SOCIEDAD DE INGENIEROS DE PETRÓLEO

CAMBIO CLIMATICO Y ENERGÍA RENOVABLES APLICADAS A LA INDUSTRIA PETROLERA

Manuel Loli
Consultor de AccessESP
26 de enero 2018

SPE International
Society of Petroleum Engineers

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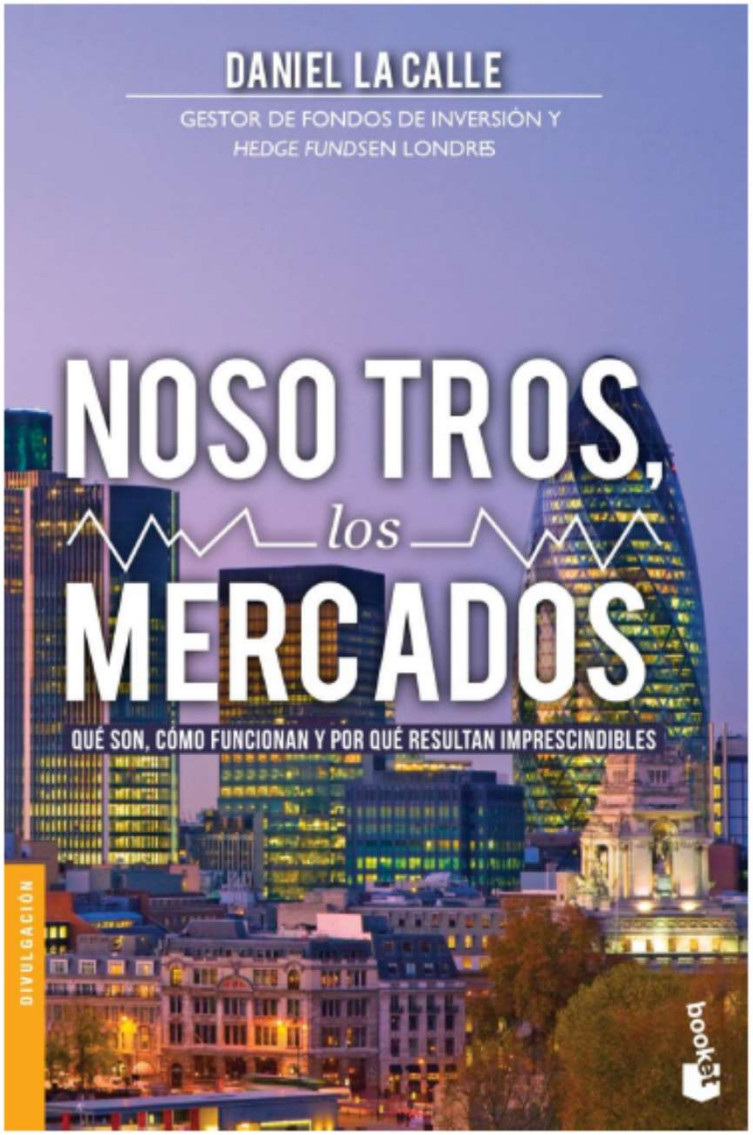
"'Consensus will only take you to mediocrity', me dijeron los tres. Piensa 'fuera de la caja' cuestiona los dogmas porque mantenerse en el consenso, en el rebaño, solo te llevará a la mediocridad"

Daniel Lacalle



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LA TIERRA ESTA MURIENDO

https://www.youtube.com/watch?v=JQYXJfMlD30

TIMELINE: THE LONG ROAD TO COP21

The Paris conference was crucial because it provided a new international agreement to combat global warming. However the road to the Paris summit began three decades ago.

1972 First UN environment summit in Stockholm on environment, key issues discussed chemical pollution, atomic bomb testing and whaling.

1979 World first climate conference, held in Geneva, led to the establishment of the World Climate Programme.

1987 Montreal Protocol agreed, restricting chemicals that damage the ozone layer.

1988 FIntergovernmental Panel on Climate Change (IPCC) formed to collate and assess evidence on climate change.

1990 Second climate conference, held again in Geneva, it led to the establishment of the UNFCC, of which the Kyoto Protocol is a part.

1990 IPCC produces First Assessment Report, concludes that humanity's emissions are adding to the atmosphere's natural complement of greenhouse gases.

1992 In Rio de Janeiro, for the first time, binding greenhouse gas emissions reduction targets were set for industrialised countries.

1997 Kyoto Protocol agreed. Developed nations pledge to reduce emissions by an average of 5% by the period 2008-12, with wide variations on targets for individual countries.

2001 FPresident Bush removes the US from the Kyoto process, arguing that it puts more of the burden for reducing emissions on industrialized nations instead of developing ones.

2005 Kyoto Protocol becomes international but without major emissions producers, including the U.S. and Russia on board, it's essentially a symbolic agreement between the 141 nations who ratified it.

2007 At UN negotiations in Bali, governments agree the two-year "Bali roadmap" aimed at hammering out a new global treaty by the end of 2009.

2009 192 countries convene for the UN climate summit in Copenhagen.

2010 UN summit in Mexico does not collapse, as had been feared, but ends with agreements on a number of issues.

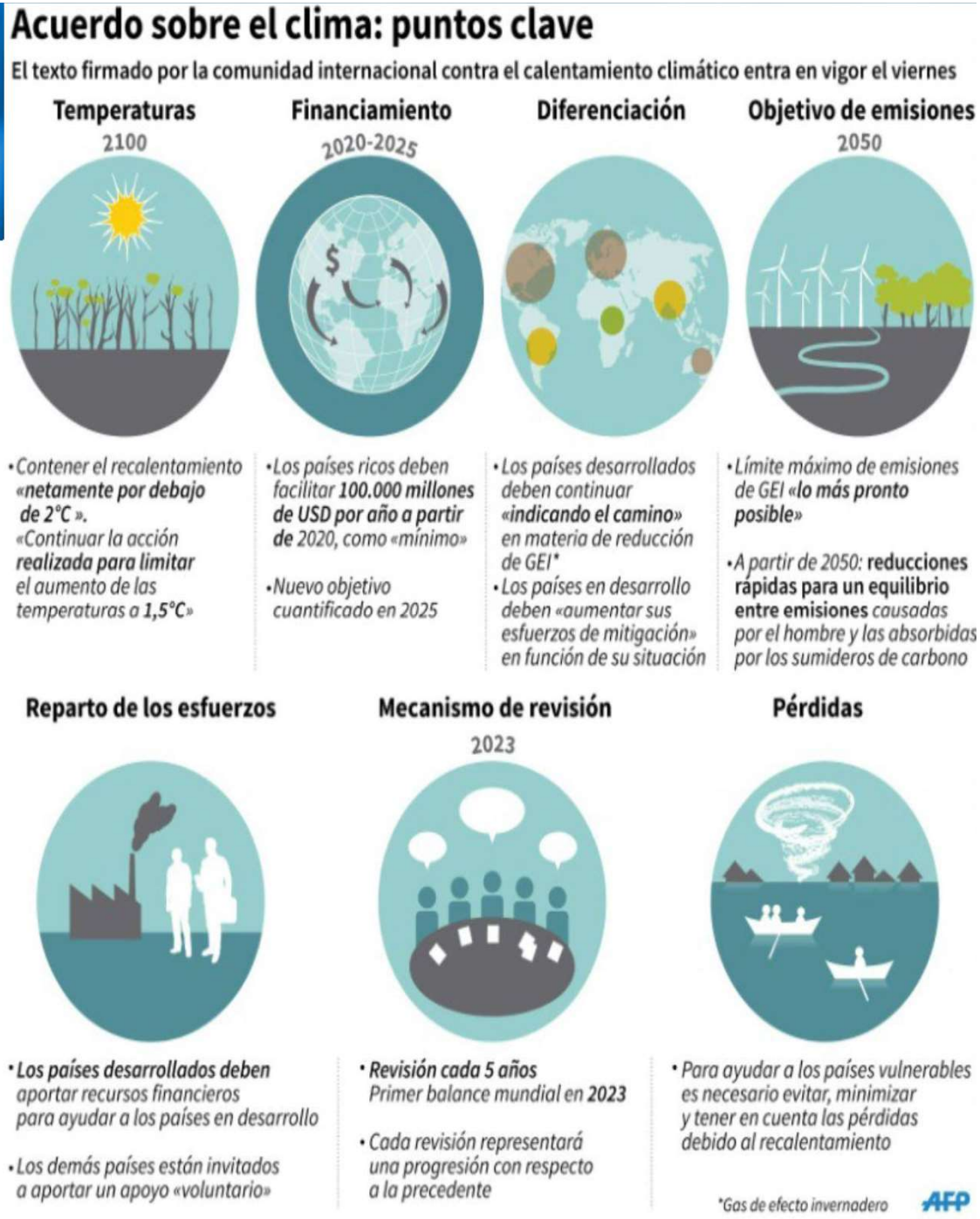
2011 More than 190 nations meet in Durban to try to agree what to do after the first stage of the Kyoto Protocol expires in 2012.

2015 Global agreement on the reduction of climate change in Paris, will become legally binding if joined by at least 55 countries. The countries will need to sign the agreement in New York between in 2017.

Acuerdo de Paris 2015

195 países presentaron sus Contribuciones y compromisos Previstas y Determinadas a Nivel Nacional:

- Canadá: 30% al 2030
- US: 26 a 28% al 2025
- Unión Europea: 40% al 2030
- China: 60-65% al 2030, RER 20%, 2030
- Japón: 26% al 2021
- Saudí Arabia: 130 millón toneladas de CO2eq por 2030 por tecnología
- Chile: 30% al 2030 y 30-35% Internacional
- Perú: 30% al 2030, 20% con recursos internos y el 10% con financiamiento internacional



Gases de Efecto Invernadero(GEI)

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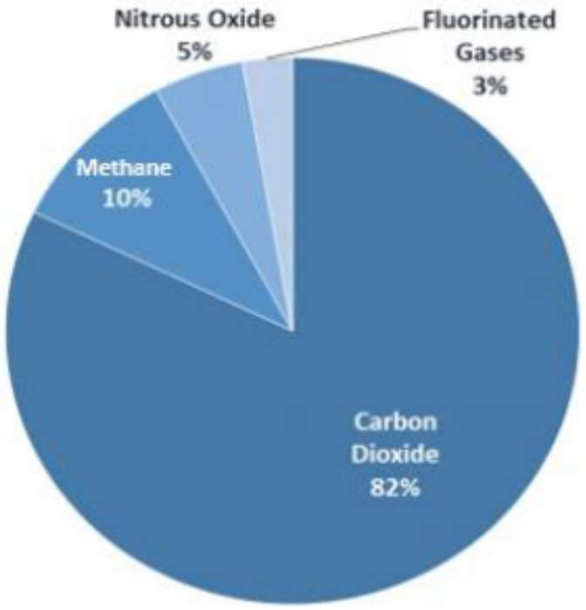
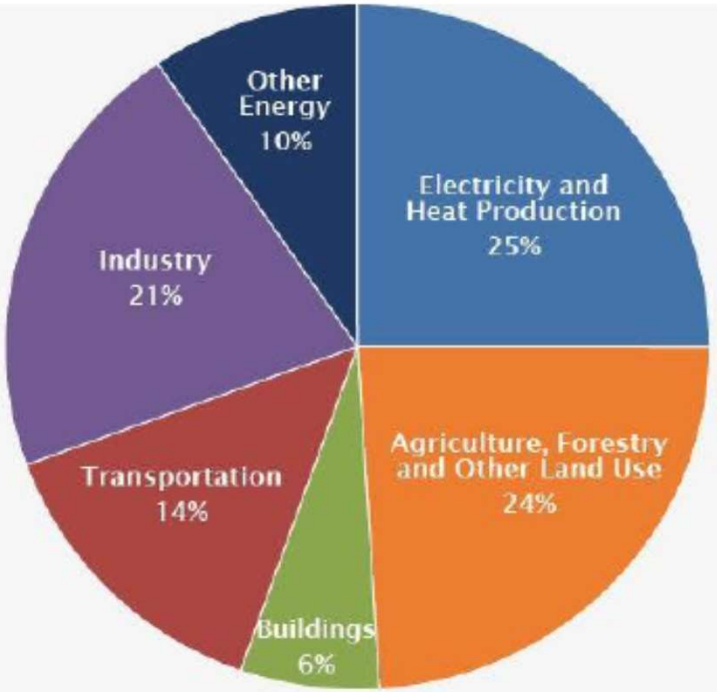
GEI Global por Tipo de Gas



U.S. Environmental Protection Agency (2017). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015*.

Fuente: IPCC (2014), EPA (2017)

Emisiones de GEI por Sector Económico



Gases de Efecto Invernadero(GEI)

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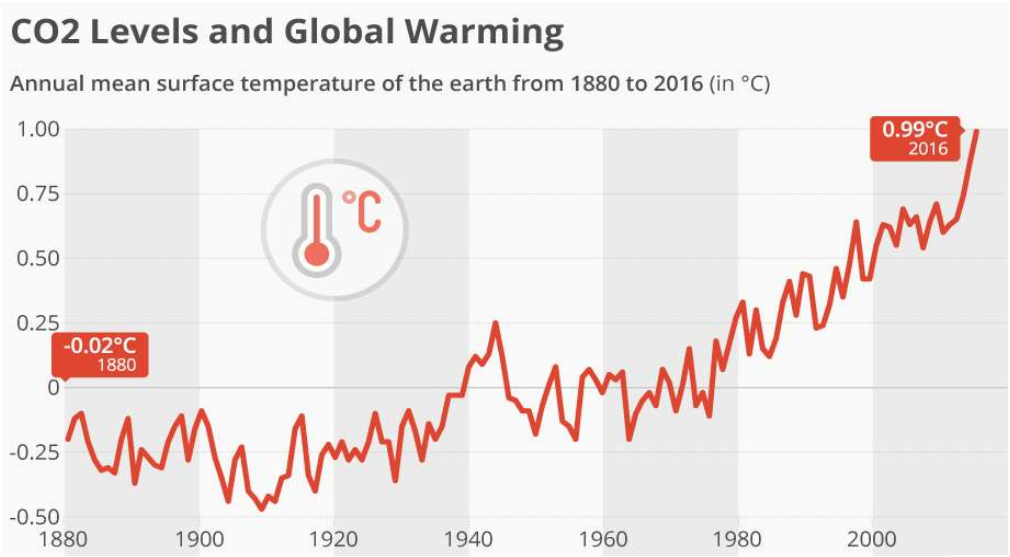

