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Assessing the Potential Effects of a Carbon Tax in Turkey

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INTRODUCTION

Adopting a carbon taxation mechanism is one of the main policy options by which Turkey can further its mitigation efforts against climate change. The premise of a carbon tax is that the level of taxation under the system is determined by the level of carbon emissions caused by an economic activity. With this, a carbon tax aims to discourage the utilization of carbon intensive economic activities by internalizing a share of the costs inflicted by these harmful emissions to the society such as their effect in causing climate change and various types of local health hazards.

As many types of economic activities cause carbon to be emitted into the atmosphere, the utilization of such a tax can be expected to have wide ranging impacts on an economy. It is important to assess these impacts before the utilization of such a policy tool. Thus, the aim of this report is to deliberate on the main effects of the employment of a carbon tax on the country's economy.

There are multiple aims pursued by the policymakers in designing the energy policies of the country. The energy supply of the country will need to be significantly increased in order to provide affordable energy to meet the needs of the growing economy into the future. However, in doing this, Turkey will also need to address the rising carbon emissions originating from the country and the problem of import dependency in energy sources. In the near future, Turkey will have to devise an energy policy which will enable the country to power its growing economy while decreasing the dependence on imported energy sources and minimizing the negative effects on the environment. Utilization of a carbon tax can contribute to realizing these aims if the policy tool is designed to suit the specific needs of the country. It is important to analyze the potential impacts of a carbon tax mechanism on these three goals pursued by the country's energy policy.

A carbon tax can have a particularly substantial effect on the electricity generation sector in the country which has been undergoing rapid transformation in the recent years. The electricity generation sector is one of the main drivers of carbon emissions in the country's economy and the emissions caused by the sector are expected to rapidly increase into the future with various incentives that are being utilized in the promotion of thermal power plants fueled by domestic coal. The developments in the electricity generation sector are set to be among the main factors determining the future emissions trajectory of the country. Therefore, significant emphasis should be given to the sector.

OVERVIEW OF A CARBON TAX ACROSS SECTORS

The distinguishing characteristic of a carbon tax is that the level of the tax is based on the carbon content of economic activity. Therefore, under a carbon tax that uniformly applied economy-wide, the main sectors that will be affected are those that are most carbon intensive. The main sectors responsible for the carbon emissions in the country include energy industries, manufacturing, transportation, the residential sector and the agricultural sector. The make-up of the Turkish GHG emissions for the year 2014 can be seen in the table below.

Turkish GHG Emissions by Sector (2014)[1]

		Amount (kt of CO2 equivalent)	Percent of Total Emissions
Fuel Combustion Emissions	Energy Industries	132,248	28,3%
	Manufacturing industries and construction	70,085	15%
	Transport	73,700	15,8%
	Residential/Commercial Fuel Combustion	51,178	10,9%
	Fuel Combustion in Agriculture	31,73	0,7%
	Fugitive emissions from fuels	87,19	1,9%
	CO2 transport and storage	0.13	0%
Emissions from Industrial Processes	Mineral industry	41,884	9%
	Metal industry	12,151	2,6%
	Chemical industry	3,469	0,7%
	Product uses as substitutes for ozone depleting substances	4,917	1,1%
	Non-energy products from fuels and solvent use	388	0,1%
Agriculture		49,522	10,6%
Waste Sector		16,114	3,4%
	Total Emissions	467,548.13	100%

According to the 2014 figures, around 28.3% of the GHG emissions in the country were from the energy industries, 15.8% were from fuel combustion in the manufacturing and construction sectors, 15% were from the transportation sector, 10.8% from the residential and commercial sectors, 13.5% from industrial processes and 10.6% from the agricultural sector. This shows that under a carbon tax uniformly applied on carbon emissions from different sources, these would

1 Turkish Statistical Institute, 'National Greenhouse Gas Inventory Report 1990-2014'(2016)

be the sectors that the burdens of the tax would proportionately fall on.

The emissions from the industrial sector consist of those that are caused by fossil fuel combustion and those that are the result of various industrial processes. The industrial sector consists of a diverse list of subsectors and those that would be impacted the most from a carbon tax would be the industries that are most carbon intensive. Some such industries include the iron, steel and cement production. In 2014, the industrial sector in Turkey consumed a total of 5.3 million tons of hard coal, 4 million tons of lignite and 8.7 million standard cubic meters of natural gas. The bulk of the coal consumption came from the cement production industry and the steel industry was the sector that consumed the most natural gas[2]. Because of this high reliance on fossil fuel consumption, such sectors are likely to be the most adversely affected from the application of a tax on carbon.

