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Securing Tomorrow's Energy Today

About the Energy Sustainability of Peru

Jaime E. Luyo, PhD

About the Energy Sustainability of Peru

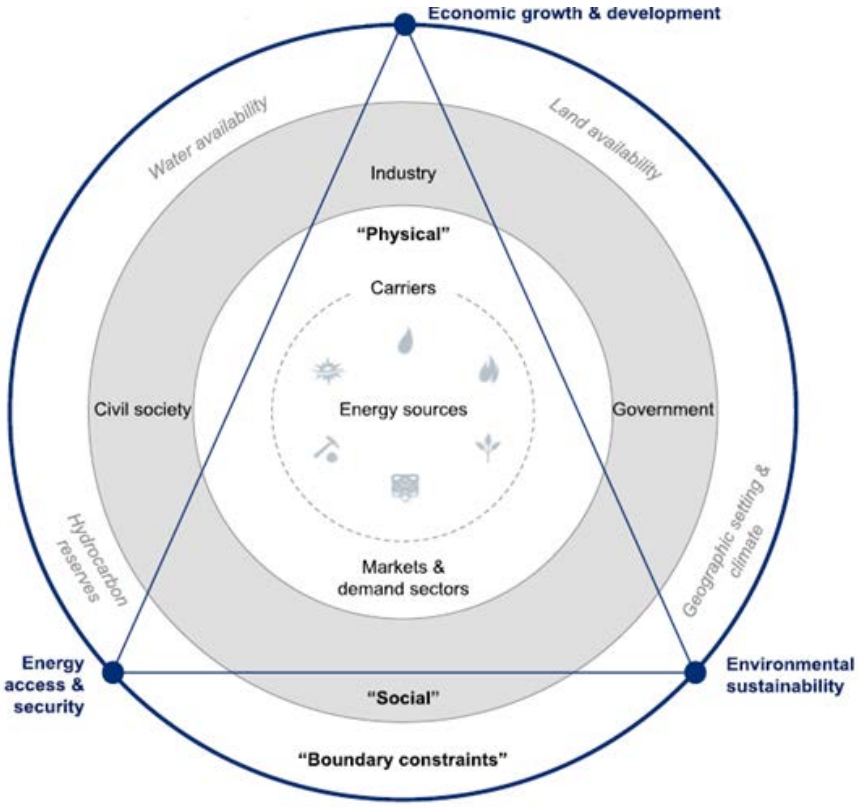
- Peru in the *Global Energy Arquitecture Performance Index (EAPI)2013*
- Peru's Energy Matrix
- About Economic Growth and Development
- About Access and Energy Security
- About the Enviromental Sustainability
- Myths about Energy in Peru and elsewhere
- Some policy proposals for the Energy Sustainability of Peru

Rating of Peru by the *World Economic Forum*

- The EAPI 2013 Ranking is among 105 countries worldwide.
- Peru is *at first* in the *Economic Growth and Development* dimension, but in *Access and Energy Security* in the *66th*, and *Environmental Sustainability* in the *51st* position.
- Occupying the *15th* place in the overall ranking.

Source : The Global Energy Arquitecture Performance Index 2013 (EAPI 2013)