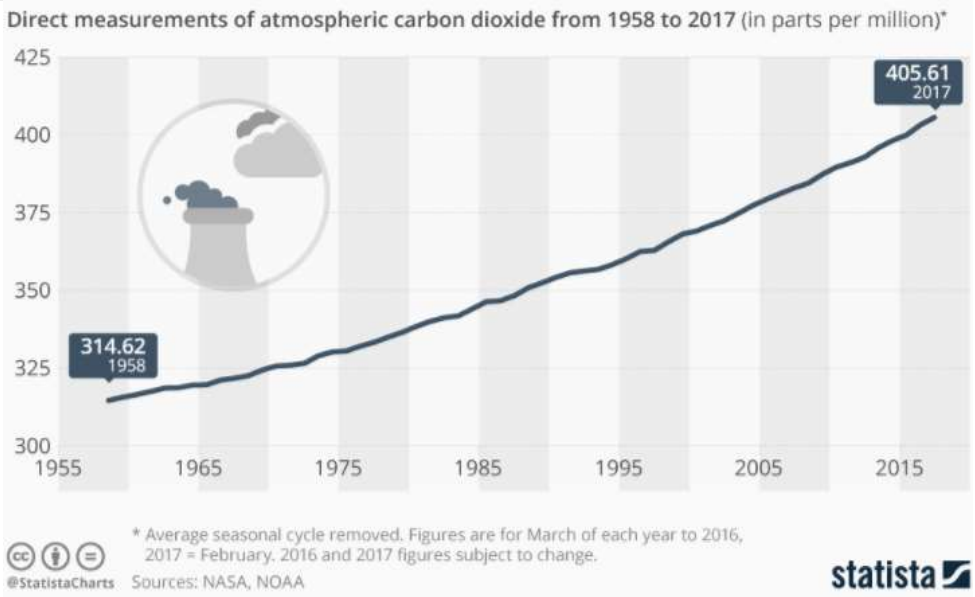

https://www.statista.com/chart/8471/co2-levels-and-global-warming/

Relación entre PIB y CO2

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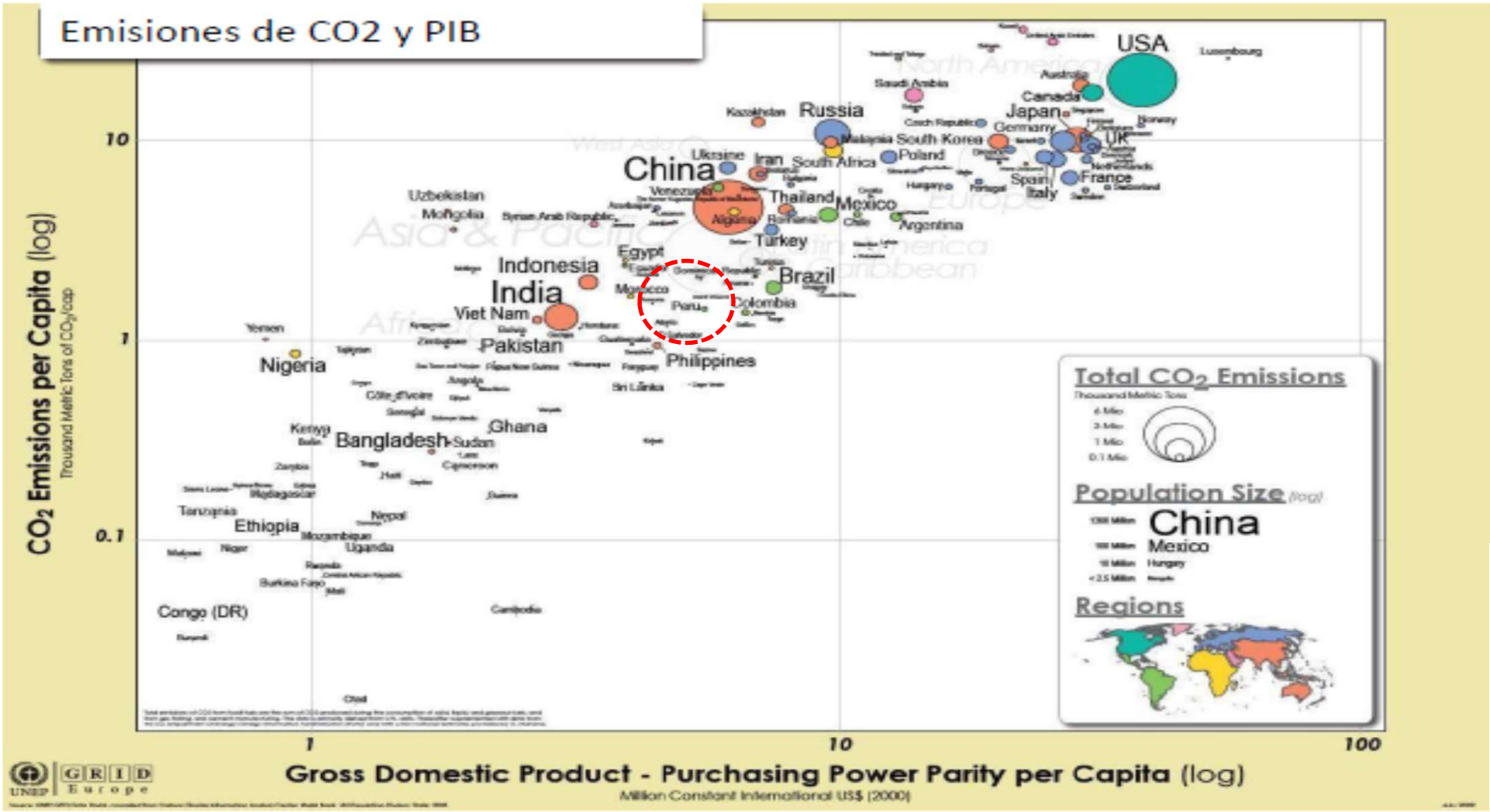

Huella de Carbono por Tecnología (gr CO2/KWh)

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Source: Al Gore webpage

Inventario de GEI en el Perú (2012)

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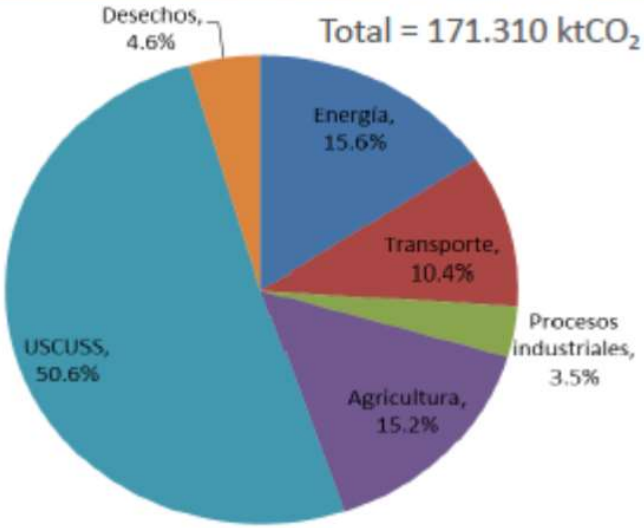

GEI en el Sector Energético en el Perú

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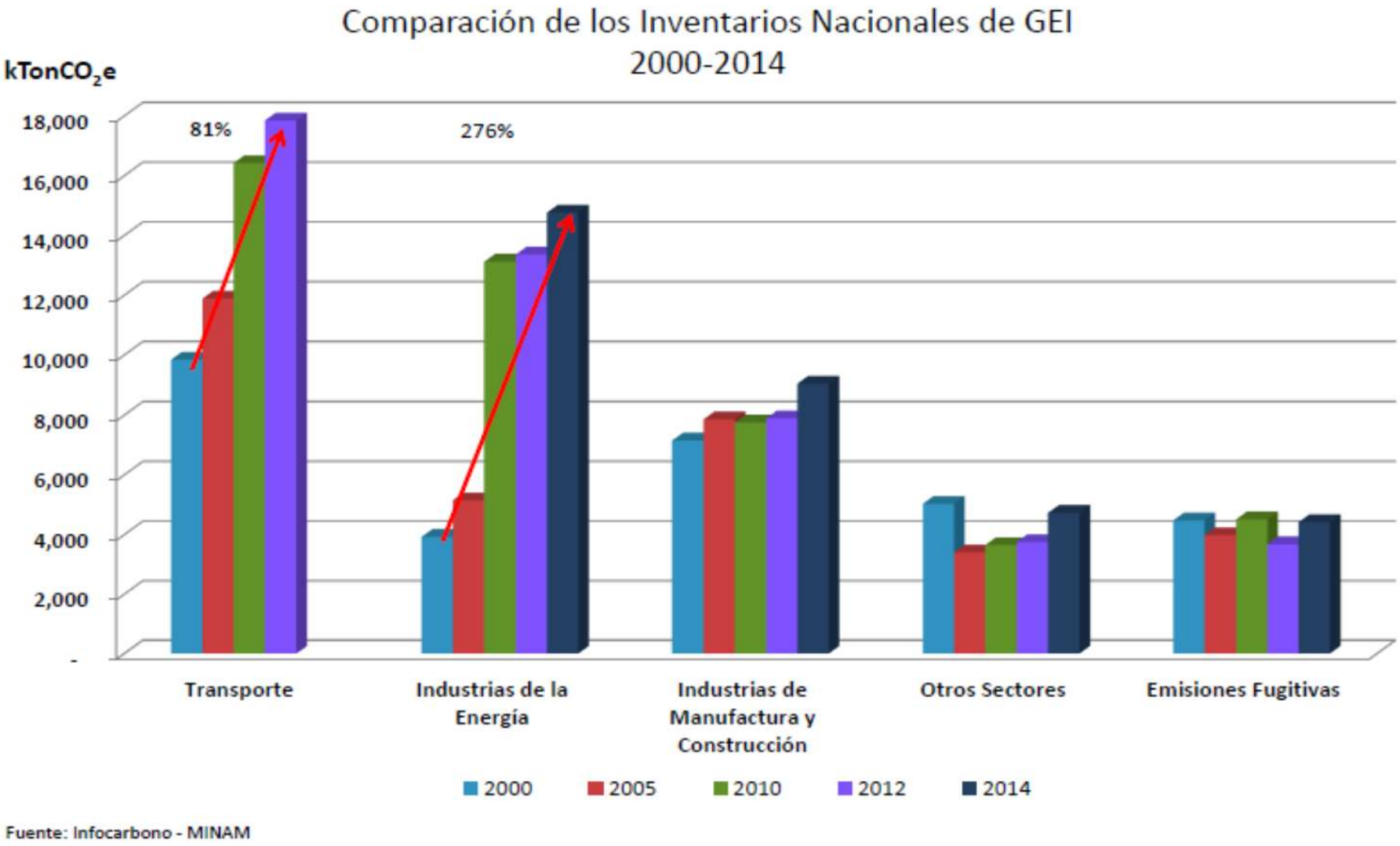
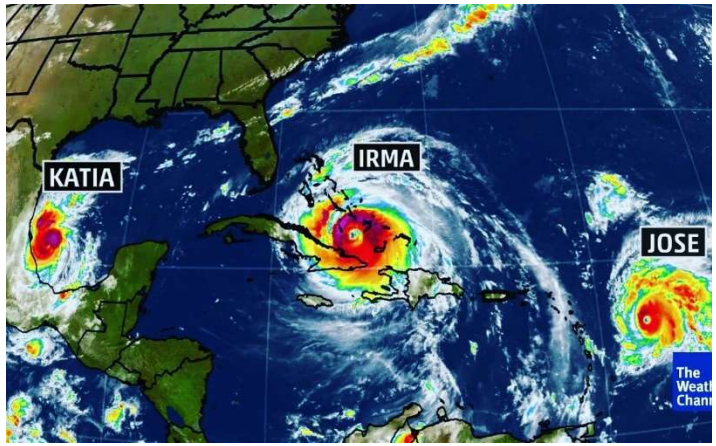


Fuente: Infocarbono - MINAM

Cambio Climático y Huella de Carbón

Climas en el mundo 32 y el 80% están en el Perú.

Consecuencias de Cambio Climático

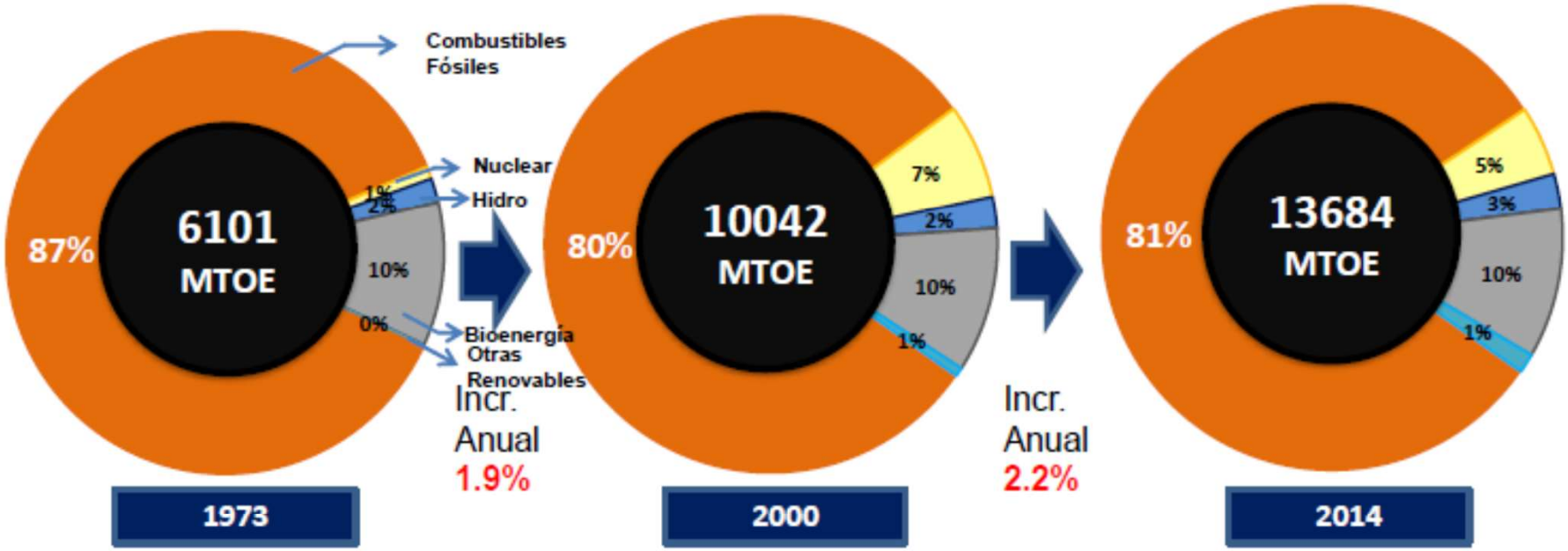


- Huracán Harvey: inundaciones dejarán un saldo USD 106.000 mills, Texas, USA
- Huracán Irma: Los daños generados por USD 50,000 mills Florida, USA.
- Huracán María provocó pérdidas de USD 20,000 millones para Puerto Rico
- Otros, Katia, Jose,
- El tifón Hato golpea el sureste de China: 16 muertos, 200 viviendas destruidas y desplazadas 27.000.
- En Perú: la reconstrucción costaría mas de US$ 9,000 millones.
  - Lima, Tumbes, Piura, Lambayeque, La Libertad y Ancash
  - Se han perdido muchas hectáreas de cosechas, escases del Limon
- **Como consecuencia de estos desastres se han paralizado las importaciones y exportaciones y pérdidas de cosechas completas.**

Huella de Carbón:

- La Unión Europea “UE”, CHINA, Japon y otros países desarrollados importaran solo productos de bajo huella de carbón **MINERALES VERDES**

Evolución de la Demanda de Energía Primaria en el Mundo



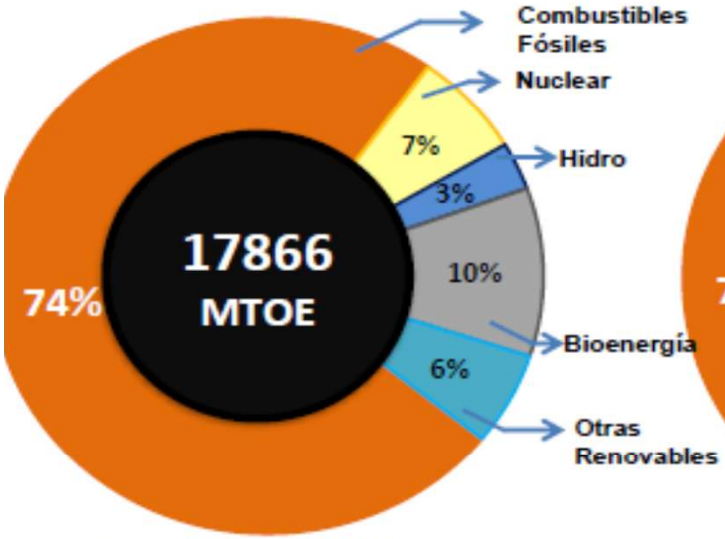
	1973	2000	2014	Tasa anual (1973-2000)	Tasa anual (2000-2014)
Combustibles Fósiles	5290	8056	11085	2%	2%
Nuclear	55	676	662	10%	0%
Hidro	110	225	335	3%	3%
Bioenergía	641	1026	1421	2%	2%
Otros Renovables	6	60	181	9%	8%
Total	**6101**	**10042**	**13684**	**2%**	**2%**

Fuente: IEA (2016) Key World Energy Statistics 2016

Energía Primaria en el Mundo al 2040

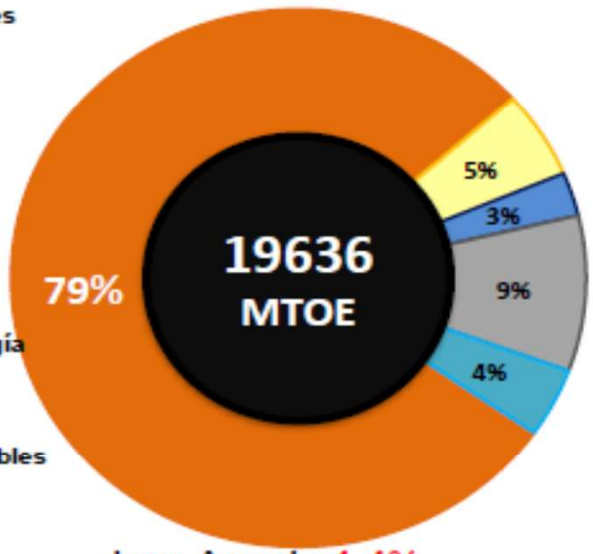
Escenarios al 2040

Nuevas Políticas



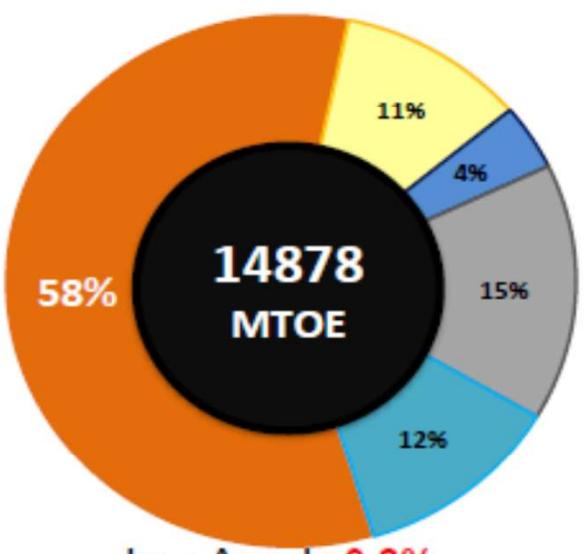
Incr. Anual : 1.0%

Políticas Actuales



Incr. Anual : 1.4%

Escenario 450

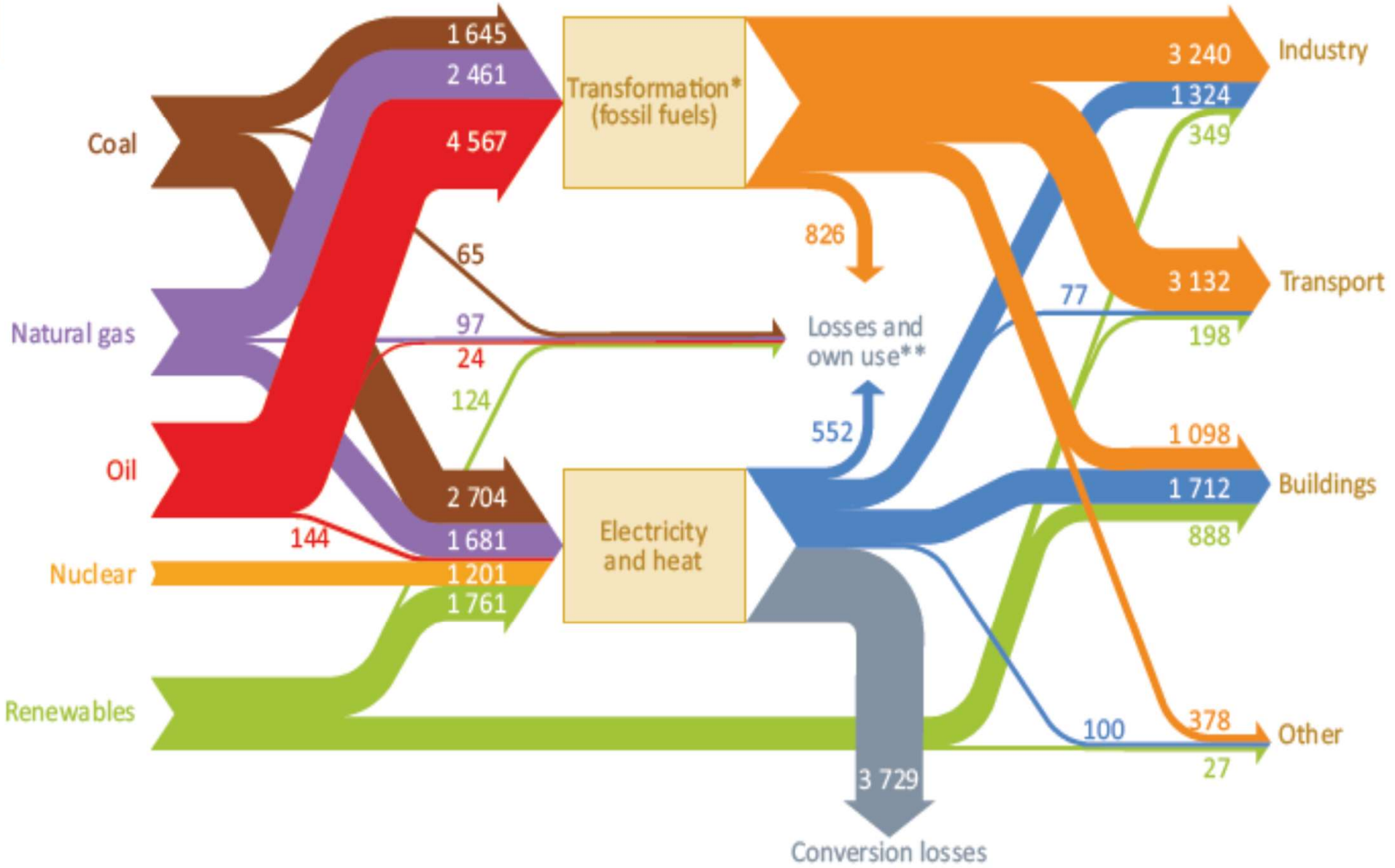


Incr. Anual : 0.3%

Escenario de Nuevas Políticas	2014	Tasa anual (2014-2040)	Tasa Acumulada (2014-2040)
Combustibles Fósiles	11085	1%	119%
Nuclear	662	2%	178%
Hidro	335	2%	160%
Bioenergía	1421	1%	133%
Otros Renovables	181	7%	573%
Total	**13684**	**1%**	**131%**

Fuente: IEA (2016) World Energy Outlook 2016 – Global Energy Tren

Figure 2.11 ▷ World energy demand by fuel and sector in the New Policies Scenario, 2040 (Mtoe)



Perú en el contexto global

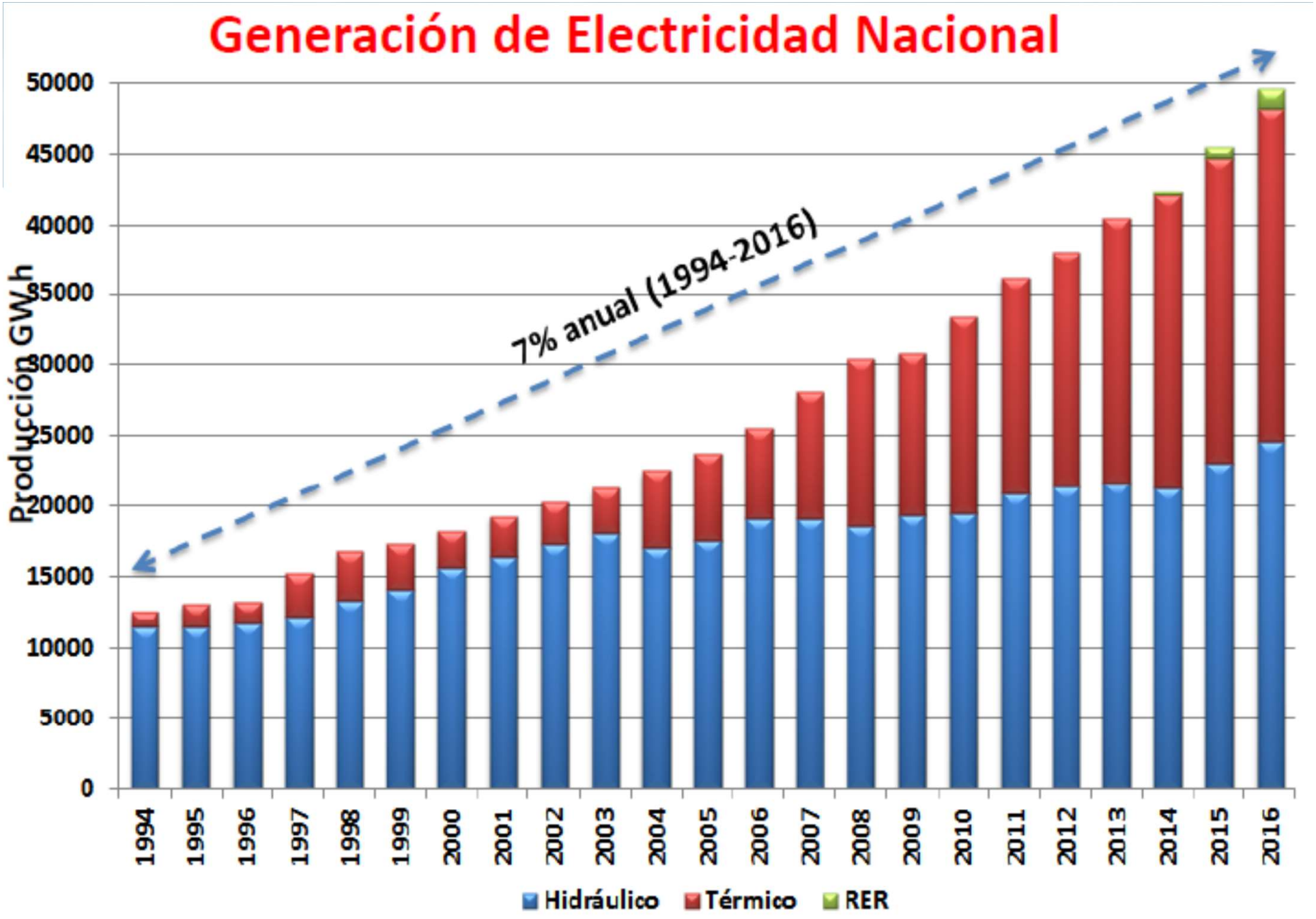
Energías primarias

	Perú	Mundo
Petróleo	45%	33%
Gas Natural	28%	24%
Carbón	4%	29%
Nuclear	0%	4%
Renovables	23%	10%
Total MTOE*	24	13147
Participación	0,18%	100%

