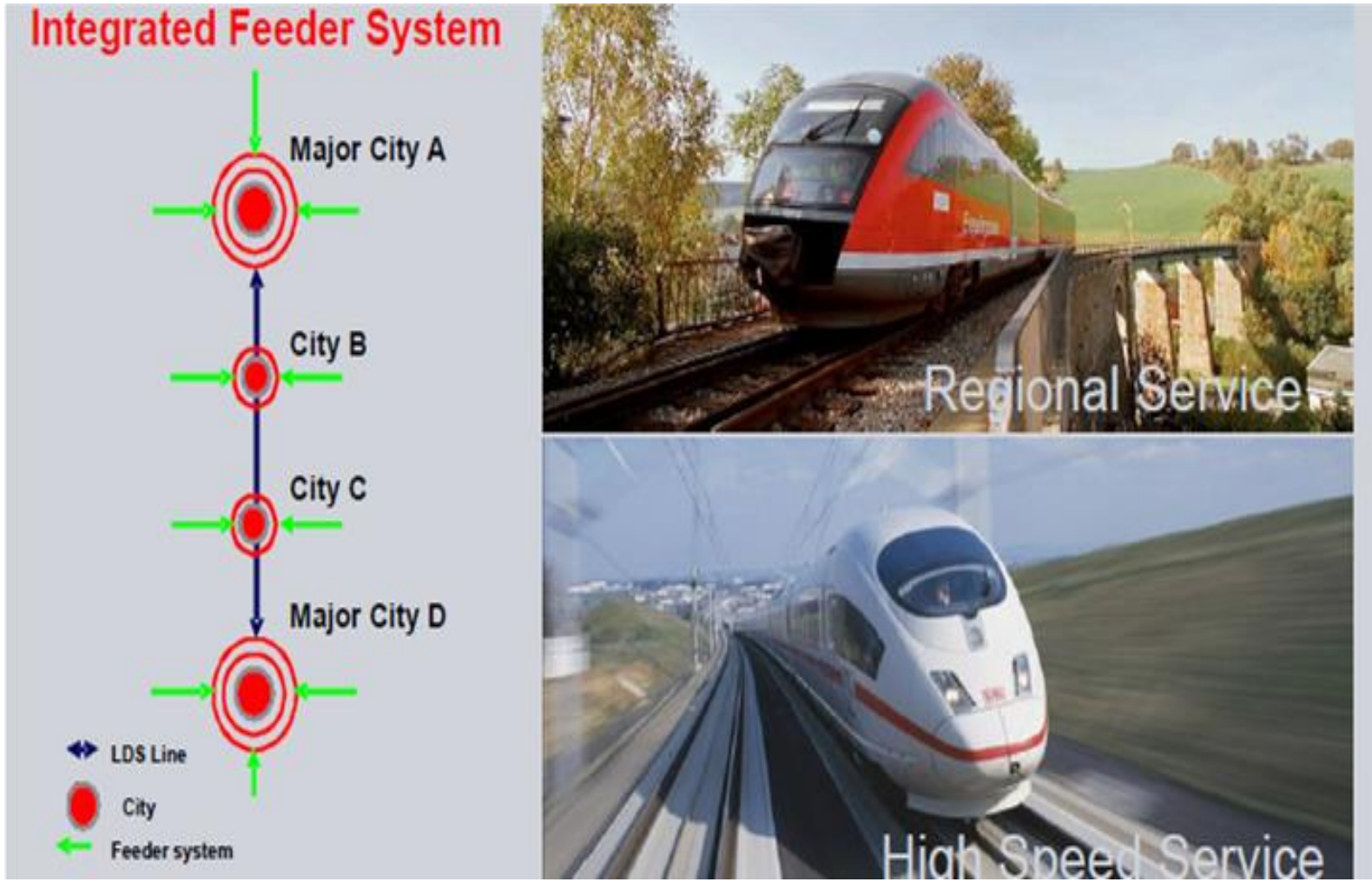
# Classification of Rail Systems



# Integrated Feeder System

**Long Distance Service is the backbone of Rail systems**
**+**
**Regions get interconnected by attractive feeder systems**

**High Speed Lines attract more demand and customers have a higher willingness to pay compared to regular trains**



# The Project

**Creating a Trains Peru - Ecuador Railway Connection Line**

**Countries: Peru & Ecuator**
**Mode: Rail**
**Activities: Traveler & Freight**

**Problem: north south connection**
**Quito Guayaquil & Lima Cusco Arequipa**
**in a problem of regional integration**

**Difficulties: Very long distance,**
**difficult topography,**
**large number of unconnected sections**

**Maturity: upstream**
**Maturity: Long term**

**Background:Existing lines but not connected**

**Constrained topography : Layout - Insertion - Technical solution - Geology - Climatology and Sub-regional strategy**

# Presentation plan

**A- Putting into perspective the situations of the feasibility study for both countries regaerding:**

1) Geography
2) Economy
3) Transportation Modes
4) National  New projects
5) Global Heritage
6) Maritime Traffic
7) Socio-Economic of transportation

**B- Case Study and BIM Methods**

# 1. Geographic data


## ➢Ecuador

➢3000km maritime frontage
Bordering Colombia to the northeast, Peru to the southeast.
➢16.5 million inhabitants300,000 km² or 16 inhabitants per km² on average

➢Area 300,000 km² 300,000 km²

➢Main cities :
Quito(capital), Guayaquil (more populated), Cuenca, Riobamba

## • Peru

* 3000km maritime frontage Surrounded by Ecuador and Colombia to the north, Brazil to the east, by Bolivia and Chile to the south.
* 32 million inhabitants (25 inhabitants per km² on average)

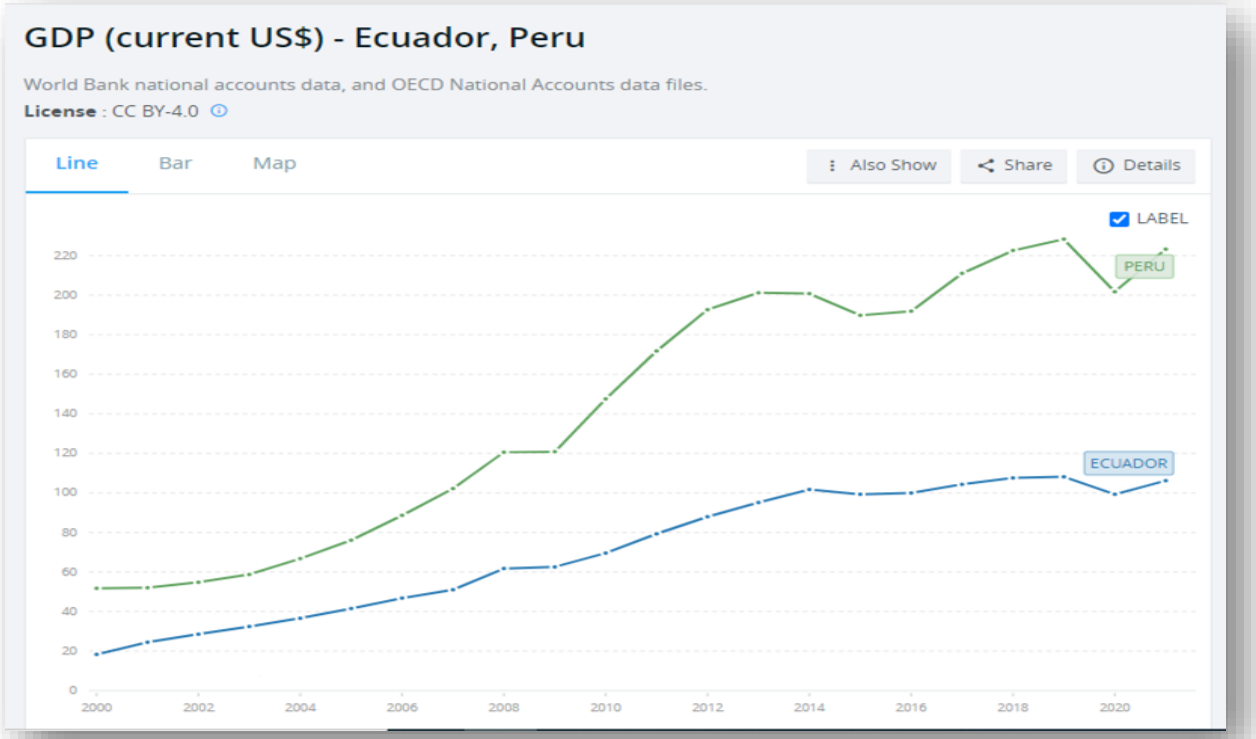
* Area 1,300,000 km²

*Main cities :
Lima(capital), Arequipa
Chiclayo, Cuzco
Iquitos, puno


**Three areas, landscape and climate:**

Costa = Coast = coastal plains
Sierra = Mountain
Selva = range jungle = Amazon

# 2. Economic situation




The two countries present
a delicate economic situation

- Peru's GDP at 228 B$ in 2019
- twice as large as in 2005, four times as large as in 2000: $211 billion in 2005
- Average growth of 5% since 2005.
- Low standard of living: average monthly salary of €500 (equivalence)
- 4% of the population does not have access to electricity

- Ecuador's GDP at $108bn in 2019 (very slightly increasing)
- Negative or extremely low growth in recent years. 1.1% in 2018, estimated at 1.3% for 2020.
- Significant budget deficit (greater than 4%)Decreasing unemployment rate, reaching 4% in 2018.
- A third of jobs are "inappropriate" (dangerous, unpaid, etc.)

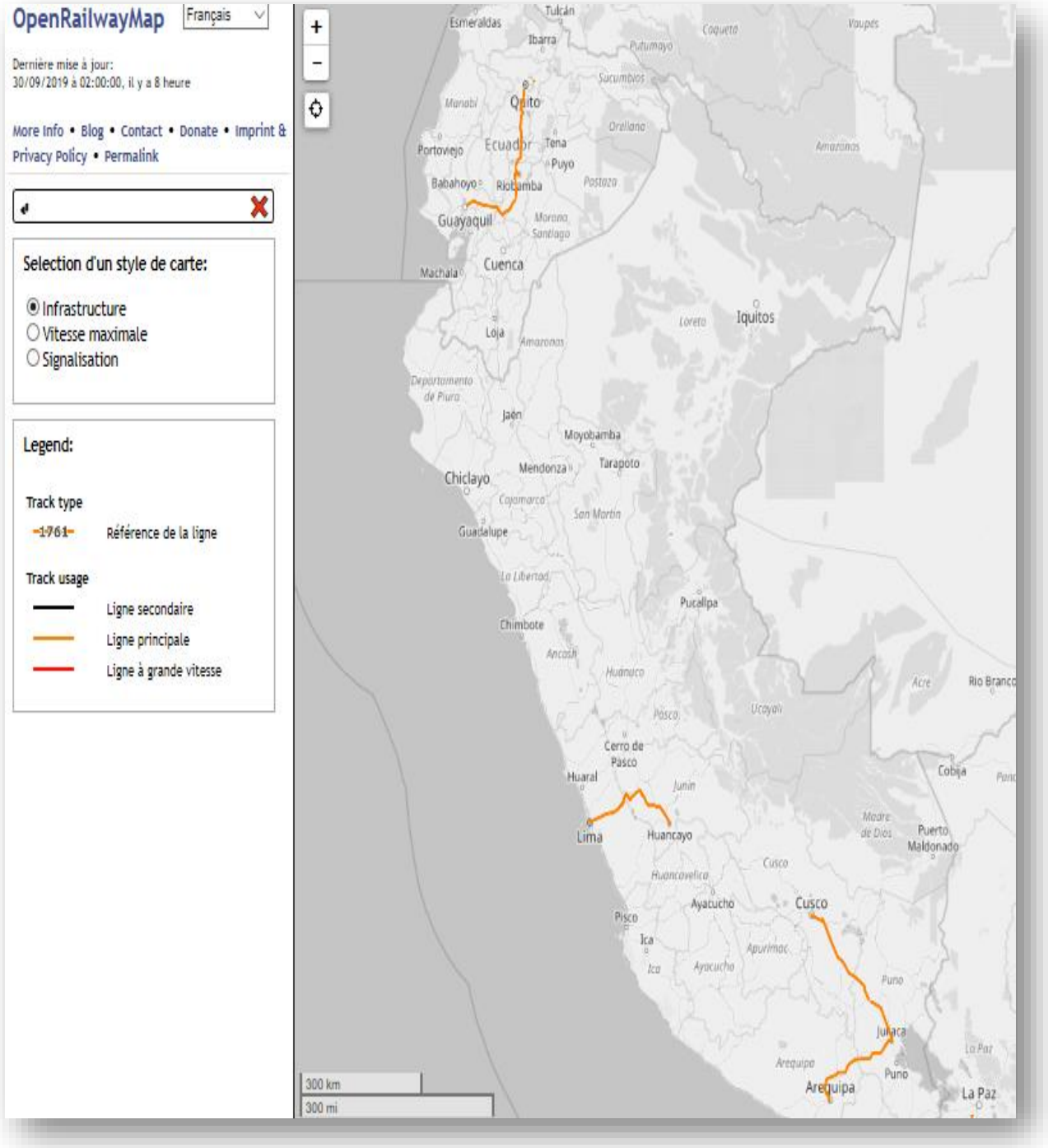
# 3. Transportation Modes

## Ecuador

- Daily flights between Quito and the main cities (1 per hour)
- Rail transport more of a tourist attraction (Riobamba line) than an efficient transport system
- Highly developed buses (inter-city or international buses), very low costs. Access to difficult schedules
- Bus Rapid Transit BRT: system in the city of Guayaquil