Residential and commercial heating is another sector that is set to be affected by the application of a carbon tax. In the recent past, natural gas has emerged as the main source of heating that is being used in residential and commercial heating in the country. However, to a lesser degree, coal is also being used in homes for the purpose of heating especially in low-income households. A total of 5.6 million tons of hard coal and a total of 3 million tons of lignite was used for heating purposes in 2014[3]. It can be surmised that the application of a carbon tax would serve to increase the competitiveness of natural gas vis a vis coal, given there are no special provisions in place to offset the impacts of the carbon tax on low-income households which have to rely on coal for their heating needs.

The transportation sector is also one of the major sectors that will be affected by the utilization of a carbon tax. The four main modes of transportation utilized in the country are road transportation, railway transportation, domestic aviation and domestic navigation. According to the figures provided in the 'National Greenhouse Gas Inventory Report', the total emissions caused by transportation reached a total of 73.7 million tons of CO2 equivalent for the year 2014. The bulk of this amount was caused by road transportation with 67 million tons of CO2 equivalent while the other mode of ground transportation, railroads, only accounted for 563,000 tons of CO2 equivalent. When the figures of distance traveled by the two modes of ground transportation are compared, it can be seen that road transportation is a decidedly more carbon intensive than railway transportation. For each kilometers of distance traveled by road transportation, around 0.243 kilograms of CO2 equivalent was released into the atmosphere for the year 2014 while the same figure stood at around 0.117 kilograms for railway transportation. This means that in theory, under a uniformly applied carbon tax set at 1 US dollar per ton of CO2e, the costs of a kilometer traveled by road transportation would increase by 0.024 US cents on average while the same increase would be around 0.011 US cents per kilometer traveled by railways on average. Thus, the employment of a carbon tax in the transportation would serve to promote railway transportation at the expense of road transportation.

2 Ministry of Energy and Natural Resources, General Directorate of Energy Affairs, accessed from http://www.eigm.gov.tr/tr-TR/Denge-Tablolari/Denge-Tablolari on 16.9.2016

3 Ibid.

GHG Emissions caused by Road and Railway Transportation (2014)[4][5]

	Total Kilometers Traveled*Passenger	Total GHG Emissions(CO2e)	Ton of CO2e per km
Road Transportation	276,073,000,000	67,070,000	0.000243
Railway Transportation	4,828,000,000	563,000	0.000117

A similar estimation can also be made for the case of domestic aviation and domestic navigation. In 2014, a total number of 85,416,166 passengers were transported through domestic flights and 161,048,004 passengers used domestic sea routes. On the other hand, the total emissions caused by the domestic aviation sector amounted to 4,090,000 tons of CO2 equivalent and the emissions caused by domestic navigation amounted to 1,350,000 tons of CO2 equivalent. Therefore, on average, for every US dollars of carbon tax applied on the sector the cost of a domestic flight per passenger would increase by nearly 5 US cents while the same increase would be around 0.8 cents for an average maritime passenger.

GHG Emissions caused by Domestic Aviation and Navigation (2014) [6][7][8]

	Number of Passengers	Total GHG Emissions (ton of CO2e)	Ton of CO2e per Passenger
Domestic Aviation	85,416,166	4,090,000	0.047883
Domestic Navigation	161,048,004	1,350,000	0.008383

Perhaps the most significant sector that contributes to the general emissions stock is the electricity generation sector. In the electricity generation sector, the main culprits of GHG emissions are thermal power plants

4 Turkish Statistical Institute, accessed from http://www.tuik.gov.tr/PreTablo.do?alt_id=1051 on 27.8.2016

5 Turkish Statistical Institute, 'National Greenhouse Gas Inventory Report 1990-2014'(2016)

6 Turkish Statistical Institute, accessed from http://www.tuik.gov.tr/PreTablo.do?alt_id=1051 on 27.8.2016

7 Turkish Statistical Institute, 'National Greenhouse Gas Inventory Report 1990-2014'(2016)

8 Ministry of Transport, Maritime Affairs and Communications, accessed from https://atlantis.udhb.gov.tr/istatistik/istatistik_kabotaj.aspx on 13.9.2016

fueled by coal, natural gas, and to a lesser degree by liquid fuels. In the last decade, increasing coal based electricity generation has been one of the main pillars of the Turkish energy policy. The main aim of this policy was to decrease the dependence on imported energy sources by the increased utilization of domestic lignite sources. As a result, coal fired electricity generation capacity increased rapidly in the last decade with increased utilization of both domestic lignite and imported coal. The total capacity of coal fired power plants rose to around 15.5 GW by the end of 2015 up from around 5.2 GW in 1990[9]. As a result, the emissions caused from the sector also rapidly increased. The total emissions caused by the energy industries in the country reached a total of 132 million tons of CO2 equivalent by the year 2014[10].