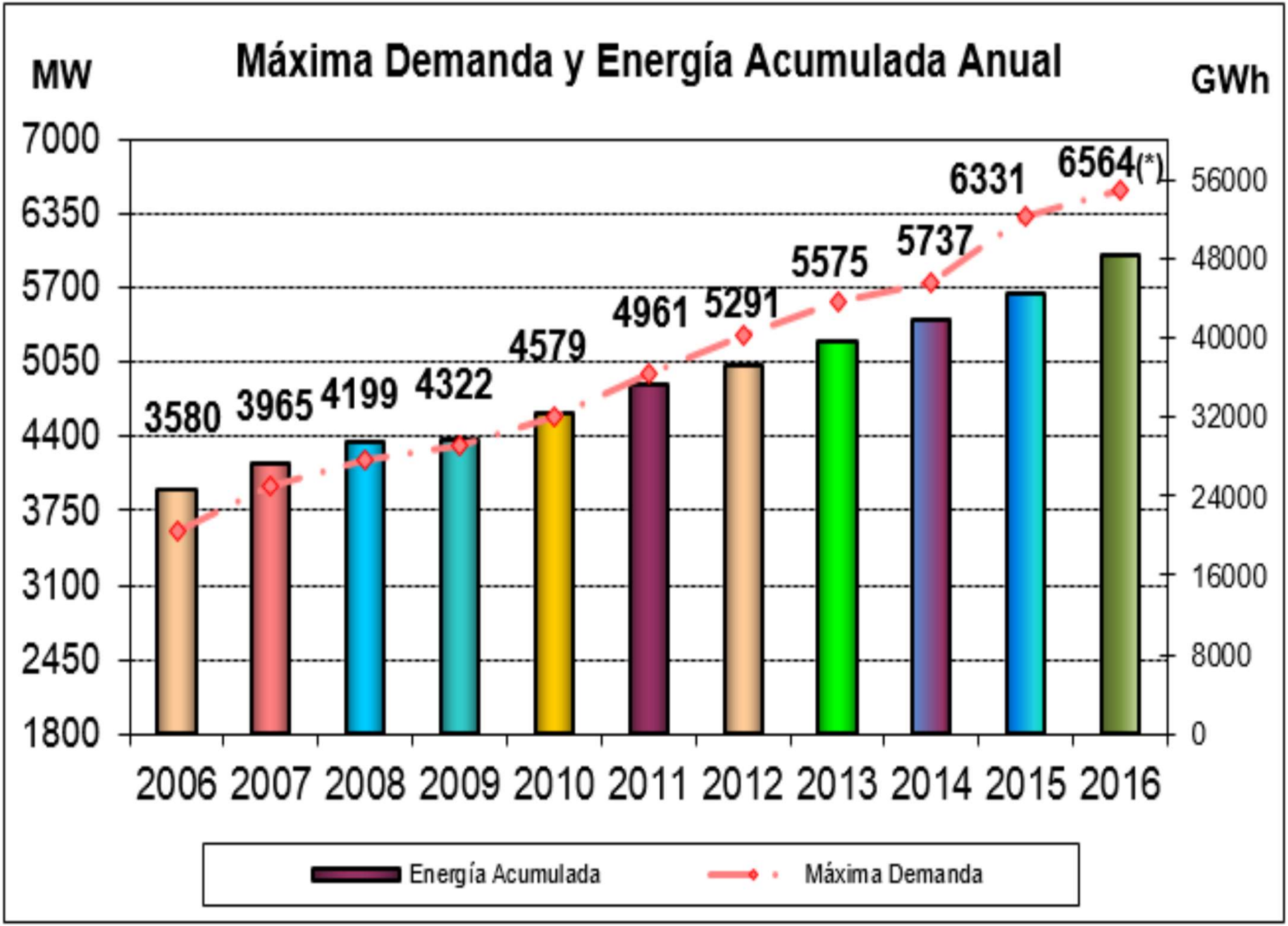
*Nota: Million Tonnes of Oil Equivalent

Fuente: BP Statistical Review of World Energy June 2016

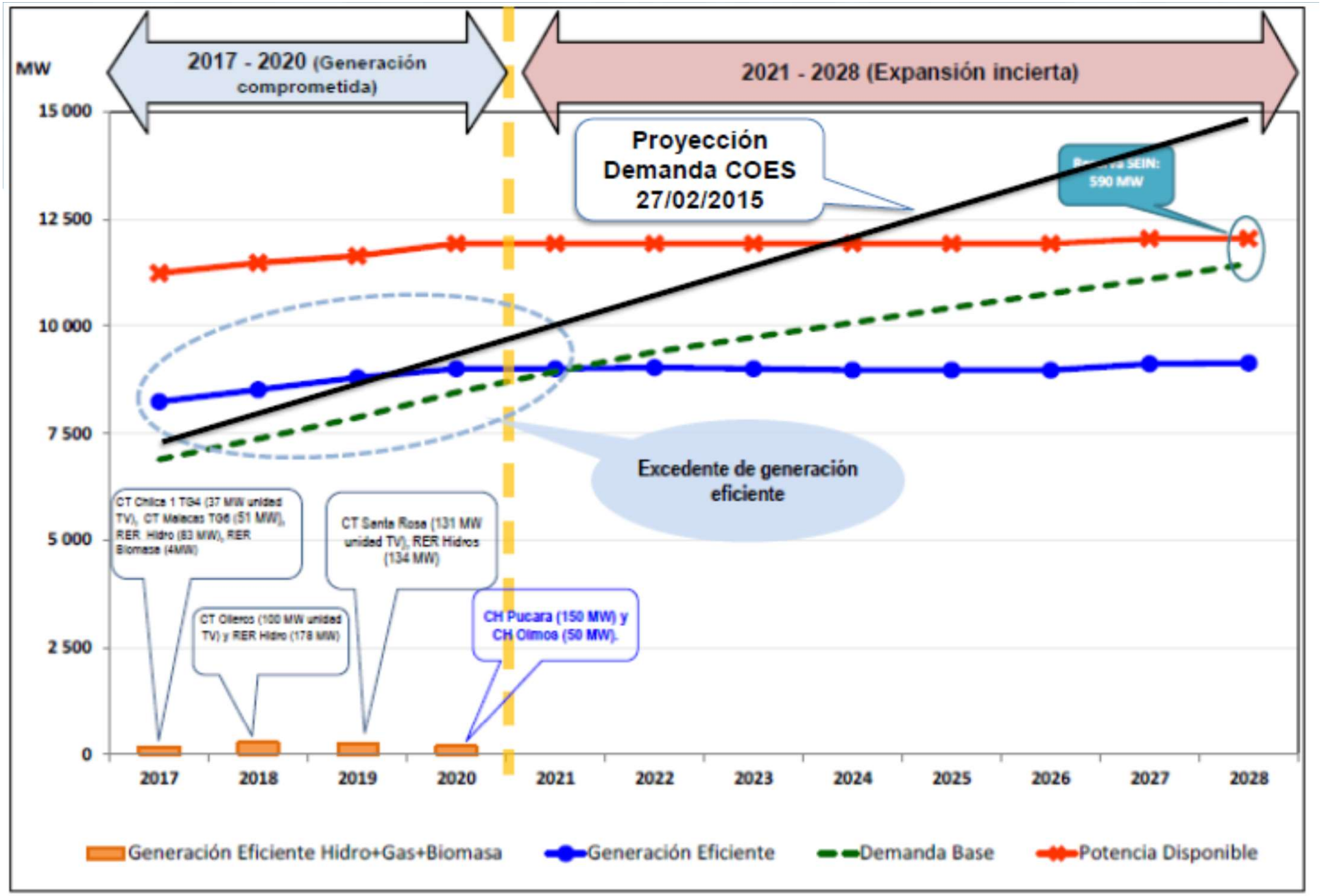
Generación de Electricidad Nacional



Fuente: Portal oficial Osinergmin



(*) Máxima demanda a nivel de generación registrada el día 17.02.2016 a las 15:00 horas.



Generación Eficiente en el SEIN CASO RETRASO GSP. Escenario de Demanda

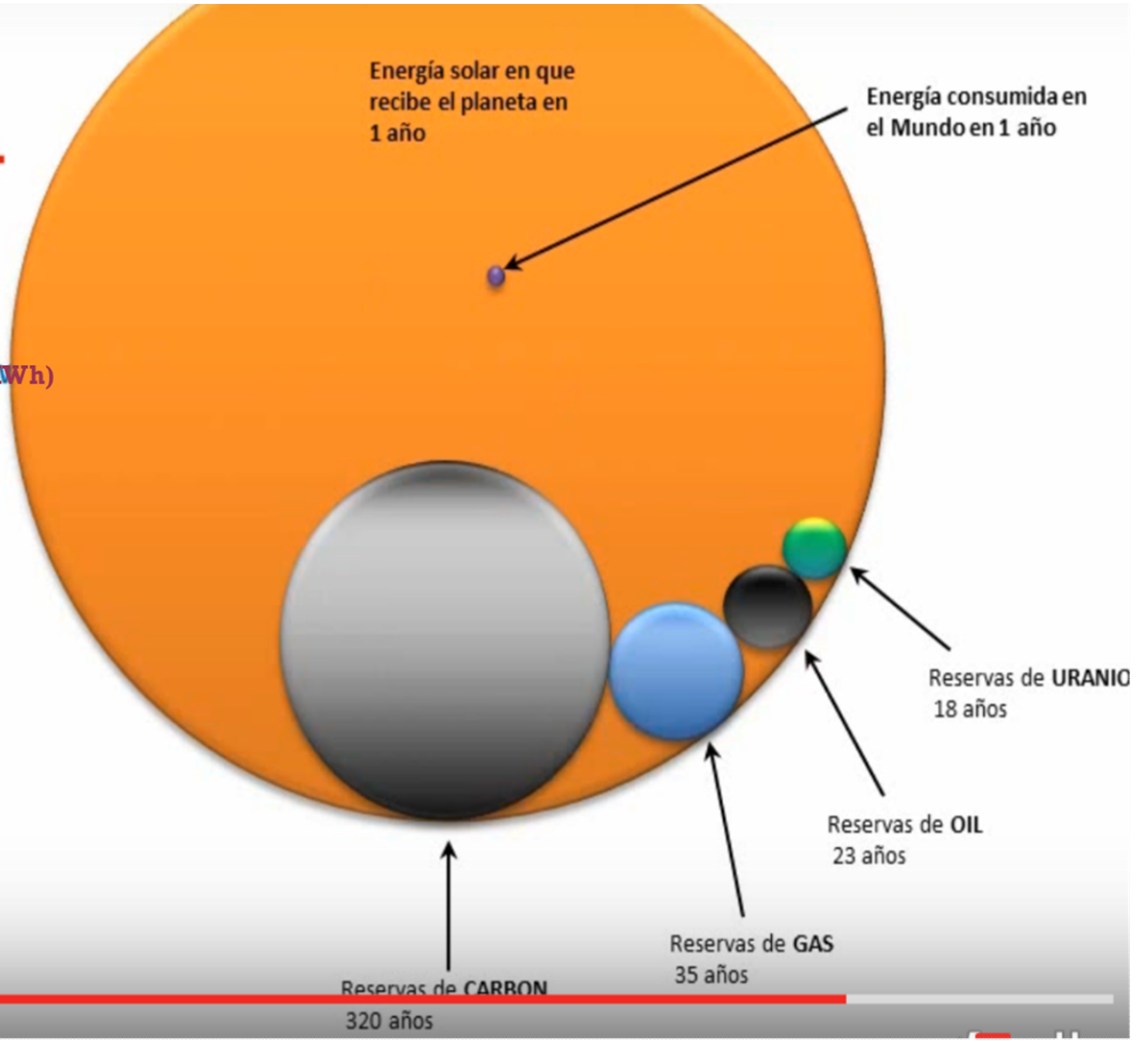
Recursos Energéticos

Potencial de Energía Solar En el Mundo

Society of Petroleum Engineers

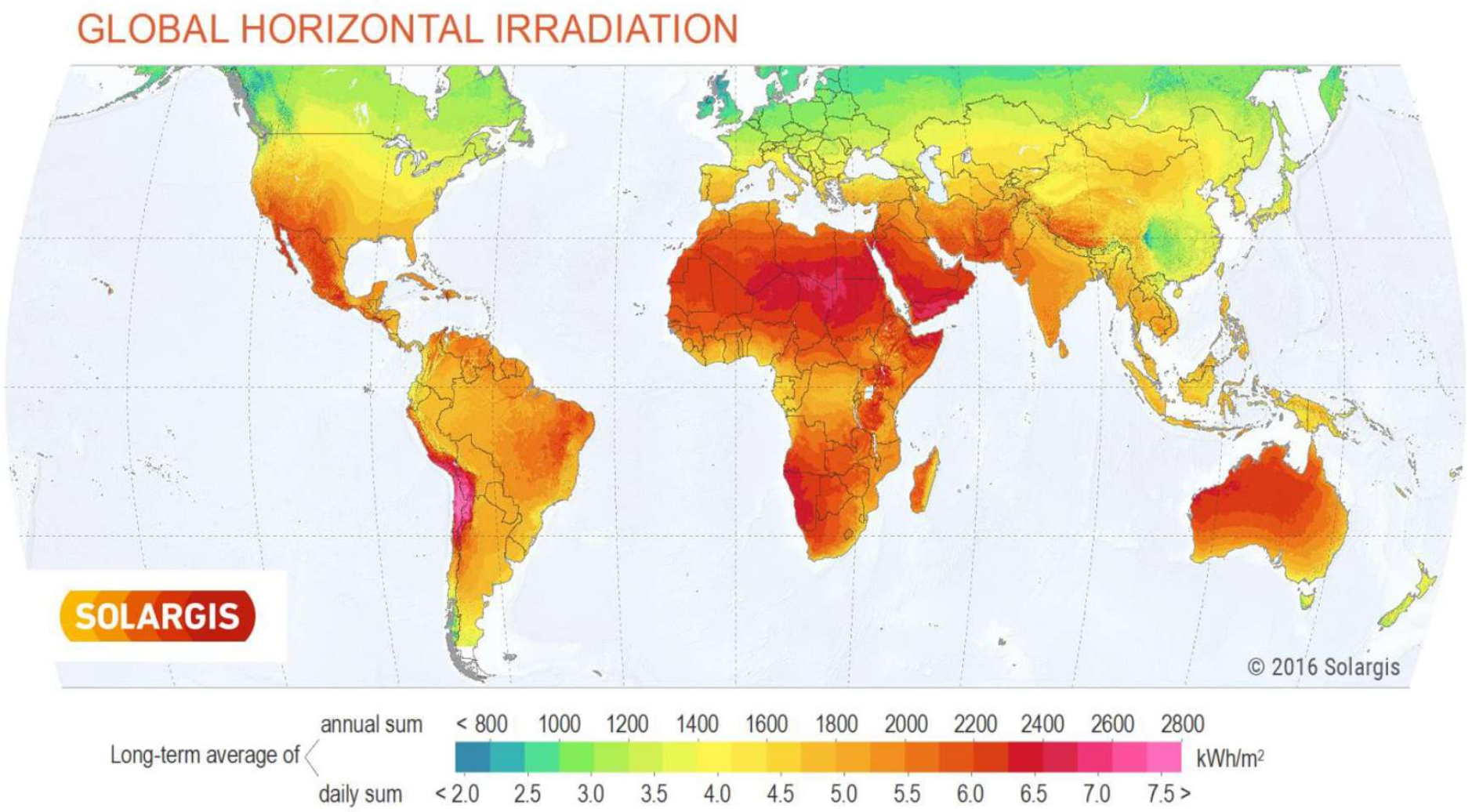
Energía Mundial en un día 2012

153.261.224	Energía usado mundialmente hoy (MWh)
124.140.916	Fuentes no renovables (MWh)
29.120.307	Fuentes renovables (MWh)
1.144.291.791.675	Energía solar incidente sobre la Tierra hoy (MWh)
32.798.307	Petróleo bombeado hoy (barriles)
1.280.204.603.283	Petróleo restante (barriles)
15.241	Días hasta fin del petróleo
1.152.671.823.788	Gas restante (boe)
60.667	Días hasta fin del gas
4.403.280.603.604	Carbón restante (boe)
151.837	Días hasta fin del carbón



Potencial de Energía Solar En el Mundo

Society of Petroleum Engineers



Potencial Energético Renovable en el Perú

Society of Petroleum Engineers

Potencial Hídrico = 70,000 MW.
El 86% de la Cuenca del Atlántico,
14% de la Cuenca del Pacífico y
0,3% de la Cuenca del Río Titicaca.

Potencial Eólico = 22,000 MW
El mayor potencial en la costa peruana.
potencial sobre los 77 000 MW,

Aprox. 25,000 MW

Potencial Solar = No determinado
Atlas Solar contiene registros de rangos prom. de radiación solar. Niveles más altos se dan en el sur: **6,0-6,5 kWh/m2**.