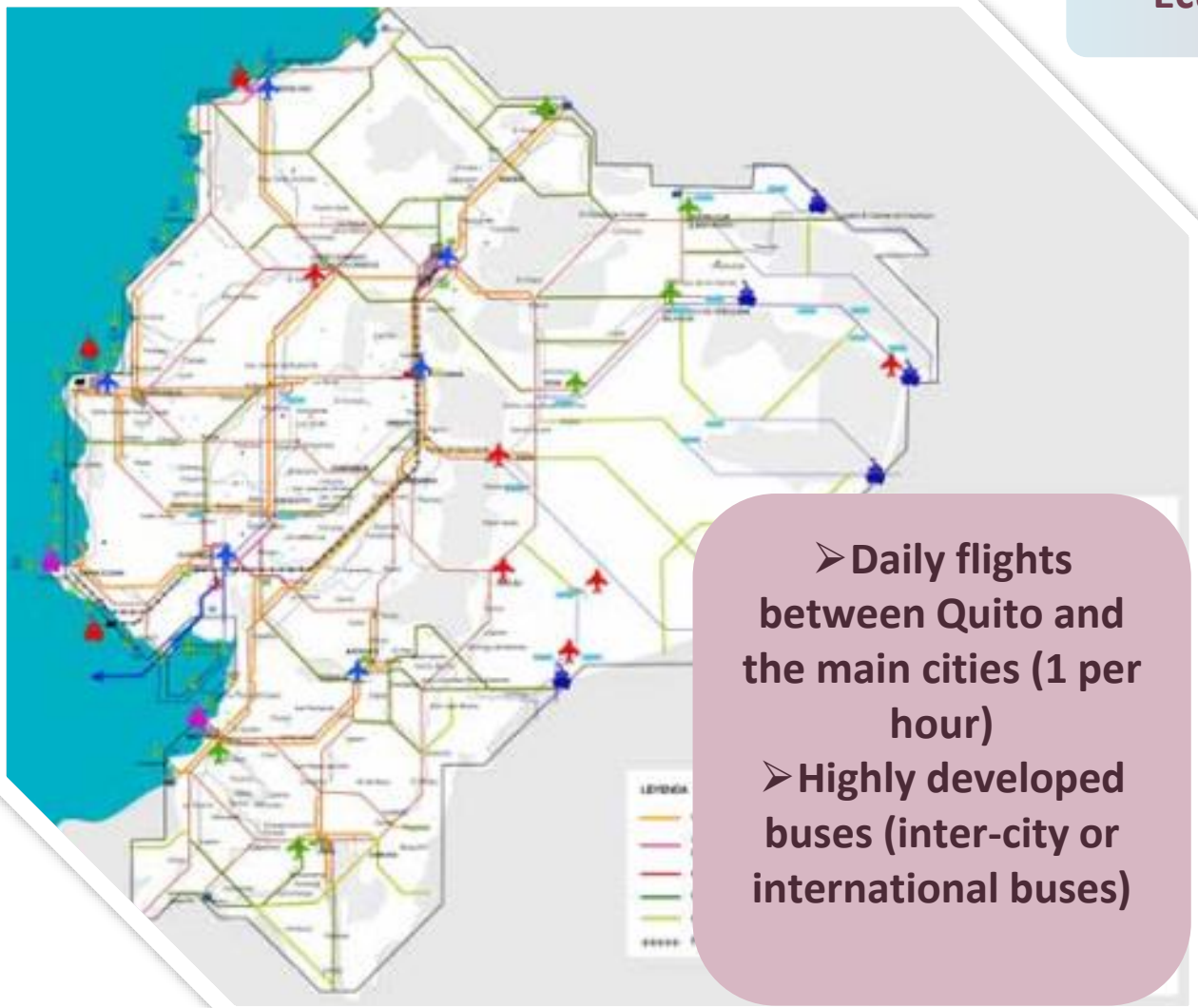
## Peru

- Daily flights between Lima and the main cities
- Rail passenger transport almost non-existent because sparse and disconnected from needs
- Marginal freight: 82% of freight transport is carried out by truck
- The bus is the main mode of transport.
- Very dangerous road, high speeds, fatal accidents normalized with Peruvians



# 4- National New Project

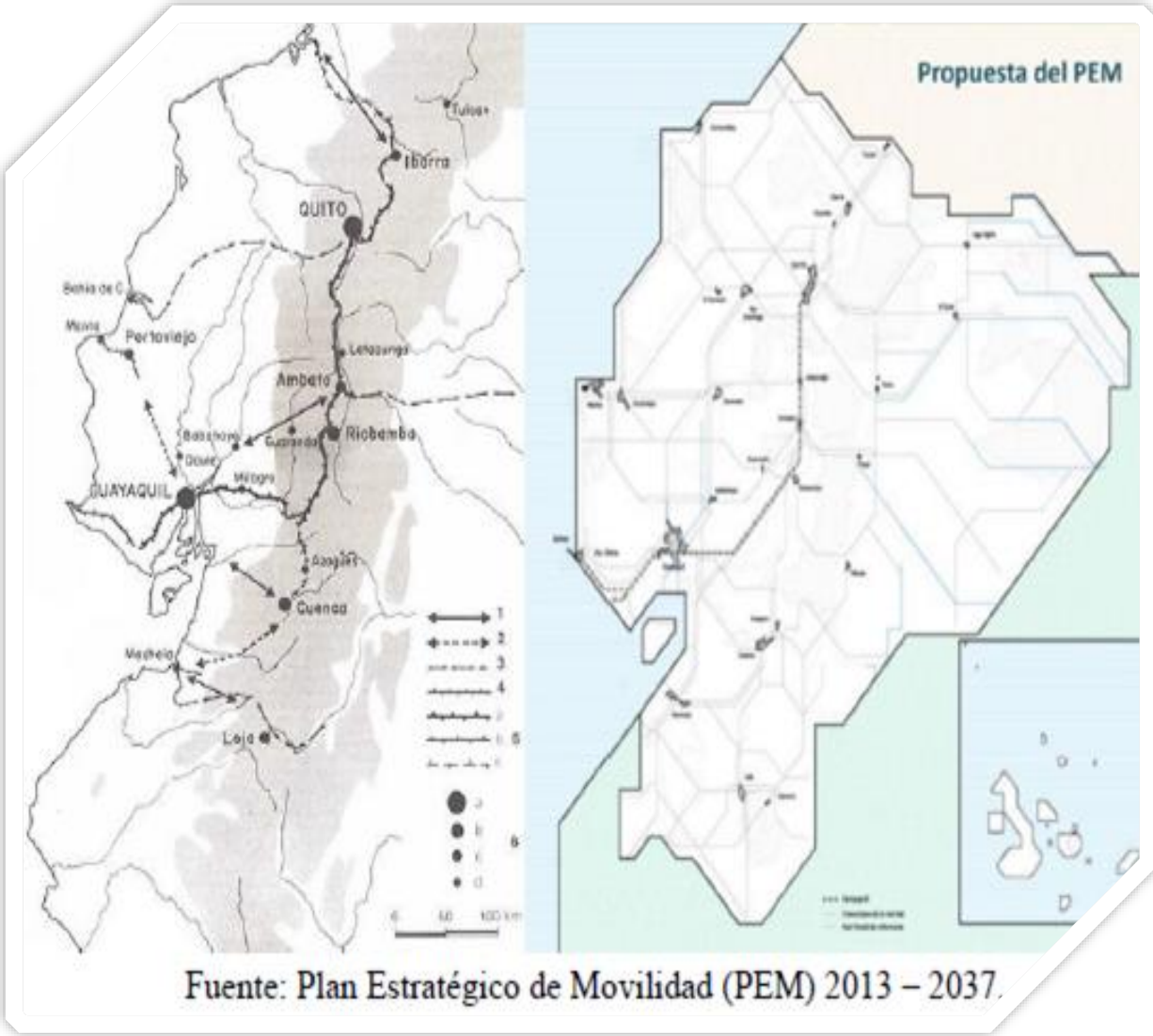
Ecuador



➢Daily flights between Quito and the main cities (1 per hour)

➢Highly developed buses (inter-city or international buses)

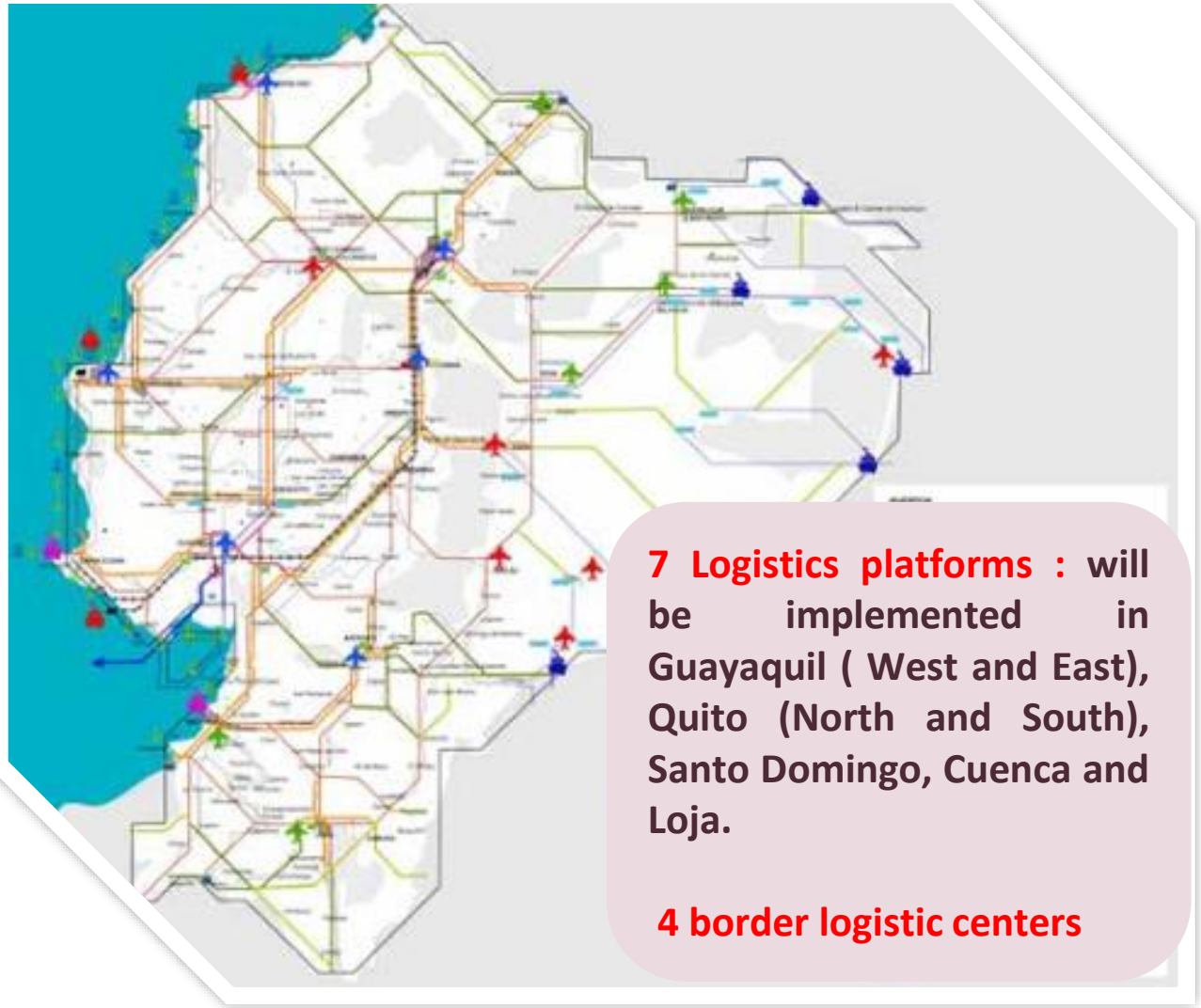
➢Strategic Mobility Plan 2013-2037 Rail links with the entire transport system, proposals for metropolitan rail corridors for public transport




Fuente: Plan Estratégico de Movilidad (PEM) 2013 – 2037.