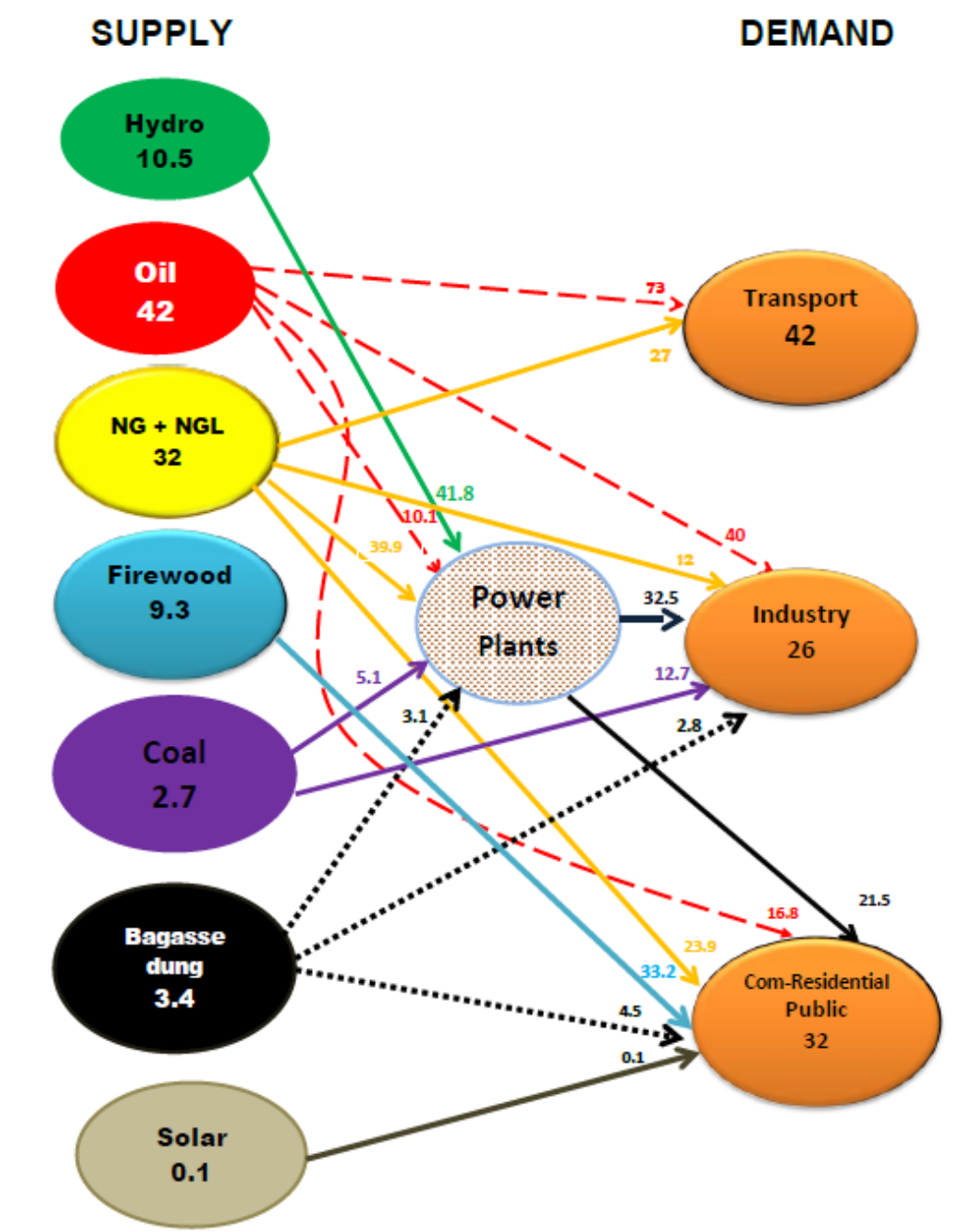
The Energy Triangle



Map of top economic growth and development performers

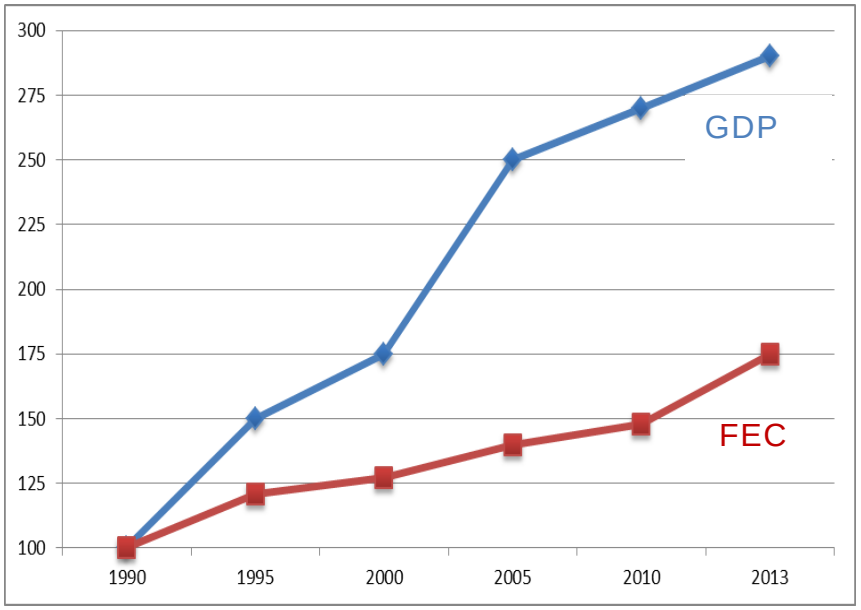
Peru's Energy Matrix

- The use of firewood, dung-Yareta bagasse is maintained even at *13%* that covers about *38%* of residential energy consumption in rural areas of the Andes and Amazon region and the current country's electrification ratio of *88%* still shows high ***energy poverty.***
- The high supply of oil, gas and petroleum products (*74%*), for the transport sector and to a lesser extent by the