This figure is expected to continue to increase into the near future with several additional incentives that have been put in place to boost the utilization of domestic coal. One of the main subsidies provided is a purchase guarantee for electricity produced by domestic coal at the rate of 0.185 Turkish Liras (around 0.06 US dollars) per kWh for up to 6 billion kWh's[11]. Moreover, under the new legislation, it has been made possible to divide up large coal fields between different investors to facilitate new investments[12] and other incentives were provided for investments that are deemed strategic, which new coal investments will be able to enjoy[13]. Additionally, a levy of 15 dollars per ton was recently brought up on imported coal sources[14]. These new policies are expected to further increase the utilization of domestic lignite in the near future and limit the increase in coal imports to a degree. These developments related to electricity in general and coal in particular will be a deciding factor in the future emissions trajectory of the country.

On the other hand, it can be expected that the utilization of a carbon tax would mostly effect the domestic lignite sources dues to their low calorific value. The defining characteristic of carbon taxation policies is that the level of taxation is based on the amount of carbon emissions resulting from the economic activity subject to the tax. Therefore, under the policy tool, the fuels that will be most liable for taxation will be those with higher carbon content.

The impacts of a carbon tax on different fuels can be estimated by identifying the varying carbon contents in different energy sources. Four main fossil fuel sources can be identified that are being used in the electricity generation mix of the country. These are hard coal, domestic lignite, natural gas and fuel oil.

9 Turkish Electricity Transmission Company, accessed from http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2015/istatistik2015.htm on 20.9.2016

10 Turkish Statistical Institute, 'National Greenhouse Gas Inventory Report 1990-2014'(2016)

11 Official Gazette, accessed from http://www.resmigazete.gov.tr/eskiler/2016/08/20160809-4.pdf on 21.9.2016

12 Anatolian Agency, 11.7.2016, 'Yerli üretim teşvikleri yatırımcıyı çekiyor', accessed from http://aa.com.tr/tr/ekonomi/yerli-uretim-tesvikleri-yatirimciyi-cekiyor/605538 on 3.8.2016

13 Turkish Grand National Assembly, accessed from https://www.tbmm.gov.tr/kanunlar/k6745.html on 12.9.2016

14 Official Gazette, accessed from http://resmigazete.gov.tr/eskiler/2016/08/20160802-4.pdf on 21.9.2016

Emission Factors of Fuels used in Turkey's Greenhouse Gas Inventory 2014 [15]

Fuel Type	Emissions Factor(t/TJ)
Sub-Bituminous Coal	97.43
Biogas	54.60
Natural gas	58.29
Industrial Waste	143.00
Fuel Oil	77.79
Coking Coal	97.44
Turkey Lignite	107.63
Diesel Oil	73.19
Animal Waste	112.00

Net Calorific Value of Fuels used in Turkey's Greenhouse Gas Emissions Inventory 2014 [16]

Fuel Type	Weighted Average(TJ/kT)
Sub-Bituminous Coal	21.7
Biogas	24.29
Natural Gas	50
Residual Fuel Oil	40.59
Coking Coal	23.7
Turkey Lignite	7.19
Diesel Oil	42.6

The emissions factors and the net calorific values of different energy sources used in Turkey for the year 2014 are provided in the 'National Greenhouse Gas Inventory Report' submitted to the UNFCCC. By using these figures and the energy balance tables provided by the Ministry of Energy and Natural Resources[17], the specific level of emissions caused by each fuel type per kWh of electricity generated can be estimated with the methodology outlined by the United Nations Framework Convention on Climate Change (UNFCCC)[18].

