Turkey's Compliance with the Industrial Emissions Directive

A Legislation Gap Analysis

and

its Possible Costs on the Turkish Energy Sector

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Executive Summary

As climate change is becoming more of a pressing issue of the international agenda, in spite of national and international efforts to slow the increase in the global temperatures down; the importance of collective action and national emission reduction pledges are once again at the center of the post-Kyoto discussions. Discussion of the Sustainable Development Goals which are to replace Millennium Development Goals by 2016 and efforts to design post-2015 agenda of the UN Framework Convention on Climate Change (UNFCCC) makes the year 2015 a turning point and deserves close attention. This report, acknowledging the importance of the timing, aims to increase awareness regarding the costs of implementation of clean fossil fuel (mainly coal) technologies and their alternatives with the discussion of Turkey's compliance with EU's Industrial Emissions Directive (IED).

The IED, through an integrated approach, obliges industrial and agricultural activities to minimize their polluting emissions in the atmosphere, water and soil, as well as other wastes, with the aim of achieving a high level of environmental and health protection. It brings together one horizontal (the main regulatory instrument, The Integrated Prevention and Control Directive (IPPC)) and six sectoral pieces of legislation, including the Large Combustion Plant Directive (LCPD); the Waste Incineration Directive (WID); the Solvent Emissions Directive (SED); and the 3 directives pertaining to Titanium dioxide, into a single directive on industrial emissions, by cancelling out possible overlaps and simplifying procedures. The proposed Directive was ratified by the European Council in 2010, which then became part of national legislation in the Member States and applied to new installations. It is scheduled to apply to Large Combustion Plants by 2016.

The Legislative Framework

A brief introduction of each directive, ratifications brought by the IED and Turkey's compliance level can be summarized as:

IPPC Directive (2008/1/EC): Through an integrated approach, it aims to prevent/reduce emissions from certain industries (energy, minerals and metals, chemical, agriculture and waste management) to the air, water and soil. It also

includes complementing issues such as waste management, efficient use of energy, accident prevention and restoration of sites when industrial activities cease. Emission Limit Values (ELV) is based upon Best Available Techniques (BAT) which are prepared for each sector and updated regularly. The IED strengthens the role of BATs by effective use of BAT Reference Documents (BREFs) in determination of ELVs. As part of compliance efforts of Turkish government, draft legislation has been prepared and it is expected to come into force in 2015. BAT documents for 4 selected sectors are already in place and a regulatory impact assessment has been completed, calculating the total cost of the IPPC in Turkey within a range of € 20-40 billion, during the first 10 years of implementation.

LCPD (2001/80/EC): It aims to limit the SO2, NOx and dust emissions from large combustion plants (with thermal input of 50 MW or higher) covering all types of fuels (gas, liquid or soil). Plants are categorized according to their authorization dates (new – after 27th November 2002, old – between 1st July 1987 and 27th November 2002 and older – before 1st July 1982) and different provisions on the compliance are brought onto these plants accordingly. National emission reduction plans were required to be prepared and present to the European Commission by 27th November 2003. The IED brings more stringent limits, by almost halving the emissions and brings down the permitted operational hours to 1.500 from 2.000, of plants that are built before 2003 and choose not to comply with the Directive. The LCPD has been transposed into the Turkish legislation on 8th June 2012, by the By-Law No.27605 which is compatible with that of the EU at 98 percent, where the only missing component is the national action plan for emission reductions. This By-Law will apply to the existing plants from 8th June 2019.

WID (2000/76/EC): The main purpose of the Directive is to prevent or restrain both negative effects of incineration and co- incineration of waste via emissions into air, soil, surface water and groundwater on environment and resulting risks to human health. A subsequent objective of the Directive is to achieve energy conservation and production, especially at the local level. With the provisions imposed by the IED improved measurement technologies and more stringent rules are introduced to control emissions periodically. Despite the efforts by the MoEU to adopt new WID, that entered into force in 2010, Turkish legislation still lacks the access to information and public participation aspect, which is considered as one of the crucial articles. Also, the absence of a RIA process prior to the preparation of the legislation has caused problems in the implementation phase, forcing MoEU to revise the legislation to come into force by 2015.

VOC Directive (1999/13/EC): Industries using solvents (basic, fine and specialty chemicals, metal degreasing, paint application printing, glues and adhesives, rubber) and others (oil refinery, use of CFCs, bread and alcoholic beverage production) are the main sources of VOC emission, therefore the Directive aims to regulate emissions from these sectors. Replacing 4 older directives, the IED promotes a treatment at source, by reducing the amount of solvents used and also keeping of solvent records to quantify the best solvent streams in the system. Regarding compliance of Turkish legislation, a twinning project has just been completed by the MoEU which includes a RIA process on the adoption of the VOC Directive and a drft legislation is being prepared.

Titanium Dioxide Directives (78/176/EEC, 82/883/EEC and 92/112/EEC): These directives aim to reduce and eliminate industrial waste caused by TiO2 production, which is heavily (80 percent) used in paper, plastics, paint and varnish sectors as a pigment. Older sub-directives tried to prevent, progressively reduce and ultimately eliminate pollution from titanium industrial waste and strengthen its monitoring and surveillance. The IED, by recasting the 3 existing directives, lowers the maximum emission limit values, both gas and liquid. It also extends its provisions to facilities with 20-50MW capacity, where the earlier directives only covered facilities above 50MW. As the IED only apply to the production of TiO2 and currently there are no such facilities in Turkey, this part of the IED is not yet relevant to Turkey.

Turkish Energy Sector and Possible Costs Implied by the IED

Turkish energy production is highly fossil fuel depended, where 88 percent of the total primary energy supply is through natural gas (31), coal (29) and oil (28) resources. Regarding coal utilization composition, it is reported that 51 percent of total coal use is through utilization of hard coal, 96 percent of which is imported. Combined with natural gas and oil import figures, import share of total energy sources is at 80 percent level, which brings the energy deficit to 6 percent of GDP. Thus, import dependency in energy production becomes the major driving force behind the Turkey's current account deficit problem. High fossil fuel utilization in the energy sector does not only exacerbate current account deficit by adding to the fragility indicators of Turkish economy but also increases the greenhouse gas (GHG) emissions. National GHG Inventory report depicts that energy sector accounts for 71 percent of total GHG emissions during 1990-2012 and is the leading CO, NOx and CO2 emitter among all sectors. Also, energy sector is reportedly responsible for 60 percent of SO2 emissions. These figures put the energy sector directly under the spotlight when compliance with the IED is considered. Provisions brought by the

IPPC and the LCPD, two major components of the IED, have important implications for the energy sector both at the level of electricity generation and residential/industrial utilization. Calculation of their effects on the energy sector would be a good indicator for the total cost of the compliance.

Although there is a strong relationship between economic activity (GDP growth) and per person net electricity consumption growth, official projections for 2030 goes beyond GDP and population growth projections for the same period. TEPAV predicts a 500 TWh electricity demand by 2030, which is almost 30 percent below official projections. In order to meet this demand, Ministry of Energy and Natural Resources (MoENR) estimates an average yearly cost of new investments at a level of $12 billion, including infrastructure investments for transmission and distribution. Also, increase in the use of domestically produced coal is prioritized as a part of the "Action Plan for Domestic Resource Depended Energy Production Program (2014-2018)", which would be associated with higher GHG emissions from energy sector due to low calorific value of domestic lignite reserves.

Revision of the electricity production license data reveals that 457 of total effective 1,697 production licenses are fossil-fuel fired plants and 20 of them are coal fired plant which are subject to LCPD with an average capacity of 617 MW. With the plants under construction and licenses under evaluation this number would increase to 28. The license figures also contradict with the aims of increasing domestic coal utilization, with 10 of the 11 licenses in evaluation being reported as planned to use imported coal.

The IED, with its emission control measures, has direct implications on the energy sector. Since the sub-directives imposes limit values on SO2, NOx, CO and dust emissions, utilization of technologies to reduce these emissions, is the main cost item related with energy sector's compliance with the IED. One technology discussed in this report is the flue gas desulphurization (FGD) technique, which is associated with 90 – 95 percent of decrease in SO2. Calculations are done for a 150 MW plant with 15 years of operation, where capital and operational/maintenance costs are included. Net present value of such installations is calculated within a range of € 73.5 – 104.8 million, which is compatible with the calculations presented for the EU member states. This investment need may correspond to 0.1 percent of GDP under the assumption that 50 percent of the plants need such installations.

An important aspect about this total investment is that, it is not directly related with energy production but rather with the filtration of the emissions caused by the coal fired power plants. Considering the number of new coal projects and the age of the

existing plants (50 percent over 15 years), investment need for new FGD installations and/or retrofitting of old installations are of concern, regarding its total cost.

In an era where action against climate change is considered as urgent and should be coordinated among nations, transition to low-carbon economies is considered as one of the principle strategies. An important component of such a strategy would be phasing out the use of coal fired power plants, which requires mass investments not only for its operation but also for emission control measures. Directing these investments to renewable technologies that have experienced a price fall at a level of 40-50 percent since 2008 and expected to fall even further, would have a double dividend by contributing both to low-carbon strategies and decreasing the import dependency in energy resources.

Introduction:

What is Industrial Emissions Directive (IED)?

Industrial production generates emissions of greenhouse gases and acidifying substances, wastewater emissions and waste, that all together account for a considerable share of the overall pollution in Europe. There are around 52,000 large industrial installations in Europe and the emissions of just 5 pollutants from these industrial installations account for €164 billion in annual health costs, without even considering the costs in environmental damage. On December 2007 the EU Commission proposed the Industrial Emissions Directive (IED) in order to minimize polluting emissions in the atmosphere, water and soil, as well as waste from industrial and agricultural activities, with the aim of achieving a high level of environmental and health protection. In particular, the environmental obligations industrial installations must undertake with respect to the IED include: preventive measures against pollution; the application of best available techniques (BAT); causing no significant pollution; reducing, recycling or disposing of waste in the manner that creates the least pollution; maximizing energy efficiency; preventing accidents and limiting their impact; remediating sites when activities come to an end.

Evolution of the IED

The IED brings together one horizontal and six sectoral pieces of legislation into a single directive on industrial emissions. It is the culmination of a two-year review launched by the European Commission in November 2005. The review of these directives was initiated in order to ensure clearer environmental benefits, remove ambiguities, promote cost-effectiveness and encourage technological innovation, while not altering the main underlying principles and level of ambition set in the existing directives.

The Integrated Pollution Prevention and Control Directive (IPPC) was the EU's main regulatory instrument to reduce harmful emissions. Although it required permits with strict environmental controls, many Member States had fallen behind on delivering permits, benchmarks for environmental performance were not consistently upheld, and vague language made infringement procedures difficult to pursue. The Commission therefore updated the IPPC and combined it with six other directives that include: the Large Combustion Plant directive (LCPD); the Waste

Incineration Directive (WID); the Solvent Emissions directive (SED); and the 3 directives pertaining to Titanium dioxide. The timetable regarding the IED can be summarized as follows:

2005	Start of two-year review of existing environmental directives on pollution control.
2007	EU commission proposes one unified directive for pollution control.
2009	Member States reach political agreement on the IED draft proposal.
2010	The European Parliament, and later that year the European Council, ratify the proposal.
2011	New provisions of the IED come into effect.
2014	The IED becomes part of national legislation in EU Member States and applies to new installations.
2016	IED scheduled to apply to Large Combustion Plants.

Even though Member States must bring into force the laws and regulations, as of 6 May 2014, the majority of Member States did not or only partially transposed the new directive by the 7 January 2013 deadline. Turkey, as part of its harmonization efforts with the EU legislation framework, has drafted bills to comply with the IED. These efforts are summarized under the coming sections of this report which individually analysis each component of the IED with respect to their coverage, path of evolution and the current situation in Turkey.

What does the IED cover?

The IED covers industrial activities with major pollution potential as listed in Annex I of the Directive, such as energy industries, production and processing of metals, mineral industry, chemical industry, waste management, rearing of animals, etc. In order not to inhibit R&D activities by imposing additional requirements, it does not apply to research activities, development activities, or the testing of new products and processes.

