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Impact of solar coronal mass ejections (CME) on formation of Earth climate and weather pattern

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Abstract— Earth Observation System (EOS) program is designed to examine the role of Earth-Sun connection in wide-scale global processes in order to determine the function of the Earth as a single system. One of global climate change reason is caused due to emissions of greenhouse gases like carbon dioxide into the atmosphere. The real drivers of climate are the Sun's insulation (light and heat), its magnetic flux, and the relative position and orientation of the Earth to the Sun.

The variations in the Sun's magnetic flux control the amount of cosmic rays enter the atmosphere. Cosmic rays produce ionizations and the ions form nuclei for cloud formation. Cloud cover has a great effect on global temperature, but this area is still poorly understood and not addressed in climate models. Meteorological effects resulting from fluctuations in the solar wind are presently poorly represented in weather and climate models. Geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. These storms result from variations in the solar wind that produces major changes in the currents, plasmas, and fields in Earth's magnetosphere. The largest storms that result from these conditions are associated with solar coronal mass ejections (CME) where a billion tons of plasma from the sun, with its embedded magnetic field, arrives at Earth. CME typically take several days to arrive at Earth,

Geomagnetic indices are important parameter in weather forecasting methods. The development of the global circulation processes are depending on their capacity in, and then the emergence of the local weather. Applying Earth's magnetosphere model is conducted the continuous observation on the magnetic field and the expected geomagnetic storms have to be predicted what is important in weather formation on the earth

The correlation between geomagnetic storms and meteorological elements (temperature, precipitation, wind) have been determined for Georgian region using meteorological observation and NASA's Solar Dynamics Observatory and NOAA Space Weather Prediction Center data. The results show that there exist dependence between weather parameters and income radiation. New approaches have been suggested to explain observation results.

Key words: Coronal mass ejection, Earth magnetic field, Geomagnetic storm, geomagnetic indices.

Examination of Fuel Efficiency of a Hybrid-Electric City Bus under Urban Driving Conditions

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Abstract

Because of its regenerative braking system, a hybrid city bus is highly beneficial in terms of fuel economy. The benefits are especially pronounced under urban driving conditions where stop-and-go operations are frequent. During its operation, a city bus overcomes the resistive forces, which are mainly rolling, aerodynamic, grade and acceleration resistances. The loss energy due to the rolling and aerodynamic resistances are inevitable and recovery of them is impossible. However, braking energy losses due to deceleration (frequent stop-and-go) and negative road grade (downhill) can be recovered, which provide an intelligent opportunity to improve the energy efficiency.

In this work, main operating characteristics of internal combustion engine of a hybrid city systems were examined under real world urban driving conditions at three different bus routes in the city of Sakarya. The magnitudes of the hybrid system benefits in terms of fuel savings were quantified, also. The bus routes have different characteristics in terms of average speed ranged between 17 and 30 km/h, number of stop-and-go operations ranged between 2 and 4 per km travel, and the altitudes ranged from 33 to 188 m. It was observed that fuel saving benefits of the hybrid system strongly depends on the characteristics of the routes. The benefits increased with the average bus speed, the number of stop-and-go operations and decreasing altitudes from beginning to the end of the routes.

Key words: Hybrid city bus, fuel efficiency, energy recovery, regenerative braking, urban driving.

Optimal electrical and thermal energy management of a residential energy hub in the presence of solar PV systems

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Abstract

In order to reduce greenhouse gas emissions, transmission and distribution losses and the consumption of primary energy specific strategies are needed in all energy services. The energy hub is a new concept for future multi-carrier energy systems. An energy hub acts as an interface between different energy carriers such as electricity and natural gas distribution systems. From a maingrid point of view, an energy hub is a functional unit capable of receiving, converting and storing of various forms of energy [1, 2]. In fact, an energy hub plays an important role in connecting and interdependent operations of current various energy infrastructures. The energy hub can include different types of components such as combined heat and power systems (CHPs), boilers, electrical energy storages (EES), heat energy storages (HES), etc. The energy hub can range from an industrial plants or big building complex like hospital, airport or shopping mall to a region or city [3]. In addition, worldwide concerns over global warming and climate change have caused to a recent global push towards many forms of renewable generation technologies. The energy hub offers an opportunity to system operators by providing the flexibility to manipulate the effects of volatility and intermittency of renewable, in particular wind and solar, energy resources. Since, energy hub can connect to the upstream network or distribution network, and import /export electricity from/to the maingrid, proper operation of the energy hub is crucial from the maingrid point of view. In this paper, a stochastic model of energy hubs for solving the optimal scheduling problem is presented. Also, a linear two-stage model is presented for optimal scheduling of energy hub consisting of solar panels, boiler, CHP system and energy storage devices. The objective is to supply daily electrical and thermal demands of a residential energy hub for tackling penetration of renewable energies, providing reserve and reducing operation cost. Stochastic programming method is adopted to handle the uncertainties of solar power generation as well as energy demands. The Monte Carlo simulation approach is used to generate several scenarios. A proper scenario reduction method is also applied to reduce the volume of computations. At last, the results obtained from the studied cases indicate the appropriateness and usefulness of the proposed model. The main contributions of this paper can be summarized as follows:

- In addition to conventional resources of electrical energy, solar panels are used as renewable energy resources.
- A two-stage stochastic programming method is used to model uncertainty related to solar generations as well as electrical and thermal demands.
- EES and HES are considered to reduce the intermittent nature of solar generation and to provide reserve energy for more optimal scheduling of energy hub.
- The penalty cost is defined based on value of lost loads (VOLLs) for the energy hub and is utilized during optimization process.

Keywords: Energy hub; photovoltaic generation; energy storage system; stochastic programming.

Emission Trading in context of Green Economy in Kazakhstan

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Abstract - Transition to Green Economy is a part of political course followed by Kazakhstan since 2013, including implementation of Emission Trading Scheme (ETS), introduction of renewables into energy balance, energy efficiency measures (Expo "Future Energy", 2017). Green economy development is considered as result of its innovative industrialization according to world trends. The Green Concept covers three periods (2020/2030/2050) with a goal on decreasing of the greenhouse gases (GHG) emissions 15% by 2030 towards 2012 and 40% by 2050.

The aim is to update the ETS status in Kazakhstan specifically addressing the Marginal abatement cost curves approach and to analyze first quantitative suggestions for an ETS cap path in context of achieving the national goal to reduce GHG emissions for Green Growth. The analysis shown that ETS reduction obligations influence the overall efficiency of total abatement measures to be conducted in Kazakhstan. As a result, the further implementation of improved ETS will make a significant contribution to achieve the national target of Green Growth. The abatement options costing up to 143 euro per ton amounts to nearly 87 million tons of CO_2 eq. ,93.9 percent of which belong to the ETS. Transition to green economy by 2050 will increase employment of more than 450.000 jobs. The four key steps are recommended for Green Growth in Kazakhstan, including: strong political leadership; active government intervention; active public participation and mobilization of global and local partnership and investments.

Keywords: Emission trading, green economy, climate change

REFERENCES

[1] Information provided by the Ministry of Energy of the Republic of Kazakhstan, http://en.energo.gov.kz
[2] Turan-Astana University. *General Information,* http://www.turan-astana.kz
[3] ROMITHEAS, 2013. *General Information. PROMITHEAS*, http://www.promitheasnet.kepa.uoa.gr
[4] S. Inyutin, G. Zhaparova, L. Inyutina, "Transition to green economy a new vector of Kazakhstan's innovative development", PROMIHEAS-4: 6th International Scientific Conference on Energy and Climate, vol.1, pp.38, 2013
[5] Ministry of Environment Protection of Kazakhstan, 2013."Concept to Green Growth Path of the Republic of Kazakhstan", http://www.turan-astana.kz; http://www.promitheasnet.kepa.uoa.gr
[6] Carbon Pulse (2016, in press, https://carbon-pulse.com/16179/
[7] Kazakhstan Intended Nationally Determined Contributions (INDCs), (http://www4.unfccc.int/submissions/INDC/Published%20Documents/Kazakhstan/1/INDC%20Kz_eng.pdf)
[8] NERA Economic Consulting, Bloomberg New Energy Finance (2011): The Demand for Greenhouse Gas Emissions Reduction Investments: An Investors' Marginal Abatement Cost Curve for Kazakhstan. Prepared for European Bank for Reconstruction and Development (EBRD, www.ebrd.com/downloads/research/economics/.../Kazakhstan_MACC_report_ENG.p.. http://www.ebrd.com/downloads/research/economics/publications/specials/Kazakhstan_MACC_report_ENG.pdf
[9] Dr. Marco Artavia, Dr. Petra Opitz ,DIW Econ (2015): Proposal for the National Allocation Plan 2016-2020 for Kazakhstan, https://www.dehst.de/SharedDocs/downloads/EN/publications/country-study-kazakhstan.pdf?__blob=publicationFile&v=2
[10] Online Platform for Monitoring and Reporting Greenhouse Gases, in press,20188, http://www.worldbank.org/en/news/press-release/2018/02/05/kazakhstan-launched-online-platform-for-ghg-reporting

The Effect of Volatile Organic Compounds on Atmospheric New Particle Formation

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Abstract

Secondary new particle formation (NPF) plays a significant role in atmospheric particulate matters (especially those with aerodynamic diameter smaller than 2.5 μm, PM2.5), and has raised much concern over the past decades, especially in China which suffers severe haze pollutions featured by long-lasting time, extensive coverage, and high PM2.5 concentrations. As a remarkable precursor, volatile organic compounds (VOCs) with larger space occupation and more complexed structures including cyclic, linear and branched, are reported to have more significant effect on NPF than inorganics. Whereas, the role of VOCs in aerosol particulate formation is still an open question. Herein, a new insight of the effect of VOCs on aerosol particulate pollution is presented. NPF starts at nanoscale and can hard to be observed directly by experiments due to the measuring limitations. To explore the role of VOCs in NPF, a multicomponent kinetic model (MKM) along with a morphological simulation framework for NPF has been developed in H_2SO_4-HNO_3-NH_3-VOC (Volatile Organic compounds) system based on gas kinetic theory and graph theory. By the morphological simulation, an orthogonal test with two levels and four factors has been designed and carried out. It is found that PM2.5 would be looser and suspend longer in atmosphere due to VOCs existing (VOCs can reduce about 67% of PM2.5 density). By the MKM, alkanes with 2-15 carbons are selected for model analysis. The results show that alkanes especially those with cyclic structure or with carbon numbers ≥4 can play a bridge role to motivate the nucleation. The dominant size of nuclei, as well as the concentration of particles larger than 1 nm, is enhanced by the increasing carbon number in alkanes. Taking alkanes with same carbon number for comparison, the effect of molecular structure on nucleation is found to follow the order cyclic>linear>branched, and become slighter with increasing branches. Therefore, VOCs, especially those with cyclic structure or longer chain of carbon number ≥4, are proposed to be restricted preferentially for effective mitigations of particulate pollution.

Keywords: PM2.5, volatile organic compounds, new particle formation, graph theory

CAN KENYA LEAD THE WAY TO 100% RENEWABLE ENRGY IN AFRICA?