In the table below, the results of the calculation can be seen. The specific emission factors and calorific values provided in the Turkish National Greenhouse Gas Inventory Report are used to estimate the CO2 emissions caused by the utilization of domestic lignite and hard coal employed in electricity generation per kWh of electricity produced. On the other hand, European averages are used for determining the amount of carbon emitted by natural gas and oil used in electricity

15 Turkish Statistical Institute, 'National Greenhouse Gas Inventory Report 1990-2014'(2016), p. 57

16 Ibid.

17 Ministry of Energy and Natural Resources, General Directorate of Energy Affairs, accessed from http://www.eigm.gov.tr/tr-TR/Denge-Tablolari/Denge-Tablolari on 16.9.2016

18 United Nations Framework Convention on Climate Change, accessed from https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf on 17.9.2016

generation[19]. Using country specific figures is especially important for local lignite since the lignite sources in Turkey are quite particular and have substantially lower heating rates compared to lignite sources from elsewhere in the world.

Estimated Change in Costs of Electricity Generation by Fuel under different Tax Rates (per kWh)

Price of CO2 ($ cents per ton)	1	3	5	8	20
Domestic Lignite	0.12	0.36	0.61	0.97	2.43
Other Coal(Average)	0.08	0.25	0.42	0.67	1.68
Natural Gas	0.05	0.15	0.25	0.39	0.98
Oil	0.08	0.25	0.42	0.67	1.67

According to the results, around 0.12 kilograms of CO2 is estimated to be released into the atmosphere for the generation of a kWh of electricity using domestic lignite. The same figure is significantly lower for hard coal at 0.08 and around the same level for oil. The least polluting of the fossil fuels used for power generation is natural gas at around 0.05 kilograms of CO2 emitted per kWh of electricity generated. These figures show that the generation of electricity using domestic lignite causes around 50% more CO2 to be released into the atmosphere compared to hard coal and oil and around 1.4 times more CO2 to be released compared to natural gas for the same amount of electricity generation.

With these results, it can be surmised that the application of a carbon tax would increase the competitiveness of hard coal vis a vis lignite and would increase the competitiveness of natural gas vis a vis all other fossil fuels used in the electricity generation sector. The potential impact on lignite would be substantial. For example, under a tax rate of 3 dollars per ton the cost of producing electricity from lignite would increase by 0.36 cents per kWh. The same increase would amount to almost 1 cent per kWh under an 8 dollars per ton tax rate and would amount to nearly 2.5 cents per kWh under a tax rate of 20 dollars per ton of CO2. The significance of these figures can be shown by pointing out that the purchase guarantee recently provided for lignite power plans was at the level of approximately 6 cents per kWh[20].

However, the main beneficiaries of such a tax would naturally be renewable energy sources and nuclear energy that don't emit significant levels of gases into the atmosphere in the electricity generation process. Turkey has an ample potential for the utilization of renewable sources like wind and solar energy and significant steps have been taken in the recent years in the utilization of this potential. In terms of nuclear energy, the first nuclear power plant of the country is scheduled to become operational by the year 2023[21],

19 Berghmans, Nicolas and Alberola, Emilie, 'The Power Sector in Phase 2 of the EU ETS: Fewer CO2 Emissions but just as much as Coal'(2013), accessed from http://www.cdcclimat.com/IMG/pdf/13-11_climate_report_no42_co2_emissions_in_the_power_sector.pdf on 18.9.2016

20 Official Gazette, accessed from http://www.resmigazete.gov.tr/eskiler/2016/08/20160809-4.pdf on 21.9.2016

21 Anatolian Agency, 21.0.2016, accessed from http://aa.com.tr/tr/turkiye/nukleerden-uretilecek-elektrigin-ticaretine-2023te-baslanacak/575954 on 20.9.2016

and there currently are plans to go ahead with two other nuclear plant projects. Overall, it can be summarized that the employment of a potential carbon tax would significantly hamper the financial prospects of thermal plants operating with domestic lignite. Plants fueled by hard coal and oil would also be adversely affected. Natural gas plants would gain competitiveness against these sources but the main beneficiaries of the tax would be renewables and nuclear energy.

POTENTIAL EFFECTS ON GHG EMISSIONS

A carbon tax can reduce the GHG emissions in an economy through two main influences. Firstly, a carbon tax can reduce the emissions in a country through a substitution effect, incentivizing switching to fuels that are less carbon intensive. Secondly, a carbon tax can reduce emissions through the demand effect with reducing energy demand due to higher overall prices in the energy sector and in the economy in general[22].