industry, and NG thermoelectric generation, are the main sources that affect ***environmental health.***
- There is still low use of ***clean renewable sources*** (*11%* approx.) in total supply.
- The greatest impacts to ***ecosystem vitality*** are related to the exploitation of hydrocarbons and access roads in the Amazonian forests.



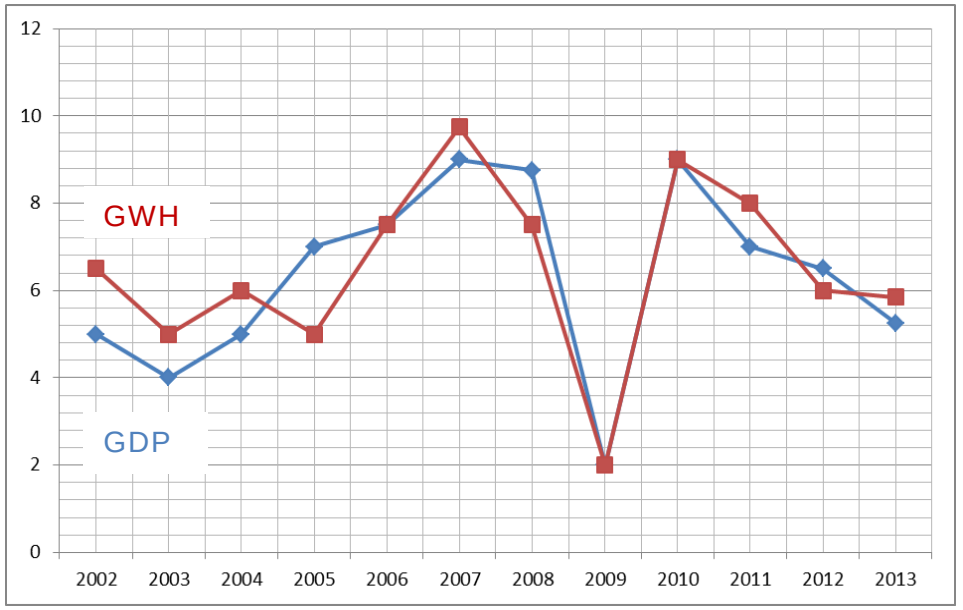
About Economic Growth and Development

Peruvian GDP and Final Energy Consumption Growth (base 1990 = 100)



Peruvian Gross Domestic Product and Energy generation

annual growth rate (%)