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Abstract

Energy demand is rising rapidly in Kenya because of rapid population and economic growth. The electricity sector faces serious challenges of inadequate supply that is characterized by frequent power outages, low access in rural areas and over-reliance on imported fossil fuels for power generation especially during dry spell. The current energy policy is biased towards fossil fuels. However, with the volatile international oil prices this will strain and limit the pace of economic development. As the country achieved middle income status in 2014, the number of households that can afford major household appliances has increased, with many of the consumers buying inefficient appliances; thereby unnecessarily burdening the national grid and widening demand and supply gap. Kenya Vision's 2030 aims to enhance and diversify power generation and supply to meet the increasing energy demand. The Kenya National Climate Change Action calls for investment in a low carbon climate resilient pathway to reduce greenhouse gas emissions. These plans can help accelerate renewable energy supply and promote sustainable economic development. For a sustainable economic development, Kenya needs to consider increasing the share of renewable energy to 100%. For a transition to 100% renewable energy system, all types of renewables and storage technologies need to be used. Does Kenya have the required technologies and resources to supply 100% renewable energy? We explore this potential by analyzing the current energy mix situation, then looking at current and projected demand and finally the possibility of meeting this demand entirely from renewable sources. It was found that the country has enough potential to meet its current and future power demand. Kenya is endowed with enormous renewable energy potential such as hydro, geothermal, wind, solar and biomass that can be utilized to supply 100% of its electricity demand from renewables. Geothermal resource in Kenya is estimated to have potential to contribute up to 7,000MW of electric power if well harnessed, small hydro potential of 3,000MW, average sun hours of 5.5 and suitable sites for wind power estimated to be over 30,000MW. Despite this, the country is still relying on imported fossil fuels for power generation contributing to 33.7%. In consideration of the potential of non-variable renewable energy source such as geothermal, currently supporting up to 28.5% of the electric power demand, the country has potential for 100% power generation from renewable energy sources while maintaining grid stability and providing reliable clean power to her economy. The promotion and adoption of renewable energy will also quicken the government's plan of providing universal access to electric power and the country can pioneer integrated 100% renewable energy power supply in Africa.

Batch ethanol production from sweet sorghum stem juice under high gravity fermentation and its kinetic models using MATLAB software

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Abstract

Sweet sorghum, *Sorghum bicolor* (L) Moench, is an alternative feedstock for the future supplies of ethanol production because its stalks contain high fermentable sugars mainly sucrose, fructose and glucose and many trace elements essential for microbial growth and ethanol fermentation. The aim of this research was to study batch ethanol fermentation from sweet sorghum stem juice (SSJ) under high gravity condition (240 g/L of total sugar and 9 g/L of yeast extract) by *Saccharomyces cerevisiae* NP01 and to develop kinetic models of the fermentation. The fermentation was carried out at 30 °C and agitation rate of 200 rpm. The results showed that the ethanol concentration and ethanol productivity obtained were 109.51 g/L and 3.04 g/L.h, respectively. The kinetic models for cell growth, substrate consumption and ethanol production were then developed using the MATLAB software. The estimated values of μ_m and Monod constant (K_S) using the Lineweaver-Burk plot were 0.495 h^{-1} and 83.424 g/L, respectively. It was found that the kinetic model for biomass formation was dependent on the substrate inhibition constant for growth (K_{IS}), the minimum ethanol concentration that inhibited growth ($P_{X.max}$), the ethanol inhibition constant (α) and the death constant (K_d); whereas the kinetic model for the substrate consumption was dependent on the biomass yield ($Y_{X/S}$) and the cell maintenance coefficient (m). For the kinetic model of product formation, it was dependent on the maximum specific ethanol production rate (q_{max}), the ethanol saturation constant (K_{SP}), the substrate inhibition constant for ethanol formation (K_{IP}), the maximum ethanol concentration for ethanol fermentation ($P_{P.max}$) and the ethanol inhibition constant (β). From overall results, it was found that the three kinetic models fitted the experimental data very well with $R^2 > 98\%$. The results obtained could be concluded that the developed models using MATLAB software were suitable to be used for the prediction of the batch ethanol fermentation under high gravity conditions.

A Simulation on a New Piezoelectricity Energy Harvesting Structure from Vortex Induced Vibration

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Abstract: A new structure of energy harvesting is proposed. In the structure, the bimorph piezoelectric cantilever is inside the flexible circular tube, the circular tube stands in the fluid, the axial direction is perpendicular to the incoming flow direction, and the neutral plane of the cantilever beam in the cylinder is parallel to the flow direction. The cyclical vibration of the flexible tube caused by the flow-induced vibration drives the piezoelectric cantilever inside the tube to vibrate and generate electric energy. The effect of bluff body to the vibration of structure was investigated using FSI(fluid structure interaction) simulation. The results showed that the vibration of harvesting structure was more stable when a rigid cylinder was in front of the structure as a bluff body than a flexible cylinder. Then the simulation of three flexible tubes standing in a line and a rigid cylinder as a bluff body was performed, in order to find the optimal position for placing the flexible tube behind the bluff body. The simulation results showed that the second flexible tube behind the bluff body has an optimal and stable vibration response. Then the relationship between the fluid velocity and the vibration of structure was researched using the simulation method. The results showed the optimal vibration state occurred when the fluid velocity was 1.1m/s and the radius of the tubes was 10mm. Furthermore, piezoelectric coupling simulation and energy harvesting circuit simulation were carried out. The voltage distribution and the voltage with time were obtained. The voltage response was 85V, 9Hz AC when the harvesting structure was in optimal vibration state. Finally, the LTC3588 chip was used to simulate and experiment the energy harvesting circuit, and the simulation results were in good agreement with the experimental results.

Keywords: Energy harvesting; Piezoelectric material; Vortex-induced vibrations; FIS; Simulation; ADINA;

Title: Renewable energy production and environmental conservation: keystones of leadership of Costa Rica

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The main goal of this paper is to present the road map and milestones of current leadership of Costa Rica within renewable energy production and environmental protection. The country is a small developing economy located in the Central American isthmus, in the curve of land between Nicaragua (north) and Panama (south). Leader in carbon neutral strategy, hosts 5% of world biodiversity, one quarter of its territory consists of national parks and reserves devoted to nature conservation of biological heritage. Nearly total energy produced (11210 GWh) during 2017 came from renewable sources, counting more than 350 days' demand was met with 99% of total clean energy entirely avoided fossil fuels in generation. Total installed capacity accounted 3529 MW, hydropower contributes with 77.4%, followed by wind energy (11.49%), geothermal (9.97%), and with less contribution, bagasse (0.78%), solar PV (0.02%) and thermic (0.33%). Present-day administration has made environmental protection a national priority and one of those main concern has been to reduce Costa Rica's greenhouse gas emissions through decreasing the use of fossil fuels and promoting green portfolio energy sources. In fact, a positive change in regulations and a massive market, for clean and renewable sources, stamps a new era of investigation and exploration towards increasing share of renewable sources in primary energy supply. Local strategies include scheduling more hydro projects, in both sides of the country, with big reservoirs for better dam regulation, adding new geothermal fields, spread distributed energy plan of PV projects and expand power to wind-offshore capacity. Additionally, encourage private distribute generation, reducing thermal power, and take advantage of private investment through tenders of renewable markets for non-conventional renewable sources. Newer mechanisms such as net metering, feed-in tariffs they are also opportunities for developing renewable energy initiatives. Still remain challenges, hundreds of megawatts of hydro, marine and geothermal potential are confined to national parks, preserved areas and Indian territories. Therefore, is predictable additional complexities imposed by the negotiations and agreements with indigenous communities, although a part of this potential could not be affordable. Other challenge facing is world economic crisis and lack of financial sources. Nevertheless, Costa Rica it is remain as a strategic country for investment, nor only for special peaceful and social economic stability, but also for the wide portfolio of renewable energy options forthcoming. This analysis is based on extensive and multidisciplinary surveys, interviews with stakeholders, statistics and updated journal reports.

Reduce toxic emissions of As, Cr, and Cu during woody biomass gasification: A thermodynamic equilibrium study

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Abstract:-

Gasification of blended waste wood samples resulting from different activities and operations would be beneficial for reducing toxic emissions of metal (loid) elements while producing energy. This paper deals with willow wood (40%) and demolition waste wood (60%) gasification specifically focusing on the phase transformation temperature and speciation formation of As, Cr, and Cu which are regularly present in woody biomass. The gasification of mixed fuel was modelled under atmospheric pressure as typical reaction zones; partial combustion reaction (PCR) and boudouard reaction (BR). The PCR performed at temperature range of 0-1800 (°C) and both equivalence and steam/air ratios were 0.28 and 1:2, respectively. On the other hand, the BR model was operated from 0 to 1300 (°C) along with typical CO_2 to biomass ratio of 1:3. The samples were selected from ETI-UK database (83 willow wood) and ECN PHYLLIS2 database (9 demolition waste wood). Further, @Risk analysis simulation package was exploited to estimate the best composition data of each element in these samples. Refinement of the obtained results by PCR reveals that the phase transformation temperature of both As and Cr increased about 150 (°C) and 100 (°C), respectively, comparing to those obtained by gasification of willow wood. On the other hand, solid –gas phase transition of Cr was decreased about 100(°C) comparing to that when only demolition wood was gasified. In regards to BR, the phase transformation temperature of As, Cr, and Cu was similar (~1100(°C)) for all gasified woods. However, only concentration shifts were observed in gaseous phase of these elements. Eventually, the results from this study could be useful to reduce emissions and to disposal contamination waste wood via gasification process.

Keywords— Reduce toxic emissions; Waste wood; Elemental contaminants; Gasification; MTDATA.

Examination of energy efficiencies of Conventional, Diesel-Electric and Hybrid-Electric city buses under urban driving conditions

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Abstract

During its operation, a city bus must have high enough traction force to overcome the resistive forces, which are mainly rolling, aerodynamic, grade and acceleration resistances. The losses due to the rolling and aerodynamic resistances are inevitable losses and recovery of them is impossible. However, braking energy losses due to deceleration (frequent stop-and-go) and negative road grade (downhill) can be recovered, which provide an intelligent opportunity to improve the energy efficiency.

At the present work, basic operating characteristics of Conventional, Diesel-Electric (DE) and Hybrid-Electric (HE) city buses were examined with the aim of comparing energy efficiencies of the buses under real world urban driving conditions. To perform the comparison, real-time operating data of the buses were collected on Campus-Return route of Sakarya Municipality. It was observed that although traction powers versus bus speeds indicated similarities for all the buses, engine powers versus bus speeds did not indicate the same similarities. The main difference was that while the engine powers of the Conventional and DE buses increased steeply to their maximum with the increasing bus speed, the engine power of the HE bus increased gradually to its maximum. Traction, braking and engine energy traces of the buses indicated similar trends, also. While the traction and braking energy traces were quite similar, the engine energy traces were significantly different although the buses were driven on the same route. The engine energies per km travel for the HE, Conventional and DE buses were 1.30, 1.55 and 2.08 kW-h/km, respectively. Compare to the engine energy of the HE bus, that of the Conventional and DE buses are 20% and 60% higher, respectively. In addition, the engine energies were 1.29, 1.48 and 1.84 times higher than their respective traction energies for the HE, Conventional and DE buses, respectively. The main reason for the lower energy consumption of the HE bus is that while it takes advantages of recovering the braking energy losses due to downhill and frequent stop-and-go driving, the Conventional and DE buses waste their braking energies.