The IED functions upon an “integrated approach” which aims to prevent and reduce pollution to all aspects of the environment such as air, soil, water, resources/energy use, and waste generation from industrial activity. It is one of a few legal instruments that recognize that environmental impacts should not be tackled in an isolated way.

The “integrated approach” is one of the five main principles of the IED. The second principle aims to reduce emissions, primarily through the better application of Best Available Techniques (BAT). The BAT benchmarks were part of the IPPC directive, but have been strengthened in the IED primarily by giving NGOs a role in permitting procedures and challenging the environmental performance benchmarks through active public participation. The implementation of BAT serves as a reference for the drawing up of permit conditions. Operators need to work in line with BAT and illustrate compliance by creating a baseline report, either before initiating operations or before a permit is updated. BAT conclusions are used as a reference for setting permit conditions. The European IPPC Bureau of the Institute for Prospective Technology Studies at the EU Joint Research Center in Seville, Spain helps companies and licensing authorities determine BAT by organizing an exchange of information between EU Member states, industry, and environmental organizations. The results of the Commission are the BAT Reference Documents (BREFs).

The third and most controversial principle is that the IED contains certain elements of flexibility by allowing the licensing authorities to set less strict emission limit values in special cases. These cases are typically when an assessment shows that geographic location, local environmental conditions, or technical characteristics will create disproportionately higher costs compared to the environmental benefits. The cost-benefit assessment may therefore lead to flexibility measures in the permit. The flexibility however, is limited by the minimum binding requirements (called the European Safety Net) that allow limited amounts of emissions in certain highly polluting activities. In the next few years, the goal is to close gaps built into the minimum binding requirements, especially with regards to Coal-Fired Combustion Plants, which allows operators to evade expensive pollution abatement techniques or dodge the forced closures of plants in 2016.

The fourth principle of the IED is mandatory requirements on environmental inspections. Member states must set up their national environmental inspection systems and plans that cover all relevant installations and are regularly reviewed and updated. Site visits must be carried out for the appraisal of environmental risks, annually for high-risk installations and every 3 years for installations posing the lowest risks.

The fifth principle is public participation. The IED ensures that the public has a right to participate in the decision-making process and to be informed of the consequences. The public has access to permit applications, permits, results of emissions monitoring, and European Pollutant Release and Transfer Register (E-

PRTR) that has since been replaced with European Pollutant Emission Register (EPER). This register is intended to provide environmental information on major industrial activities. The IED accepts that citizen involvement, supported by NGOs, is essential for shaping the legal framework in ways that will provide a high level of protection for the environment as a whole.

What are the Emission Performance Standards (EPS)?

The European Emission Trading Scheme (EU ETS) was introduced in 2005, at which time future carbon prices were projected at €40-50. The current ETS price however is €5 per ton, which does not drive incentives for carbon capture and storage technologies (CCS). Since ETS is too vulnerable to economic developments and political choices, it fails to provide the business case for investing in CCS. Even though CCS is still being promoted as a cleaner alternative for the use fossil fuels, it hasn't been proved to be commercial yet due to its high technology and operating costs and problems about the storage spaces. That is why it has been removed quietly from the carbon strategies of many power companies in Europe and the United States.

A decade ago, the European Commission actively supported CCS by creating subsidy schemes for CCS demonstration projects throughout Europe. However, legal and financial constraints have prevented these large demonstration projects from getting beyond studies and the preparation stage. The European Commission tried to re-open the debate on CCS through a public consultation process during the first half of 2013. While it remains unclear how the whole process will unfold, it is clear the system does not provide long term certainty that a consistently higher ETS allowance price will be reached. Energy companies do not therefore have proper incentive to invest in expensive CCS. Also, as far as the 2^0C limit is concerned, it's been argued that the use of CCS technologies create just a little variation regarding the permitted use of fossil fuels in order to stay under this limit[1].

In 2009, the EU debated setting an EPS while revising the IPCC and unifying pollution regulations into the Industrial Emissions Directive. This proposal would have limited the CO_2 emissions of power plants to 450 g/kWh. However, the proposal was rejected in the European Parliament and an emissions cap-and-trade system was structured instead.

[1] McGlade, Christophe and Paul Ekins. (2015). The *Geographical Distribution of Fossil Fuels Unused When Limiting Global Warming to 2^0C.* Nature 517 (187-190)

Thus, efforts should be made to create an EU-wide CO_2 emissions performance standard to meet the expectations set by the IED and other complementary directives. In the mean time, Member States should take advantage of their autonomy to set their own CO_2 emission standards for power generation. Such an effort would be a significant leap towards a better environment, against the background of pressure from industry to outlaw EPS in the EU. So far, the UK and the Netherlands have set their own EPS.

EPS in the United Kingdom

According to the UK's EPS scheme, the Office of Carbon Capture and Storage oversees the implementation of the system to limit the amount of CO_2 emitted by new fossil fuel power stations. It is expected to help UK energy companies make wiser and environment friendly investment decisions.

The EPS acts as a regulatory backstop on the amount of carbon emissions new fossil fuel plants can emit, and helps deliver the Government's commitment to prevent the most carbon intensive power stations from being built. In particular, the EPS makes sure new coal-fired power stations are equipped with CCS technologies. Instead of providing a flexible system such as cap-and-trade, it imposes a plant-based standard that all installations must obey.

The statutory limit on the amount of CO_2 emissions allowed from the new fossil fuel generating stations is set at 450 g/kWh[2]. Power stations consented at that base level are then subject to that level until 2045, a process called 'grandfathering' providing long-term certainty to gas investors. Provisions exist for certain plants with regard to regulations about monitoring and enforcing compliance with the limit. To minimize regulatory duplication, both monitoring and enforcement arrangements are based on those for the EU ETS.

In short, EPS will limit the amount of carbon emitted by new fossil fuel plants, thus working to drive decarbonisation while maintaining security of supply and affordable prices. It will give investors greater certainty and is completely compatible with the ETS. It will ensure only the cleanest fossil-fired power plants could be built, avoiding the CO_2 lock-in caused by building polluting and inefficient coal power plants now on the promise of CCS, which may never be commercially viable. This is key, while the EPS will better incentivize CCS than the current system, more importantly it will promote alternative and renewable energy developments.

[2] This is the same amount originally proposed and rejected by the European Parliament in forming the guidelines of the IED.

In the case of Turkey, the EPS is not yet on the table since as a newly industrialized country, the Turkish government's strategy is only to comply with the minimum requirements. That is why only the compliance level regarding the components of the IED is investigated in the following chapters.

IPPC (2008/1/EC) and Turkey's compliance

What is the IPPC?

The EU's Directive on Integrated Pollution Prevention and Control aims to prevent/reduce emissions from certain industrial activities (as listed in Annex I[3] of the Directive). While doing so, it takes an integrated approach by including all relevant issues such as emissions into air, water and soil, waste management, efficient use of energy, accident prevention and restoration of sites when industrial activities cease. In cases where stricter national Environmental Quality Standards (EQS) are present, the IPPC creates room for improvement of environmental quality by requiring additional measures in the permit. Without prescribing the use of any technique or specific technology, the IPPC requires that the integrated permits, including emission limit values (ELVs), to be based on Best Available Techniques (BAT), which are updated on regular basis. Other factors that determine ELVs can be listed as local environmental conditions, the technical characteristics of the installation and its location.

Even though BAT identifies the most effective and advanced techniques for providing the basis for ELVs for different kinds of installations through BREFs (BAT Reference Documents), it also ensures that the cost of applying techniques is not excessive in relation to the environmental protection they provide. Therefore, the IPPC determines BAT not only through environmental assessment (identification of the technology with the lowest overall environmental effect) but also through economic assessment (by including capital and operating costs, as well as any possible cost saving). The IPPC also puts no extra burden on R&D activities by leaving out the installations or parts of installations used for research, development and testing of new products and processes.

In detail, permits granted to installations under the IPPC ensure minimization of long distance and trans-boundary pollution; protection of soil and groundwater and proper management of waste; protection of the environment in times of start-up, malfunction, leaks or temporary stoppages; site monitoring and remediation; proper monitoring of emissions with specified methodology, frequency and

[3] Annex I covers following activities: energy industries, production and processing of metals, mineral industry, chemical industry, waste management and others such as specific agricultural installation.

evaluation procedures; submission of regular reports to the regulator; provision of immediate information to the regulator in cases of incident or accident that may cause pollution.

Public participation is also an important component of the IPPC, where permits for new installations, any substantial change in the operation of an installation or updating of a permit/permit condition should be open to public discussion by the regulator as early as possible to ensure efficient participation.

How has the IPPC evolved? How does the IED update the IPPC Directive?

As stated earlier, the adoption of the IED in 2010 brings together the horizontal IPPC directive and 6 other sectoral directives by cancelling out possible overlaps and simplifying procedures. The IED also imposes new provisions on the IPPC, mainly by strengthening the role of the BREFs. BREFs are now recognized as more active documents within the permit process since IED requires the determination of ELVs through BAT and effective use of BREFs in this sense. The IED also revises minimum ELVs for installations, which were previously regulated by sectoral directives (such as large combustion plants). Regarding LCPs, a detailed explanation of flexibility mechanisms and derogation requirements are also provided by the IED. In addition, precise rules for planning inspection of installations are specified and permit conditions are revised to be integrated with the BREFs.

What is the level of compliance in Turkey with the IPPC Directive?

With the international assistance provided through a Twinning Project[4], which was completed in 2013, the Ministry of Environment and Urbanization (MoEU) has prepared a draft legislation for the purpose of adopting the IPPC component of the IED into Turkey's legal framework. The project also involved the preparation of guidance documents for the applicants and the staff of the MoEU and national BAT sector guides for the selected 4 sectors[5]. A training programme was also designed for these sectors in order to improve the quality of applications and of the integrated permits. In 2012, draft legislation was open to discussion of stakeholders and the MoEU has been revising the legislation in light of the responses coming from public and private stakeholders. It is expected that the revision will be completed by the end of 2014 and new legislation will come into force in early 2015.

[4] Project title: IPPC-Integrated Pollution Prevention and Control, Twinning number: TR 08 IB EN 03.
[5] These 4 sectors are Coal and Lignite Combustion Plants, Textile Industry, Electric Arc Furnace and Steel Installations and Oil Refineries.

Parallel with this Twinning Project, a Technical Assistance (TA) Project[6] was also pursued by the MoEU, which aimed at the conduct of a regulatory impact assessment (RIA) on the implementation of the IPPC in Turkey, preparation of an online IPPC database and the conduct of an inventory evaluation report. The preparation of the database aimed at collecting and updating information about over 6 thousand installations that are subject to integrated permit process. Training for the MoEU experts who are responsible for updating the database was planned into the Project to ensure a more effective operation of the database, as well as trainings on RIA and the implementation of the IPPC. A survey evaluating the effects of the IPPC on firms' strategies, was also conducted to provide more data for a possible derogation application of the IPPC by the Turkish government to the EU.

Even though the MoEU recognizes the complementarity of all components of the IED, these projects have only focused on the transposition of Section I: the horizontal Articles (1-9) and Section II: the Articles concerning the activities listed in Annex I of the Directive (10-27).

The RIA study conducted as a part of the above mentioned TA Project deserves more attention as it calculates the total monetary cost of complying with the IPPC for Turkey. There are 3 alternative ways of adopting the IPPC defined within the study. These are:

- Adoption of the IPPC with maximum environmental benefits: a strict implementation of the legislation with no derogations to any of the sectors.
- Adoption of the IPPC with a feasibility focus: adoption timetable and criteria of each sector are negotiated between the EU, the Turkish government and sector representatives. Administrative simplification is an exception for some SMEs (with a better compatibility with environmental standards), and limited financial incentives are available to SMEs and LCPs.
- Adoption of the IPPC with a simplified scheme: environmental legislation is coordinated with all relevant policy areas through an inter-ministry body, adoption dates are negotiable at installation level, administrative simplification (both at the application and reporting phases) are available to all SMEs, and there are vast incentives for adoption mobilizing both national and EU funds.

[6] Project title: Technical Assistance for implementation of IPPC-Integrated Pollution Prevention and Control in Turkey, Ref no: EuropeAid/129470/D/SER/TR, TA no: TR0802.04-02/001.