According to studies, the electricity generation sector offers the most potential for major mitigation opportunities that can be realized in a relatively short amount of time[23]. In the case of Turkey, the most severely impacted power plants would be those fired with lignite due to the low calorific value of these sources and the most opportunity lies in switching these plants with power plants using less carbon intensive fuels. In the short run, the employment of a carbon tax can potentially urge the operators of thermal power plants to retrofit their plants in order to produce the same amount of electricity while emitting less GHG gases. Such investments that were viewed as too costly can be profitable with the application of a carbon tax[24]. In the longer run, a relatively strong carbon price would work to shift generation away from carbon intensive sources and towards low carbon sources such as renewables. Additionally, the GHG emissions from the sector can decrease due to decreased consumption if the general electricity prices increase in response to the tax.

On the other hand, mitigation of emissions caused in other sectors may occur more gradually compared to electricity generation. For example, in the transportation sector, there is generally less opportunity for shifting fuels as the substitutes for gasoline and diesel may be too expensive to enable a substantial change in behavior. It has been observed that short term increases in gasoline prices have not resulted in significant changes in consumer behavior[25].

Although it is hard to quantify the effects of a specific carbon tax rate on future emissions, several attempts have been made. For example, the US Energy Information Agency estimated that with a 25 US dollars per metric ton of carbon price to be implemented on the energy sector with an annual increase of 5%, the emissions would fall by 22% below the country's reference scenario[26]. A similar study has also recently been made for Turkey by the WWF and Istanbul Policy Center in the report 'Low Carbon Development Pathways and Priorities for Turkey, Climate-Friendly Development in Turkey: A Macro Level Evaluation'. In the study, it was estimated that a 40% reduction in the country's GHG emissions by 2030 can be possible with the application of a carbon tax that would reach 1.2% of the country's total GDP by the same year, given that the revenues collected by the tax are

22 Benavides, Carlos, Gonzales, Luis, Diaz, Manuel, Fuentes, Rodrigo, Garcia, Gonzalo, Palma-Behnke, Rodrigo and Ravizza, Catalina, 'The Impact of a Carbon Tax on the Chilean Electricity Generation Sector'(2015), Energies 8, p. 2675

23 Kaufman, Noah, Obeiter, Michael and Krause, Eleanor, 'Putting a Price on Carbon: Reducing Emissions'(2016), World Resources Institute, p. 5

24 Ibid, p. 9

25 Kaufman, Noah, Obeiter, Michael and Krause, Eleanor, 'Putting a Price on Carbon: Reducing Emissions'(2016), World Resources Institute, p. 5

26 U.S. Energy Information Administration, 'Annual Energy Outlook 2014', Appendix E, p. 12, accessed from http://www.eia.gov/forecasts/aeo/pdf/0383(2014).pdf on 17.9.2016

earmarked to promote renewable energy sources[27].

POTENTIAL EFFECTS ON IMPORT DEPENDENCY

Since Turkey lacks substantial reserves of fossil fuel sources, an overwhelming amount needs to be imported from abroad. Around 99% of the natural gas supplies used in the country and around 89% of the oil supplies have to be met by imported sources on an annual basis[28]. The only considerable fossil fuel reserves existing in the country are lignite sources which are of low thermal quality as previously discussed. It is estimated that there is a total of over 15 billion tons of lignite reserves in the country, of which around 7.5 billion tons were discovered between the years 2005 and 2015[29].

As a result of this picture, curbing the dependency in energy imports is one of the main aims of the country's energy policy and promoting domestic lignite has so far been a large part of this strategy. The employment of a carbon tax would favor the utilization of natural gas in electricity generation against coal in general and would favor imported coal against the utilization of domestic lignite due to differences in the carbon content of these sources. Therefore, a carbon tax can potentially exacerbate the problem of import dependence in the short run by boosting the competitiveness of natural gas and increasing the need of imports.

On the other hand, the energy sources that would most benefit from a carbon tax would be renewable energy sources and nuclear energy which cause insignificant carbon emissions. Therefore, in the long run, a carbon tax can potentially have a positive effect in reducing the import dependence in energy sources. Turkey has an ample potential in solar and wind sources and the employment of a sizeable carbon tax can accelerate the deployment of these sources. Combined with falling costs of renewables due to technological advances and the introduction of nuclear energy, a carbon tax can potentially help to reduce the import dependence of the country and contribute to building a sustainable energy regime into the future.