Keywords: city bus, regenerative braking, urban driving, hybrid city bus, waste braking energy

Key Factor Identification for PM2.5 Formation in China: The Role of NH_3 in Atmospheric New Particle Formation

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Abstract

PM2.5 (particulate matters with aerodynamic diameter smaller than 2.5 μm) pollutions with adverse effect on human health and global climate has occurred frequently and caused widely concern in China. The main chemical compositions in PM2.5, *i.e.,* SO_4^{2-}, NO_3^-, NH_4^+ and organic compounds, are converted from SO_2, NO_x, NH_3 and volatile organic compounds (VOCs), respectively. In order to find out the key factor for PM2.5 generations to help to relieve the air pollution, formation characteristics of PM2.5 is investigated. A property of electric neutrality of PM2.5 is proposed according to the least-energy principle and verified through electricity-charge calculation in this paper. As the only cation in the main chemical compositions of PM2.5, NH_4^+ is vital for anions (such as SO_4^{2-} and NO_3^-) to aggregate together and is a key factor for PM2.5 formations. The major source of PM2.5 is secondary new particulate formations (NPF) in atmosphere. Herein, to identify the role of NH_3 in atmospheric NPF, a new kinetic model, combining the oxidation of SO_2/NO_2 in SO_2/NO_2/NH_3/H_2O/air system and the aggregation of clusters in H_2SO_4/HNO_3/NH_3/VOC system, is established based on gas-kinetic theory. From the modeling analysis, it is found that NH_3 can enhance PM2.5 formations not only by facilitating conversions of SO_2 and NO_2 indirectly, but also by promoting aggregations of H_2SO_4, HNO_3, NH_3 and VOCs directly. And the enhancement of conversion fractions for SO_2 and NO_2 during oxidation processes is the major effect of NH_3 on PM2.5 formations. In addition, the presence of NH_3 can particularly promote the contribution of HNO_3 in NPF process. Therefore, in order to relieve PM2.5 pollutions in China, the control strategies for NH_3 as current restrictions on SO_2 and NO_x are suggested to be enhanced by government, such as decreasing the amount of nitrogenous fertilizer utilization, or changing the fertilizing environment from dry condition to wet condition.

Keywords: PM2.5, NH_3, new particle formation, modeling studies, haze mitigation

Climate and Renewables: The EU's New Targets & Policies for 2030 & 2050

International Conference on Environment and Renewable Energy

Vienna, Austria, 18 May 2018

Dr Pierre Dechamps
Policy Officer, Climate Action
Directorate General for Research and Innovation

Research and Innovation

Outline

- Initial objectives - The 2008 Energy and Climate Change Package
- A Policy Framework for Climate and Energy from 2020 to 2030
- Vision and Objective - The 2050 Roadmap
- The Energy Union – Clean Energy for all Europeans

Initial objectives

- The 2008 Energy and Climate Change Package

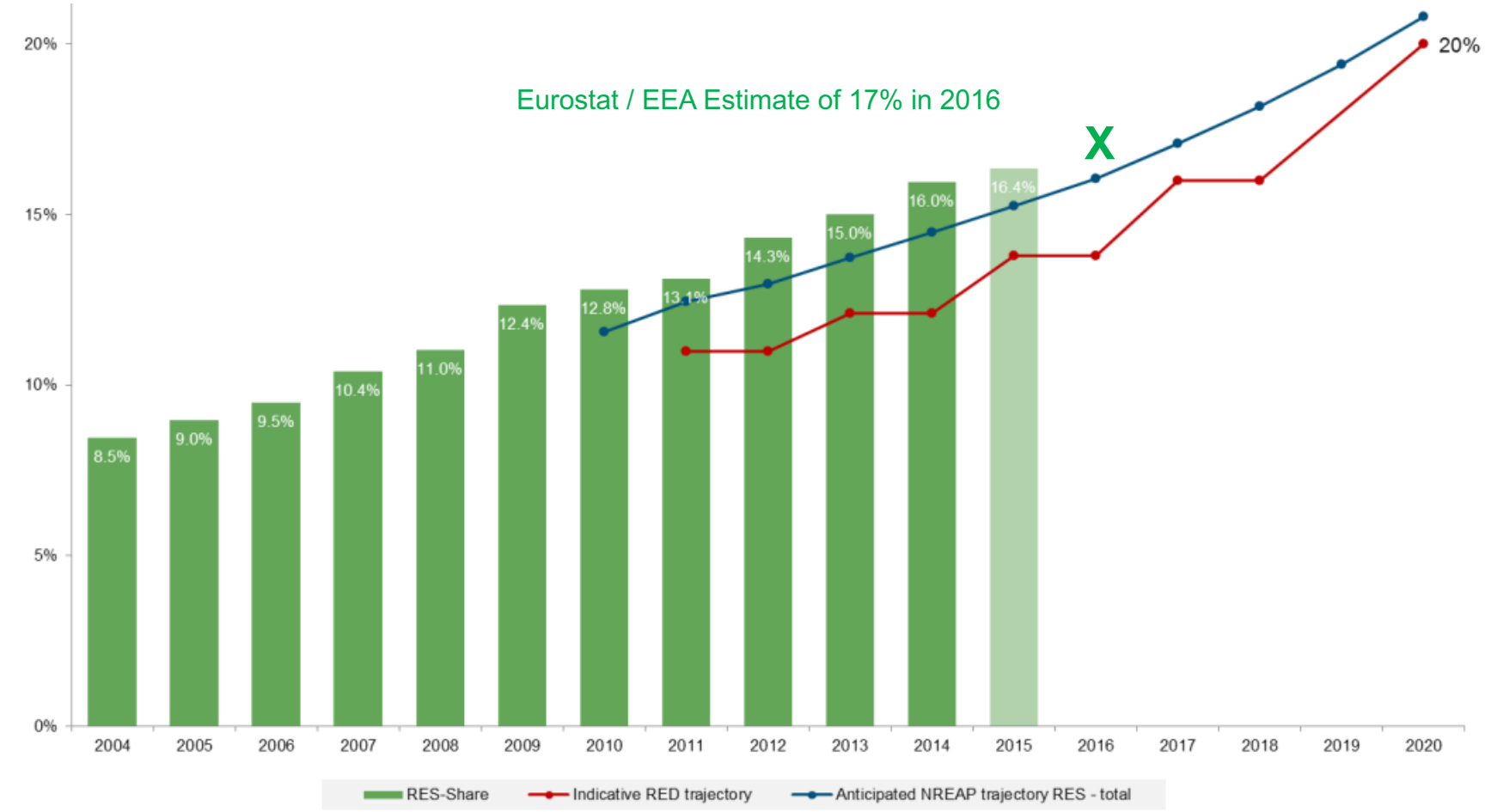
The Energy and Climate Change Package

Adopted at the end of 2008:

20% GHG emissions in 2020, compared to 1990 (legally binding)
ETS sectors, and non-ETS sectors
20% share of renewables by 2020 (legally binding)
20% more energy efficiency by 2020
+
The CO2 Geological Storage Directive
+
Inclusion of CCS in the ETS phase III

= The legal framework for a carbon constrained economy, a low carbon growth

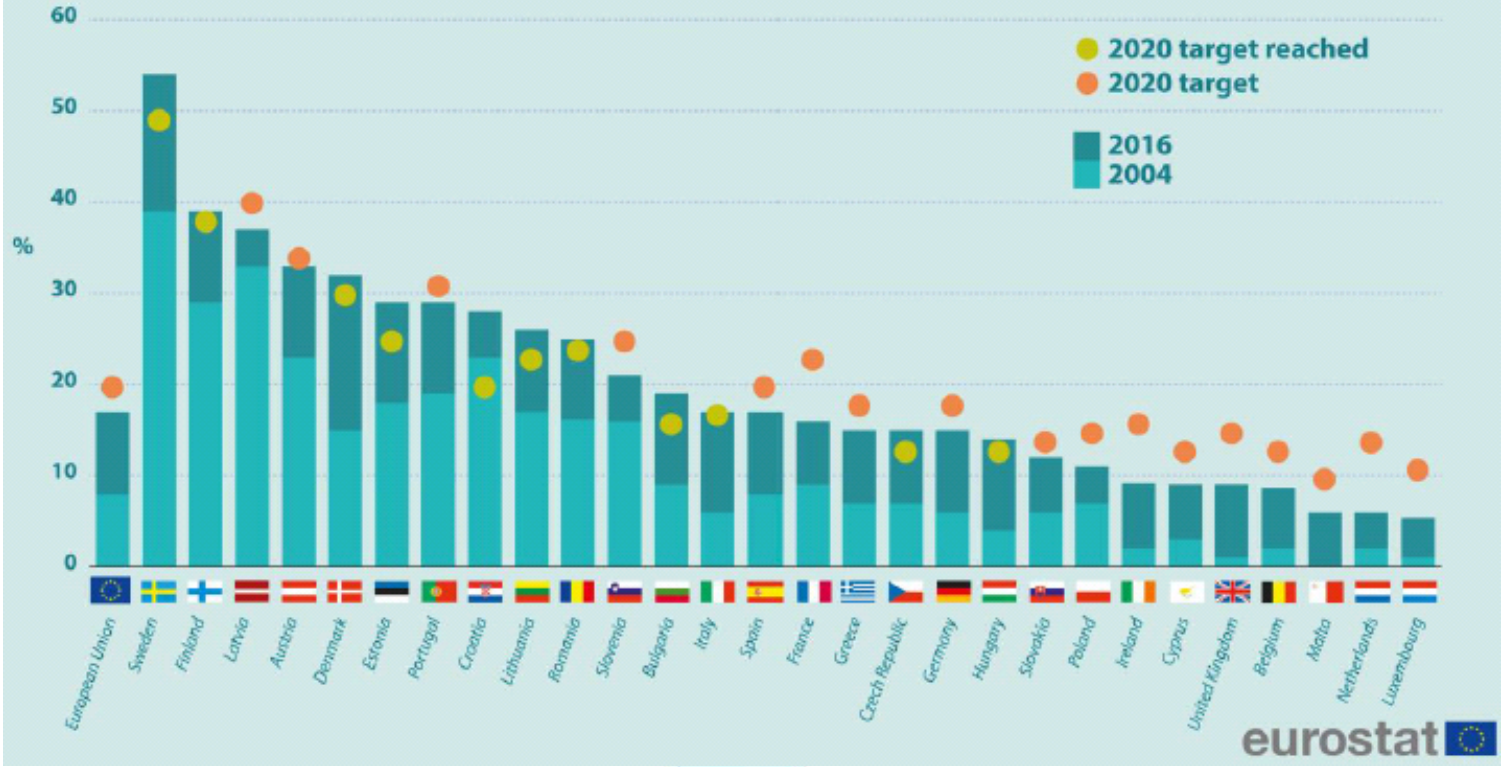
Renewable energy shares in the European Union vs. Renewable Energy Directive and National Renewable Energy Action Plan Trajectories