Based on the number and technical specifications of installations present in previously prepared IPPC database, the study calculates the total cost of the IPPC in Turkey within a range of € 20-40 billion, during the first 10 years of implementation. A separate RIA study was also be conducted to determine the cost and benefits of compliance of the Turkish energy sector with the National Emissions Ceiling Directive (2001/81/EC), again as a part of the TA project[7] concluded in 2012. According to this study, the cost of emission reduction between 2010-2025 is a little over € 18 billion with 2010 prices and the possible yearly cost corresponds to %0,1 - 0,2 of GDP.

The RIA studies and IPPC inventories prepared through TA projects sets the position of the MoEU for EU negotiations. Even though the IPPC is expected to come into force in 2015, the MoEU is planning for 10 years of a phased implementation of the legislation. The cement industry is presumed to be the first sector which is going to comply with the IPPC, and the MoEU is designing a project jointly with the Ministry of Development for the compliance of the automobile industry next.

What are the current discussions on the IPPC?

Draft legislation prepared by the MoEU in 2012 faced with many criticisms raised by the stakeholders. Many of them focus on the additional burdens that the adoption of the IPPC would impose on industries that are subject to this regulation. These additional burdens do not only include investment in new technologies, but also an active public participation procedure and measures that must be taken during the cease of activities. Therefore, the industrial sector demands for a phased compliance scheme along with financial support provided by the government to all types of installations regardless of their size. Also, prepared BATs are criticized for not being aligned with the economic and technical realities of Turkish industry. Thus, revision of these 4 BAT documents by sectoral experts, as well as preparation of the remaining BAT documents is another issue brought to the interest of MoEU officials.
The industrial sector mainly demands a more predictable investment climate to preserve or even to improve the competitiveness of the Turkish economy and therefore asks for a more clarified legislation and a simplified compliance scheme. Taking into account these views and concentrating on a phased compliance with derogations, the MoEU is now reviewing draft legislation to be ready by the end of 2014.

[7] Project title: Improving Emissions Control, Ref no: EuropeAid/128897/D/SER/TR, TA no: TR802.03/001

The LCPD (2001/80/EC) and Turkey's compliance

What is the Large Combustion Plants Directive (LCPD)?

Large combustion plants have several important effects on the environment. These can include emissions into the air, water consumption, waste water discharge and waste control. Emissions into the air are mainly results of the combustion process itself. Different types of fuel used in the process result in different types of emissions. When coal is used, sulphur dioxide (SO_2), nitrogen oxide (NOx), carbon dioxide (CO_2) and dust are emitted into the air. Water is also used during the process of combustion because of its cooling effect. Hence, the higher the heat is during the combustion process, the greater the polluting effect of the water discharge. Combustion plants using coal also produce large amounts of waste in the form of cinder and ash.

The LCPD aims to limit the emissions of large combustion plants, those with thermal input of at least 50 MV, into the air. In doing so, the EU plans to limit the effects of these pollutants on both the environment and human health. The provisions cover the use of all types of fuel (solid, gas or liquid), resulting in the discharge of SO_2, NOx and dust into the air. Yearly limits for these emissions have been determined according to best practices. The directive also encourages the process of cogeneration, the joint production of heat and electricity.

The LCPD brings different provisions on the compliance with these limit values: While all plants need to comply with limits on SO_2, NOx and dust, younger plants, those authorized after 27th November 2002, need to carry out these requirements according to Part B of Annexes III to VII. For plants authorized before 27th November 2002 and after 1st July 1987, Part A of the Annexes III to VII specifies the details. For older plants, authorized before 1st July 1987, substantial cuts are required as well. While these details specify plant-based emissions, national plans for emission reduction is also provided as an option, with a target limit total number of emissions in the country. Under this directive, plants may choose not to comply with the limits provided that they do not operate for more than 20,000 hours between 1st January 2008 and 31st December 2015.

Member states are required to form national emission reduction plans and present these to the European Commission by 27th November 2003. The Commission is to provide guidelines for the member states in designing these national plans. The national plans need to include detailed information on objectives, measures, monitoring mechanisms and timetables. The methods for monitoring and measuring emissions are also provided in the Annex VIII of the directive.

New provisions brought by the IED

The IED, adopted in 2010, will bring more stringent rules on the power generators within the EU, effectively replacing the LCPD in 2016. The ELVs of large combustion plants for SO_2, NOx and dust are renewed on the basis of current best practices, bringing more stringent limits, by almost more than half:

- SO_2 limits are decreased from 500/Nm^3 mg to 200 mg/Nm^3,
- NOx from 500 to 200 for solid fuel and 400 to 150 for liquid,
- Dust from 100 to 20 Nm^3.

All large combustion plants (equal to or greater than 50MW) should comply with these new limit rules or close down by the beginning of 2024 or after 17.500 hours, whichever is sooner.[8] "Older" plants that are subject to less stringent limit values have a lower limit of working hours per year: Plants built before 2003 can operate with higher limit values, as long as they do not run more than 1.500 hrs per year, instead of the 2.000 hrs per year in the LCPD. BATs and BREFs play a more important role in the IED compared to the LCPD.

Under the IED, similar to the LCPD, member states are to design "transitional national plans" and present these to the European Commission. The scope and limits of these national plants are elaborated and specified more thoroughly in the new directive. This gives member states an option for a more flexible transition until mid the 2020s. Especially for countries that are heavily reliant on fossil fuels such as Poland, this gives a better chance of a level playing field. [9] However, this compromise is not well received in countries such as Germany, where the directives on emissions are applied more stringently already.

[8] Bloomberg Research Note, 2014

[9] http://www.independent.co.uk/news/business/news/eu-gives-power-stations-until-2020-to-meet-emissions-rules-2021093.html

Turkey and the LCPD

In order to comply with EU regulations, the "Large Combustion Plants Directive" has been transposed into Turkish law by the By-Law No.27605 on 8th June 2012. With the enforcement of this By-Law, Turkey aims to control the emissions released into the air in the form of dust, fume, gas, steam and aerosols and clear the unwanted effects of these pollutant on human health and the environment. It applies to:

- New plants using other fuels form 8th June 2010
- New plants using liquid fuels form 12th June 2012
- Existing plants from 8th June 2019

Although, is an important step regarding emissions from fossil fueled power plants, it should be emphasized that with the transposition of the LCPD, Turkey only complies with the earlier version of the Directive (2001/80/EC), rather than enforcing the new limits envisioned by the IED for large combustion plants. As reported by MoEU officials, the level of compliance with this version of the Directive is at about 98 percent, where the remaining 2 percent represents the national action plan that is missing.

Unlike the IPPC, a regulatory impact analysis (RIA) has not yet been performed prior to the transposition of the LCPD into the Turkish legal system. As of July, 2014 the MoEU has started a twinning project for the purpose of conducting an RIA study to estimate the effects of the LCPD implementation on publicly owned LCPs in Turkey. For this purpose, a survey will be conducted to prepare a full inventory of LCPs (covering both public and private LCPs) including information about their thermal capacities, emission values and utilized technologies. Also, training sessions will be provided to all stakeholders, the scope of which will be decided upon a needs assessment, which remains to be conducted.

There are about 37 LCPs using hard coal in Turkey, 34 of them with a capacity of at least 300MW. Although, the state owned plants are still in operation, the privatization process is underway and transfer of these plants to the private sector is expected to be finalized soon. An improvement in the amount of emissions released by these plants is estimated to be greater than other sectors. Compliance with the IED is therefore, expected to put pressure on electricity prices in the future.[10]

[10] Türkiye'de EED/EKÖK Direktifinin Uygulanması için Düzenleyici Etki Analizi (DEA) Raporu, 2013

The Waste Incineration Directive (2000/76/EC) and Turkey's compliance

What is the Waste Incineration Directive (WID)?

An "*incineration plant*" is any stationary or mobile technical unit or equipment dedicated to the thermal treatment of wastes with or without the recovery of the combustion heat generated. This includes the incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes in so far as the substances resulting from the treatment are subsequently incinerated. These kinds of plants aim to dispose of waste with thermal treatment. On the other hand, "*co-incineration plant*" means any stationary or mobile plant whose main purpose is the generation of energy or production of material products. Co-incineration plants use wastes as a regular or additional fuel; or in which waste is thermally treated for the purpose of disposal.

Incineration and co-incineration methods have been used by EU countries for several decades in order to reuse wastes for generating energy. Across Europe, there are more than 400 incineration and/or co-incineration plants. For these plants, the 2000/76/EC directive was established by the EU Commission fourteen years ago in order to prevent or restrain both negative effects of incineration and co- incineration of waste via emissions into air, soil, surface water and groundwater on environment and resulting risks to human health.

Before this directive, there were three different directives on waste management such as 89/369/EEC (the prevention of air pollution from new municipal waste incineration plants), 89/429/EEC (the reduction of air pollution from existing municipal waste-incineration plants) and 94/67/EC (incineration of hazardous waste). Via 2000/76/EC, these were reassessed and merged into one.

New regulations were enforced by this directive to control emissions periodically by way of improving measurement technologies. Detailed emission limits for hazardous and non-hazardous elements and measurement techniques were determined once again within this directive's annexes. Daily, monthly and annual controls were shaped with limitations more strictly. Under the provisions of this directive, the member countries need to adopt more stringent rules in the European continent.

According to the latest directive (2000/76/EC) on incineration of waste, the permit for an incineration or co-incineration plant should also comply with any applicable requirements laid down in Directives 91/271/EEC (concerning urban waste water treatment), 96/61/EC (concerning integrated pollution prevention and control), 96/62/EC (ambient air quality assessment and management), 76/464/EEC (pollution caused by certain dangerous substances discharged into the aquatic environment of the Community), and 1999/31/EC (the landfill of waste).

When the EU Commission dealt with this directive, parliament also took public participation during the permitting process of incineration plants into account in order to ensure transparency in the permitting process. The public should have access to information with a view to allowing it to be involved in decisions to be taken following applications for new permits and their subsequent updates. New permits for incineration and co-incineration plants should be available at one or more locations accessible to the public, such as local authority offices, for an appropriate period to enable it to comment on them before the competent authority makes a decision.

Incineration of waste regulation in Turkey

In order to adopt new WID (in compliance with EU accession period), the MoEU declared provision about incineration of waste, which entered into force after it was published in the official gazette in 2010. However, there is still a gap between two regulations which should be filled by new amendments to recover the management process of incineration and co-incineration of waste.

One of the crucial articles of this directive, which is about access to information and public participation (Article 12), was not considered by the MoEU. Article 17 of the provision states that information about permits of incineration and co-incineration plants and subsequent updates can be accessed by the public on the web site of the MoEU. It points out that without direct public participation and detailed information about the process of application and permit, the permits of incineration and co-incineration plants can be given by competent authorities.

Another crucial requirement for compliance is regulatory impact assessment (RIA). Although the RIA is essential to transforming policies to the execution of the compliance of regulations, the WID was enforced in order to comply with EU regulations without an accompanying RIA study. The absence of an RIA study

resulted in problems during the implementation phase, some of which are translation problems and ambiguous statements about advanced technologies that are to be utilized. Facing these problems without an effective implementation of the legislation, the MoEU is now revising it after 4 years, to be executed by early 2015.

Moreover, high-standard measurement techniques are required to monitor emissions to ensure compliance with the emission limit values for the pollutants. But in Turkey, control mechanisms of emissions for incineration and co-incineration plants have not been improved yet. Although the limit of emissions is defined by the provision explicitly, technical departments and the capacity of incineration and co-incineration plants are not enough to implement the regulation faultlessly.

Waste incineration and the energy sector in Turkey

Although the main aim of the WID is related to the environment and human health, a subsequent objective of the directive is to achieve energy conservation and production (especially at the local level).

In Turkey, there are some projects about incineration and co-incineration plants such as İSTAÇ, İZAYDAŞ, AKÇANSA etc. Especially in the cement industry and municipal initiatives, incineration and co-incineration plants have been used almost for four years. As cement production requires intensive energy, cement producers have tried to find out solution to decrease fuel consumption. Recently, to reduce energy costs, the cement industry has been making increasing use of incineration and co-incineration of waste. With the fact that Turkey is ranked 6th among cement producing countries, with production of 70 million tonnes of cement per year, incineration and co-incineration of waste in cement production would be a significant tool to reduce costs. And on the local level, saving and producing energy by way of incineration and co-incineration of waste would be preferred by municipalities as a sustainable energy measure. At least, to prevent loss of electricity throughout transmission lines (5 percent in 2014[11]), municipal incineration and co-incineration plants can be a solution to overcome this loss at the local level.