Potencial Geotérmico = 3,000 MW
Posibilidad de instalar campos geotermales en 6 regiones:
Mayor potencial en el Sur (Puno y Cusco)

75 **Fuente**: Minem

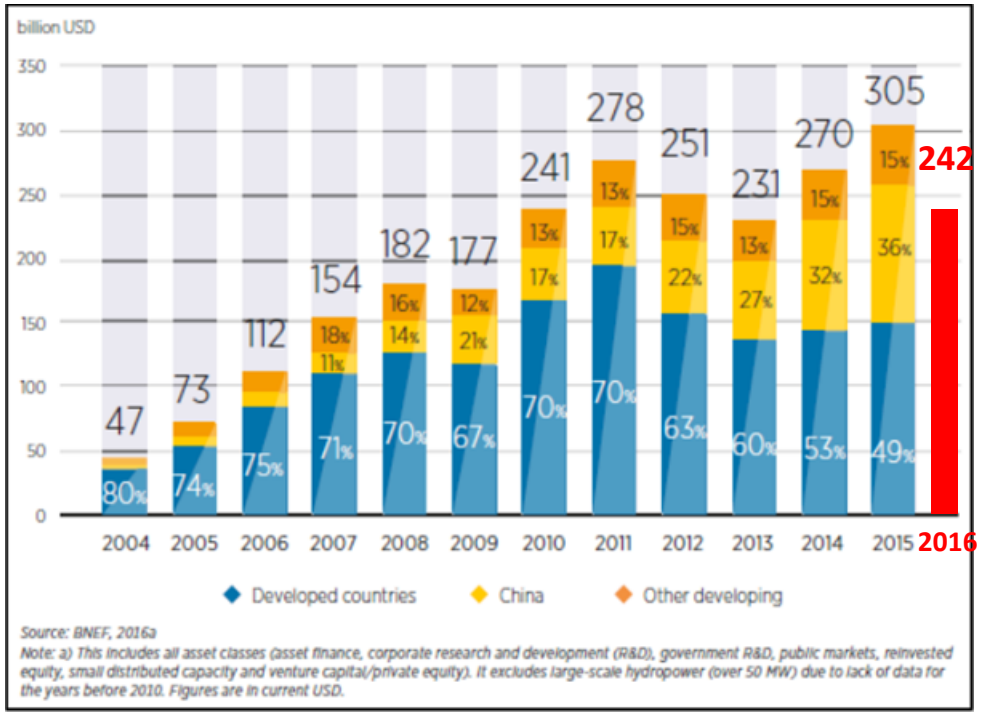
jestela@samienergy.com

SAMI Energy Consulting

Energía Renovable

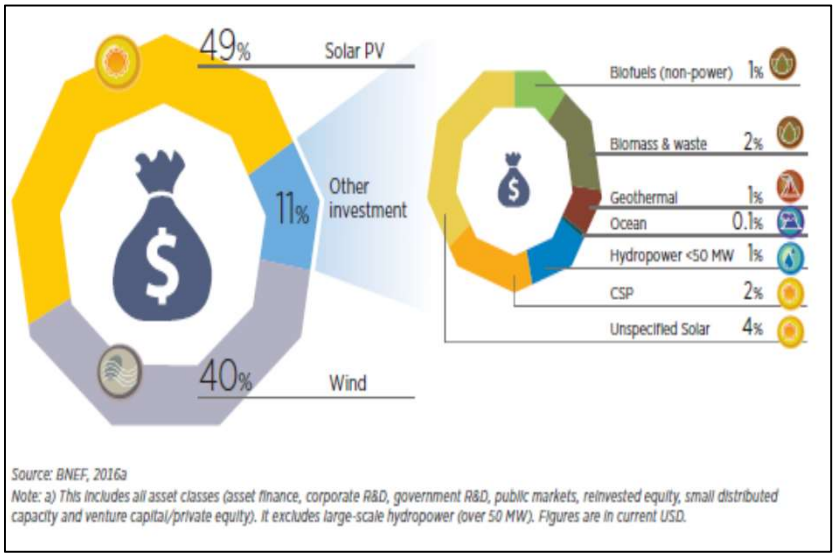
Inversión Global en Energía Renovable por Tecnología

Society of Petroleum Engineers



Source: BNEF, 2016a

Note: a) This includes all asset classes (asset finance, corporate research and development (R&D), government R&D, public markets, reinvested equity, small distributed capacity and venture capital/private equity). It excludes large-scale hydropower (over 50 MW) due to lack of data for the years before 2010. Figures are in current USD.



Source: BNEF, 2016a

Note: a) This includes all asset classes (asset finance, corporate R&D, government R&D, public markets, reinvested equity, small distributed capacity and venture capital/private equity). It excludes large-scale hydropower (over 50 MW). Figures are in current USD.

Precio: Energía Renovables en las Subastas

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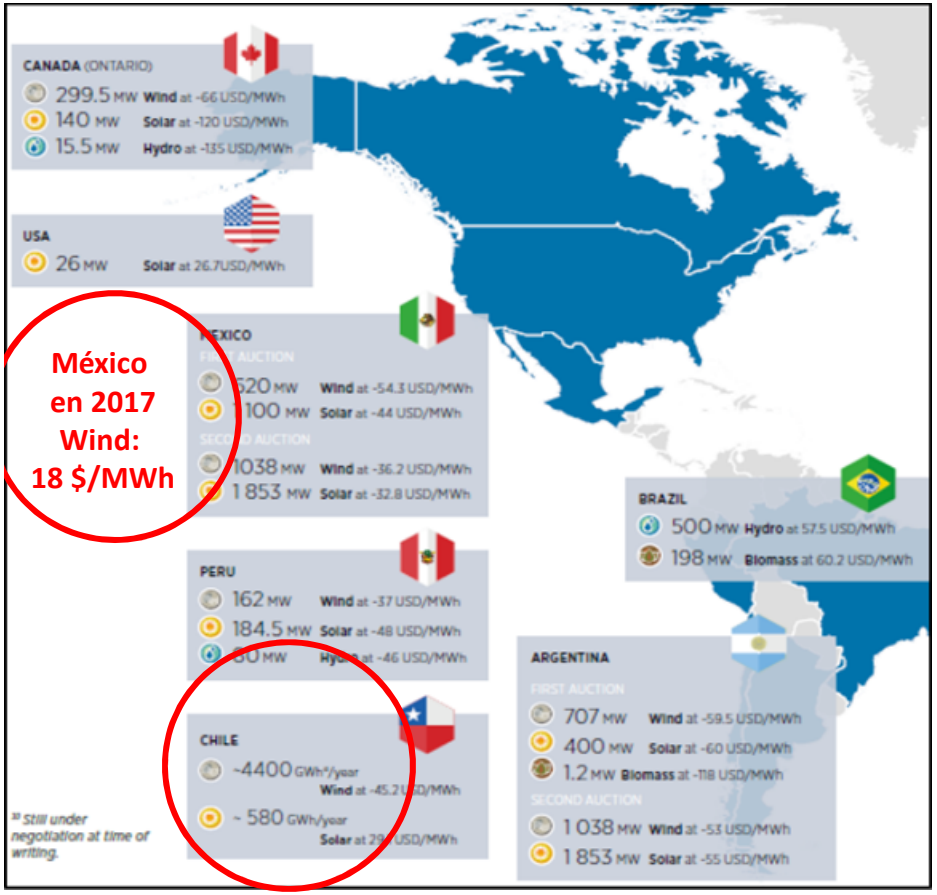

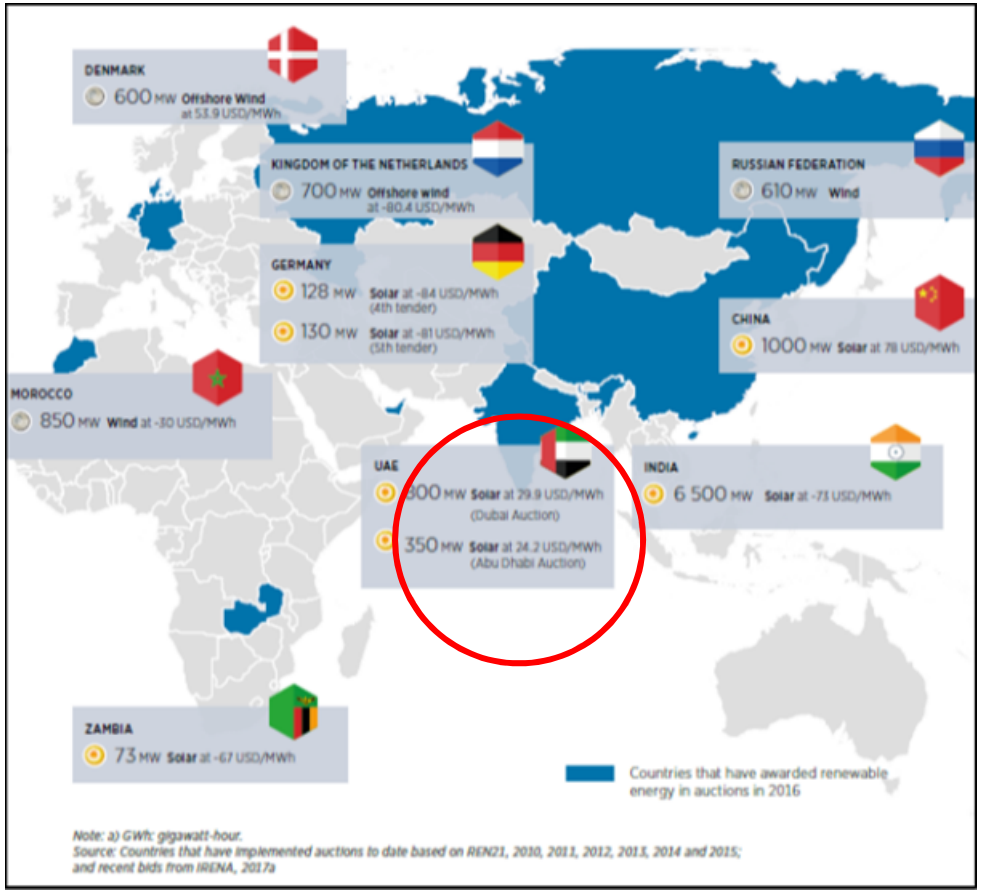

Subastas 2016

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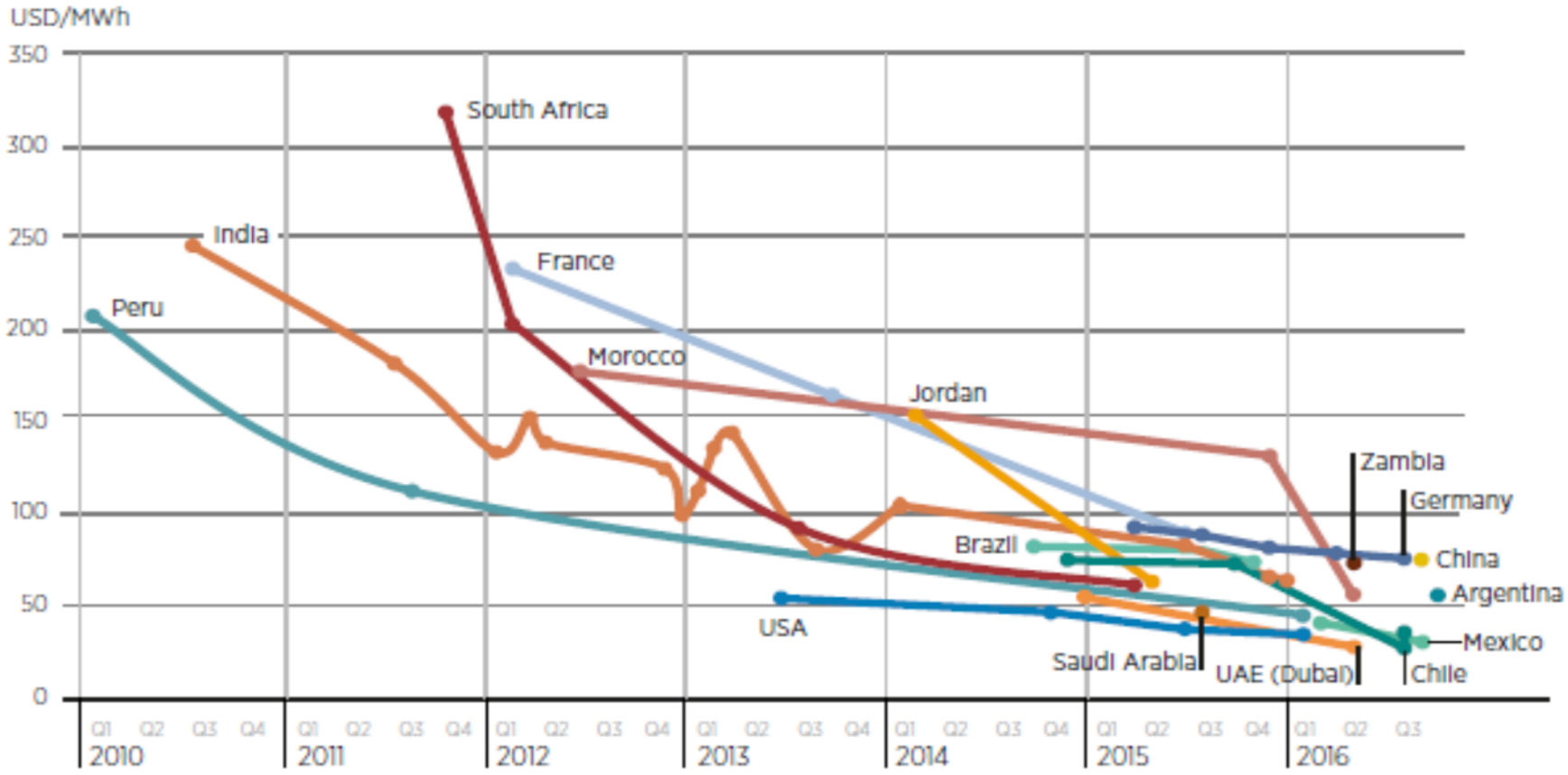
Evolución de precios de energía solar PV, en el Mundo