European Commission

Share of energy from renewable sources in the EU Member States

(in % of gross final energy consumption)

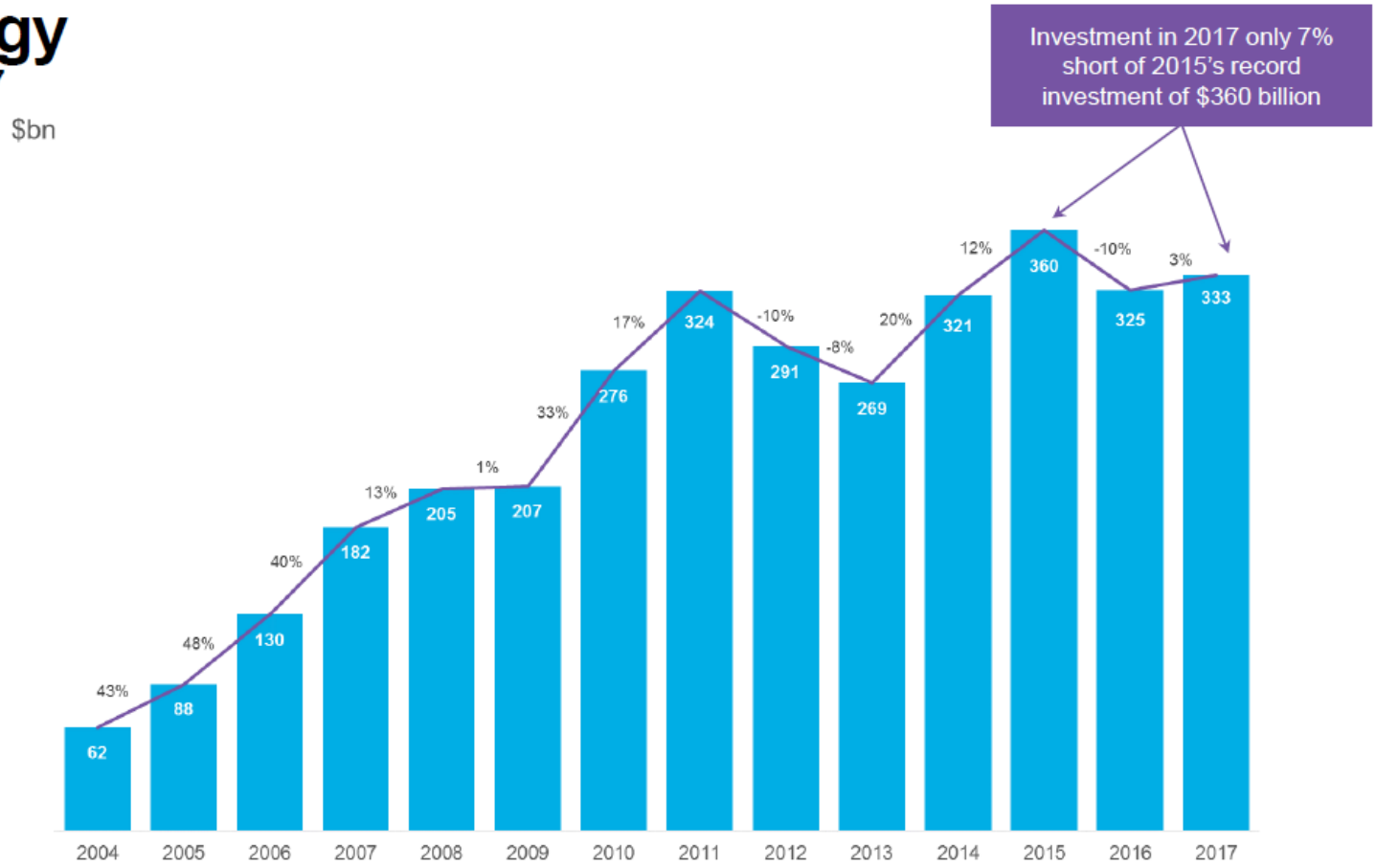


Research and Innovation

European Commission

Global New Investment in Clean Energy

2004 – 2017



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All values nominal

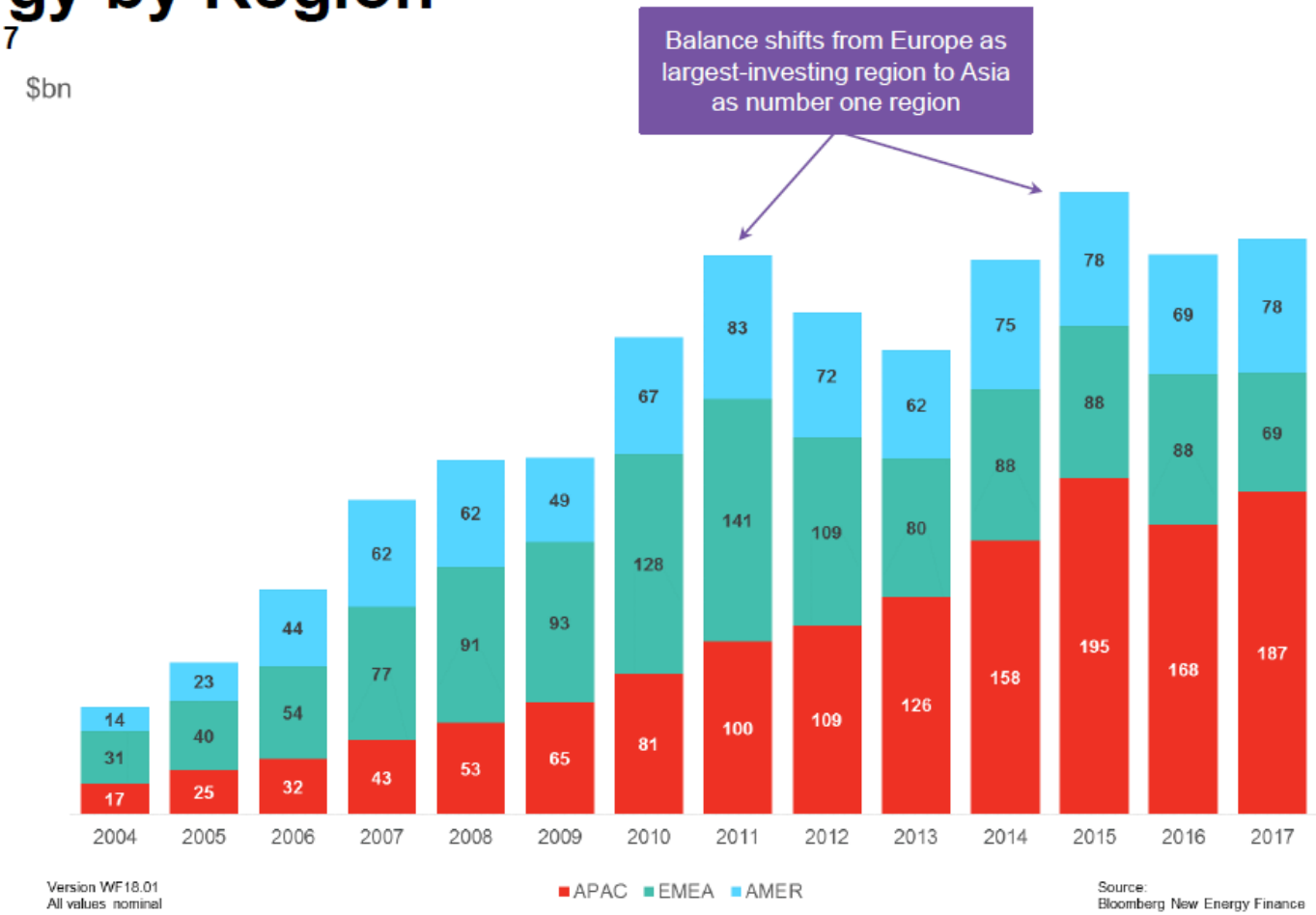
Source:
Bloomberg New Energy Finance

Research and Innovation

European Commission

Global New Investment in Clean Energy by Region

2004 – 2017



Version WF18.01
All values nominal

Source:
Bloomberg New Energy Finance

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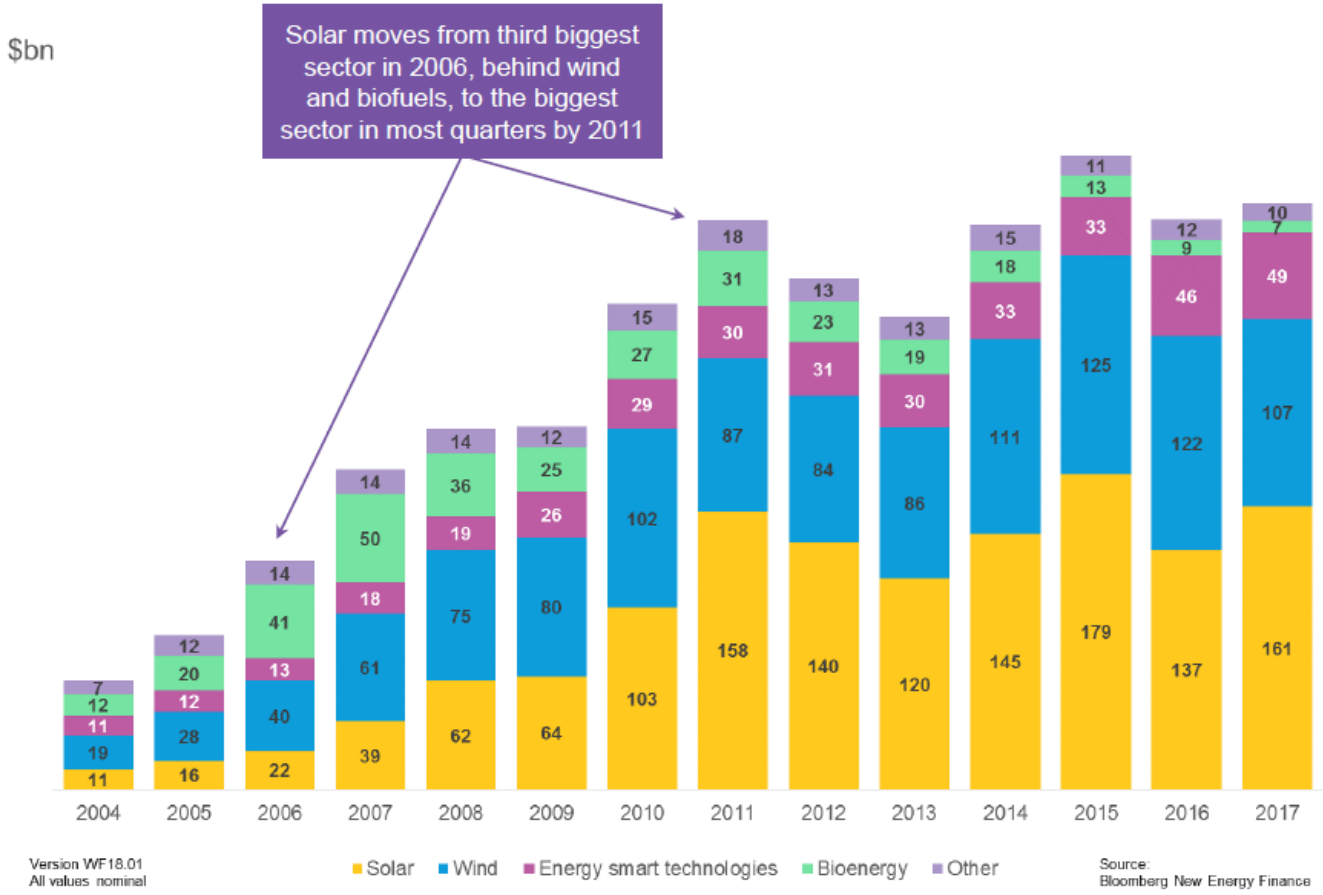
Global New Investment in Clean Energy by Sector