# 4- New National Projects

## Ecuador



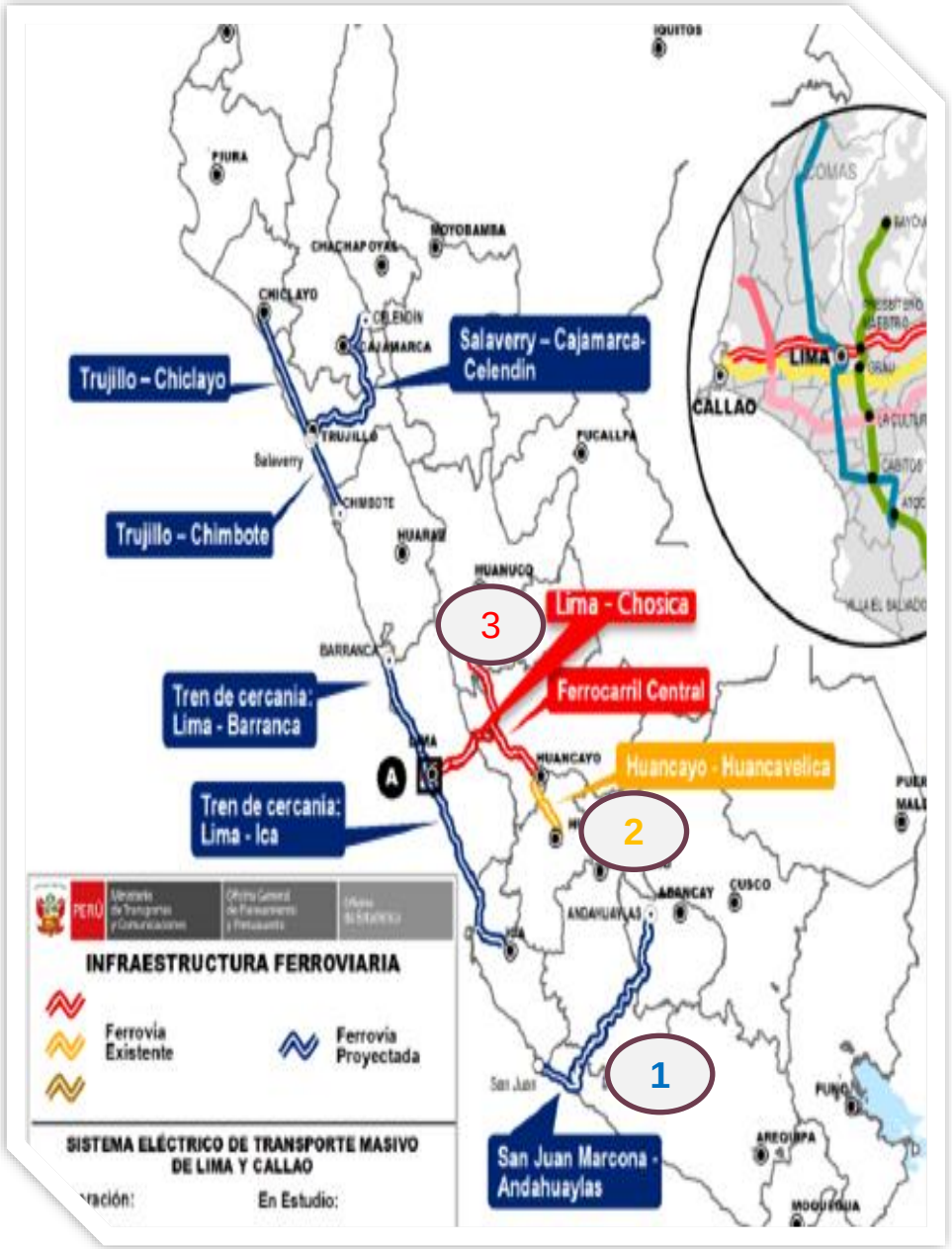
**7 Logistics platforms : will be implemented in Guayaquil ( West and East), Quito (North and South), Santo Domingo, Cuenca and Loja.**

**4 border logistic centers**

**Devil's Nose Railway (Nariz del Diablo)**

**Rail transport more of a tourist attraction (Riobamba line) than an efficient transport system**

# 4- New National Projects




## Peru

### National Railway Development

- **Project For intercity transport - Commuter train: Lima-Barranca, Lima –Ica and Lima –Chosica**
- **Railway:**
  1- from San Juan de Marcona – Andahuaylas
  2- “Marcona Rail Corridor to Andahuayla
  3- Lima Chosica Railway Corridor
- **Urban transport:**
  Lima and Callao Metros - Line 2, Line 3, 4, 5 and 6

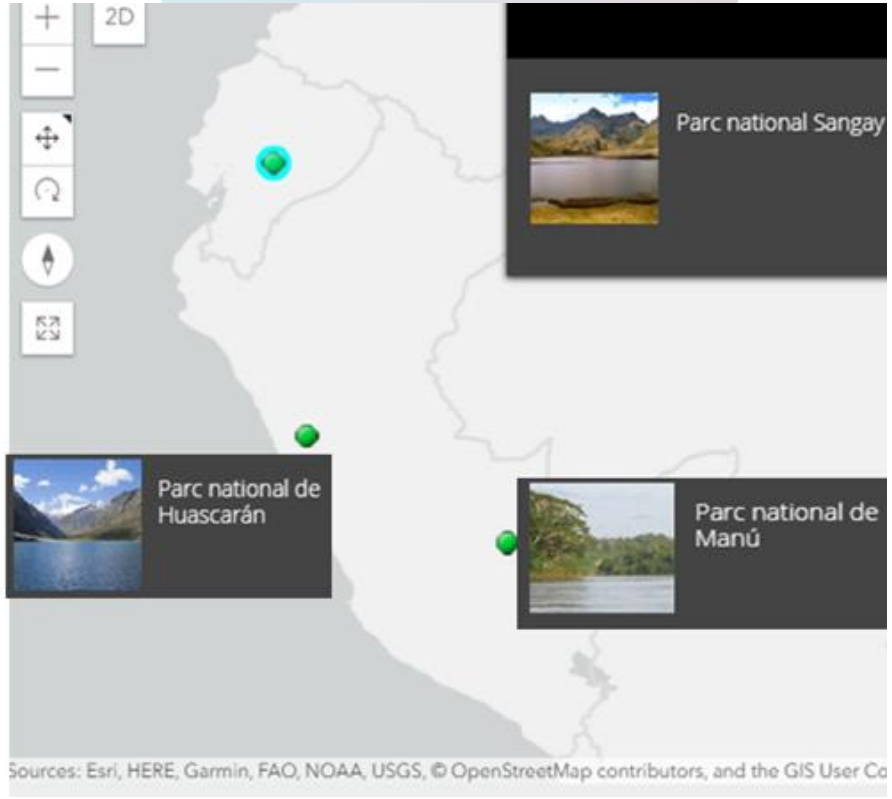
## International Railway Connections

Peru-Brazil rail link
Rail link Peru-Bolivia-Brazil-Paraguay


**The Knowledge and the labor and the construction tools in railway**

# 5- Global Heritage

## Natural Heritage Sites




Huascaran and Manu National
Park Chan Chan Archaeological Zone

## Cutural Heritage Sites



- The Historic Center of Santa Ana
- Sangay National Park
- The city of Quito, which is classified as Cultural Heritage

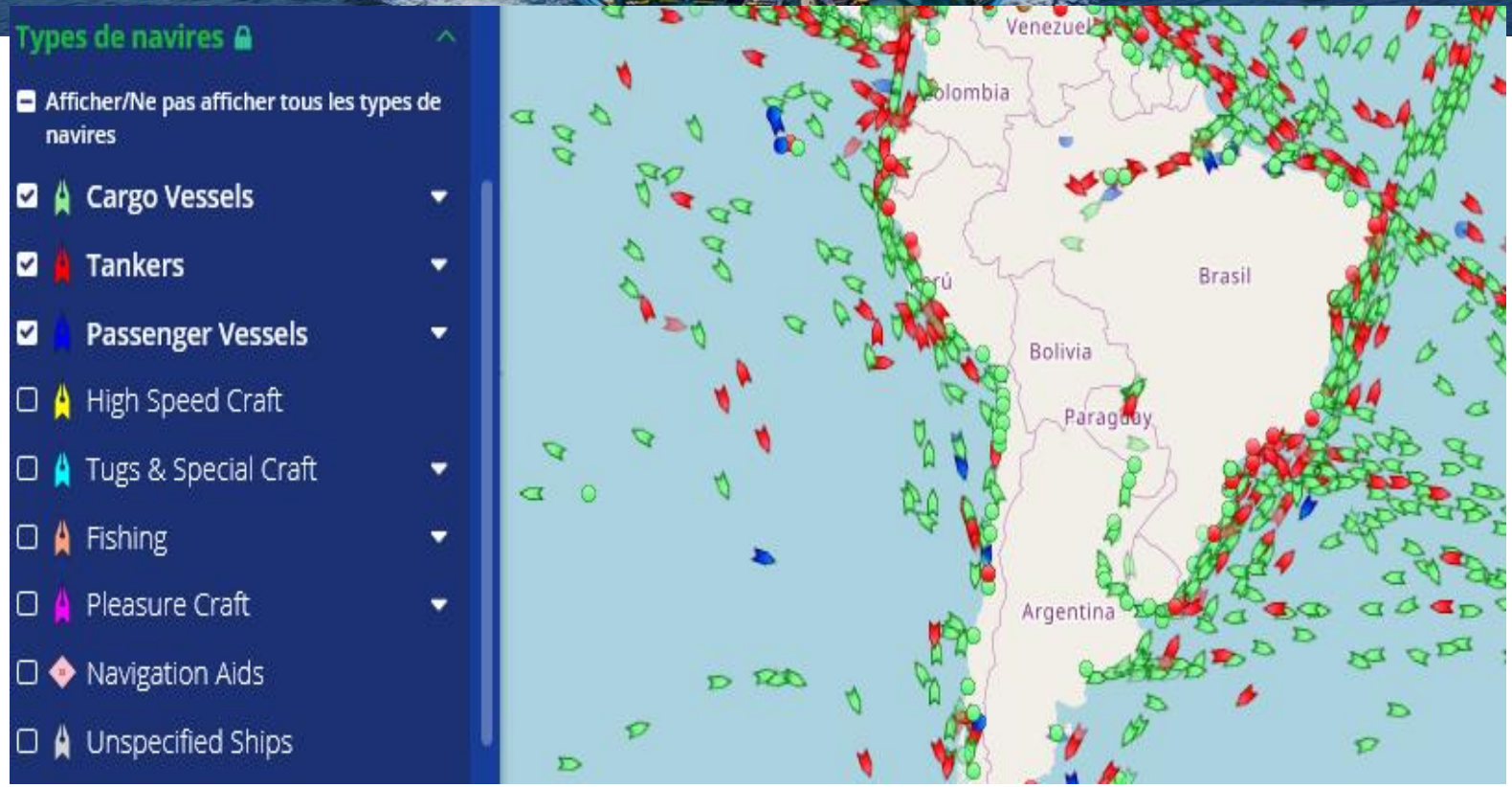
# 6- The Traffic Maritime

**Peru**

Annual traffic in Million TEU/ TEU

Callao Port:

2250/ 2018
2054 / 2017




**Maritime traffic in Latin America**

**https://www.marinetraffic.com // At nov. 1est. 2019**

**Ecuador**

Annual traffic in Million TEU/ TEU

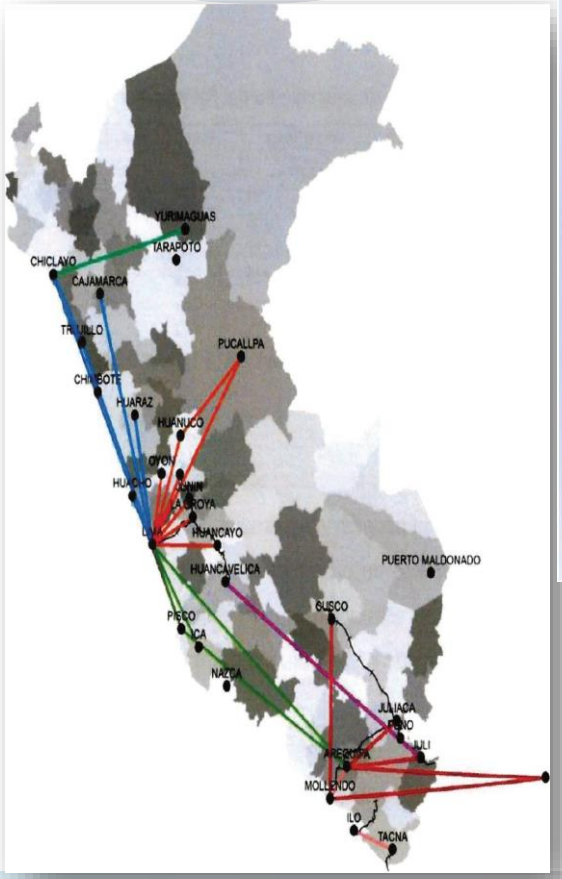
Guayaquil Port :

1871/ 2018

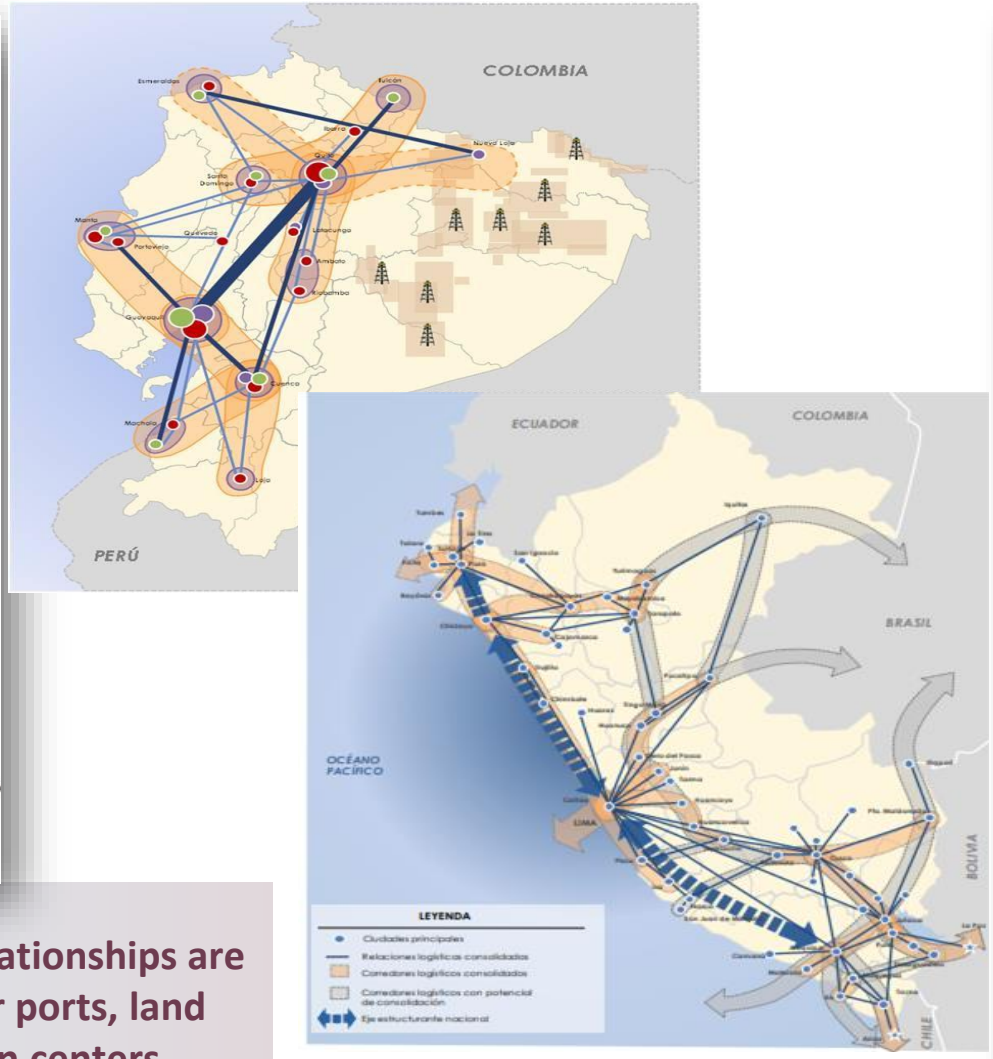
1821/ 2017

# 7- Socio-Economic Transport

**Freight Traffic**



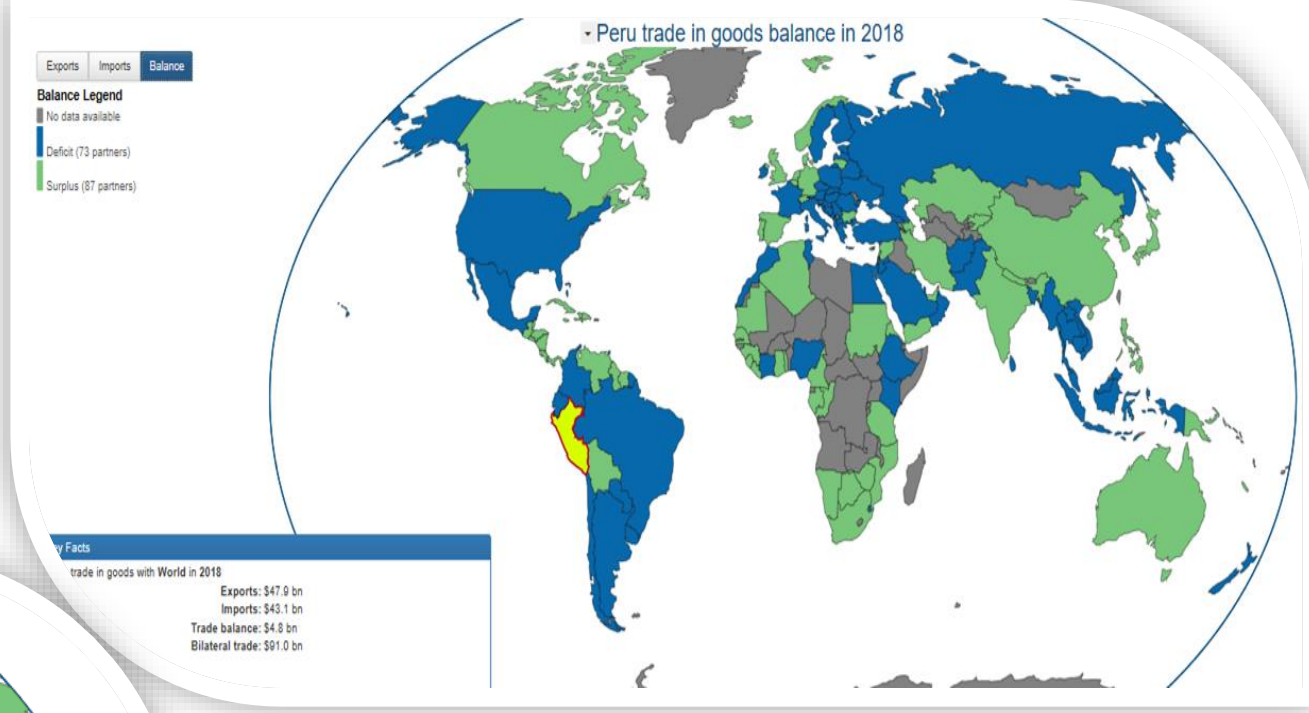

**People's movements**

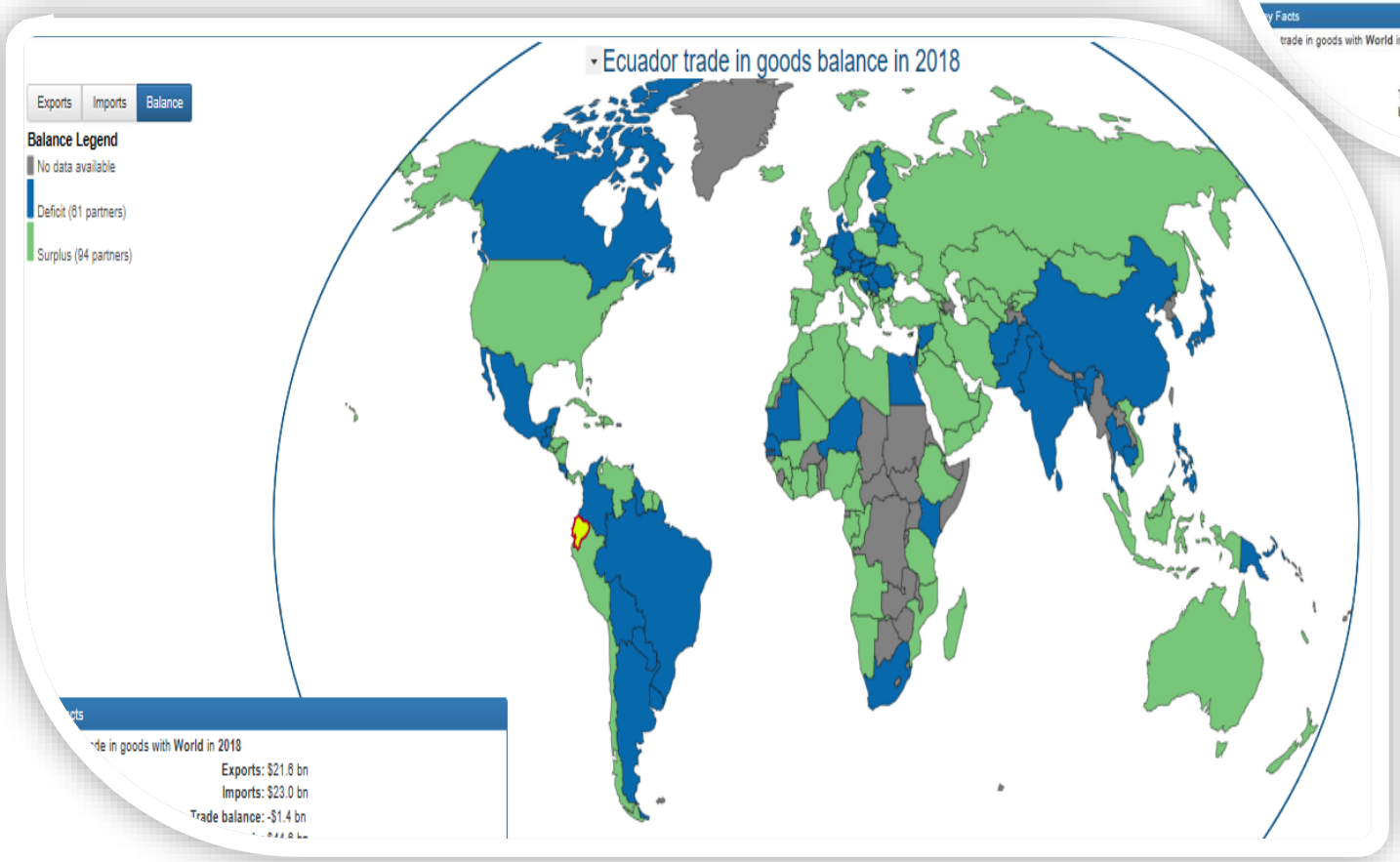



**Goods flows and logistical relationships are structured radially to major ports, land borders and consumption centers**