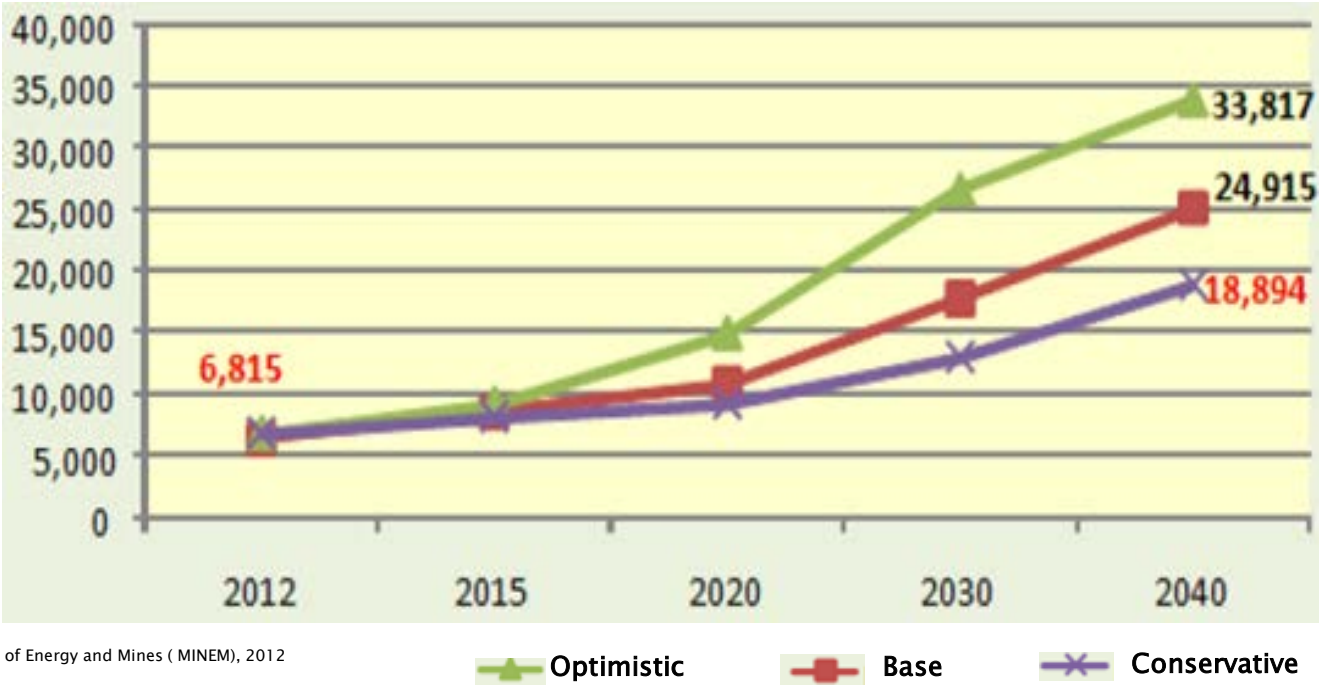


Source: J.E. Luyo . Data: BCRP (1994 prices), MINEM,INEI, COES. Peru Statistics.

- *Energy growth has been decoupled from economic growth.The energy intensity is 35% lower in 2010 than in 1990.*
- *There is a positive correlation between the a.g.r of the GDP and the a.g.r. of the Electrical Energy.*

About Economic Growth and Development

Capacity supply projections (MW). Peruvian Interconnected Power System
Period 2012-2040



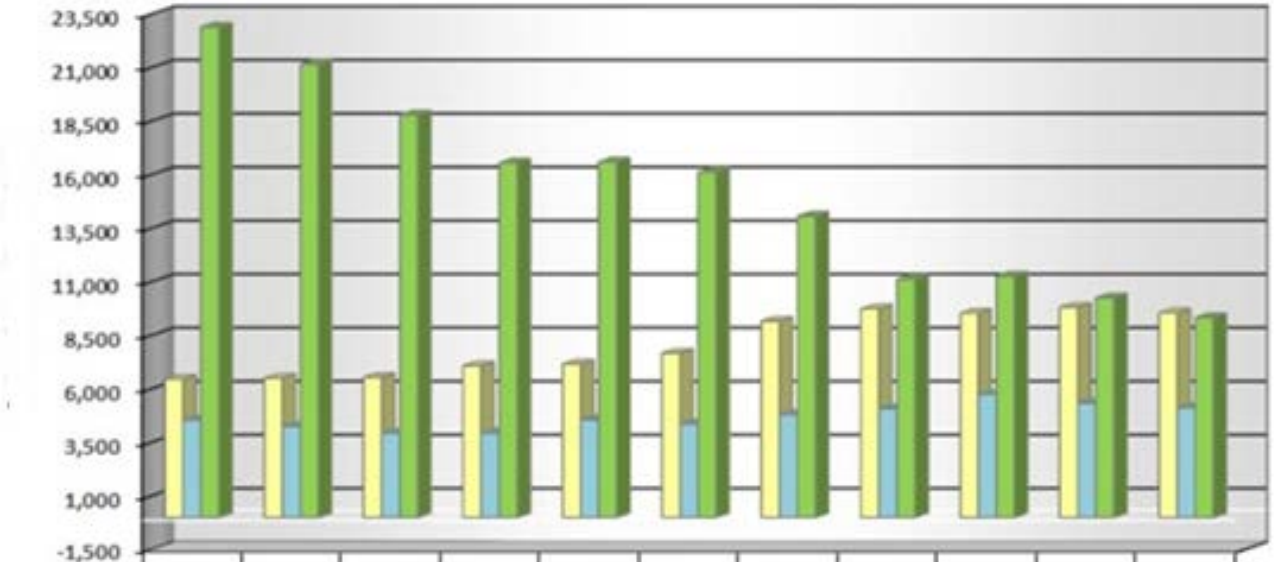
Source: NUMES Study, Ministry of Energy and Mines (MINEM), 2012

- By **2023**, it is needed ***additional 6,000 MW*** in Base and, ***additional 11,000 MW*** in Optimistic and; by **2040**, additional ***18,000 MW*** in Base and additional ***27,000 MW*** in Optimistic projection.