2004 – 2017



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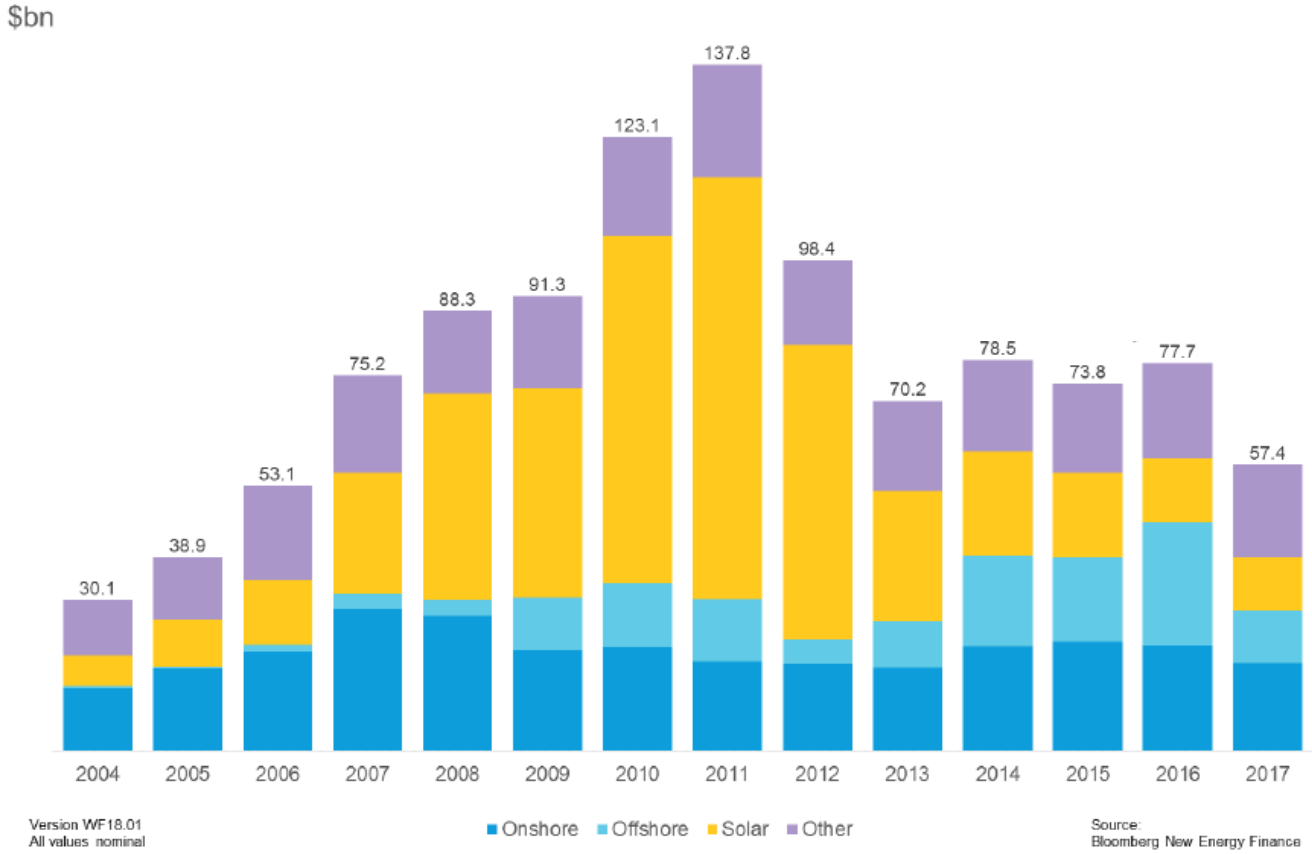
New Investment in Clean Energy Europe

2004 – 2017



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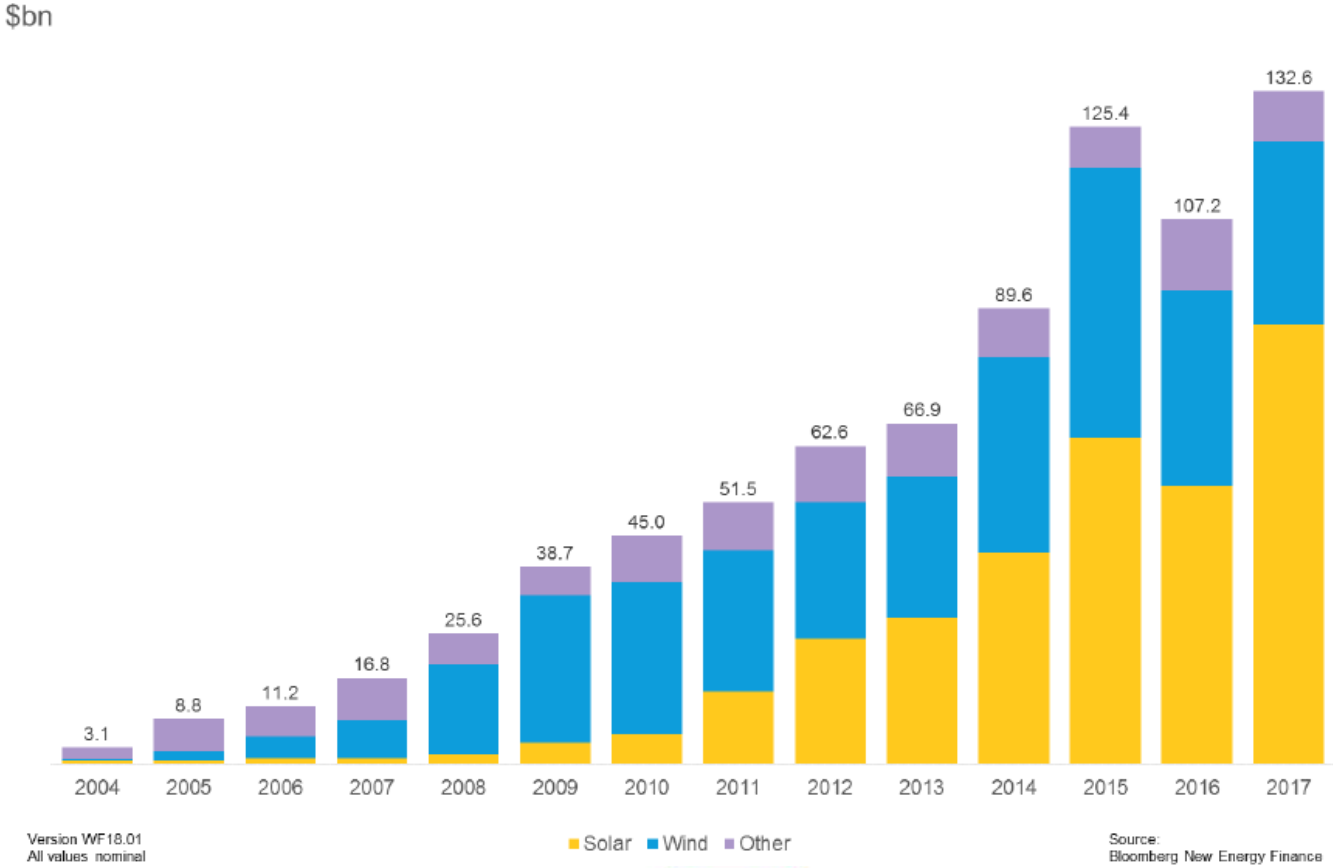
New Investment in Clean Energy China, by sector