For instance, Scandinavian countries have the highest rates of garbage incineration, using the measure on at least 50 percent of their waste. Such plants have become both the mainstay of garbage disposal and a crucial fuel source across Denmark, from wealthy exurbs like Horsholm to Copenhagen's downtown area. Their use has

[11] EPDK- 31/04/2014 http://www.epdk.org.tr/index.php/elektrik-piyasasi/tarifeler?id=142

not only reduced the country's energy costs and reliance on oil and gas, but also benefited the environment, diminished the use of landfills and cut carbon dioxide emissions.[12] However, incineration and co-incineration plants are prevalent across the continent. In eastern and southern Europe, incineration rates lag far behind northern Europe, posing significant environmental problems due to lack of high tech, efficient control mechanisms and high cost of incineration and co-incineration plants.

As mentioned above, there is inefficiency about incineration and co- incineration of waste in both southern, eastern European countries and Turkey. In case of elimination of deficiencies, incineration and co-incineration of waste would be a significant step to reach a solution on saving energy, as well as improving Turkey's industry and economy as a whole.

Current discussions on the incineration and co-incineration of waste

Despite new amendments that are implemented by the government, there are still controversial issues on the civil society level. There are more than one hundred NGOs working on the issue, most of them being more concerned about the environmental outcomes of the incineration process than its energy saving nature. Their claim is that society continues to generate more waste due to the activity of waste incineration. They argue that incinerators may reduce the volume of solid waste, but they do not dispose of the toxic substances contained in the waste. They create the largest source of dioxins, which is one of the most toxic chemicals known to science. Incinerators emit a wide range of pollutants in their stack gases, ashes and other residues. The filters used to clean incinerator stack gases produce solid and liquid toxic wastes, which also need to be disposed.[13] Therefore, recycling of waste rather than waste incineration is discussed by environmental NGOs.[14]

[12] Rosenthal, Elisabeth, "Europe Finds Clean Energy in Trash, but the US lags", 2010. http://www.nytimes.com/2010/04/13/science/earth/13trash.html?pagewanted=all&_r=0

[13] Greenpeace Turkey, "Atık Yakma Neden Yasaklanmalıdır?" http://www.greenpeace.org/turkey/tr/campaigns/di-er-kampanyalar/toksik-maddeler/at-k-yakma-neden-yasaklanmal-d/

[14] In Turkey The Union of Chambers of Turkish Engineers and Architects (TMMOB) - Chamber of Environmental Engineers (ÇMO) and Greenpeace Turkey are some of the NGOs that advocate for waste recycling. On the EU side Zero Waste is an example of an initiative which encourages waste recycling.

Although there are different perspectives on waste incineration, it is obvious that incineration and co-incineration plants can provide heat for municipal heating systems or steam for electricity, recovering some of the energy used to produce fuel. Recycling and incineration of waste can coexist within well-defined effective policies which can be managed by the private, public and civil society initiatives. Like Scandinavian countries mentioned above, countries that are expanding waste-to-energy capacity, like Denmark and Germany, typically also have the highest recycling rates.

The Volatile Organic Compounds Directive (1999/13/EC) and Turkey's compliance

What is the Volatile Organic Compounds Directive (VOC)?

The volatile organic compounds (VOC) emissions are mainly due to combustion and the use of solvents, degreasers, preservatives etc. and therefore come from many sources. VOCs are a very large family of diversified products, such as benzene, acetone and perchlorethylene, which are in the state of gas or can evaporate easily under normal conditions of temperature and pressure. These are highly volatile substances.

The VOCs are carcinogenic pollutants or potentially carcinogenic to humans. Others, upon degradation in the atmosphere contribute to the disruption of chemical equilibria. These disturbances can result in the formation or accumulation in the environment of harmful compounds for plant and animal species (eg ozone formation in the lower atmosphere). To minimize these impacts, VOC emissions must be reduced, which is the purpose of the chapter limiting VOC emissions.

Industrial processes produce a significant portion of VOC emissions. These are both industries using solvents (basic chemicals and fine chemicals, specialty chemicals, metal degreasing, paint application, printing, glues and adhesives, rubber, etc .) as well as others (such as refining oil, the use of CFCs, production of alcoholic beverages or bread, etc.)

How were VOCs regulated in the EU?

At EU level, there were four older directives since 1994:

- **Directive 94/63/EC of 20 December 1994** on emissions resulting from the storage of petrol and its distribution from terminals to service stations (OJ L365, 31/12/1994 p24-33)

- **Directive 96/61/EC of 24 September 1996**, called the directive "IPPC" on prevention and integrated pollution reduction,

- **Directive 98/70 / EC** on the quality of petrol and diesel fuels. It modifies the other **Directives 93/12 / EEC** and **98/69 / EC** on measures to be taken against air pollution by emissions from motor vehicles

- **Directive 1999/13/EC of 11 March 1999**, called "Solvents Directive" on the limitation of emissions of VOCs due to the use of organic solvents in certain activities and installations (OJ L085 of 29/03/1999 p1 -22). Coating activities of textiles, fabrics, paper and plastics in particular are affected by this directive, which imposes limits on various solvents. The limit values and their implementation are based on the age of the company, the existence or absence of reducing equipment and sector of activity of the company

How does the IED approach VOCs?

The IED seeks to promote a treatment at source, by reducing the amount of solvents used, rather than downstream processing.

The IED contains emission criteria for approximately twenty industrial activities (activities listed in Annex I), from printing, to the manufacture of pharmaceutical products, through the facilities of dry cleaning, surface cleaning, wood impregnation and car bodies.

The provisions of the VOC Directive can be met in two ways:

1. Comply with limits on various emissions (waste gas, fugitive emissions and total emissions) listed in Annex IIA,
2. Implement a reduction plan, involving a primary or secondary technique, enabling the values limits in Annex IIB.

The IED also addresses the keeping of solvents records. The goal is to quantify all the best solvent streams in the system, to see more clearly in programming in general, and diffuse emissions in particular.

Where does Turkey stand with respect to VOCs?

MoEU has completed a twinning project that aimed at providing a regulatory impact assessment of adoption of industrial emissions of volatile organic compounds. As inquired from the MoEU, a draft legislation is being prepared, but the details of the study are not accessible since the process is not open to the public yet.

Titanium Dioxide Directives (78/176/EEC, 82/883/EEC and 92/112/EEC) and Turkey's compliance

What is titanium dioxide?

Titanium dioxide (TiO_2) is an oxide of the element titanium. It is also called titania or titanium oxide, or titanium white and pigment white when used as a pigment. This versatile chemical product has a wide range of industrial applications as a wide pigment, such as sunscreen, foodstuffs, coatings, paper, printing ink, textiles and fabrics, providing or enhancing whiteness, opaqueness and brightness. Hence, most of the titanium dioxide production is used for the manufacturing of white paint.[15] A share of up to 80 percent of the world's TiO_2 is used for paper, plastics, paint and varnish. The remaining 8 percent is usually used for paint ink, fibers, rubber, cosmetics and food products.

The process of producing TiO_2 involves reacting titanium ores with chlorine gas or mostly, with sulphuric acid.[16] The chlorine process results in Co_2 and chlorine, while the sulphate process does not result in any greenhouse gas emissions. However, it produces combustion related emissions.[17] Titanium dioxide can be absorbed into the human body through the inhalation of its aerosol.

The European Union, through several directives, aims to both protect the environment and remove the competitive imbalances stemming from different regulations on the reduction and elimination of industrial waste caused by TiO_2 waste.[18] The most current directive regarding the emissions caused by the production of TiO_2 in the EU is the IED.

The provisions implied by the previous directives

Before the IED, three separate directives regulated the emissions caused by the production of TiO2.

[15] EPA, 2009
[16] CEFIC, 2014.
[17] EPA, 2009
[18] Chicago Law Journal

1. 78/176/EEC – 1978, on Titanium Dioxide Industrial Waste (DISPOSAL)

This directive aimed to prevent, progressively reduce and ultimately eliminate pollution from titanium industrial waste in all member states.[19] Hence, it covers all titanium dioxide production activities within the member states of the EU. The provisions in this directive aim to improve the effects of industrial waste, both from the perspective of human health and environmental considerations. Any discharge, dumping, storage, accumulation or injection of waste is subject to the authorization of member states. This authorization will be viable for only a limited amount of time, hence periodical controls are required.

This directive renders the authorized member state to determine the responsible entity to periodically control the industrial waste in all physical, chemical, ecological and biological respects. The member states are to design and apply programs that will lead to the gradual decline and ultimate elimination of the pollution caused by titanium dioxide. Under the provisions of this directive, the member countries can also bring more stringent rules if needed.

2. 82/883/EEC – 1982, of Procedures for the Surveillance and Monitoring of Environments Concerned by Waste from Titanium Dioxide (MONITORING AND SURVEILLANCE)

This directive is concerned with the monitoring and surveillance of waste from titanium dioxide production. Any discharge, dumping, storage, accumulation or injection of waste is prone to monitoring and surveillance. The effects of these activities on soil (both above and underground) and water are covered by this directive. The directive foresees that samples are to be collected by the relevant member state authorities with minimum frequencies, and these are to be monitored according to the parameters provided in the annex of this directive. While some of these parameters are mandatory, some are optional. (The frequencies of these samplings can decrease, according to the results obtained from the samples.) For measuring the samples, common field reference methods are applied. Similar to 78/176/EEC – 1978, these samples are monitored on their physical, chemical, biological and ecological aspects. The member states are allowed to derogate from this directive in case of flood, unfavorable weather conditions or other natural disasters. The locations of the samplings are decided on a case-by-case basis.

3. 92/112/EEC – 1992, procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry (PROGRAMS FOR REDUCTION OF POLLUTION)

This directive aims to fill the legal void caused by the annulment of Directive 89/428/EEC. It covers solid waste, weak and strong acid waste, neutralized waste, treatment waste and dust as products of titanium dioxide production, both through

[19] EC, 1978

sulphate and chloride processes. As of June 1993, it bans the dumping of waste from aircraft or ships, discharges into territorial waters or high seas of solid waste or strong acid waste through sulphate process. Other types of waste are subject to limit values provided in this directive. Each member state is responsible for the monitoring of compliance with these limit values. They are also required to establish that discharges into the atmosphere are within the limit values imposed by this directive.

The provisions brought by the IED

The IED has a special section (annex/article) for installations that produce TiO_2. The articles 66-70 are related to TiO_2 as well. This part basically recasts the three existing directives regulating the production of TiO_2, rendering them invalid/out of date. It eliminates the inconsistencies and by lowering maximum emission values, brings more stringent limits on emissions, both gas and liquid. According to the new directive, the CEN Standards are to be used in the monitoring process. The IED also extended its provisions to facilities with 20-50 MV capacity, while the previous directives only covered facilities above 50 MV. This also applies to the articles related to TiO_2 production.

Turkey and titanium dioxide waste regulation

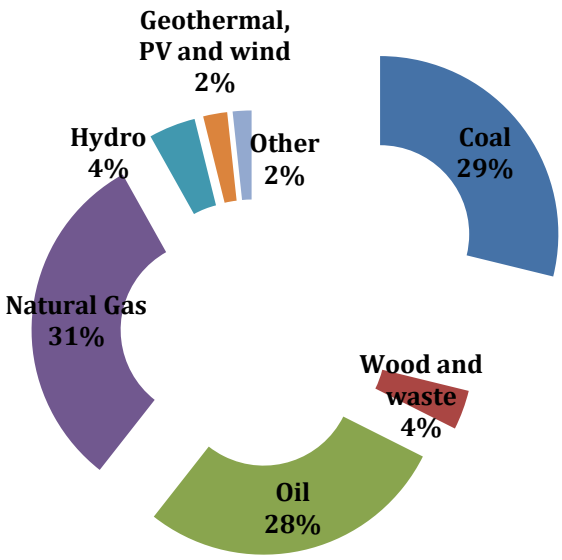
There are currently no TiO_2 producers in Turkey. As the provisions of the IED apply only to the production (and not use) of TiO_2, the accordance of Turkey's regulations to the EU is not yet relevant.