- The electrification ratio in rural areas, due to the MINEM investment shock, ***doubled in the period 2007-2012*** rising ***from 30% to 62.5%***.

About Access and Energy Security

Oil production in Peru. Period 2002-2012 (thousand barrels per year)



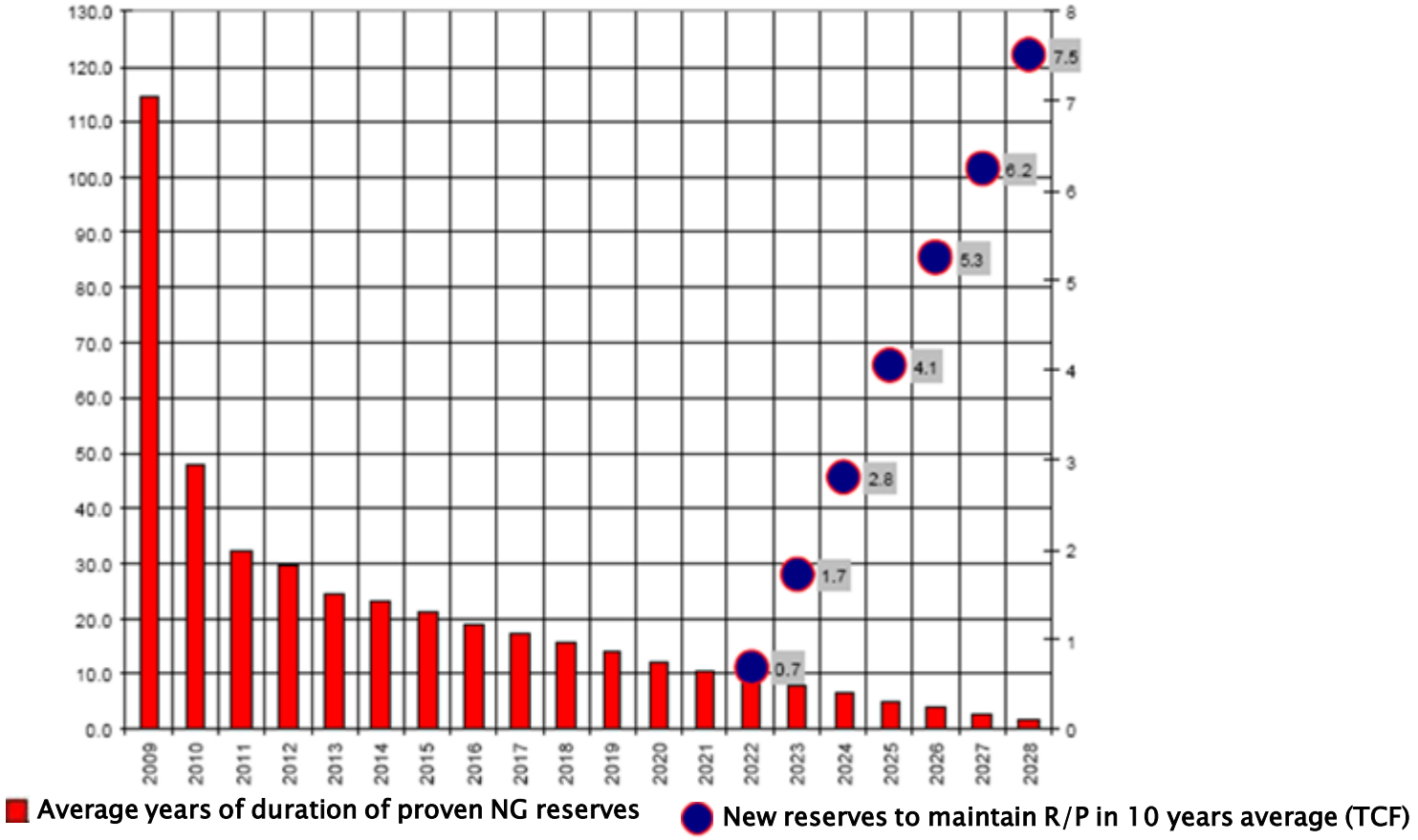
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Noroeste	6,443	6,490	6,533	7,071	7,158	7,664	9,159	9,731	9,528	9,808	9,545
Zócalo	4,526	4,238	3,930	3,922	4,556	4,367	4,806	5,075	5,737	5,332	5,115
Selva	22,893	21,144	18,780	16,548	16,601	16,116	14,063	11,121	11,267	10,246	9,323
TOTAL	33,862	31,873	29,243	27,541	28,314	28,146	28,027	25,927	26,531	25,387	23,984