2004 – 2017



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Source:
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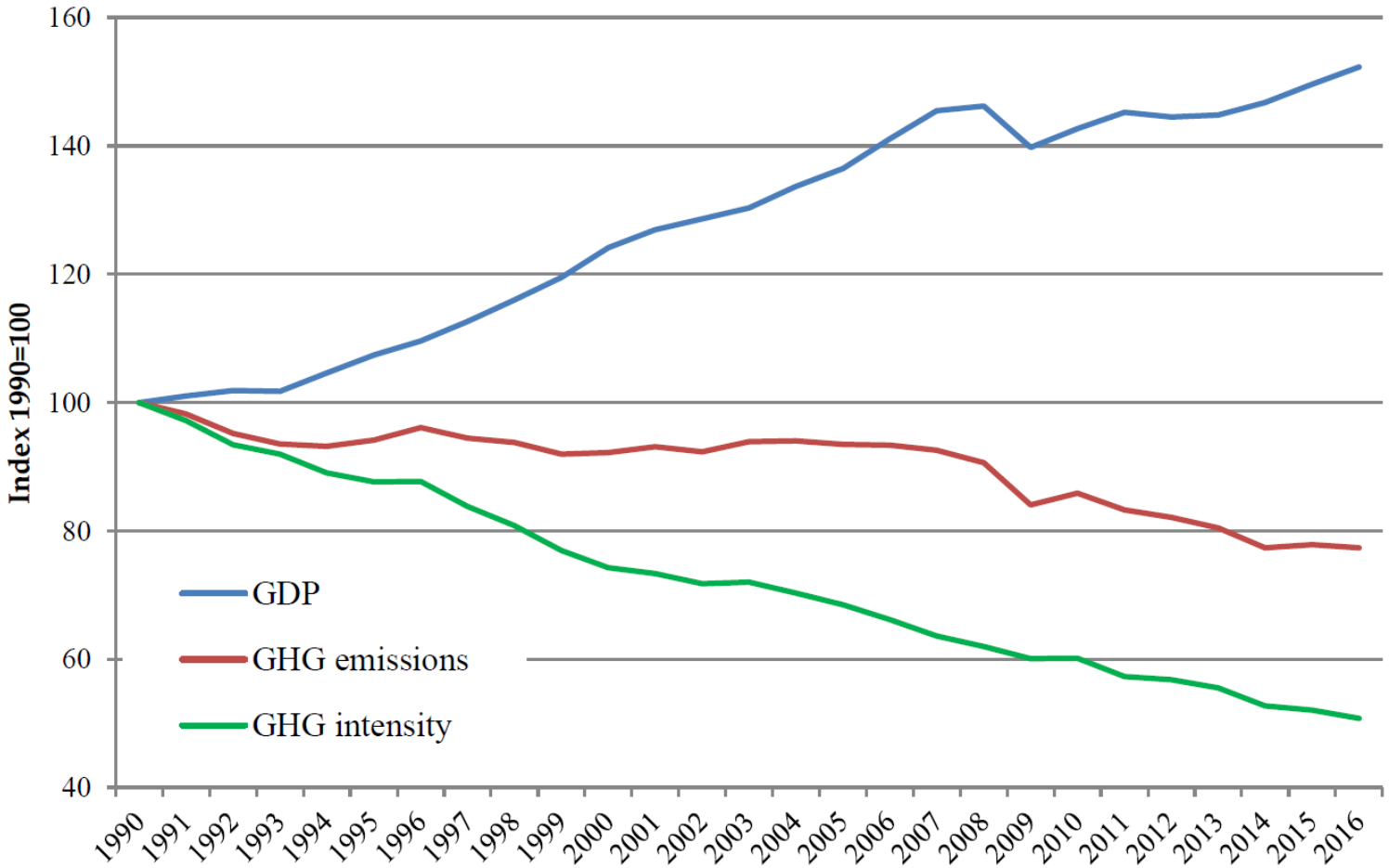
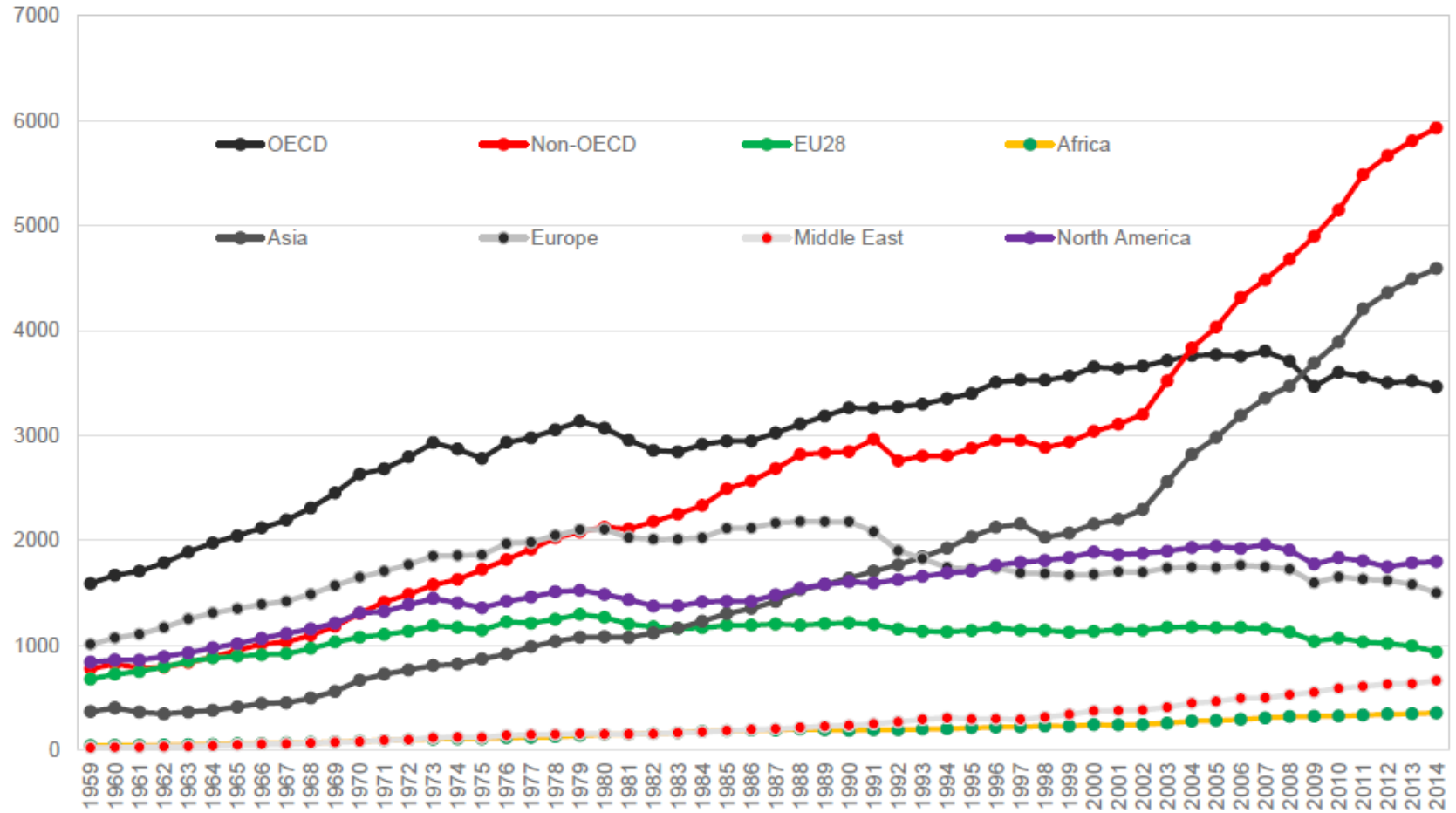
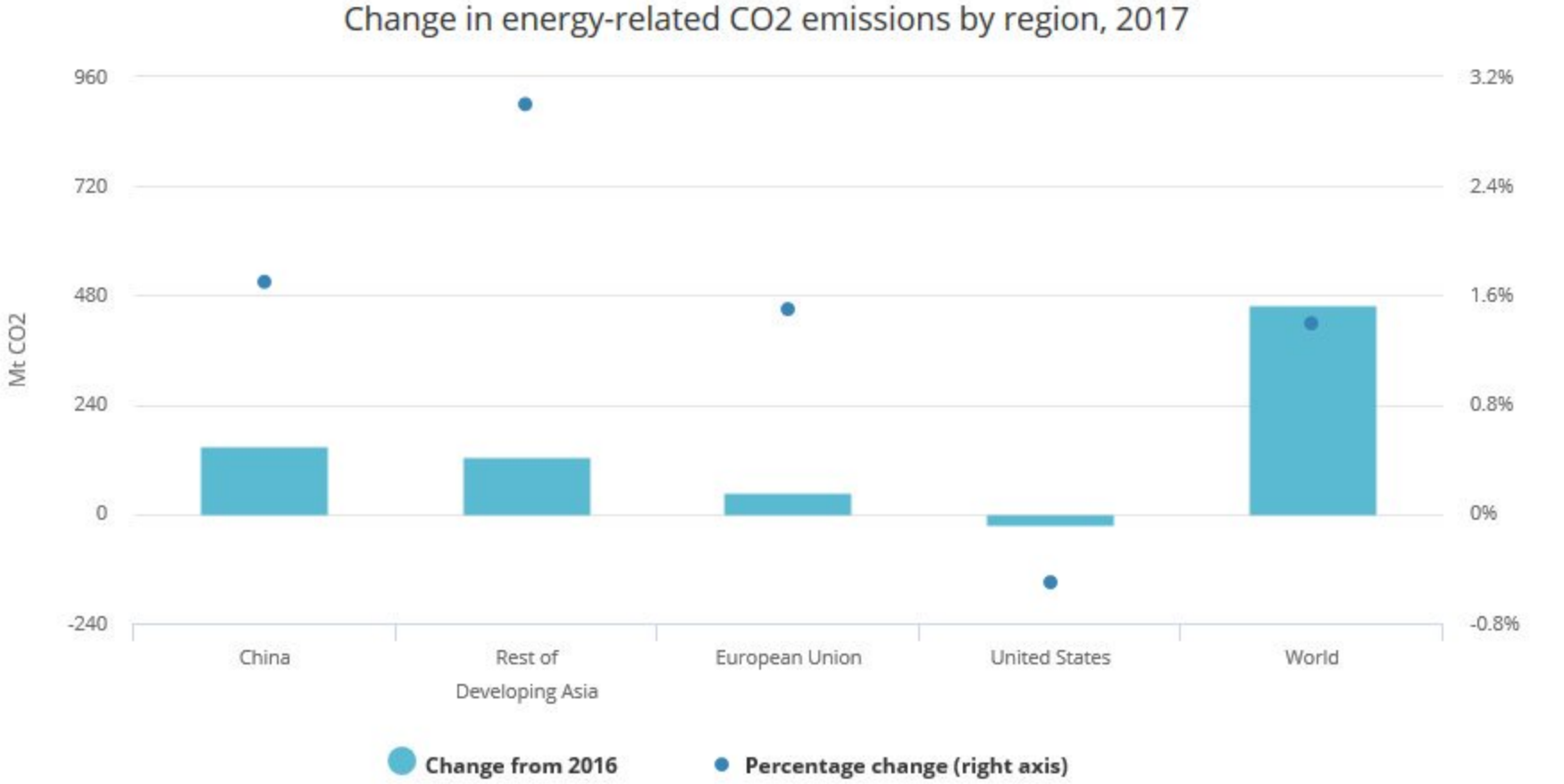
The EU is gradually decarbonising



International Context

Territorial Emissions, UNFCC Data - Vlaues in MtC/year. Own Analyses





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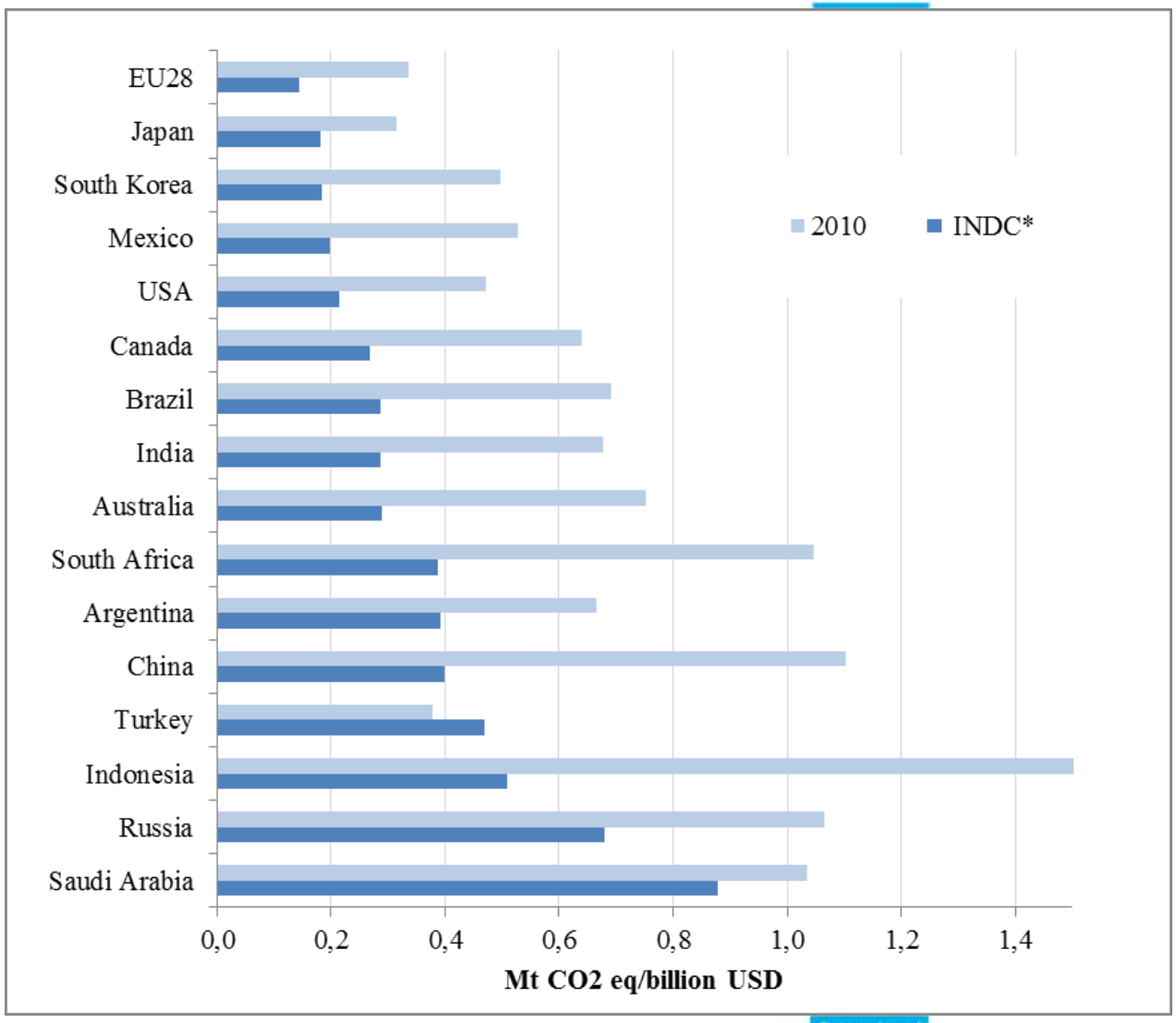