Source: IRENA, 2017a

Costo Nivelizado (LCOE) para RER 2010-2016

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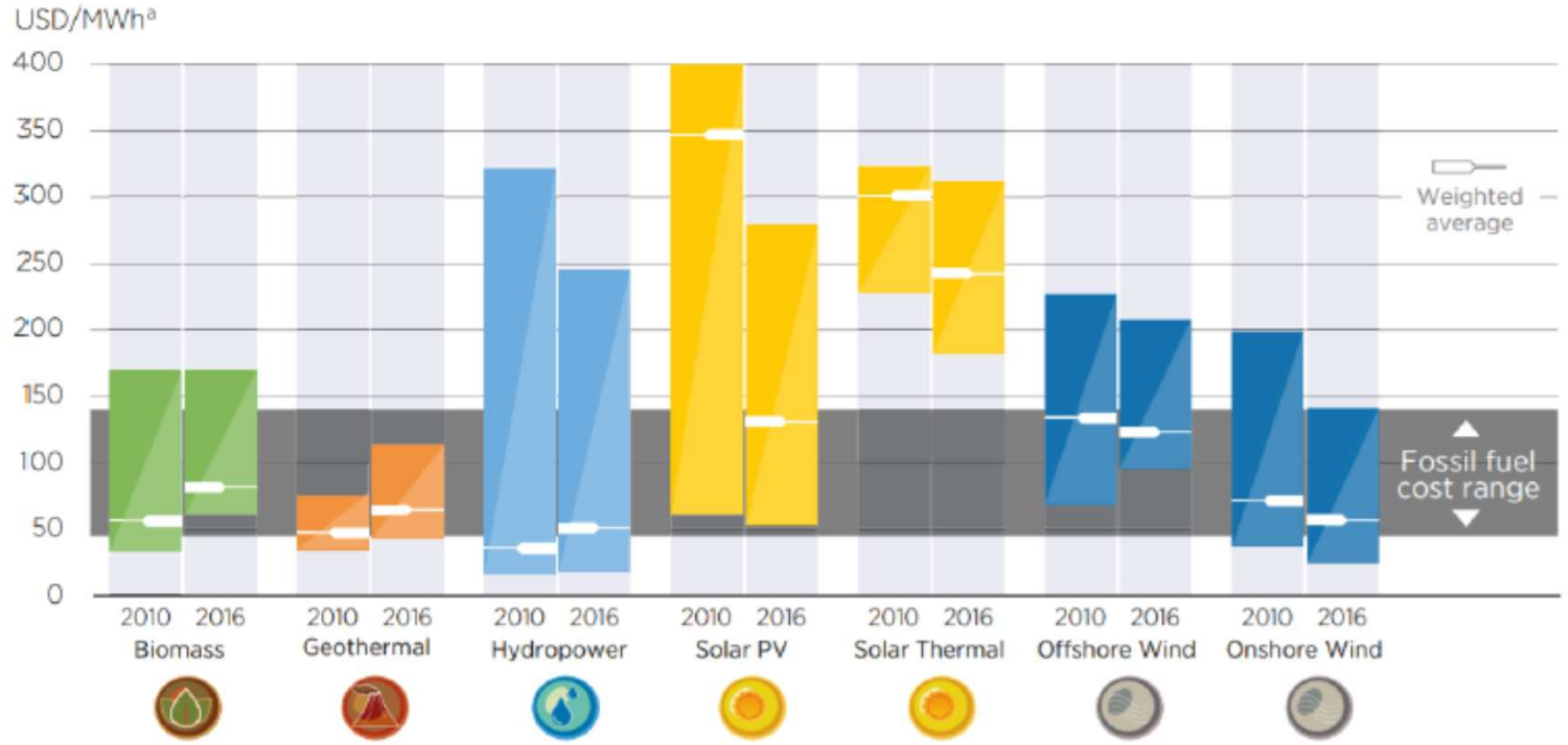
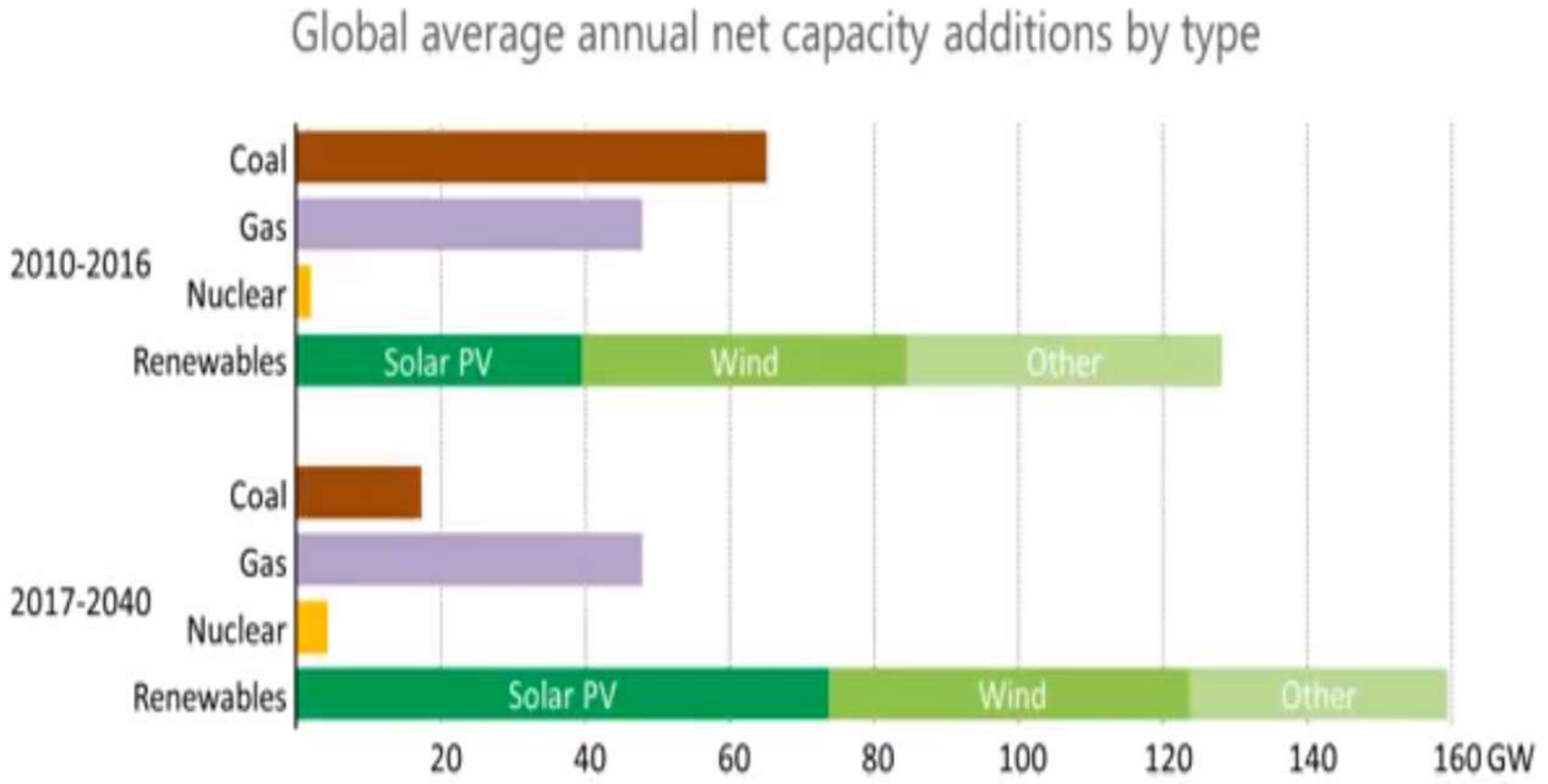


Note: a) MWh: megawatt-hour
b) All costs are in 2016 USD. Weighted Average Cost of Capital is 7.5% for OECD and China and 10% for Rest of World

Fuente: Irena (2017)

Solar PV forges ahead in the global power mix

World Energy Outlook 2017

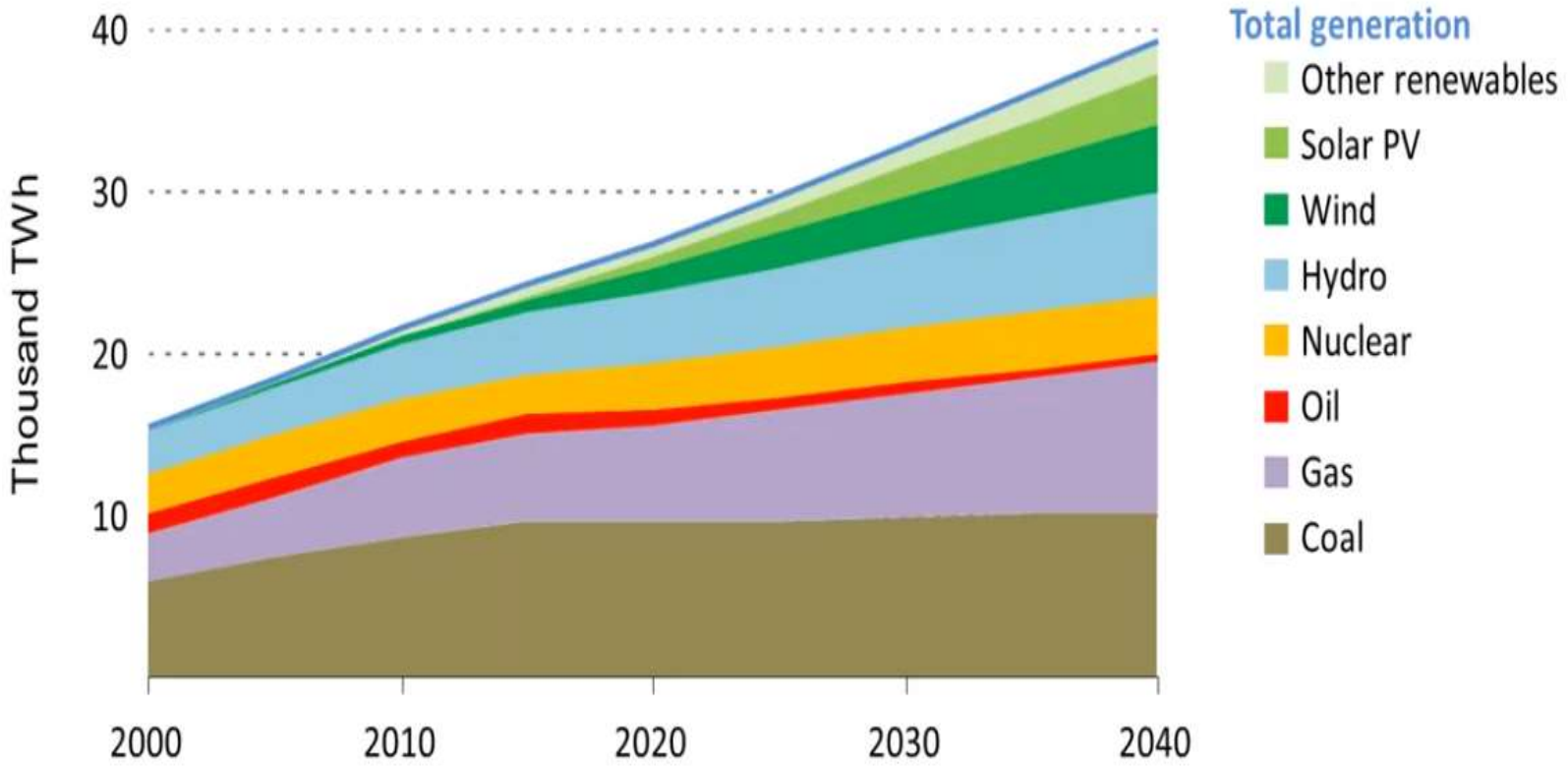


China, India & the US lead the charge for solar PV, while Europe is a frontrunner for onshore & offshore wind: rising shares of solar & wind require more flexibility to match power demand & supply

Clean energy transition underway

World Energy Outlook 2017

Global electricity generation in the New Policies Scenario

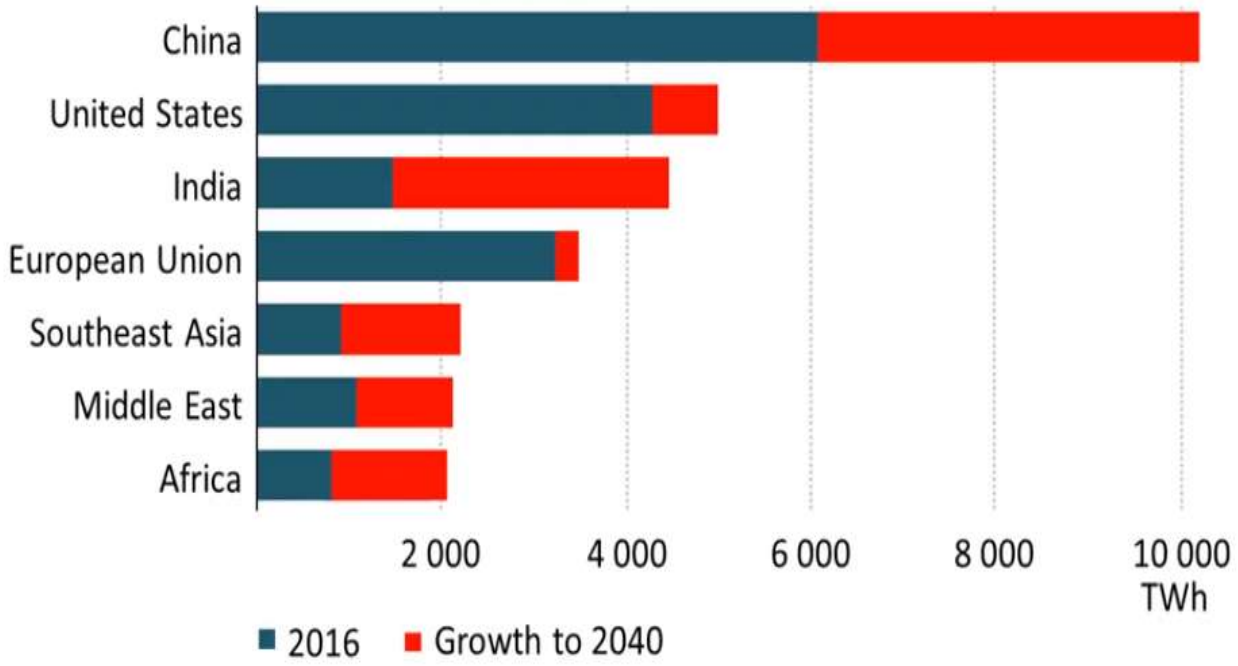


Renewables expand from one-quarter of generation today to 40% by 2040, rising shares of solar & wind require more flexibility to match power demand & supply