Source: Perupetro

- *20 years after the start of the privatization policy, domestic oil production is reduced every year.*
- *The oil and petroleum products trade balance is in deficit since the late 1980s, Peru is a net oil importer.*
- *Production of sugar cane ethanol and biodiesel has been since 2000 and 2006 but with the disadvantage of competing with subsidized USA biofuels.*

About Access and Energy Security

Average years of duration of proven natural gas reserves (Base 12-31-2008 = 14.1 TCF) and discoveries necessary to maintain the relationship projected reserves / production ratio in 10 year average based on total demands projected



Source : Osinergmin,Peru, may 2009

- *If no new NG reserves are discovered, the current reserves are exhausted in 2028.*

About Access and Energy Security

Technical Hydro-electric Potential

Basin	Total (MW)	Excluded (MW)	Technically exploitable (MW)	Distribution (%)
Pacific	11,402	2,671	8,731	12.6
Atlantic	86,971	6,345	60,627	**87.3**
Titicaca	87	0	87	0.1
Total	98,460	29,016	**69,445**	100.0

Source: Ministry of Energy and Mines of Peru (MINEM), 2011

Technical Small Hydroelectric Potential
(the 100 best hydroelectric plants of 1 to 100 MW)

	Exploitable (MW)	Technical Potential* (MW)
Total	2,145	**1,000**

*applying capacity factor

Source: Potencial Hidroeléctrico.HIDROGIS, MINEM, 2011

Technical Wind Potential

	Gross potential (MW)	Exploitable (MW)	Technical Potential* (MW)
Total	77,394	22,452	**4,500 - 6,700**

*applying capacity factor to wind farms

Source: Eolic Atlas of Peru, MINEM, nov. 2008

Highest Solar Energy Potential

Highest potential	Range
South coast	6.0 to 6.5 kWh/m^2
North coast	5.5 to 6.0 kW h / m^2

Source: Solar Atlas of Peru. MINEM.

- *The largest renewable energy resource and better alternative for Peru to sustain the country's economic development in the long term is: the hydro-electricity.*

Geothermal Energy Potential

It has evaluated a gross geothermal potential of 3,000 MW .Technical potential about **1,000 MW**

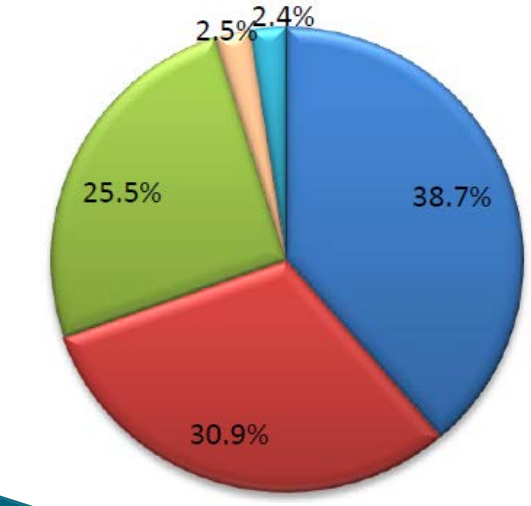
Source: Geothermal resources in Peru, 1999