Possible Effects of the IED on Turkey's Energy Sector

Turkey's Energy Outlook

Turkish energy production is characterized by a heavy use of fossil fuels and import dependency. The total use of natural gas, coal and oil adds up to 88 percent of total primary energy supply in 2013 (Figure 1). The average import to primary energy supply ratio is 80 percent but looking at oil and natural gas, this ratio reaches 112[20] and 99 percent, respectively. Regarding coal, 58 percent of the total supply is being imported, which is solely hard coal[21]. The composition of coal utilization of Turkey is 51 percent hard coal and 38 percent domestic lignite.

Figure 1: Share of energy sources in primary energy provision, 2013



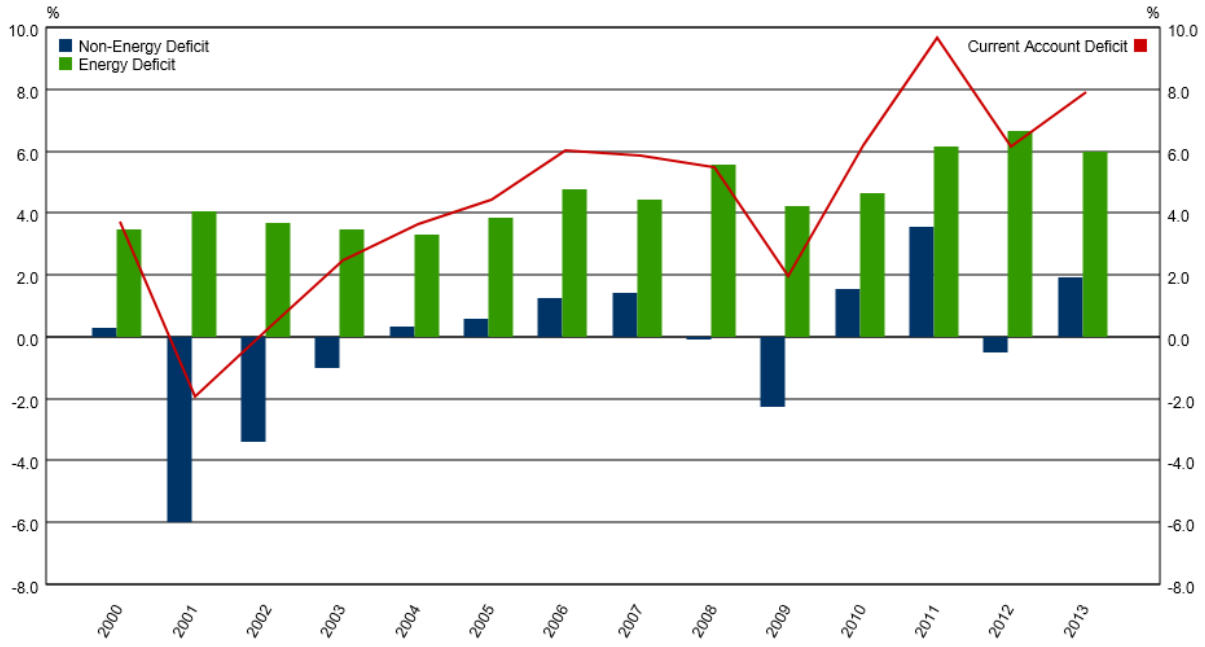
Source: 2014 General Energy Equilibrium Table, MoENR

Import dependency in energy resources at a level of 80 percent is also reflected in current account deficit figures. The increasing trend of Turkey's current account deficit to GDP ratio, starting especially from the beginning of 2000s coincides with increasing share of energy deficit in total current account deficit (Figure 2). Taking the average of deficit to

[20] International marine and aviation bunkers correspond to about 10 percent of total primary energy supply, which are not shown import figures.
[21] 96 percent of hard coal is being imported.

GDP ratio for the period 2000-2013, the energy deficit is calculated as 4.6 percent of GDP, where the total current account deficit is 4.4 percent due to negative figure presented for non-energy deficit (-0.2 percent). Also the share of net energy balance in total foreign trade balance has soared to 57.7 percent in 2014, starting from a level of 27.6 percent in 1996 and with an average of 51.3 percent during the period 2000-2013. These figures emphasize the importance of energy import dependency as one of the fragility indicators of the Turkish economy.

Figure 2: Current account deficit: Energy and non-energy (as % of GDP)



Source: Balance of Payment, Turkish Data Monitor

Due to the dominance of fossil fuel use in the energy sector – mainly electricity generation – it is the major source of greenhouse gas (GHG) emissions. As reported by the National Greenhouse Gas Inventory Report, energy sector emissions account for 71 percent of total GHG emissions during the period 1990-2012. Decomposing the GHGs into direct and indirect emissions, the inventory reveals that the energy sector is the primary cause of CO, NOx and CO_2 emissions (Table 1). Arriving at similar results with different levels, a report[22] on the effects of compliance with the National Emissions (NEC) Directive provides a complete emissions inventory of SO_2, NOx, NMVOC and NH_3 gases which are regulated by the directive. Although the results do not completely

[22] "Improving Emissions Control" is a technical assistance project which aims to determine national emissions ceilings for Turkey of the NEC Directive.

agree with the GHG Emissions Inventory and GAINS 23 model results, the NEC inventory depicts the energy production sector as being responsible for 60 percent of SO_2 emissions and 34 percent of NOx emissions (Figure 3).

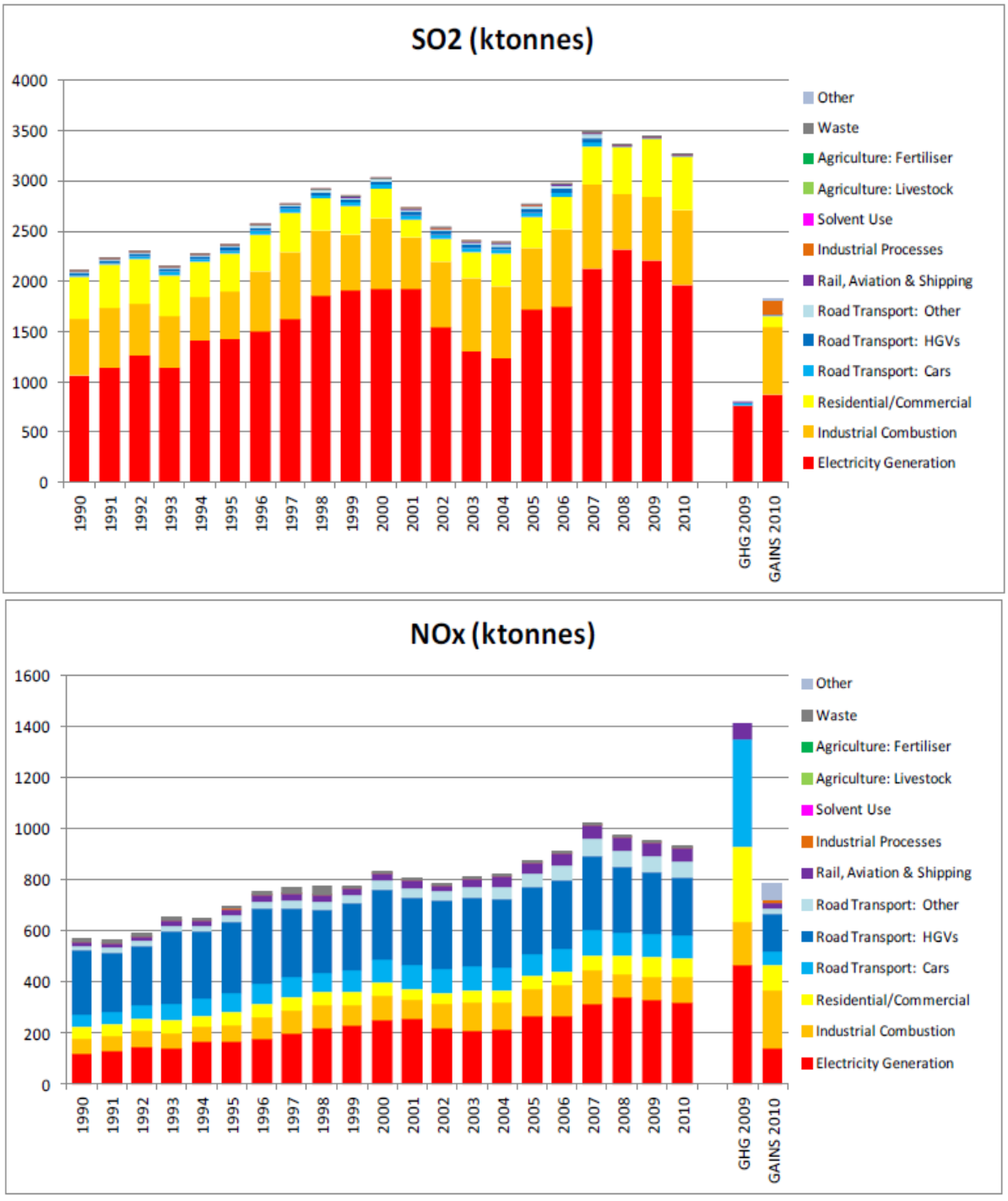
Table 1: Share of energy sector in total GHG emissions, % (1990-2012 average)

Direct GHG emissions		Indirect GHG emissions	
CO_2	88.1	**CO**	97.5
CH_4	10.2	**NOx**	94.2
N_2O	8.3	**NMVOC**	48

Source: National Greenhouse Gas Emissions Inventory (2012), TurkSTAT.

[23] Greenhouse Gas and Air Pollution Interactions and Synergies Model developed by International Institute for Applied Systems Analysis (IIASA).

Figure 3: SO_2 and NOx emissions by sectors, 1990-2010 (ktonnes)



Source: Technical Assistance for Emissions Control – Final Report (2012), MoEU.

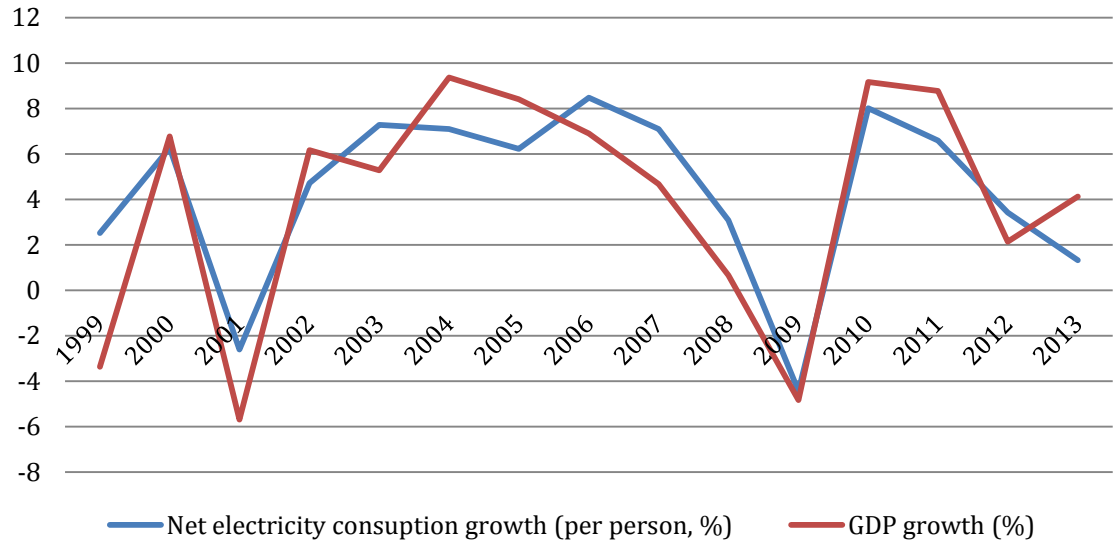
These figures put the energy sector directly under the spotlight when compliance with the IED is considered. Provisions brought by the IPPC and the LCPD, two major components of the IED, have important implications for the energy sector, both at the level of

electricity generation and residential/industrial utilization. Calculation of their effects on the energy sector would be a good indicator for the total cost of compliance.