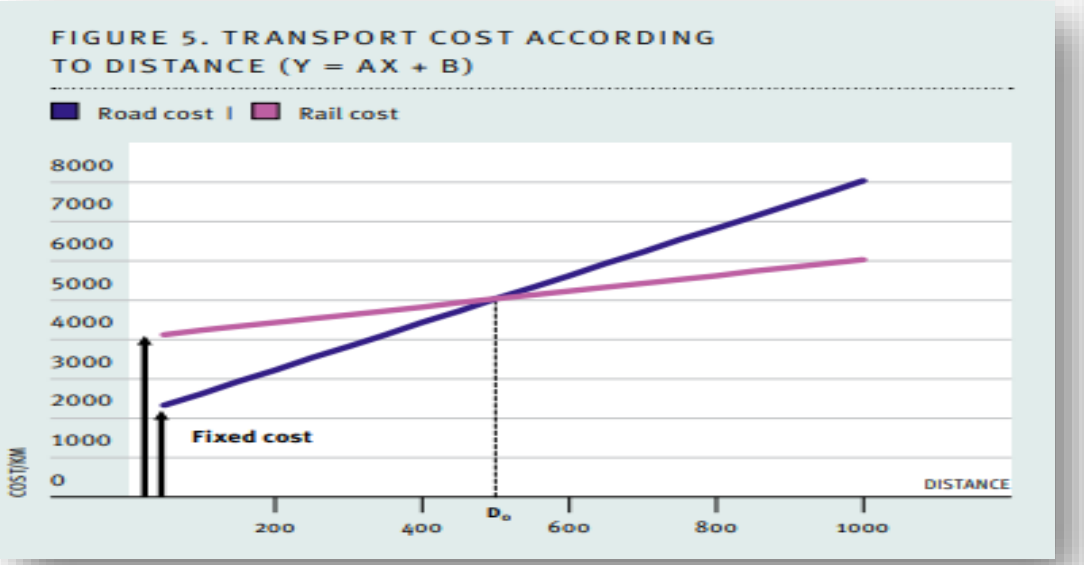
**Current axes of trade in South America**

# International Trade



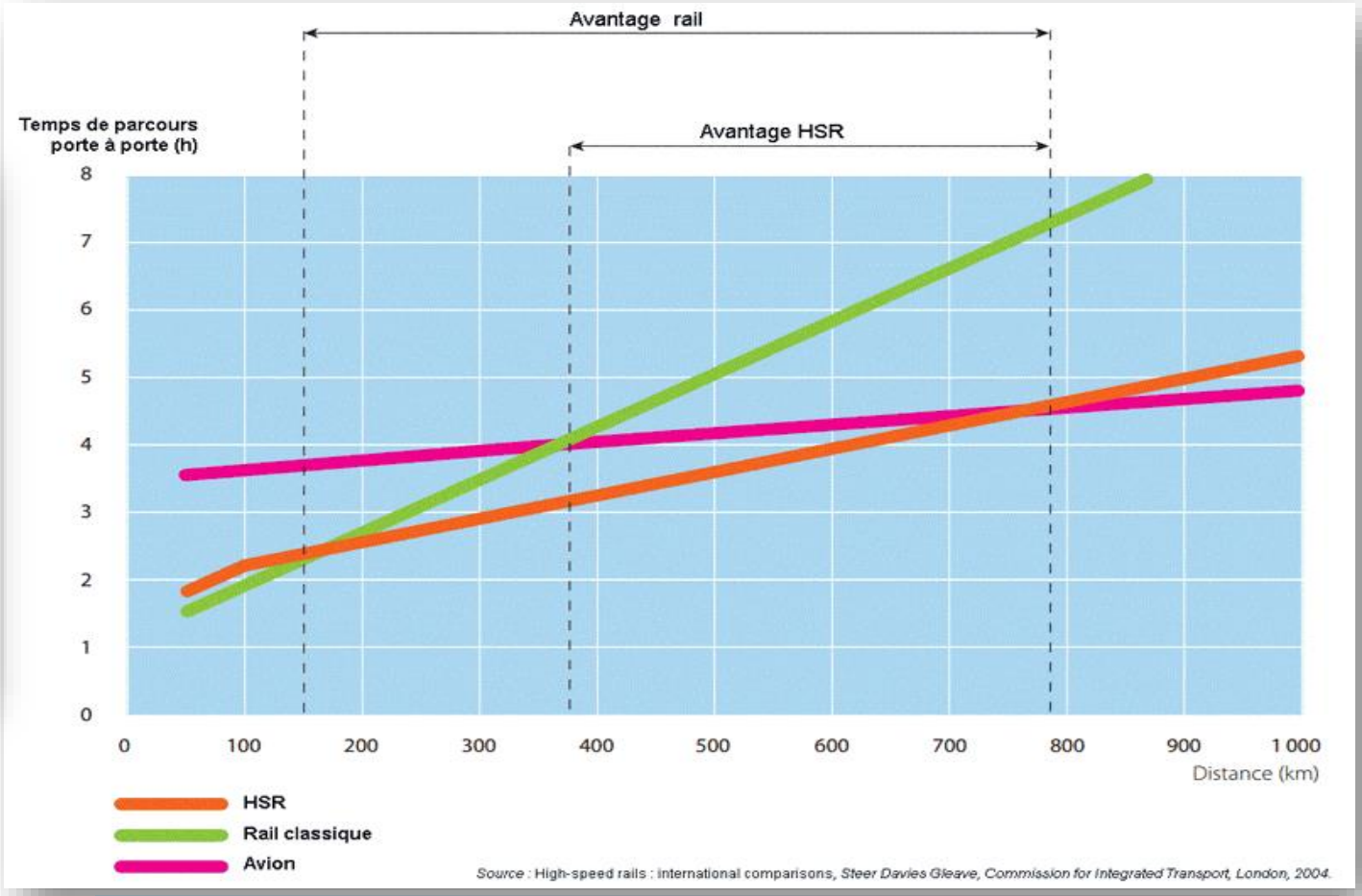
# 7- Socio-Economic Transort




A decrease in the constant cost, greatly decreases the distance from the threshold M.Savy 2018

**Constant freight cost is a matter of:**

filling heavier train (consolidation together, quantum, speed, influences both fixed and variable costs)



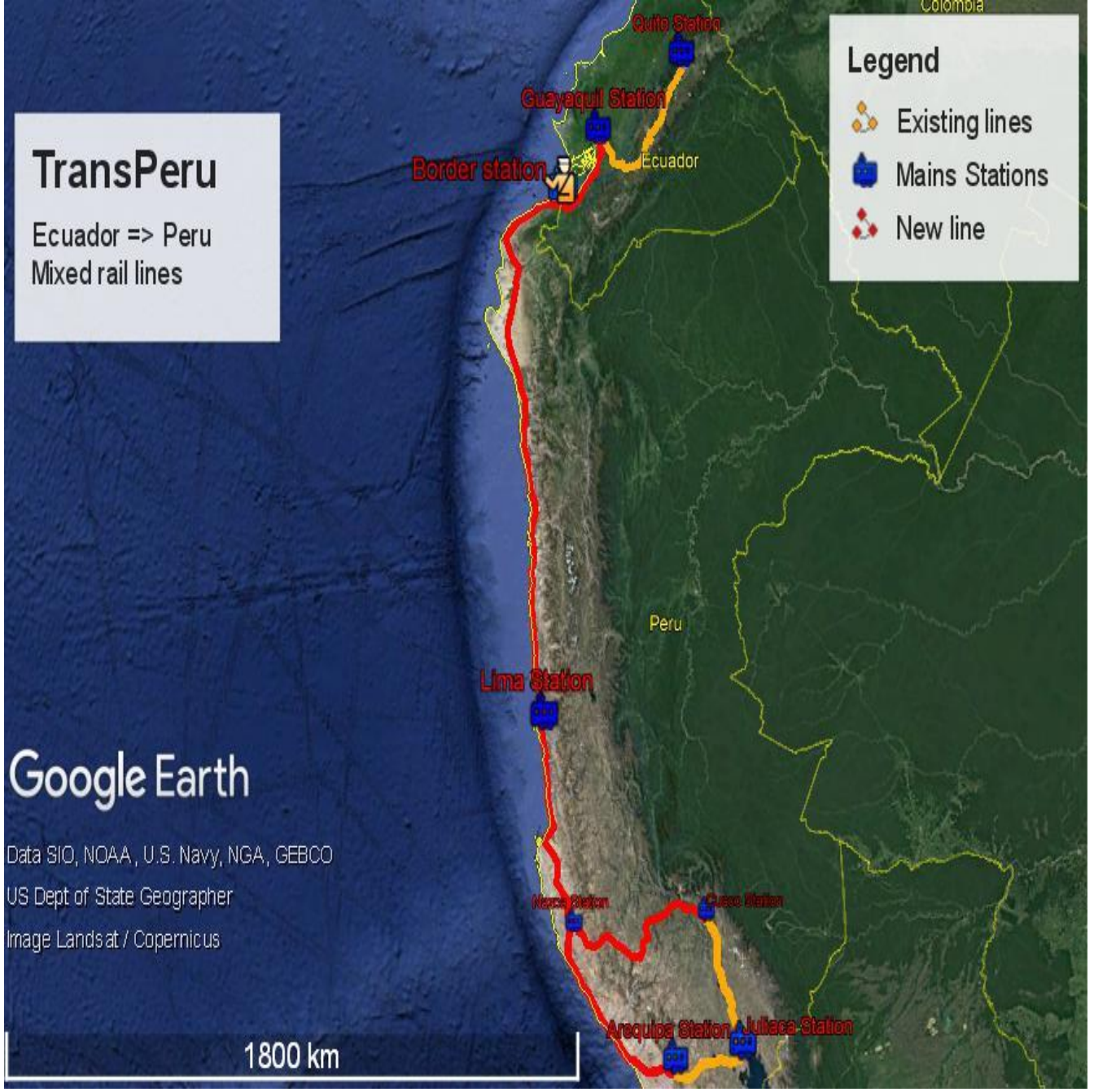

A success story for freight, comparable to the TGV (High Speed) for passengers and for long distances

**In many EU countries, switch to rail (infrastructure, less expensive vehicles, more available, more flexible, large volumes, lower energy consumption and better environmental balance)**

# 2- Case Study

**1- How to connect these different cities by rail in a sub-regional integration strategy, taking into account the geographical, geological, topographical, climatic, geostrategic and heritage constraints, while taking advantage of the different development plans proposed by the States of the two countries and the already existing routes?**

**2- Then, what technical decisions should be taken: at the economic level but also in terms of the route, civil engineering, signaling, equipment and all the elements inside and outside the rail system?**