GHG emissions intensities (MtCO2 eq/billion USD)

A Policy Framework

for Climate and Energy from 2020 to 2030

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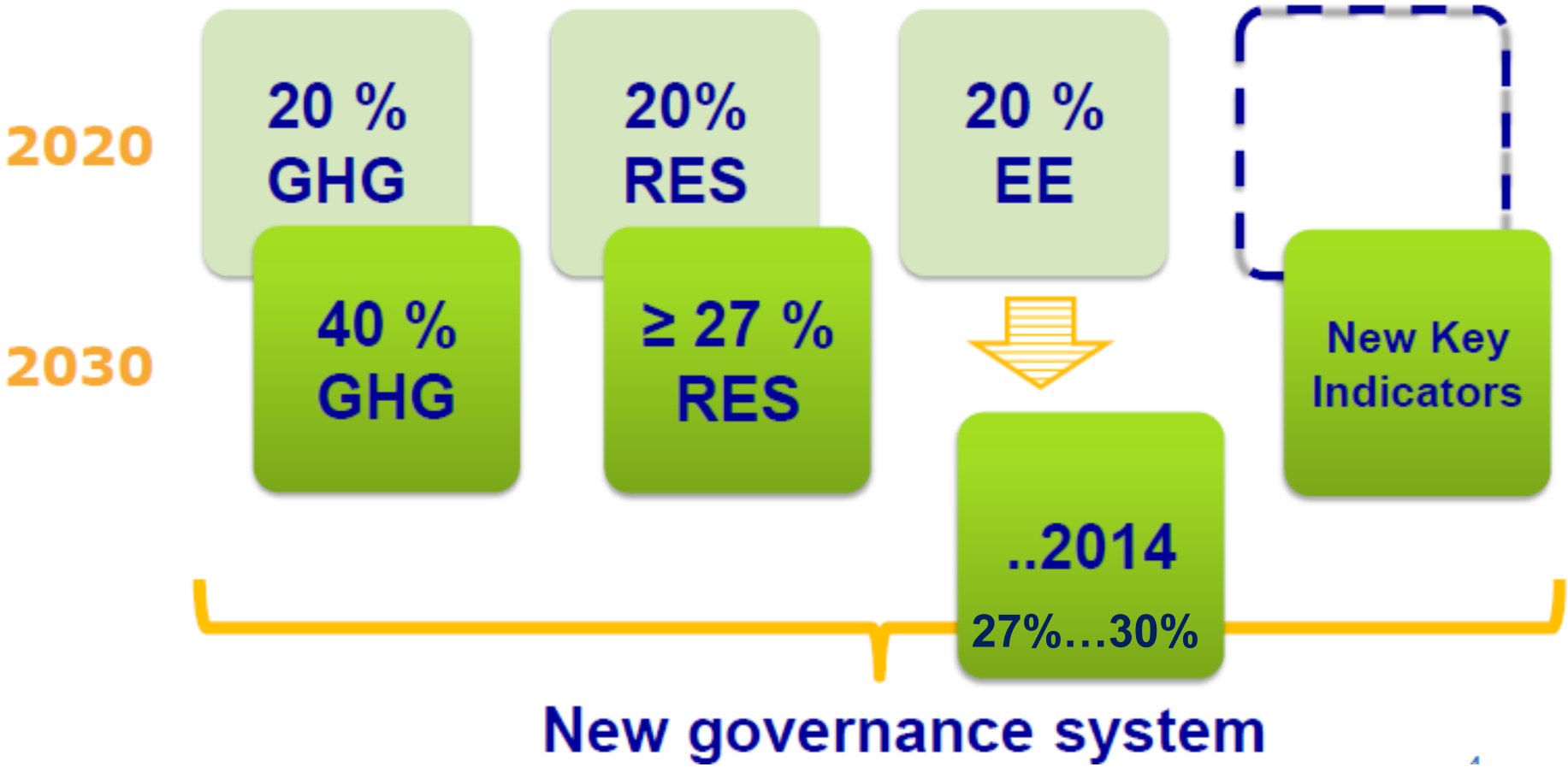
2030 Framework – the Structure



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Vision and Objective

- The 2050 Roadmap

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Energy Roadmap 2050 –

COM(2011)112

- Reduction of energy sector emissions by 85% by 2050
- Energy costs rising to 2030, coming down thereafter
- 5 scenarios

  - high efficiency

  - diversified supply technologies

  - high RES

  - delayed CCS (not commercial by 2030)

  - no nuclear
- RES more than 50% of supply in all scenarios
- CCS providing 20-30% of GHG reductions in 2050

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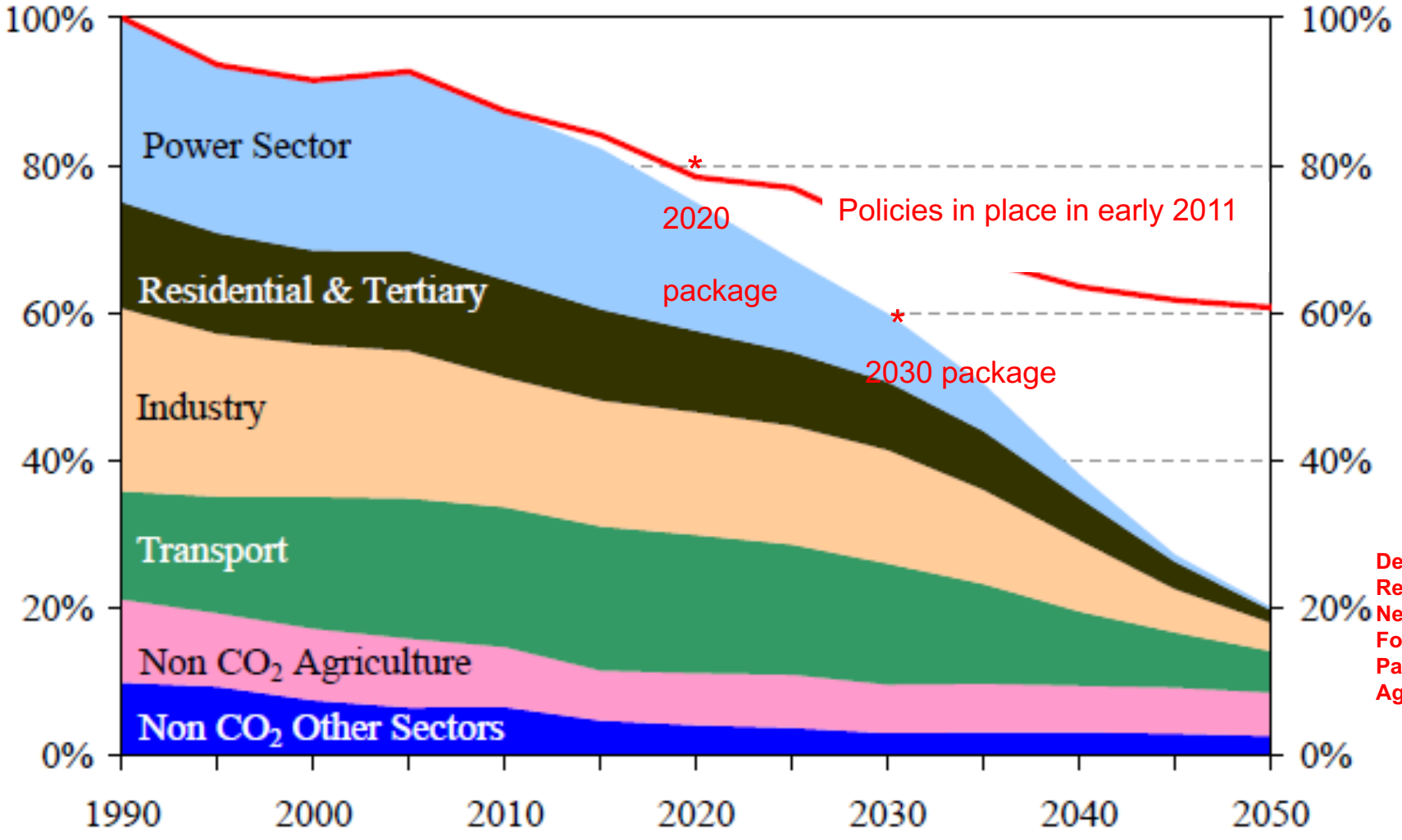
A Sectorial Approach