Energy Projections

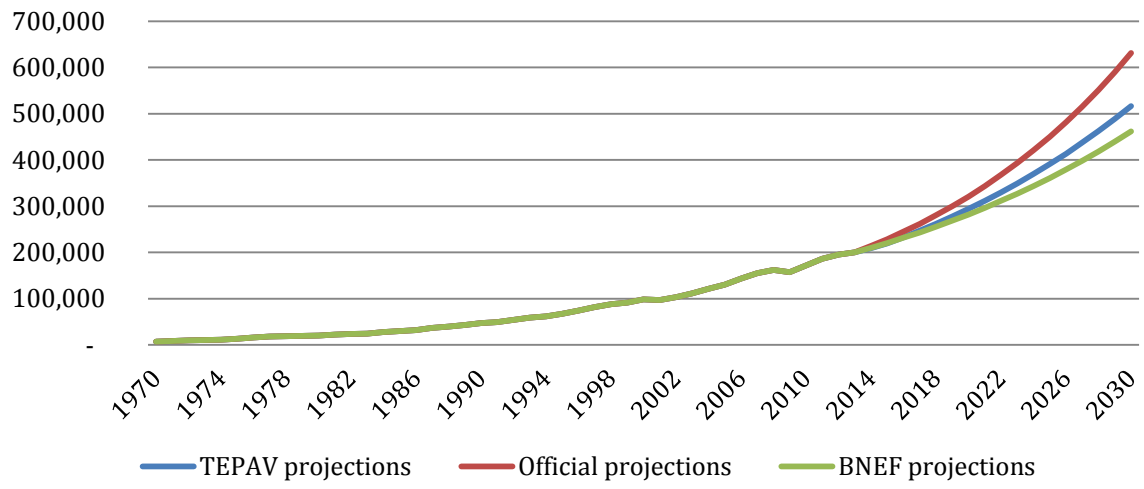
As depicted by Figure 4, there is a strong relationship between economic activity and electricity demand. Even though GDP growth is the main driving force behind electricity demand, adjusting it with population growth gives us a better picture. Historical electricity demand figures (1970 through 2013) show an average annual growth rate of 8 percent. Taking the official demand projection for 2023 as an anchor, which is around 400 TWh, brings the average annual growth rate down to 7 percent. With such a rate, electricity demand would almost triple and reach 630 TWh by the end of 2030. Figure 5 compares these numbers with two other projections. The lowest projection comes from Bloomberg New Energy Forum (BNEF) scenarios as presented in "Turkey's Renewable Energy Potential", in which energy efficiency and renewable energy potential is also calculated. TEPAV's projection, on the other hand, envisages a moderate increase in electricity demand up to a level of 500 TWh by 2030, taking an average GDP growth rate of 5 percent and 0.8 percent of population growth as predicted by TurkSTAT for this period.

Figure 4: GDP and net electricity consumption growth, 1990-2012



Source: Turkey Electricity Transmission Company, TurkSTAT

Figure 5: Net electricity demand projections, 2014-2030 (GWh)



Source: MoENR, Bloomberg-BNEF, TEPAV calculations

In order to meet this increasing demand, MoENR estimates the average yearly cost of new investments at a level of $12 billion, including infrastructure investments for transmission and distribution. While increasing energy production capacity, the government also aims to increase the share of domestic resources in order to decrease Turkey's dependency on imported resources. The performance indicators listed in the "Action Plan for Domestic Resource Dependent Energy Production Program (2014-2018)" prioritizes the increase of electricity production from domestically produced coal from 43 TWh (in 2014) to 57 TWh (in 2018). MoENR energy balance statistics for 2013 reveals that the import dependency in energy production from coal is about 58 percent (Table 2), where most of the domestic primary energy supply is coming from lignite reserves. Considering the low calorific value[24] of Turkish lignite reserves, a 33 percent increase in the production of electricity through domestic resources would result in a higher rate of increase in the utilized lignite and higher GHG emissions which, in return, requires utilization of additional measures for emission control.

[24] Net calorific values (kJ/kg) used as conversion factors by the International Energy Agency, show a ratio of almost one-to-three when lignite and other types of coal are concerned. For example, net calorific value of lignite is calculated as 11.9 kJ/kg whereas for coking coal this figure is 28.2 kJ/kg.

Table 2: Share in total primary use and import share, by fuel type (2013)

	Coal	Wood and Waste	Oil	Natural Gas	Hydro	Geothermal, Solar and Wind	Other	Total
Share in total primary energy use (%)	28.8	3.6	28.2	31.3	4.2	2.2	1.7	100.0
Import to total use ratio (%)	58.1	0.0	111.8*	99.3	0.0	0.0	23.7	79.8

*Due to international marine and aviation bunkers.
Source: General Energy Balance 2013, MoENR

A Revision of Fossil-Fuel Fired Power Plant Licenses

In Turkey, the Energy Market Regulatory Authority (EMRA) is the responsible body for the regulation of the electricity market which grants operating licenses to power plants, approves regulated tariffs and sets the limits for eligibility in market opening. Even though this licensing mechanism is criticized for being non-aligned with the overall energy strategy and lack of auditing of the licensed investments[25], revising theses licenses with respect to fuel type, installed an operating capacities and licensing dates would give a broad idea about the future composition of power plants.

As of March 2015, total number of licenses in effect is 1,697, 457 of which are coal, asphaltite, natural gas and fuel-oil fired plants[26] (Table 3). Adding the licenses under evaluation, this number is due to increase to 515. Natural gas fired plants have the largest number of plants where the total installed capacity is around 38,479 MWe, 46 percent of which is in operation, whereas coal fired plants have a total installed capacity of 19,490 MWe, 63 percent of which is in operation. Comparing the average capacities of these two types of plants, an average coal fired plant's capacity is about 4 times the capacity of an average natural gas fired plant (406 MWe and 120 MWe, respectively). Fuel-oil fired plants, on the other hand, do not have a significant share concerning total installed capacity (2,535 MWe) and average capacity (87 MWe).

[25] It has been reported by the Union of Chambers of Turkish Engineers and Architects that, as of April 2014, 50 percent of the licenses have a realization rate below 10 percent and only 23 percent of licenses have a realization rate above 35 percent, excluding one 6th of the licenses which does not provide relevant information. These figures clearly indicate the presence of a problem regarding the allocation of production licenses and their monitoring.

[26] 1,174 of 1,639 licenses (about 72 percent) are classified under "Other" regarding the fuel type. Therefore, for the purpose of this study only the coal (2.8 percent), natural-gas (22.5 percent) and fuel-oil (1.8 percent) fired plants are tabulated.

Table 3: Thermal power plants by fuel type and license status, as of March 2015

	Coal			Total Coal	Asphaltite	Natural gas	Fuel-oil	TOTAL
	Coal	Domestic coal	Imported coal					
Evaluation	1	0	10	11	0	13	0	**24**
In effect	20	16	12	48	3	323	29	**403**
Total	**21**	**16**	**22**	**59**	**3**	**336**	**29**	**427**
Terminated	3	3	2	8	0	55	10	73

Source: Production Licenses, EMRA

Revising the license data from the perspective of LCP Directive shows that, of these 48 coal-fired thermal plant licenses in effect, 34 are in operation, 20 already have a capacity of over 50 MWe, including asphaltite plants. More precisely, the total capacity of these 20 plants is equal to 12.335 MWe, which yields an average capacity of 617 MWe. With the addition of new capacities to the operational plants, the total number of plants with a capacity of 50 MWe or higher is expected to reach 21 with an average capacity of 670 MWe. The number of new plants that are under construction is 18 (including asphaltite plants), 13 of them having a capacity higher than 50 MWe with an average capacity of 488 MWe. All of the 11 licenses that are under evaluation, on the other hand, are over 50 MWe with an average capacity of 726 MWe. Therefore, even though it appears that the number of coal fired thermal plants that are subject to the LCPD is currently 21, it is expected to increase. But, regarding the possible new investments (plants with effective licenses but haven't started construction yet) it is argued by the sector experts that their realization rate is around 1 over 3[27]. Therefore, taking this information into consideration, a more realistic projection would be 5 of the 13 new plants with a capacity over 50 MWe being realized, bringing the total number to 28.

Implied Costs of the IED on Turkey's Energy Sector

As explained in previous sections, the IED's direct effect on the energy sector goes through the requirement of emission control measures. The IED embodies not only the IPPC, a crosscutting directive with implications on the energy sector, but also the LCPD, which directly regulates emissions from large combustions plants, among which electricity production plants are also present. Even though the coverage of the IPPC Directive is wider, including emissions into water and soil as well, calculating the costs

[27]According to the report released by the Union of Chambers of Turkish Engineers and Architects, as of July 2014, 43 percent of the licenses issued by EMRA have a realization rate of 10 percent or lower. The number of projects with missing information or which has not started the construction yet is 63 percent of the total licenses. This ratio is 75 percent for imported coal fired thermal plants (Turkish Energy Outlook, 2015).

of utilizing GHG emission control technologies within energy industries would still give a good approximation for the total cost of the IED on the energy sector. In this section, results from two distinct impact assessment studies will be presented.

The first of these studies is a Technical Assistance Project carried out for compliance with the NEC Directive, as previously referred to. Since the energy sector is the main sources of SO_2 and NOx emissions (regulated under the NEC Directive), management strategies described in the report mostly cover this sector. These strategies center around two main points:

1. **Shifting to zero-emission sources**: Increase of renewable energy sources' share in electricity generation (to 30 percent of national energy generation, as described in the National Climate Change Action Plan - NCCAP) and introduce nuclear power into the mix (5 percent of national demand by 2020s)
2. **Reduction of emissions from fossil fuel fired plants:** Control of the emissions at power plants burning one or more of the major fuel types (natural gas, hard coal, lignite and fuel oil).

Although plant based alternative emission management strategies by fuel type[28] have been listed in the report, calculation of the investment costs primarily include installation of FGD techniques at lignite and hard-coal fueled power plants in order to remove SO_2 emissions[29]. Due to the low sulphur content of natural gas, FGD is not required for such plants, whereas for fuel-oil plants FGD also applies since in Turkey primary/only method of use of this fuel is for control and start-up/shut-down processes at solid fuel fired plants. Since the reduction of SO_2 emissions is also regulated under the LCPD, FGD facilitation costs can be regarded as implied costs of implementation of the IED on the energy sector as well.

The NEC report estimates FGD investment costs under two headings; capital and operating[30] costs. Both calculations assume a representative power plant capacity of 150 MWe and FGD using limestone wet-scrubbing of the combustion gases. The estimated capital costs of installing such a technique is about €45.9 million at 2010 price levels and annual amortized cost is calculated under assumptions of 15 years of plant life and an annual discount rate of 3.5 percent is €3.99 million for 15 years. Annual operating and

[28] Alternative emission management strategies for fossil fuel fired power plants include Flue Gas Desulphurisation (FGD), limiting sulphur content of liquid fuels and NOx emission prevention and control strategies (such as low-NOx burners, staged air supply and selective catalytic reduction)

[29] FGD techniques are usually associated with a reduction of SO_2 at a level of 90-95 percent, barrier to achieving such efficiency at lignite fueled LCPs in Turkey is recognized as the variability of properties (water and ash content and net calorific value) of domestically produced lignite.

[30] Operating costs include: raw material (lime stone), energy-electricity, transport of by-product, materials for routine maintenance and repair, labor for maintenance, intermittent contract maintenance and water.

maintaining costs on the other hand, under the assumption of a direct proportionality to plant capacity and load factor[31], is calculated as €3.88 million[32] at 2010 prices. Thus, annual capital and operating costs of a coal or lignite power plant with an average capacity of 150 MW, a load factor of 0.75 and plant life of 15 years adds up to €7.87 million.