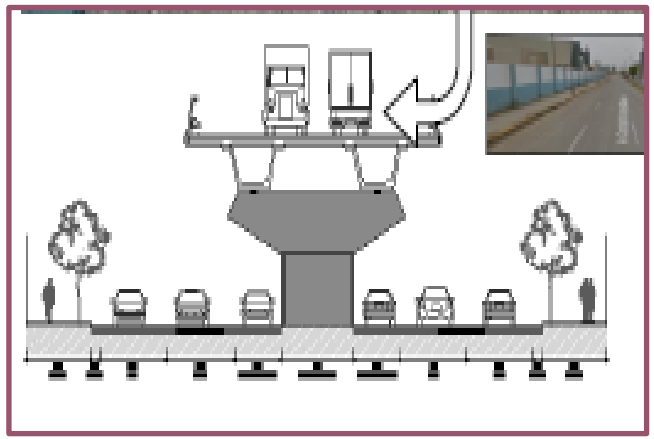


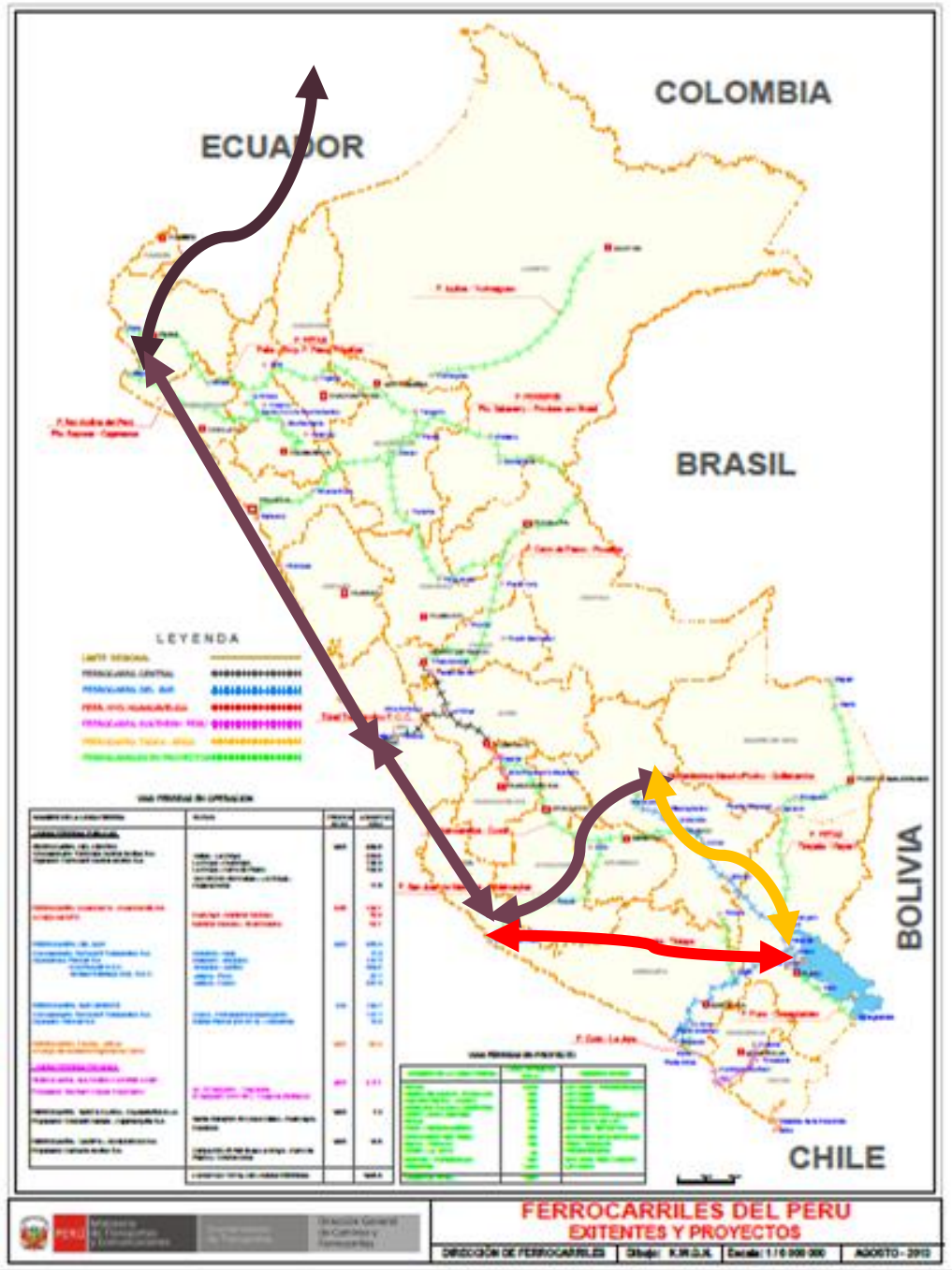

The Proposed Tracing

# 2-1. Pre - Study

The coastal corridors, parallel to the coast, do not only represent significant potential volumes of goods to be transported and travelers also and in order to serve all the coastal cities and connect them to other cities in the country and in neighboring countries.

Given the capacity constraints of the Pan-American Highway, the possibility of gradually building rail infrastructure is also an attractive option.

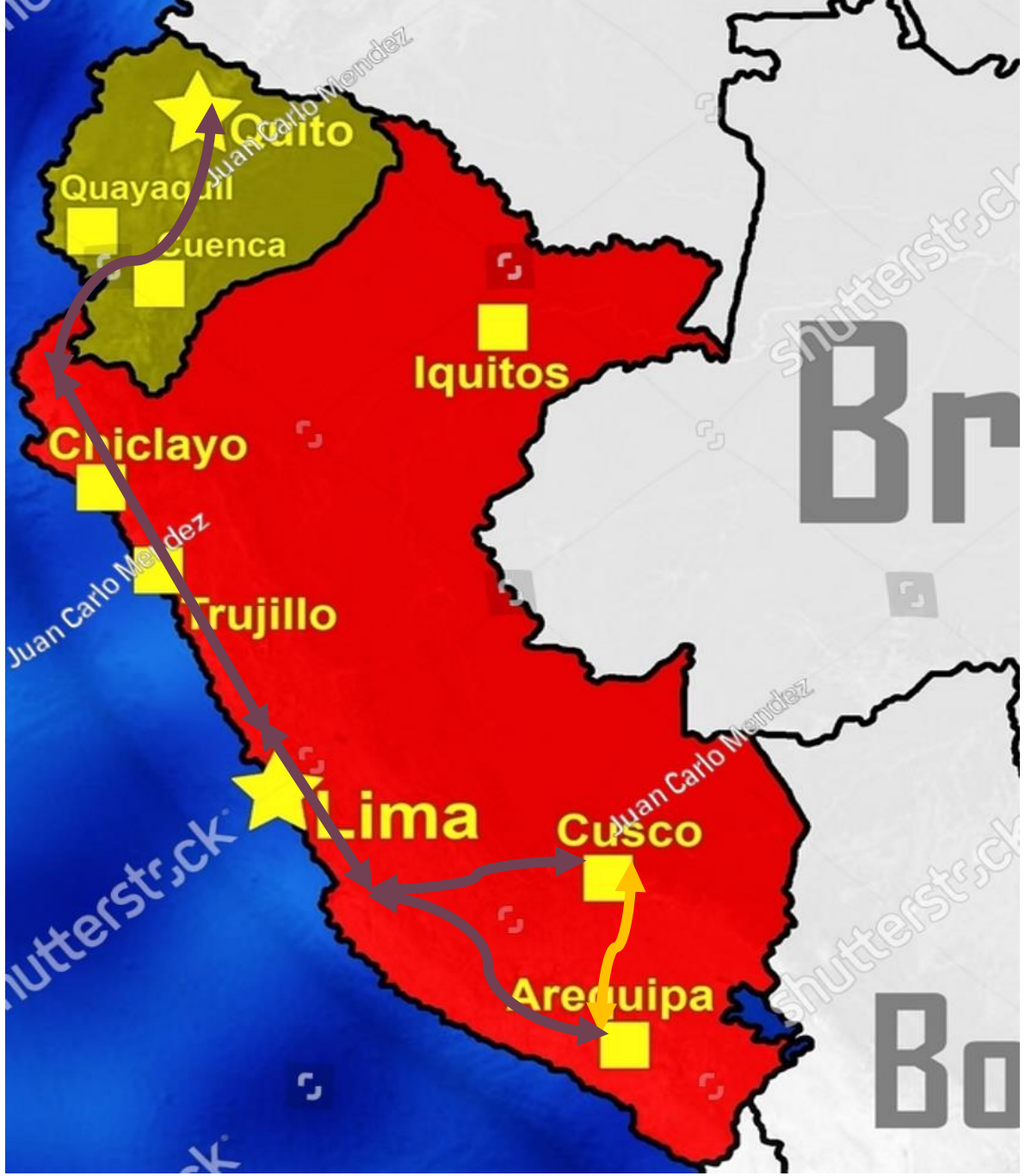





It is necessary to implement an automated signaling system along the entire railway line:

- Give priority to the passage of the train in crossings
- Ensure the safety of those who interact with the railway.