About the Environmental Sustainability

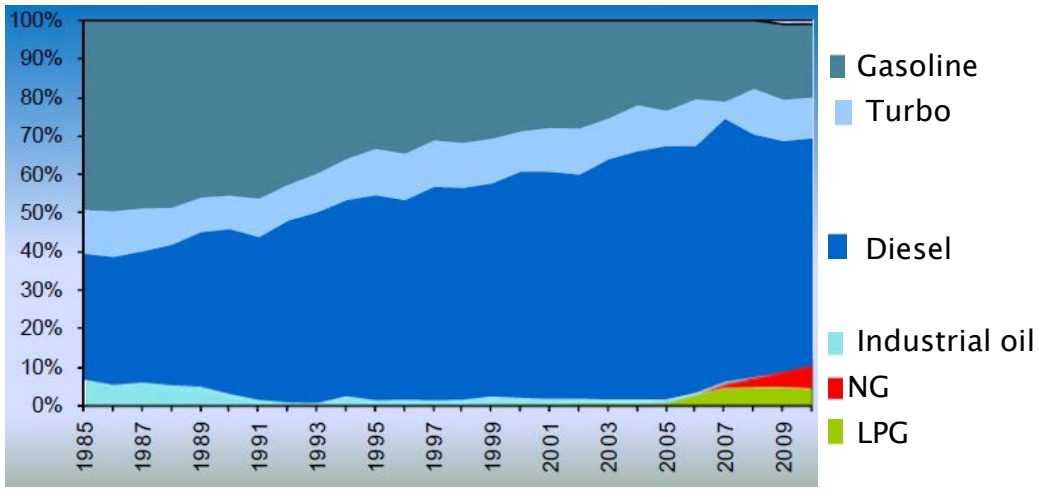
- In the *2012 Environmental Performance Index*, Peru is at ***81*** in the overall ranking among 132 countries, with a tendency to worsen. Also, is ranked ***100*** in the category ***Water***, ***119*** in the category ***Air with effect to the ecosystem*** and ; ***89 in human health***, and ***94 in forest protection.***

Source : *2012 Environmental Performance Index and Pilot Trend Environmental Performance Index.* New Haven: Yale Center for Environmental Law and Policy.