A similar calculation for retrofitting a FGD to an existing plant, rather than building a new plant (which is assumed to be the same in the NEC report) has also been done by TEPAV[33]. Capital cost, which is compatible with the properties of power generation technologies utilized at a pilot plant (a.k.a. Seyitömer) is taken from Electricity Generation Company (EÜAŞ) which is expressed as €69.3 million at 2007 prices. Annual operation and maintenance costs are also calculated under the assumption of a load factor of 0.75, but in this case, the capacity of the plant is taken as 600 MW. TEPAV calculates the annual operating and maintaining costs at €3.5 million. Correcting this figure for a 150MW plant, which is the basis for NEC calculations, yields €0.9 million.

In order to bring the NEC and TEPAV report figures to a comparable level, it is necessary to calculate the Net Present Value (NPV) of these investments for the same base year with the same discount factor. Assuming 3 years for FGD construction, where the total capital cost is incurred by the end of this time and 15 years for the operation of the FGD plant, a typical formulation of the NPV of the future investments with additional annual operation/maintenance costs under 8 percent would be:

$$NPV = \{[\text{capital cost} + \text{operating/maintaining cost}*(P|A, 8\%, 15)]*(P|F, 8\%, 3)\}$$

This formulation would give the NPV of the FGD construction and operation/maintenance costs at the price levels as reported, which is 2010 for NEC and 2007 for TEPAV reports. Therefore, it is necessary to calculate the NPV for a common year, which is taken as 2014 in this study.

NPV of a FGD facility as presented in the NEC report is:

$$NPV_{NEC,2010} = \{[€45.9\ m + €\ 2.59\ m\ *(P|A, 8\%, 15)]*(P|F, 8\%, 3)\}$$

[31] In the NEC report load factor is taken alternatively as 0.75 (for a plant operation under reasonably good conditions) and 0.50 (to capture low degree of plant reliability resulting from low levels of investment in Turkey. And the annual costs of operating and maintaining a hard-coal or a lignite fired plant are assumed the same.

[32] This annual operating and maintenance cost is associated with a load factor of 0.75. An alternative calculation for a load factor of 0.50 yields an annual cost of €2.59 million again at 2010 prices.

[33] The study titled "Strengthening the Impact Assessment Capacity, Raising Awareness on The Integration Process with a Special Emphasis on Environment Chapter", taking the environment chapter of the EU integration process of Turkey, pilots an economic impact assessment of LCP Directive through 4 publicly owned thermal power plants, which are Çan, Yatağan, Seyitömer and Soma.

= € 54.03 million

And correcting it for 2014 prices would yield:

$NPV_{NEC,2014}$ = € 54.03 m * (F|P, 8%, 4)
= € 73.5 million

Following the same formula, NPV of a FGD facility as presented in the TEPAV report is:

$NPV_{TEPAV,2007}$ = {[€69.3 m + € 0.9 m *(P|A, 8%, 15)]*(P|F, 8%, 3)}
= € 61.12 million

Again, correcting it for 2014 prices would yield:

$NPV_{TEPAV,2014}$ = € 54.03 m * (F|P, 8%, 4)
= € 104.8 million

Thus, NPV calculations of a FGD facility yield a total cost range between € 73.5 million and € 104.8 million. Considering that even the plants with largest operational capacities lack desulphurization facilities[34] and, as reported in the previous sections, there are 20 operational plants with an average capacity of 617 MW, the sum of these plant based calculations would yield up to a considerable amount[35] for the economy as a whole.

FGD facility installation costs should also be regarded from the trade deficit point of view, since such technologies are being imported. To address this issue, a project entitled "Developing a National Thermal Plant Desulphurization System" has been launched in 2014, under the supervision of Marmara Research Center of the Scientific and Technological Research Council of Turkey (TUBİTAK-MAM) with the contribution of academic and industrial partners, as well as the Electricity Generation Company (EÜAŞ). The project is scheduled such that its first 2 years are devoted to the design of the technology and by 2017 the developed technology is planned to be piloted at Soma thermal plant, at which the FGD facility is reportedly missing. Desulphurization technology is expected to be commercialized not until 2019, the date at which the existing plants need to comply with the LCPD.

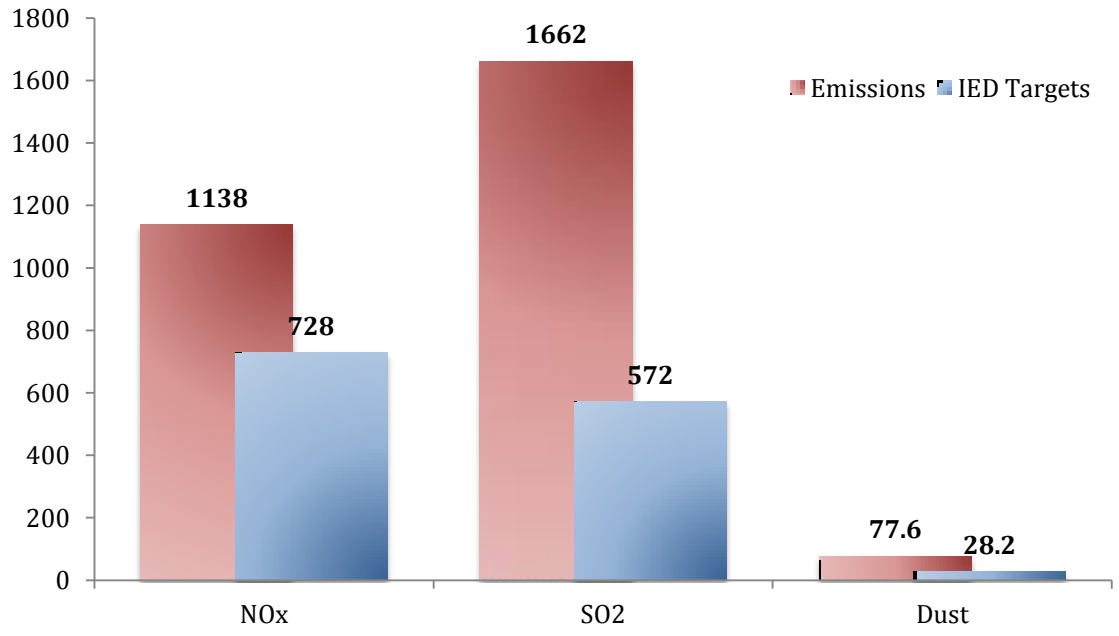
[34] A report published by Soma Research Group established within Boğaziçi University following the Soma coal mine accident, reveals that Soma thermal plant, which is the 5th biggest coal fired thermal plant in operation with its 6 units and a total of 1034MWe capacity, lack a desulphurization facility.

[35] Under the assumptions of (officially anticipated) 3 percent GDP growth rate for Turkish economy in 2014 and 50 percent of the plants requiring FGD facilities amounts to 0,1 percent of Turkish GDP, regardless of the size of the plants.

What is the EU's position with respect to the IED?

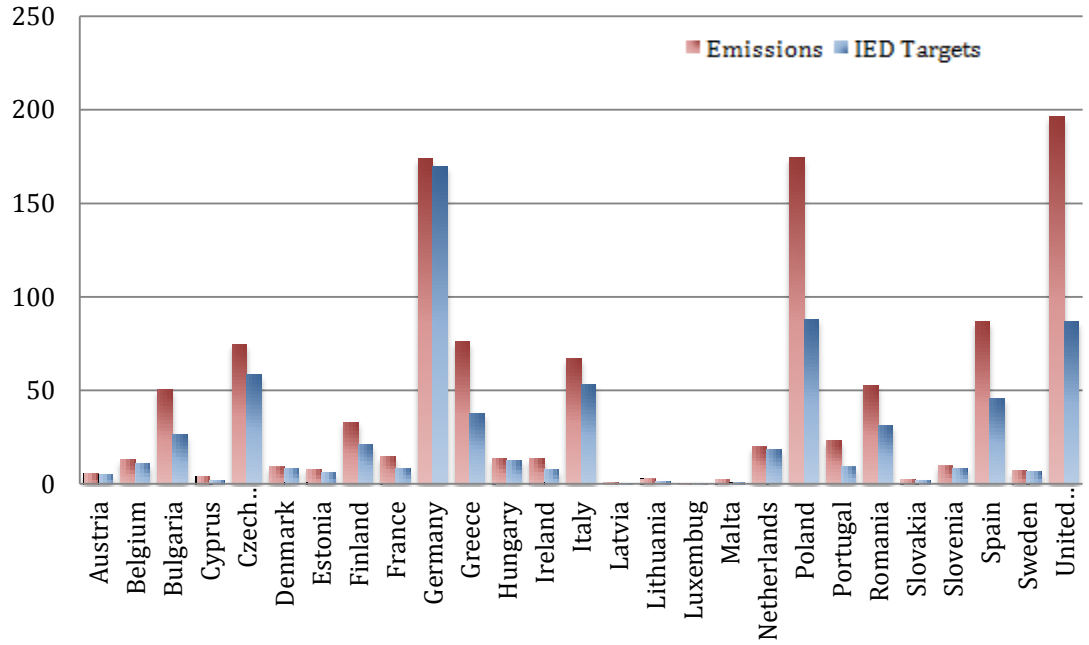
There is a strong trend in Western Europe moving away from new coal plants, while Eastern Europe, far from achieving emissions reduction targets, is building new plants. It is unclear how these countries will manage to bring down their emissions by 2016, when the IED's emission limit values (ELVs) are supposed to kick in. While some exemptions are expected to allow coal plants to operate within limited hours until January 1, 2024, these countries would still need to make drastic reductions in a short timeframe. Below are charts summarizing the positions of the EU27 as they were in 2009.

Figure 6: NOx, SO_2 and dust emission and IED emission targets, EU27 (kt, 2009)



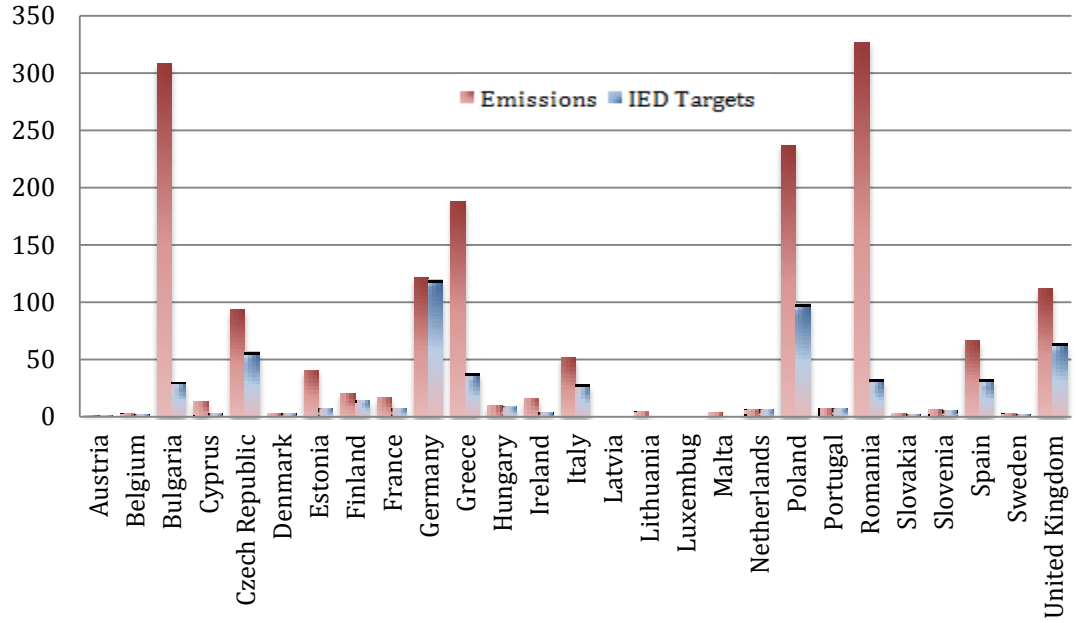
Source: EEA Technical report, 9/2013

Figure 7: NOx emissions and IED targets, by country (kt, 2009)