# 2-2 The Proposal

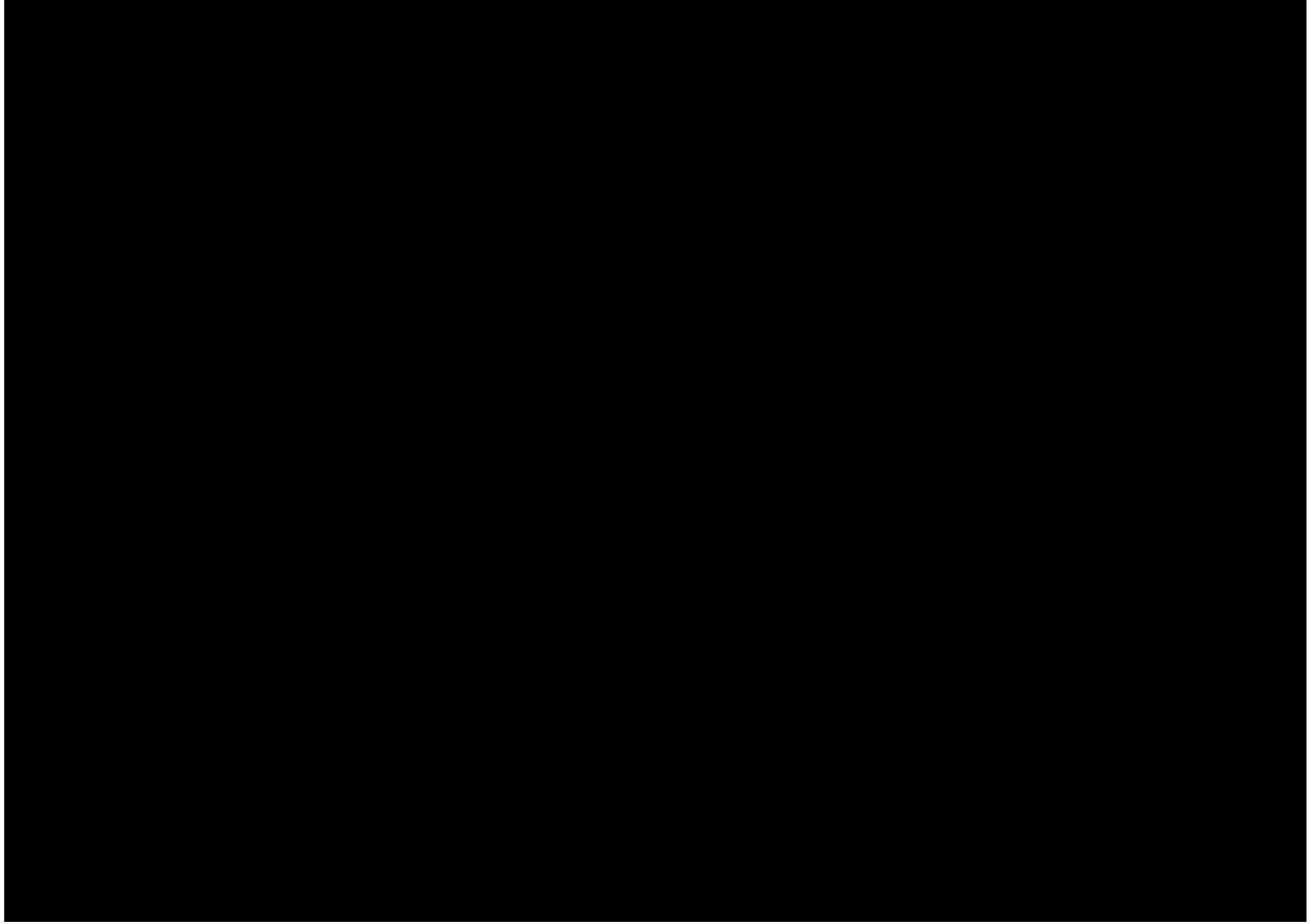



**Two animated films for this Project:**

1-

2-

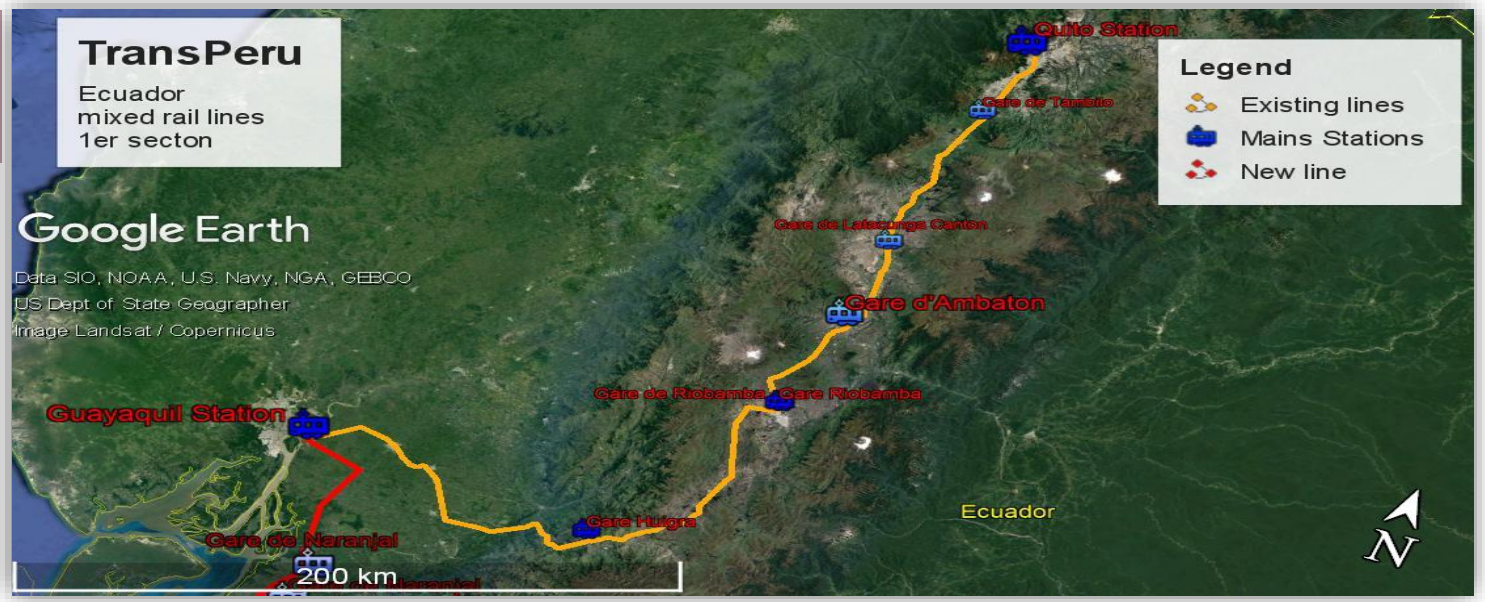

AFD
AFD
ENPC
7.18 km
Google Earth

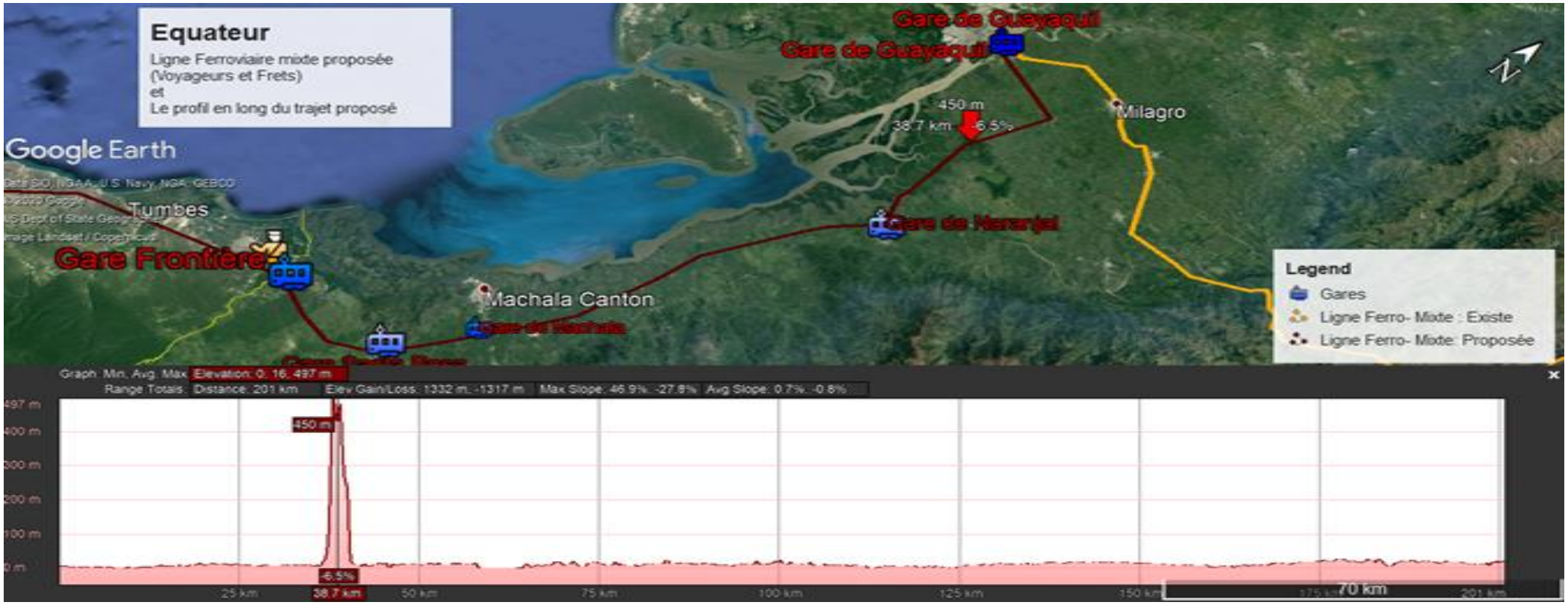


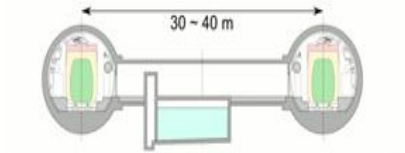
# 2-3. The section inside the Ecuador

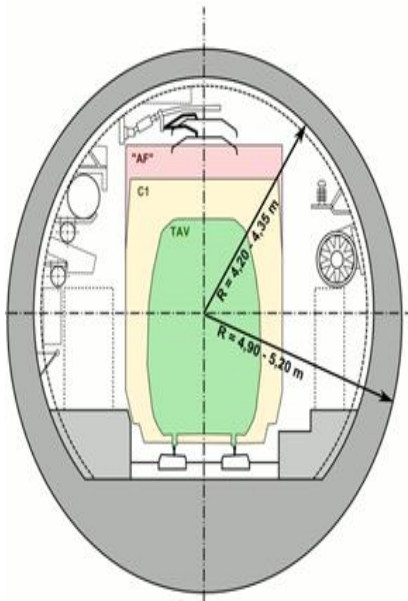
The existing Railway is 400km the average distance 57km/between two stations.

**The new link connection is 201 km with the average distance 40km between two stations**

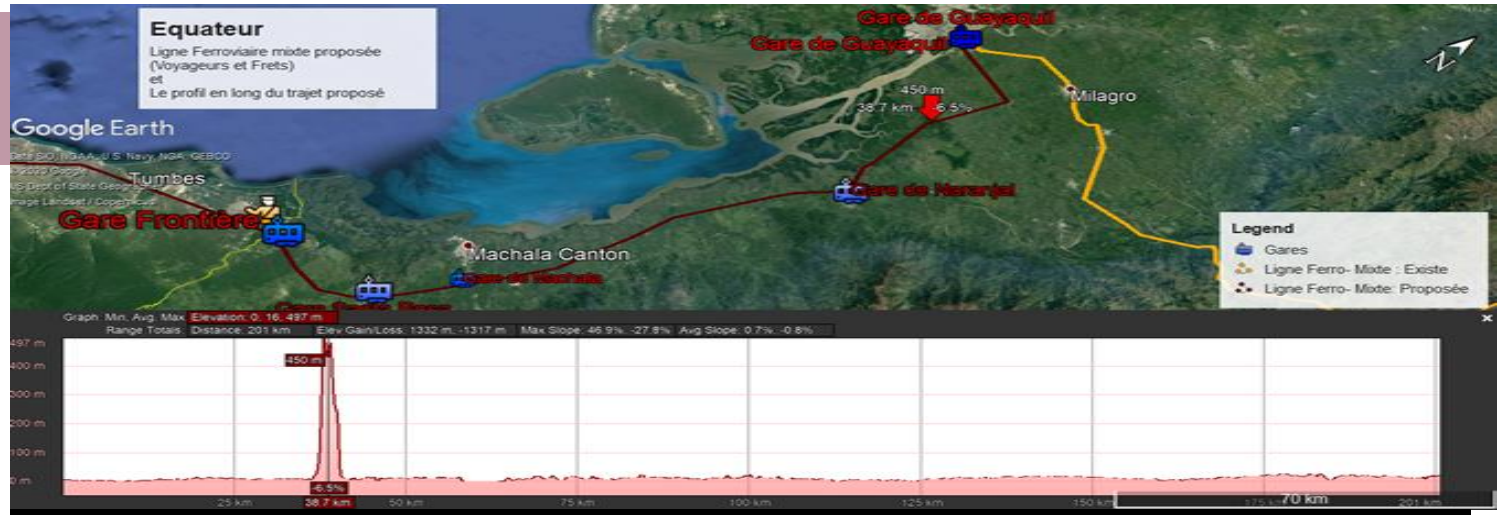


# 2-3. The section inside the Ecuador



# 2-4. The section inside the Peru

**The new Section:**

*** 1st Section: Border – Lima: 1155 km / Average distance 145km between two stations**

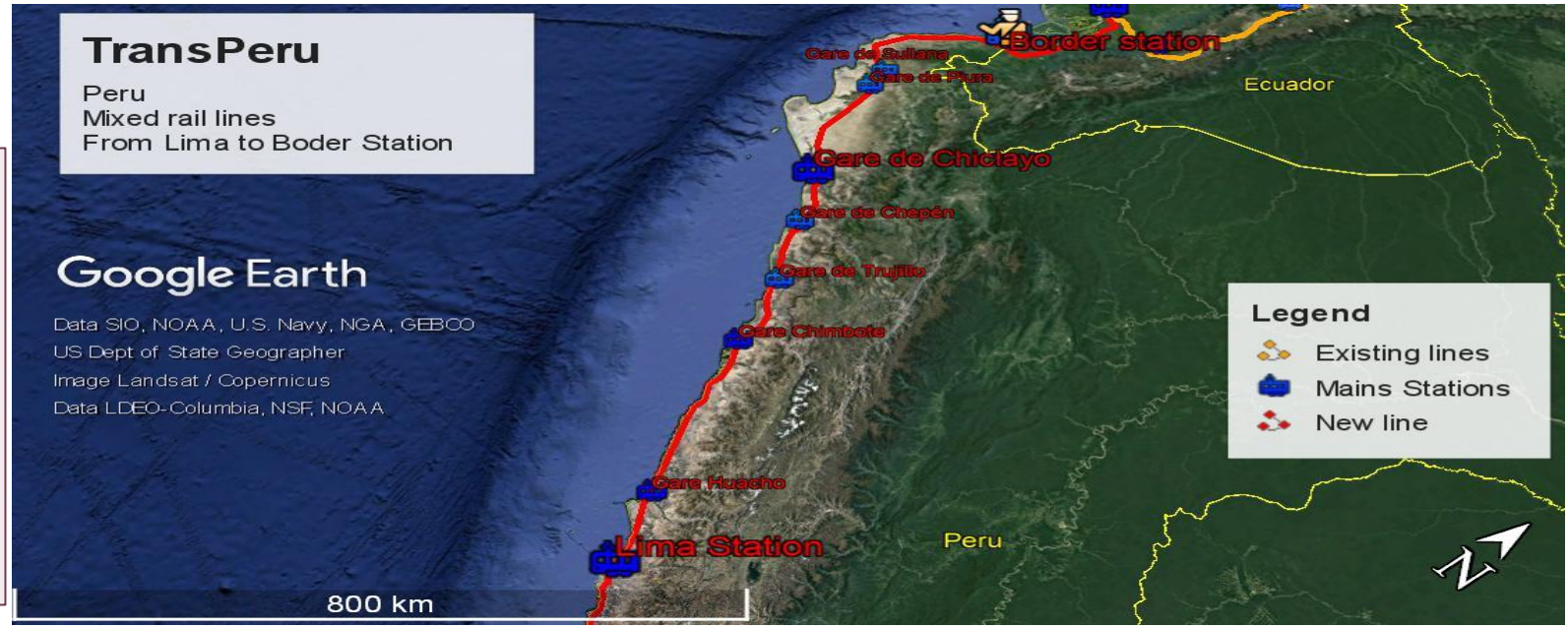
*** 2ed Section: Lima - Nazca: 432km / Average distance 87km**