Final Energy Consumption by Sector



Consumption structure-Transport sector
1985-2010

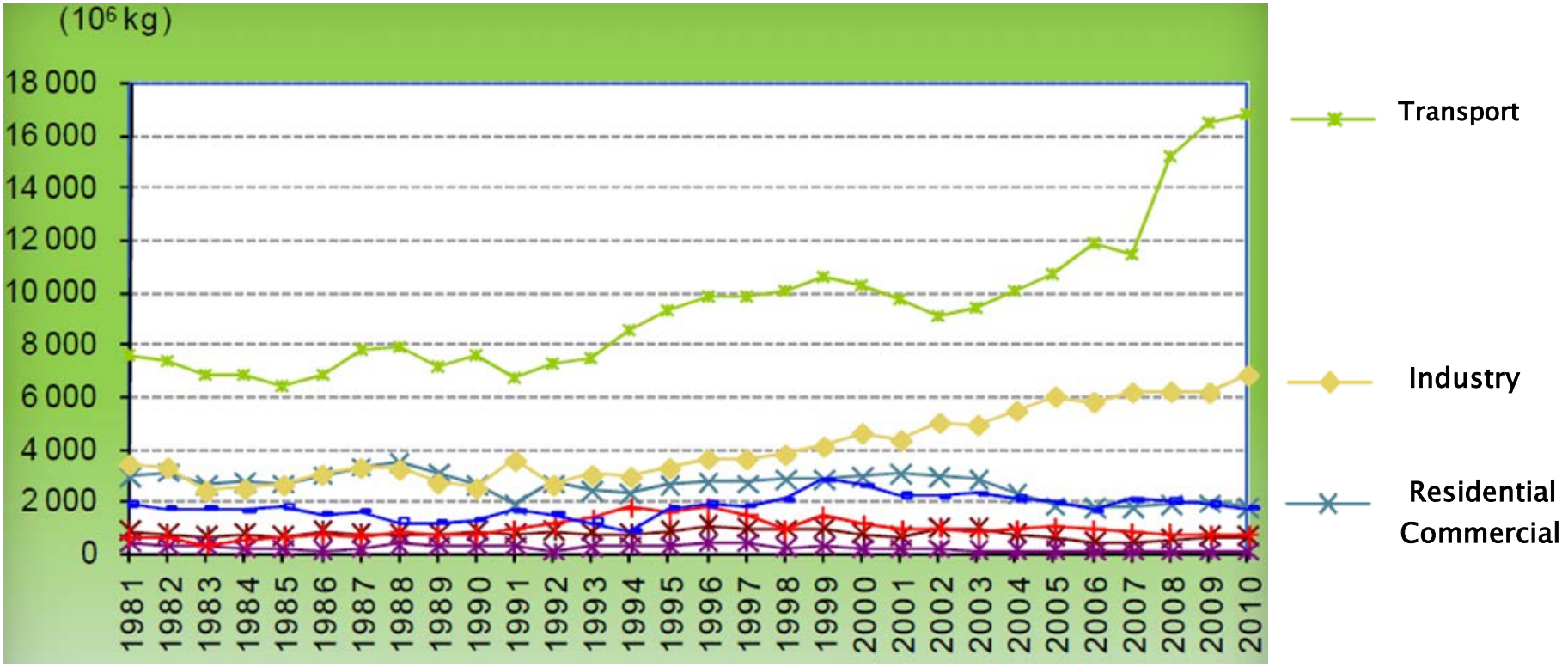


Source: MINEM, 2010

¡ *Diesel Oil consumption has double .*
The NG and LPG contribution is still small !

About the Environmental Sustainability

CO2 Emissions by Economic Sector



Source: MINEM, 2010 .

In final consumption, emissions of carbon dioxide, in 1981 – 2010, increased from ***17.46 to 28.39 billion kilograms****, mainly by consumption in the transport and industrial sectors*

Myths about Energy in Peru and elsewhere

- With the mass deployment of wind power plants and photovoltaic generation may meet the country's electricity demand in the medium and long term as there are large resources in the country. But, we have shown that electric generation capacity with ***unconventional renewable energy sources cannot satisfy electricity demand*** in the medium and long term.

- That aggregation of small hydroelectric plants can replace a large hydroelectric plant with reservoir that rather should be scheduled for the end of the XXI century. There is a widespread belief that electricity cannot be stored in large quantities, but for many decades is being indirectly stored in large dams , allowing the generation in dry season. So it is ***necessary to build large base-hydroelectric plants with regulatory capacity*** that not have small and run-of-river hydroelectric plants that are dried in dry season.

Myths about Energy in Peru and elsewhere

- The nuclear power is a clean energy. But, if these plants are evaluated throughout the project life cycle from extraction to disposal radioactive waste, ***are more polluted than all renewable energy plants.***

- Small hydroelectric plants have not impacts in river ecosystems and the biodiversity. But , the size (in MW) of hydroelectric plant is not the best indicator of the environmental impact ; in Peru and other nations, in the Andes, is possible to build dams at altitudes above 4,800 meters above sea level where life human, animal and plant is restricted. So a better indicator is the ***superficial performance*** (GWh/km^2) and/or the ***volumetric performance*** (W/m^3) ; also the ***location*** of the dam along the river course and its ***proximity*** to other dam and, ***connectivity*** to the Amazon lowlands.

Some policy proposals for Energy Sustainability of Peru

- To reach a sustainable energy system in the country, one should adopt an energy strategy with long-term vision based on three pillars: the consumption of increasing amounts of renewable and clean (conventional and unconventional) energy resources ***which are abundant in the country***, the institutionalization of efficiency and energy savings, and the energy security.

- Institute a comprehensive energy planning in the energy sector and formulate the ***first national energy plan for the medium and long term*** to optimize the use of existing energy resources in the country and keeping those non-renewable, and shifting from hydrocarbons to biofuels, within a sustainable energy development approach .

- Special attention should be given to the very high environmental, ecological and deforestation impacts caused by ***illegal mining and building of large roads*** in the Amazonian region, also to the high pollution in the ***transport*** sector.

Some policy proposals for Energy Sustainability of Peru

- To take advantage of the large hydropower resources in the Atlantic basin of Peru, it should establish an strategy for ecological, connectivity, and forest loss impacts assessment ***at a basin and regional scale*** rather than evaluating hydroelectric project individually, taking into account the ***hydrologic connectivity*** between the Andes and the Amazon.

- Advocate progressive energy integration with neighboring countries towards the creation of a subregional energy market, within a new paradigm of third economic reforms seeking ***cooperation and complementarity*** of : State and market or, public and private.

- The EAPI can be very useful tool for short and medium term monitoring and as guidance for policymakers on investments in the energy sector, yet should take into account the specific characteristics of each country regarding their vision of long term sustainable development.