HOW MUCH REVENUE CAN BE GENERATED BY A CARBON TAX?

Another important consideration for the employment of a carbon tax is how much revenue will be collected under the policy mechanism. A carbon tax can potentially generate an extensive amount of revenues. Two main factors will determine how much the revenues collected from the carbon tax would amount to and how much of an additional burden the tax will inflict on the economy. These two factors are the rate of the tax and the scope of the tax in terms of coverage.

The rates of the carbon taxes currently employed in the world vary greatly and there are several methodologies that can be utilized in determining the level of taxation. The tax rate can rise as high as 137 US dollars per ton of CO2 in a country like Sweden and as low as 3 dollars in countries like Mexico[30]. For a developing country like Turkey, examples from other developing countries can be more fitting comparisons. For example, a carbon tax at the rate of 3 dollars per ton of CO2 is set to be applied in Chile starting from 2018[31] and a tax with a rate of 8 dollars per ton of

27 Yeldan, Erinç, Voyvoda, Ebru, Özgür Berke, Mustafa, Şahin, Ümit and Gacal, Funda, 'Low Carbon Development Pathways and Priorities for Turkey, Climate-Friendly Development in Turkey: A Macro Level Evaluation',WWF-Turkey and Istanbul Policy Center

28 Republic of Turkey, Ministry of Foreign Affairs, accessed from http://www.mfa.gov.tr/turkeys-energy-strategy.en.mfa on 3.9.2016

29 Ministry of Energy and Natural Resources, accessed from http://www.enerji.gov.tr/en-US/Pages/Coal on 13.9.2016

30 World Bank Group and Ecofys, 'Carbon Pricing Watch 2016, An advance brief from the State and Trends of Carbon Pricing 2016 report, to be released late 2016'(2016), p. 6

31 Reuters, 27.9.2014, 'Chile becomes the first South American country to tax carbon', accessed from http://uk.reuters.com/article/carbon-chile-tax-idUKL6N0RR4V720140927 on 18.7.2016

CO2 is set to be applied in South Africa in 2017[32]. For this purpose, four different tax rate scenarios are used in this report including a tax rate of 3 US dollars per ton of CO2 equivalent, 5 US dollars, 8 US dollars and 20 US dollars at the more ambitious end.

There are various options that can Turkey choose to use in terms of the coverage of the tax. Four of these options are investigated in this report. One option would be to limit the scope of taxation to only the energy industries. This would approach would leave most of the emissions out of the scope of the tax, ac counting only for 28.3% of the country's emissions while addressing perhaps the most crucial sector in terms of future GHG increases. If the transportation sector is added to this figure, the total coverage would rise to 44.1%. Alternatively, all emissions from fossil fuel combustion can be made subject to the tax which would increase the coverage to nearly 73%. If the industrial emissions other than those caused by fossil fuel combustion are added, the coverage would rise up to 86%. In the table below, the estimated revenues based on 2014 figures that would be collected under these coverage scenarios with different tax rates can be seen.

Estimated Revenues based on different Tax Rate and Coverage Scenarios (Thousands of US Dollars)

	Energy Industries	Energy Industries and Transportation	All Emissions from Fossil Fuel Combustion	Emissions from Fossil Fuel Combustion and Industrial Processes
3 USD per ton of CO2e	396,950	618,569	1,018,325	1,207,683
5 USD per ton of CO2e	661,584	1,030,949	1,697,208	2,012,804
8 USD per ton of CO2e	1,058,534	1,649,518	2,715,533	3,220,487
20 USD per ton of CO2e	2,646,335	4,123,794	6,788,831	8,051,217

A carbon tax at a modest rate of 3 US dollars per ton of CO2 can generate a relatively modest amount of revenues especially when it is applied only on the energy generation sector. On the other hand, a tax rate of 20 US dollars would hypothetically generate more than 2,5 billion dollars of revenues when it is applied on the energy sector and more than 8 billion dollars of revenues when applied on all emissions from fossil fuel combustion and industrial processes. Various other scenarios all fall between these two extremes of 400 million dollars of revenues and 8 billion dollars.

32 World Bank Group and Ecofys, 'Carbon Pricing Watch 2016, An advance brief from the State and Trends of Carbon Pricing 2016 report, to be released late 2016'(2016), p. 11

When these revenue figures are compared with the Turkish gross domestic product[33] and with the general government budget[34] for the year 2014, we can get a sense of the weight carbon tax systems with different rates can potentially have on the economy. The following table demonstrates the relative weight of a carbon tax that would be applied on fossil fuel combustions under different tax rates.