The future is electrifying

World Energy Outlook 2017

Electricity generation by selected region in the New Policies Scenario

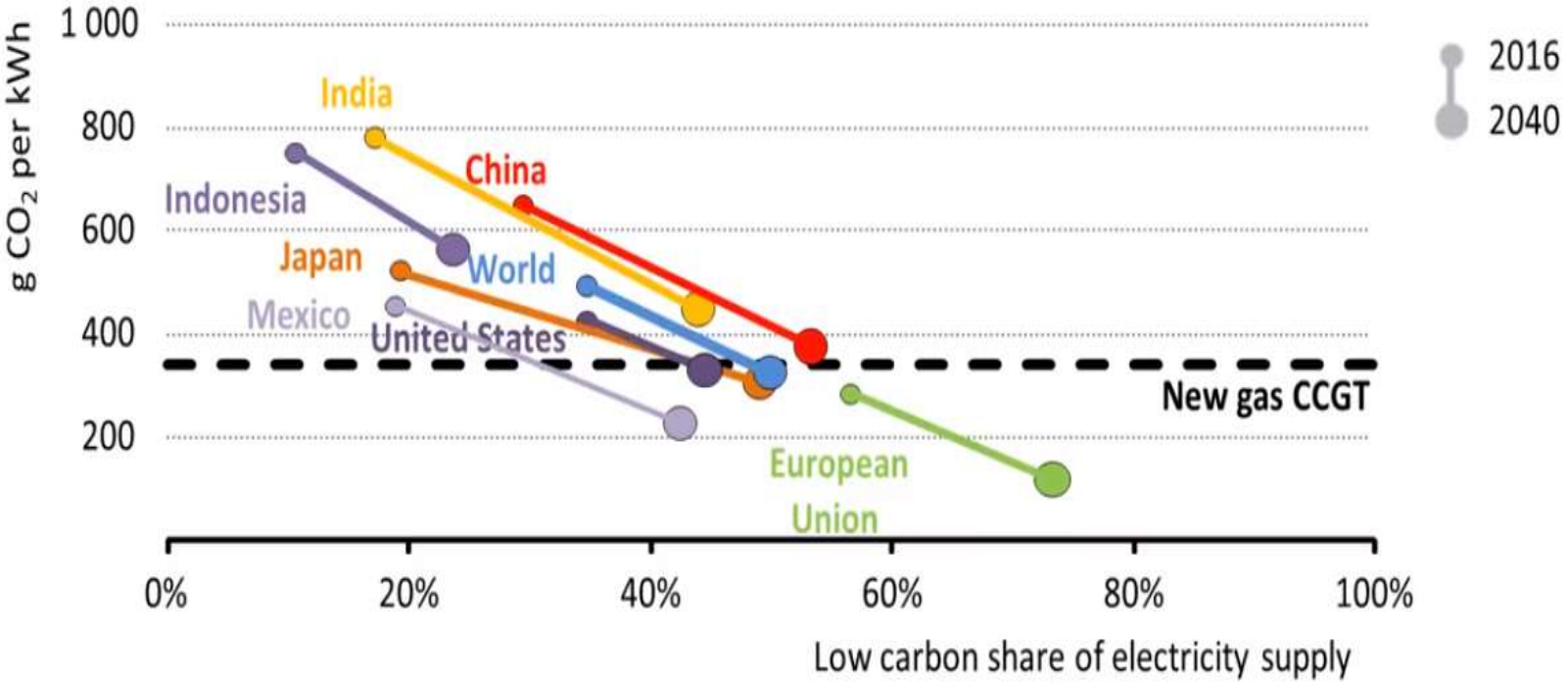


India adds the equivalent of today's European Union to its electricity generation by 2040, while China adds the equivalent of today's United States

The future is electric and clean

World Energy Outlook 2017

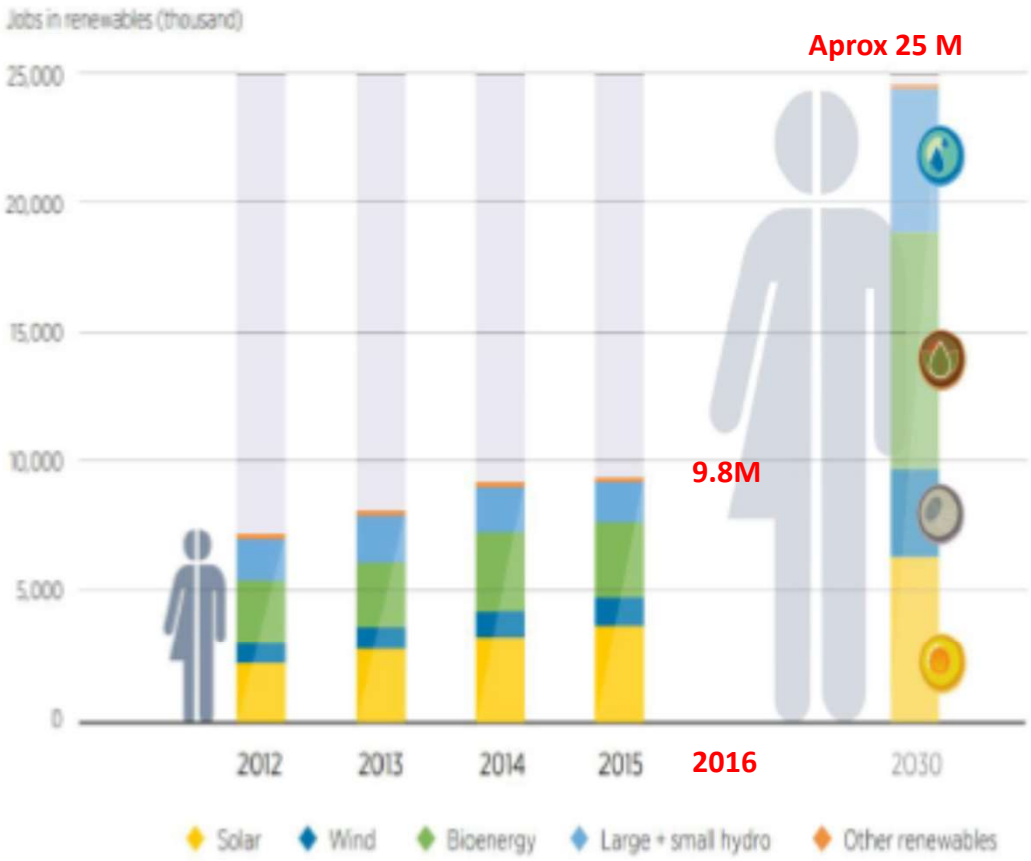
Electricity's low carbon share and CO2 intensity in the New Policies Scenario

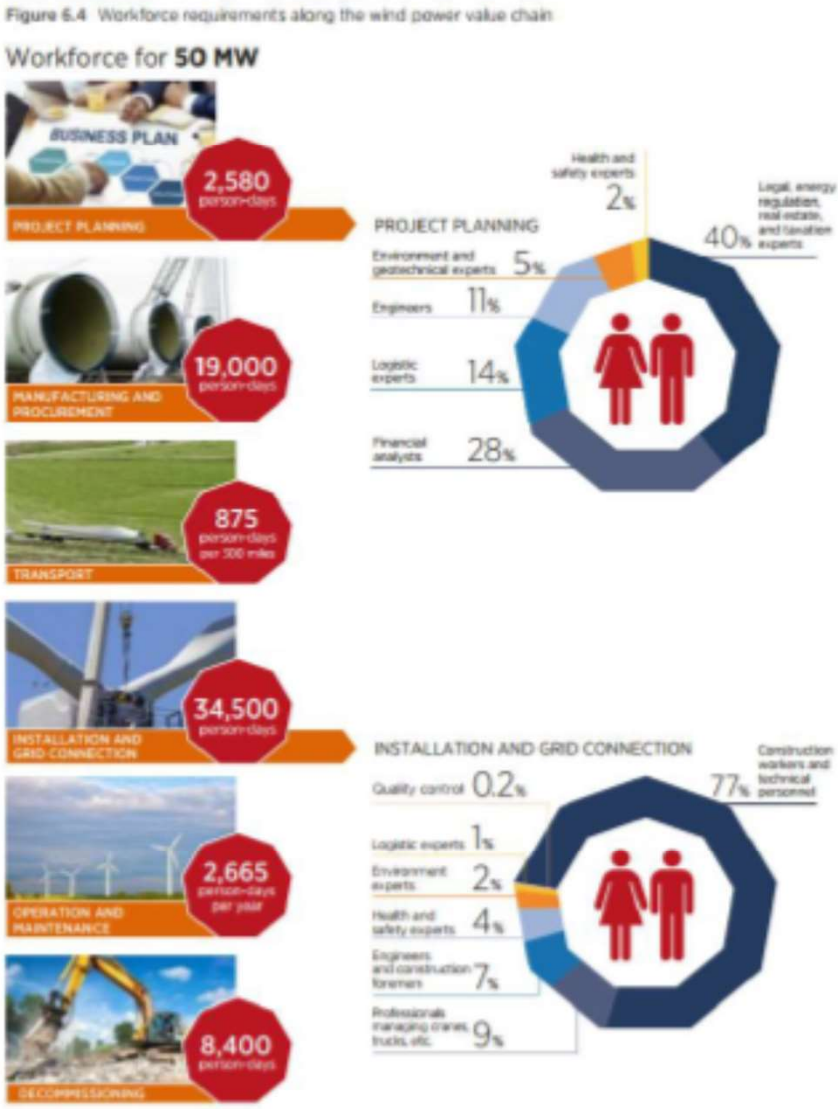


The rise of renewables raises the low carbon share in most markets, driving down the average carbon intensity of electricity supply

Creación de Trabajo

Crecimiento en Trabajo en RER





Fuente: IRENA Rethinking Energy, 2017

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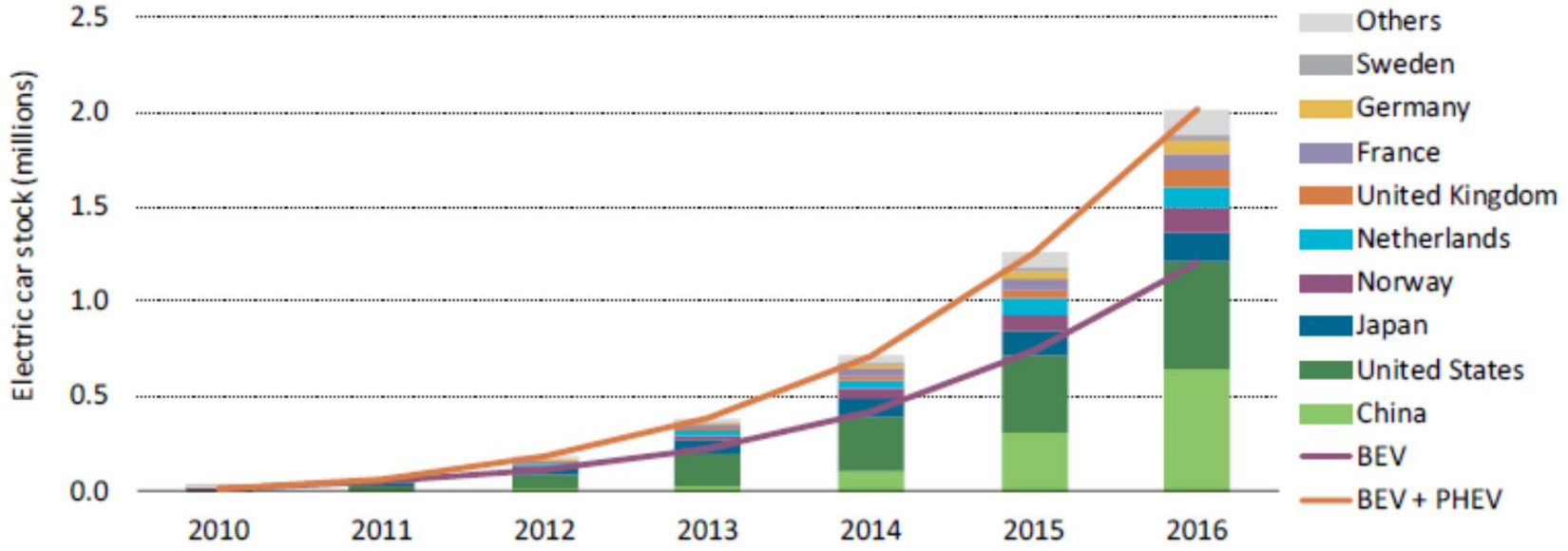
Vehículos Eléctricos en el Mundo

Transporte Eléctrico

Society of Petroleum Engineers

El parque automotor mundial superó los 2 millones de vehículos en 2016 después de cruzar el millón umbral en 2015

Figure 1 • Evolution of the global electric car stock, 2010-16



Notes: The electric car stock shown here is primarily estimated on the basis of cumulative sales since 2005. When available, stock numbers from official national statistics have been used, provided good consistency with sales evolutions.

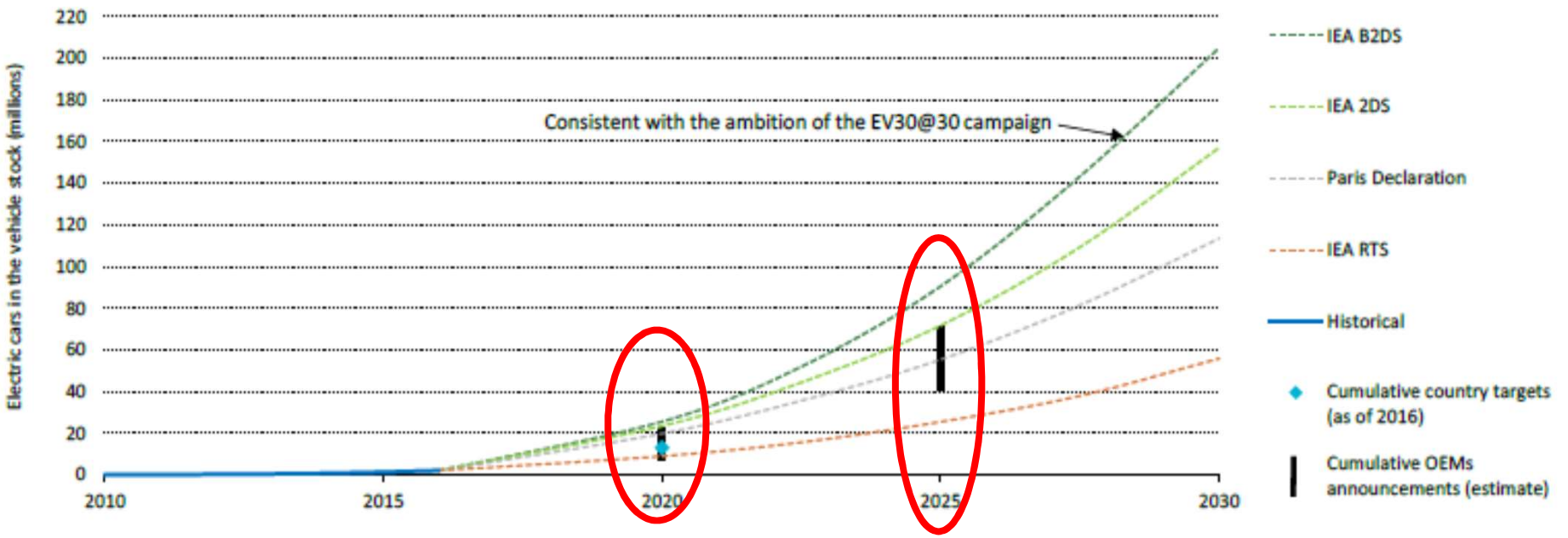
Sources: IEA analysis based on EVI country submissions, complemented by EAFO (2017a), IHS Polk (2016), MarkLines (2017), ACEA (2017a, 2017b) and EEA (2017).