Deeper Reduction Needed For the Paris Agreement

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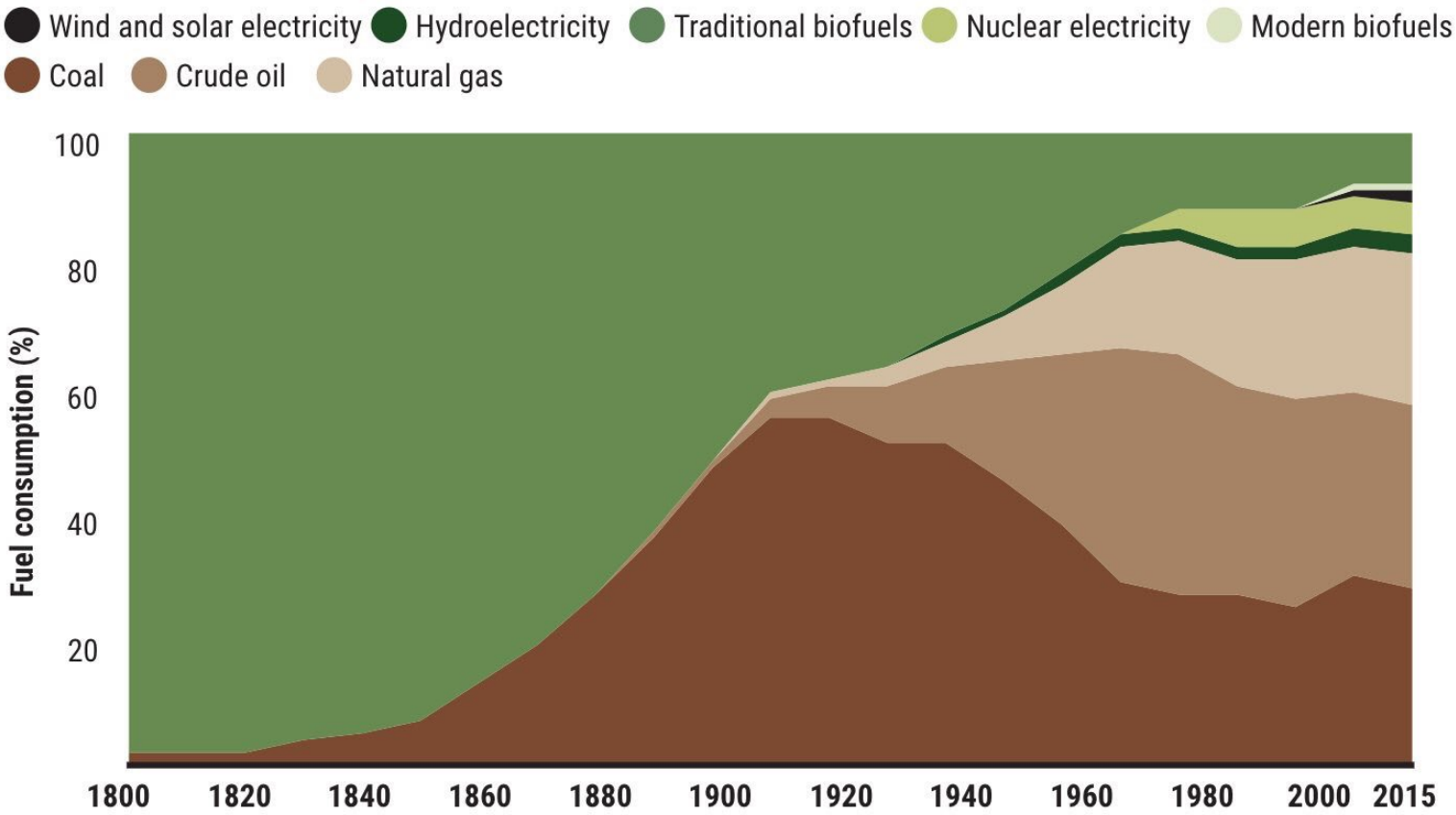
Global energy supply – extreme stability



(GRAPHIC) J. YOU/*SCIENCE*; (DATA) V. SMIL, ENERGY TRANSITIONS, PRAEGER, 2017; V. SMIL, POWER DENSITY, MIT PRESS, 2015

Deep Decarbonisation Pathways – a research and innovation initiative

Require a societal / holistic approach
a lot more than just technologies
- **behavioural issues**
- **public information / acceptability / engagement**

A totally new system is required, even the 2020 objectives are already putting the existing system under stress (capacity markets, etc)

Often run out of range of existing models

A R&I topic by nature, to feed into future policies design

A High Level Panel of 9 personalities to advise Commissioner Moedas, delivering a report, end of 2018.

Towards an Energy Union – Clean Energy for all Europeans

The "Winter Package" - Clean energy for all Europeans

- **A set of 8 legislative proposals plus several Communications and other papers**
- **Title "Clean Energy for All Europeans" – every words is important (Paris Agreement, Citizens, inclusiveness)**
- **1000 pages, more than 25 documents**
- **An attempt to move to an EU-wide Energy Union compatible with the Paris Agreement**

The "Winter Package" - Clean energy for all Europeans Renewables

No longer experimental for several technologies, mainstream for some, PV and on-shore wind at or close to grid parity, even with low wholesale prices, so could play in the market

- **Phasing out of some support schemes**
- **Common set of principles to design new support schemes, including opening to suppliers from neighbouring countries**
- **Faster and more flexible markets (from trading for the next day to intra-day trading)**
- **Gradual end of the priority dispatch, with exceptions (existing RES, small RES, etc)**

Transport: fuels to include 1.5% (2021) to 6.8% (2030) of low-C biofuels (advanced biofuels, not in competition with food)

The "Winter Package" - Clean energy for all Europeans

Fossil fuels and capacity mechanisms

- **Capacity mechanisms allowed**
- **But only in last resort, after looking at other solutions and cross border solutions**
- **Open to cross-border participations**
- **Environmental standards: only if CO2 < 550 gr/kWh, so ok for gas, not for coal**

Cooperation

- **More power to ACER (agency for the cooperation of energy regulators) (Ljubljana)**
- **Creation of a European network of DSOs (like for TSOs) to push inter alia smart grids**

The "Winter Package" - Clean energy for all Europeans

Citizens at the center

- **More and more prosumers**
- **Hence definition of their basic rights**
- **Authorised to sell excess electricity to the grid, "without disproportionate procedures and charges that are not cost effective"**
- **Able to choose and change suppliers (like other consumers)**
- **Right to a smart meter to take part in DSM**
- **Call to define "independent aggregators" to help them**

The "Winter Package" - Clean energy for all Europeans

Big Numbers and Governance

- **27% RES confirmed**
- **30% efficiency, up from 27% of the Oct 2014 Council**
- **National Energy and Climate Plans drafted in 2018, final in 2019, progress reports from 2021 every 2 years, will be reviewed, name and shame exercise, best practice sharing, plus EU actions if it is not enough**
- **Plus review of the energy efficiency in buildings Directive**

Process

- **A lot of things to agree upon, Council, Parliament**
- **Probably at least two years to finalise**
- **Big negotiation issues: 30% efficiency, environmental standard of capacity mechanisms, ACER, governance in general (2 years energy and climate plans, etc)**
- **Hence many possible tactics and need to maintain coherence and equilibrium**

The "Winter Package" - Clean energy for all Europeans

Where we are at the moment

Council:

- On RES, 3 benchmarks in 2023, 2025 and 2027 at 24%, 40% and 60% of the way to go from 2020 to 2030, with 2030 at 27% of final consumption. (so for instance, in 2025, 20% + 40/100 * 7% = 22.8%)
- MSs split on attitude towards biofuels (1st generation, advanced)
- MSs to submit integrated energy and climate reports every 2 years
- For generation and capacity allocation, new notion of "bidding zones"
- For capacity mechanisms, after 2025, only if below 550gr/kWh OR below 700kg in the year per KW. (Typically allowed for coal plants with a load factor below 0.1)

The "Winter Package" - Clean energy for all Europeans

Where we are at the moment

Commission:

- Recognises (Commissioner Canete) that the modelling used for the initial proposal at 27% is outdated, and so 27% is no longer the maximum achievable, confidence for 30%

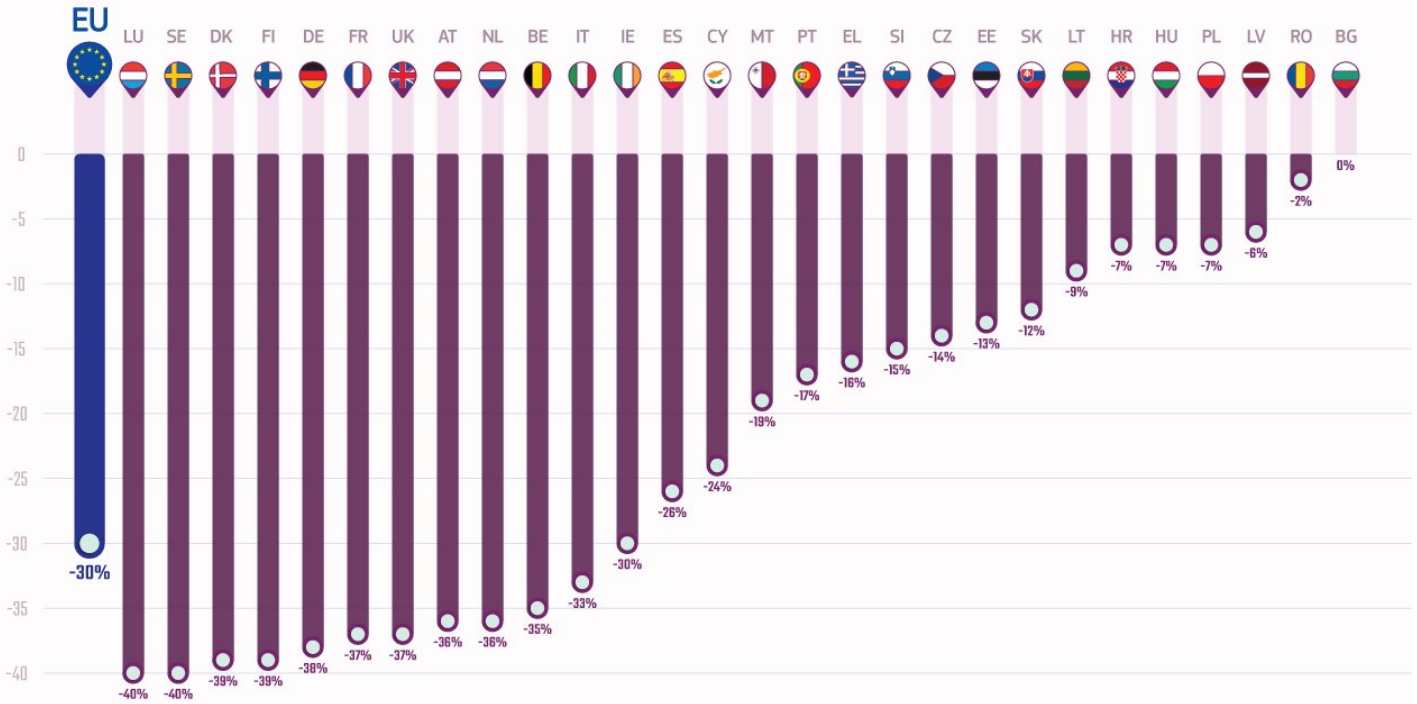
Parliament:

- Mandate to negotiate towards 35% RES
- Mandate to negotiate towards 35% efficiency improvement

European Commission

Directive adopted 14/5/2018

Member State specific emission reduction targets for 2030 compared to 2005, for sectors outside the EU Emissions Trading System



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In Conclusion

The EU energy policies are based on the three interdependent pillars: security of supply, competitiveness and sustainability;

The EU has equipped itself back in 2008/9 with a coherent energy and climate package to face those challenges, with clear objectives for 2020;

We are now extending this approach, learning from the past, to 2030, in order to provide visibility to the actors;

Beyond this, a real holistic / systemic / societal approach is required.

The objective is clear : deep decarbonisation by 2050, fully consistent with the Paris Agreement

THANK YOU FOR YOUR ATTENTION

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