The Weight of a Carbon Tax Covering Fossil Fuel Combustion in the Economy Under Different Tax Rates (2014 estimations) [35] [36]

Tax rate (USD per ton of CO2e)	3	5	8	20
Total Revenues (Thousands of USD)	1,018,325	1,697,208	2,715,533	6,788,831
Annual Revenue per Capita (USD)	13.2	22.1	35.3	88.3
Share in GDP	0.13%	0.21%	0.34%	0.85%
Share in Government Budget	0.54%	0.91%	1.45%	3.62%

A tax with a rate of 3 US dollars applied on fossil fuel combustion would translate to an annual revenue per capita of 13.2 dollars whereas a tax with a rate of 20 US dollars would translate to an annual revenue per capita of 88.3 US dollars. The proportion of the revenues that would be collected under different tax rates to the country's gross domestic product were found to be between 0.85% and 0.13% whereas the proportion to the total governmental budget lay between 3.62% and 0.54%. These figures can be compared with other countries that are currently employing carbon taxation policies.

33 World Bank, accessed from http://data.worldbank.org/country/turkey?view=chart on 12.9.2016

34 Anatolian Agency, 15.1.2015, 'Turkey's budget deficit at $10 billion for 2014', accessed from http://aa.com.tr/en/economy/turkeys-budget-deficit-at-10-billion-for-2014/83925 on 20.13.2016

35 World Bank, accessed from http://data.worldbank.org/country/turkey?view=chart on 12.9.2016

36 Anatolian Agency, 15.1.2015, 'Turkey's budget deficit at $10 billion for 2014', accessed from http://aa.com.tr/en/economy/turkeys-budget-deficit-at-10-billion-for-2014/83925 on 20.13.2016

Revenues Generated by Carbon Taxation in Selected Countries)[37]

	Annual Revenue (Thousand USD)	Annual Revenue per Capita(USD)	Share in GDP
Sweden	3,680,000	381	0.67%
Norway	1,580,000	307	0.31%
British Columbia	1,100,000	239	0.49%
Finland	800,000	146	0.29%
Switzerland	875,000	107	0.13%
Iceland	30,000	92	0.22%
United Kingdom	1,530,000	24	0.05%
Mexico	870,000	7	0.06%

The share of current carbon taxes in the GDP's of the country's they are employed in vary greatly. Sweden has the most ambitious carbon tax with an annual revenue per capita of 381 US dollars and a 0.67% share in the country's GDP. On the lowest end, Mexico's carbon tax exacts an annual revenue of only 7 US dollars per capita and makes up 0.06% of the country's total GDP. It can be expected that a carbon tax employed in Turkey would be closer to the lower end of this scale, at least at its initial phases.

CONCLUSION

Overall, it can be said that any type of carbon tax employed in the country would inflict a substantial cost on the economy and would generate a considerable amount of revenues. The utilization of a carbon tax would have wide-ranging implications for various sectors. Revenue recycling measures can potentially be used to offset the negative effects of the tax on the economy through reductions in other taxes. A revenue neutral tax design can potentially help to negate the potentially adverse effects on the economy and help in increasing the political feasibility of the carbon tax.

In determining the coverage of the tax, the electricity generation sector should be given priority since large increases in emissions are expected from the sector in the near future. Therefore, there is a large mitigation potential in this area and power generation is a sector where relatively short term changes can be possible. A considerable amount of GHG mitigation can be possible through switching from the utilization of inefficient lignite sources to less carbon intensive fuels. There are also significant mitigation opportunities in other sectors but it can be expected that these would take a longer time to materialize.

The application of a carbon tax can potentially exacerbate the problem of import dependency in the short term as it would favor natural gas and imported coal sources against the use of domestic lignite. However, low carbon sources such as renewables and nuclear energy would be the main beneficiaries from such a tax. In the long run, a carbon tax would increase the competitiveness of these sources also against natural gas, potentially contributing to solving the problems of import dependence and carbon dependence in the current energy regime of the country.

37 Carl, Jeremy and Fedor, David, 'Tracking global carbon revenues: A survey of carbon taxes versus cap-and-trade in the real world'(2016), Energy Policy, Volume 96, pp. 50-51

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