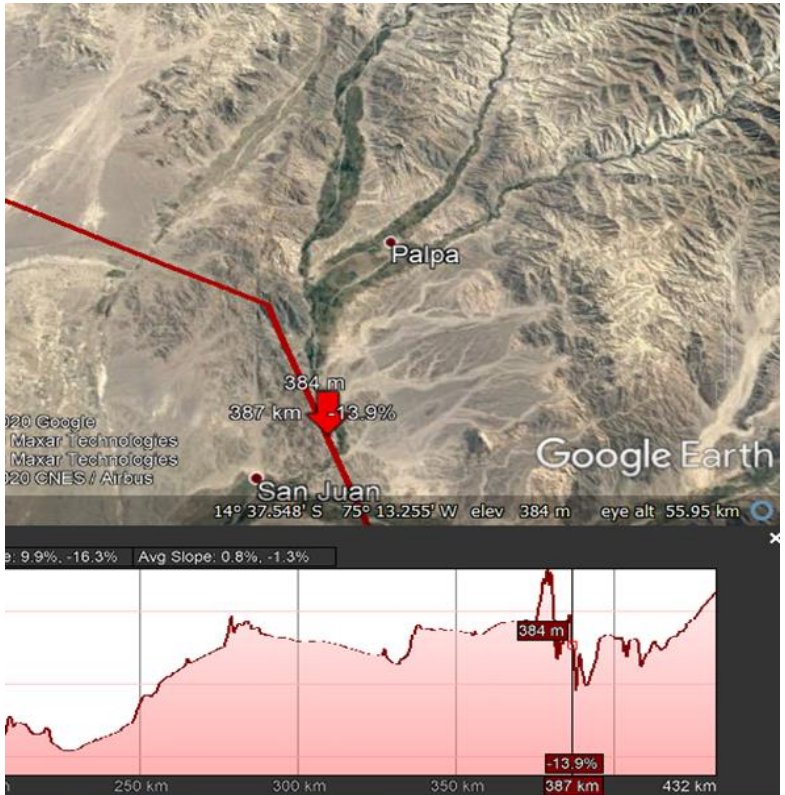
*** 3rd Section: Nazca – Arequipa: 484km /Average distance 161km**

*** 4th Section: Nazca – Cuzco: 516 km / Average distance 172km**

**The existing line:**

*** Arequipa - Cuzco 516km the average distance 172km**

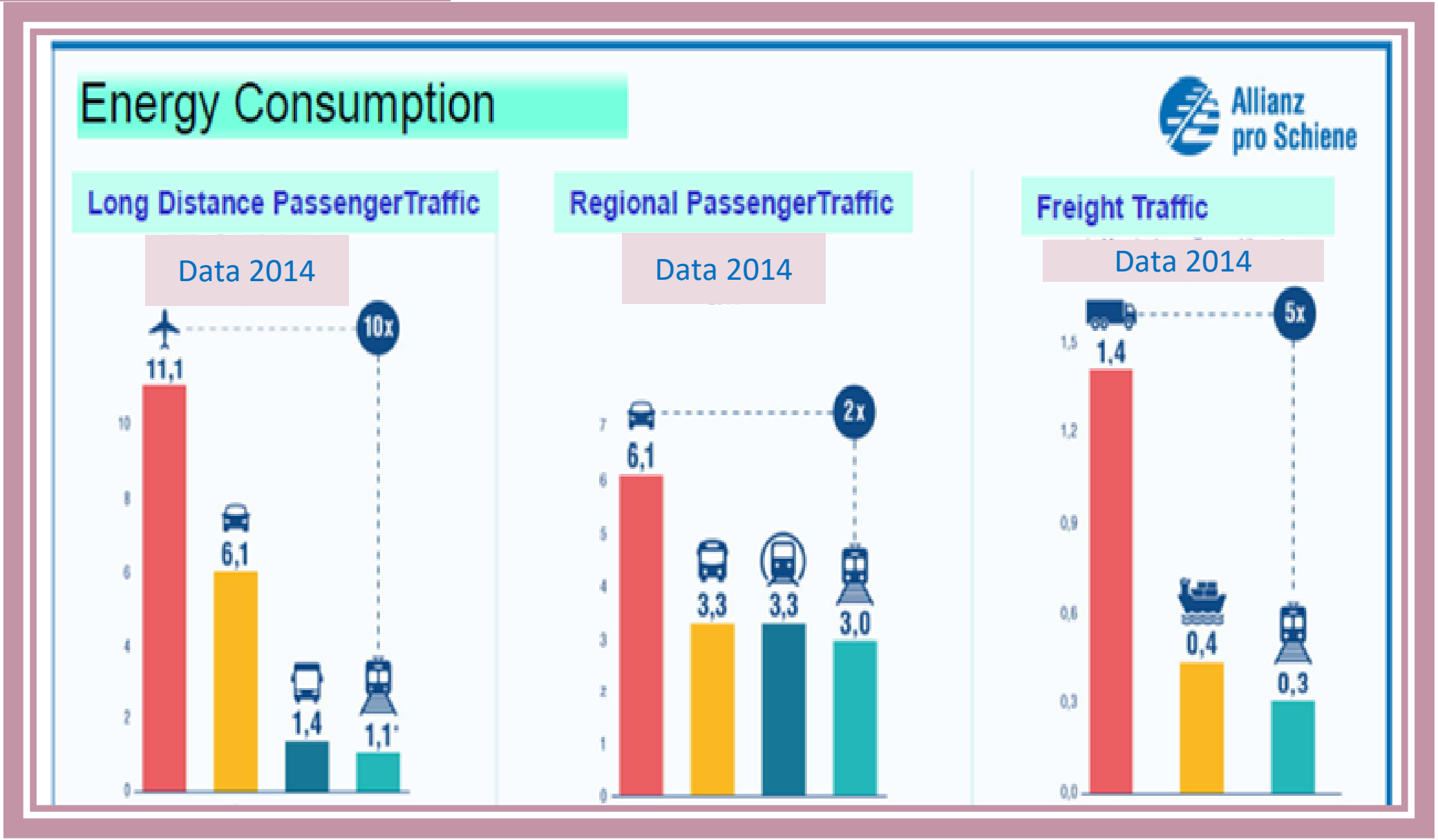




| Estimated Results | Current | Future<br>with Railway connection |
|---|---|---|
| Quito – Arequipa<br>(Passengers) | 3167 km of road<br>or 46.5 hours according to Google Maps | 2672 km of tracks,<br>i.e. 12 hours of train travel at 220 km/h |
| Quito - Arequipa (Frieght) | 100h by highway | 17h by train at 160 km/h |

# Food for Thought

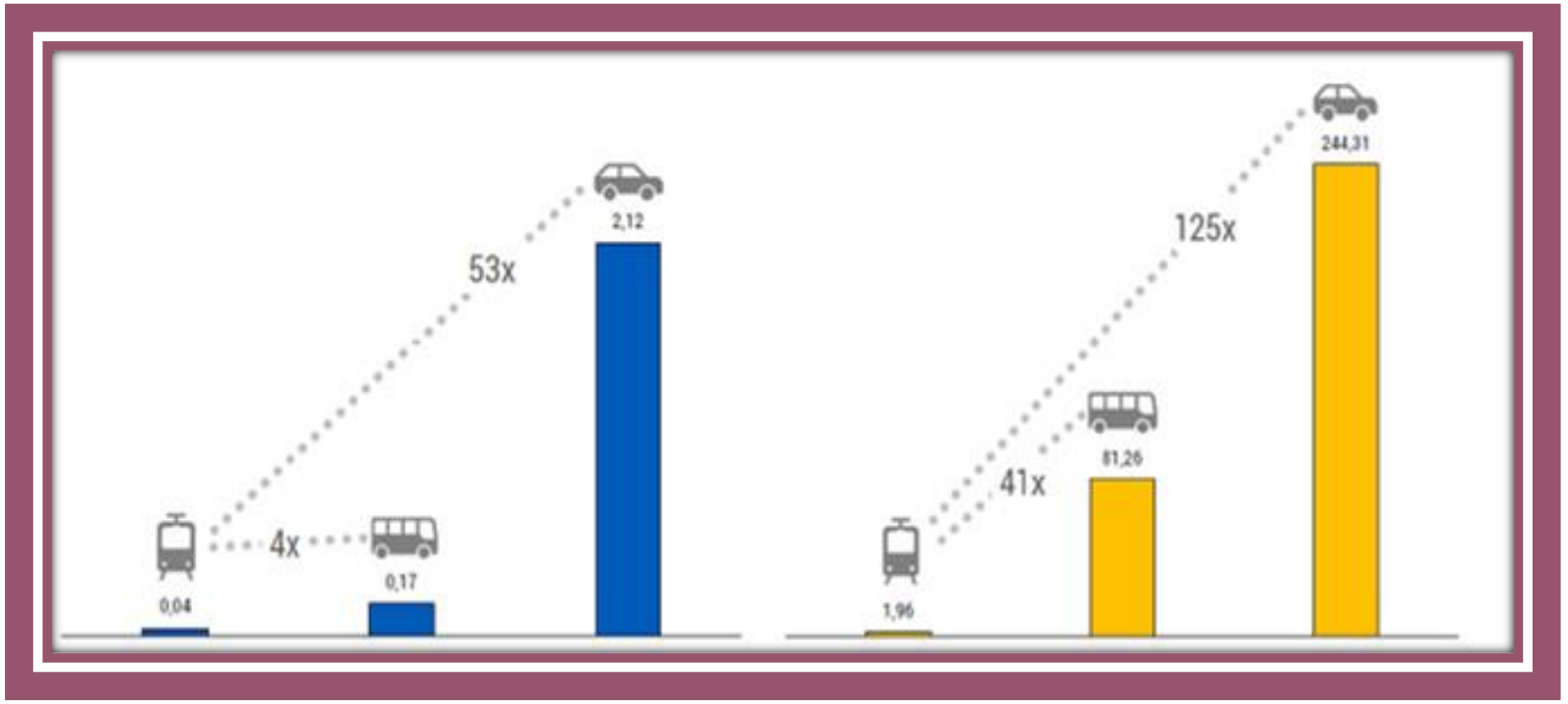


# Food for Thought

## SAFETY

**Risk of Death**

**Risk of Injury**




**Thinking of a more Efficient and Safer way to transport people**

# Thank you

References:

- OpenStreet Map: https://www.openstreetmap.org
- Worldpop: https://www.worldpop.org/
- Open Railway Map - https://www.openrailwaymap.org/
- CIA World Fact Book - https://www.cia.gov/library/publications/the-world-factbook/
- World Bank Open Data - https://data.worldbank.org