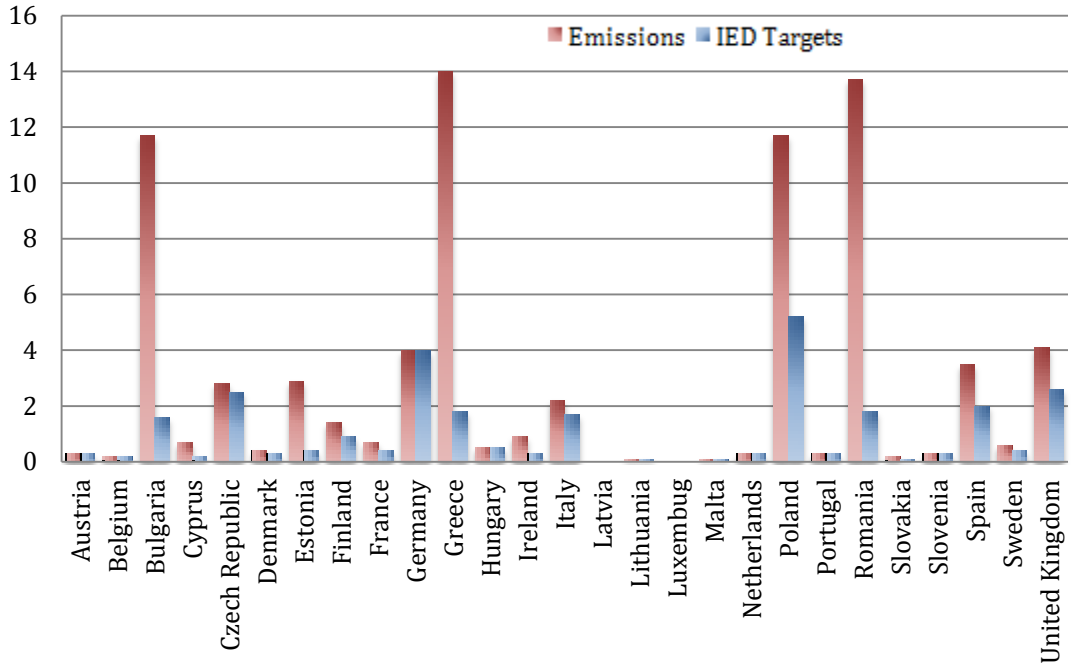
Source: EEA Technical report, 9/2013

Figure 8: SO_2 emissions and IED targets, by country (kt, 2009)



Source: EEA Technical report, 9/2013

Figure 9: Dust emissions and IED targets, by country (2009)



Source: EEA Technical report, 9/2013

On NOx, LCPs in Germany, the UK and Poland have the largest emissions. While Germany is almost within the IED's emission limit values (ELVs) however, Greece, Poland, Spain and the UK have the largest absolute difference between 2009 emissions and the IED's emission limits.

On SO_2, LCPs in Bulgaria, Greece and Poland and Romania have the highest reported emissions. Bulgaria and Romania especially contribute 40 percent of the EU 27's total SO_2 emissions. The same four members are also by far the primary offenders in dust emissions.

The Balkans stands out as a problem here. At least five lignite power plants planned in the region are most likely going to be in violation of the IED if these countries fulfill their aspirations to join the EU. One of these is in Montenegro, where three of them are in Bosnia-Herzegovina and another in Serbia. Failure to plan ahead for the IED requirements could impose heavy retrofitting costs once the directive comes into effect in 2018. Turkey seems to be part of this trend. Its lignite plants use outdated technology that pollute far beyond the limits of the IED.

Technology is the critical variable in the emissions market and make up for the discrepancy between the countries. According to European Environment Agency (EEA) report, 50 plants, making up 3 percent of the 1.595 addressed in the report, contribute 50 percent of the EU's NOx, while 454 plants, 28 percent, are responsible for 90 percent of

emissions. The figure is more skewed for SO2 emissions, with 20 plants (1 percent) responsible for 50 percent of all emissions and 165 plants (10 percent) contributing 90 percent. As for dust, a mere 21 plants (1 percent) emit 50 percent and 175 plants (11 percent) emit 90 percent of total reported dust emissions.

This means that the majority of LCPs are already within the IED's limits, while a small minority is responsible for the bulk of pollution above limits. Upgrading these plants is possible, but usually requires significant investment. Scrubbers, catalytic reduction systems, electrostatic precipitators and filters costs to deal with various emission substances cost an estimated €100/kW and €185/kW. Totally retrofitting a 500MW plant costs about €50-92 million, which is almost within the same cost range of FGD facilities calculated for coal fired thermal plants in Turkey with an average capacity of 150 MW.

Conclusion

Climate change is becoming more of a pressing agenda as we are approaching the 2°C level, which is described as the critical threshold for irreversible effects of climate change to be realized. Since the industrial revolution, global average temperatures have been risen by 0.9°C and due to the exacerbating effect of the GHG stocks, warming up of the oceans as such, this increase in the average temperatures is expected to escalate in the coming decades. Therefore, 2°C level is to be reached prior to the time period which is previously assumed and 4-5°C increase in the global temperatures is expected under the business as usual scenario until 2030. Due to the cross-border nature of this issue, it has also been addressed by the international community since the 1980s but well structured, collective actions are to follow only recently. Despite international efforts to decrease the emissions and slow down the climate change process, global GHG emissions have reportedly risen the fastest during the last decade[36]. Thus, emission reduction pledges of nations have become the central discussion in the post-Kyoto era, once again.

Electricity and heat production sector being responsible for 25 percent of global GHG emissions and dependency of energy production on fossil fuels (at a level of 87 percent according to 2014 figures) puts this sector under the spotlight when the emission reduction policies are concerned. This global picture is true for Turkey as well, where fossil fuels make up 88 percent of the total primary energy supply in 2013. Therefore, this report, determining the gaps in the Turkish legislative system in comparison to the Industrial Emission Directive of the EU, tries to draw attention to the possible costs of catching up with the IED. For this purpose, a pilot case of Flue Gas Desulphurization facility construction and operation costs has been calculated. Considering the high level of Turkey's SO_2 emissions and EU's falling far behind the SO_2 emission targets, such a calculation is perceived appropriate.

Using the figures presented in the NEC and previous TEPAV reports, NPV of construction and operation costs of a FGD facility for 15 years is expressed between € 73.5 million and € 104.8 million range. At this point, it should be stressed that these costs

[36] According to the IPPC Climate Change 2014 report, total anthropogenic GHG emissions increased at a yearly average of 2.2 percent during 2010- 2010, whereas the increase between 1970-2000 is at a level of 1.3 percent per year.

are not directly linked to electricity production (i.e. construction and operation[37] of coal fueled thermal power plants) but are rather costs of technologies that must be installed to filter the emissions caused by the use of such electricity production processes. Considering the number of new coal projects and that 50 percent of the existing coal fueled power plants in Turkey are at a age of 15 years and above, many of the plants are in need of investment for construction of new facilities or retrofitting of old ones. Under these considerations the total of these investments would yield to a considerable amount, as calculated in the previous sections.

Comparing these costs to the installation costs of renewable energy plants, would reveal the opportunity cost of investing to a thermal power plant FGD facilities. Investing in renewable energy has two important returns. Firstly, being zero-emission alternatives, renewable energy investments are being directly converted into energy production which is critical for meeting Turkey's energy demand. Secondly, renewable energy sources are domestic by their nature which is critical for Turkey's current account balance figures.

Renewable technologies have reportedly experienced a price fall at a level of 40-50 percent since 2008[38]. Although the LCOE[39] for PV is the highest for the time being it is expected to decrease by 50 percent during the coming decade and as can be seen from Figure 10, LCOE for wind (onshore) is already below coal power costs and it is expected to fall even further towards 2030. Similar figures are also presented in WWF & BNEF report on Turkey's Renewable Energy. Turkey specific calculations show that, although the LCOE for wind is $120/MWh today, by 2030 it is expected to fall to a level of $60-80/MWh, which is well below the LCOE for coal ($80-105/MWh). These levels for PV are $150/MWh and $85-120/MWh, respectively. Deutsche Bank's Solar Industry Report (2015) lists 30 out of 60 countries which are under review, where solar power is now at grid parity and Turkey is one of them. Ironically, these numbers have been reached without the realization of its average potential of 1300 kW/m^2-year, yet. The government's target for 2023 is 3.000 MW. A 600 MW worth of licenses have been distributed in 2013 and an additional capacity is to be distributed in 2015. Due to the low realization rate of the licenses (1/3), caps on PV investments can be seen as one of the factors that would slow down the process of solar market to reach its potential.

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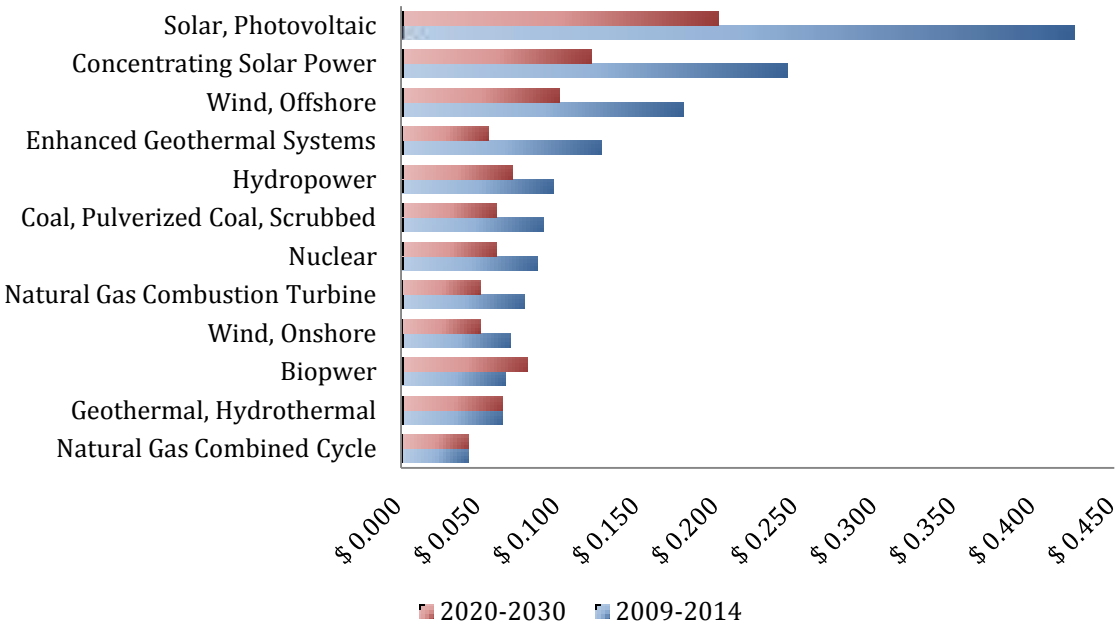
[37] TEPAV LCPD report calculates the operational costs of a 600 MW plant (namely, Seyitömer Thermal Plant which has 4 units with 150 MW capacity) at a level of € 32.47 million/year at 2007 prices. It would be equal to € 55,65 million/year at 2014 prices with a discount rate of 8 percent.

[38] Global PV Pricing Outlook 2015 and Wind Technologies Market Report are many of the two reports which highlight this falling trend in prices. These reports attribute the price falls not only to now cheaper technologies but also to cheaper labor costs and favorable financing conditions.

[39] Levelized cost of energy (LCOE) is a methodology used for comparing the costs of electricity produced by different generators. It simply accounts for all of a system's expected lifetime costs (construction, financing, fuel, maintenance, taxes, insurance and incentives) and reports the costs per kWh by dividing the total costs by the system's lifetime expected power output.

Figure 10: LCOE for alternative energy production systems (periods 2009-2014 and 2020-2030)



Source: OpenEI database (accession date 03.03.2015)

The urgency of the climate change agenda, forces the national governments and international community to take immediate and coordinated action. Post-Kyoto era, during which nations are expected to determine their goals for emission reductions and international financial and technical cooperation mechanisms to be operated, openly calls for the transformation of economies to low-carbon strategies. Fossil fuels being the principal source of GHG emissions, phasing out the use of coal fired power plants may be regarded as one of the steps of these strategies. Instead of building new coal fired power plants, high investment costs required for construction, operation and cleaning of the emissions resulting from these plants may alternatively be directed to the construction of renewable energy plants. Renewable energy prices, which are already compatible with conventional energy sources, are expected the fall in the near future, strengthening the economic viability of this conversion. Such a transition would also be expected to address to the current account balance problem of Turkey.

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