Transporte Eléctrico

Society of Petroleum Engineers

El futuro de los vehículos Eléctricos

Figure 2 • Deployment scenarios for the stock of electric cars to 2030



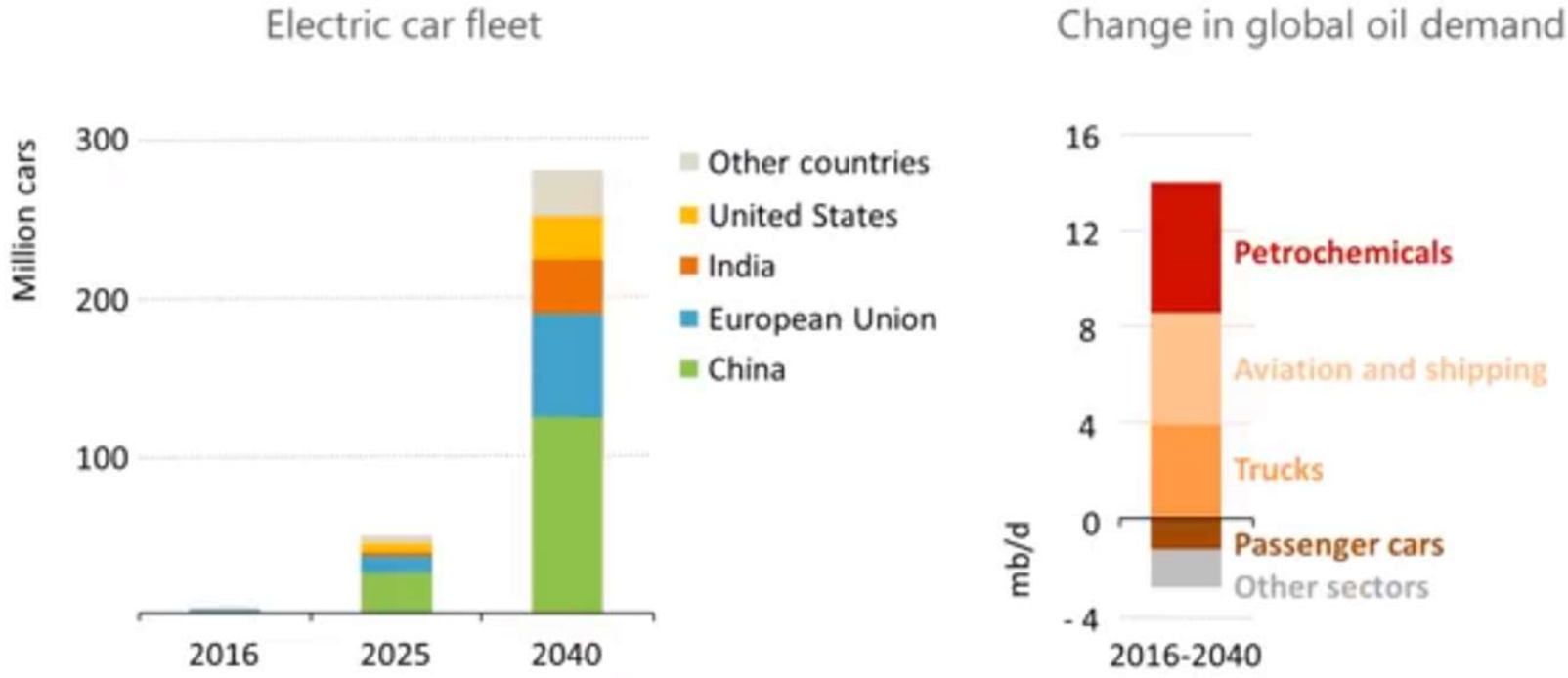
La demanda de vehículos eléctricos oscilará entre 9 millones y 20 millones para 2020 y entre 40 millones y 70 millones en 2025

Transporte Eléctrico

Society of Petroleum Engineers

Oil use from passenger cars peaks due to efficiency

World Energy Outlook 2017



Electric cars displace 2.5 mb/d of oil demand by 2040, but efforts to improve vehicle efficiency save 12 mb/d of potential additional demand

Society of Petroleum Engineers

Aplicación de Energía Renovable en la Industria Petrolera

El Nuevo Portafolio de Las Petroleras

Society of Petroleum Engineers

Eight energy companies commit to reduce methane emissions within natural gas industry

Nov 22, 2017

BP, Eni, ExxonMobil, Repsol, Shell, Statoil, Total and Wintershall today committed to further reduce methane emissions from the natural gas assets they operate around the world. The energy companies also agreed to encourage others across the natural gas value chain – from production to the final consumer – to do the same.

Total buys 23% stake in renewable energy company Eren

SEPTEMBER 19, 2017 **David Keohane**

Total has picked up a 23 per cent stake in renewable energy company Eren for €237.5m as the the French oil group looks to expand its capacity in the sector.

As part of the deal Total, which acquired an indirect stake by subscribing to a capital increase, will have the option to take control of Eren after a period of 5 years.

Big oil's competitive edge in wind energy

Posted on July 5, 2017 by dmguion

Big oil and the wind industry might seem like an unlikely combination.

But several international oil giants have competed successfully with established players in the wind energy business to win offshore wind leases.

Major international oil companies including Royal Dutch Shell, Statoil (a Norwegian company), and Eni (Italian), have begun to invest heavily in offshore wind farms.

Princess Amalia Wind Farm, in the North Sea off the Netherlands coast.

El Nuevo Portafolio de Las Petroleras

Society of Petroleum Engineers

BP Weighing Upgrade of U.S. Wind Turbines to Compete With Gas

Jennifer A. Dlouhy and Joe Ryan
16 de febrero de 2017 13:20 GMT-5 *Corrected* 17 de febrero de 2017 16:04 GMT-5

Shell creates green energy division to invest in wind power

Insiders say oil firm's New Energies renewables arm could grow very big, but not for a decade or more

A leading economist has warned oil firms such as Shell that they must change or face a 'brutal end' within 10 years. Photograph: Peter Dejong/AP

Shell, Europe's largest oil company, has established a separate division, New

Aplicaciones

Society of Petroleum Engineers

RECOPE: Refinadora Costarricense de Petróleo

Entra en operación nuevo sistema de energía solar en refinería

Publicado el 25/09/2013.

En este mes de setiembre entró en operación un nuevo sistema de generación eléctrica mediante energía solar fotovoltaica de 40Kwp**, instalado en el techo del comedor de la refinería en Moín; como parte de la política de la Refinadora Costarricense de Petróleo (RECOPE S.A) sobre ahorro energético y mitigación del cambio climático.

Los trabajos de instalación de 160 paneles fueron realizados por la empresa ELVATRON S.A y su costo fue de $113,281.22.

Al 2013 RCOPE cuenta con un total de 131Kwp de capacidad instalada en paneles solares en el plantel para producir electricidad para autoconsumo.

https://www.recope.go.cr/entra-en-operacion-nuevo-sistema-de-energia-solar-en-refineria/

Aplicaciones

Society of Petroleum Engineers

GlassPoint and Petroleum Development Oman complete the Middle East's first Solar EOR project to produce heavy oil: "The heat from the concentrating sunlight boils the water to produce steam, (and) that steam can then be injected into an oil well,"

GlassPoint and Petroleum Development Oman complete the Middle East's first Solar EOR project

https://www.youtube.com/watch?v=jIU9iRdeAGE&t=201s

Aplicaciones

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Minera en Perú: 13 Hidroeléctricas en operación, 63 MW

CH Cacray = 0.2 MW

CH Yanahuin = 0.5 MW

CH Huanchay = 1.6 MW

CH Shagua = 1.1 MW

CH Baños I = 0.9 MW

CH Baños II = 0.9 MW

CH Baños III = 1.0 MW

CH Baños IV = 5.0 MW

CH Baños V = 9.2 MW

CH San José = 1.4 MW

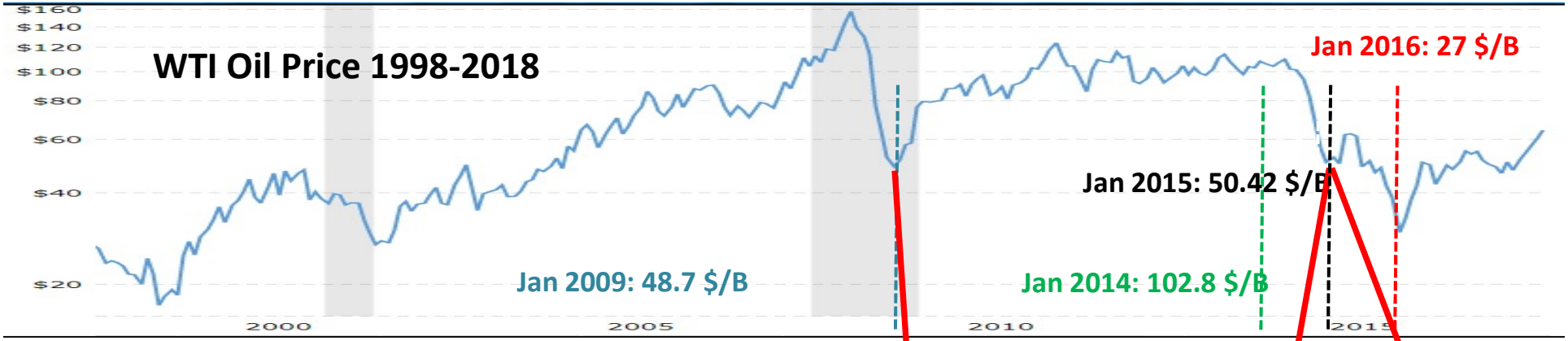
CH Tingo = 1.25 MW

CH Huanchor = 20 MW

CH Rucuy = 20 MW

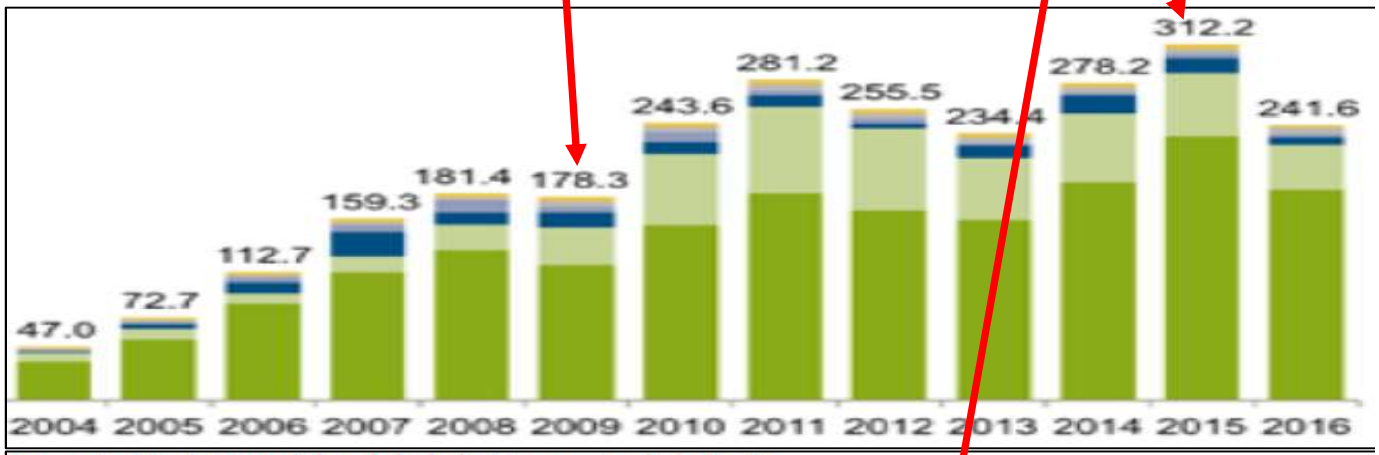
Society of Petroleum Engineers

VENTANA PARA DESARROLLAR LOS CAMPOS PETROLEROS DE LOS LOTES DE LA SELVA PERUANA Y FORMACIONES PROFUNDOS EN TALARA

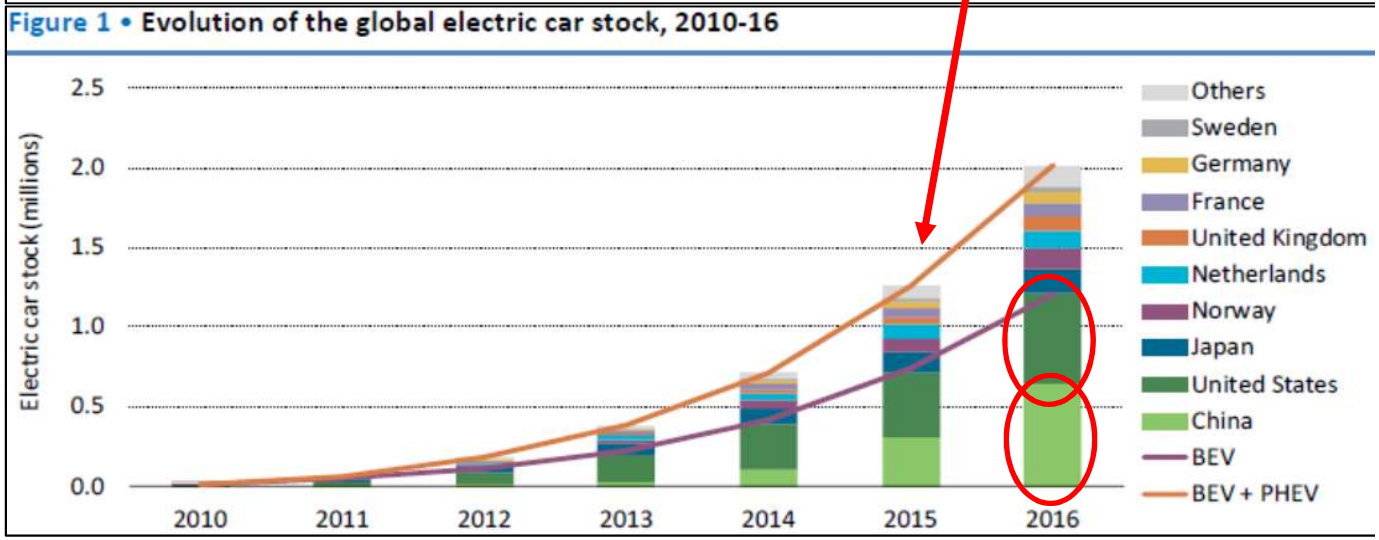


http://www.macrotrends.net/1369/crude-oil-price-history-chart

Inversión Global en Energía Renovable 2016 (Billón US$)



Evolución Global de vehículos eléctricos 2017



Conclusiones

Society of Petroleum Engineers

- La masificación de vehículos eléctricos, trenes eléctricos y camiones de carga mineros son cuestión de tiempo y eso cortara gran parte del mercado petrolero: 2 millones (2016), 55 millones (2025) y 280 millones (2040)
- La ventana para desarrollar proyectos de la selva peruana y en formaciones profundos en Talara se acorta y se tiene que desarrollar ahora
- Aprovechar la energía renovable para reducir costos operativos y alargar el punto económico de los proyectos petroleros

Conclusiones

Society of Petroleum Engineers

- Las compañías petroleras como Shell, BP, ExxonMobil y otros están diversificando su portafolio de Compañías Petroleras a Compañías de Energía .
- Actualmente se tiene una matriz energética mixta y el futuro la energía renovable incrementara pero se seguirá produciéndose petróleo y gas.
- Al 2030, las energía renovable crearán 25 millones de puestos de trabajo

Recomendaciones

Society of Petroleum Engineers

- Las Facultades de Petróleo deberían cambiar de nombre a Facultad de Energía o Gestión de Energía.

"La edad de piedra no terminó por la falta de piedras y la edad del petróleo terminará mucho antes de que el mundo se quede sin petróleo"

Sheikh Ahmed Zaki Yamani
Ministro de Petróleo – Arabia Saudita

Gracias