ENVIRONMENTAL IMPACTS OF COAL SUBSIDIES IN TURKEY: A REGIONAL GENERAL EQUILIBRIUM ANALYSIS*

Sevil Acar
Istanbul Kemerburgaz University
Department of Economics

A. Erinc Yeldan
Bilkent University
Department of Economics

April 14, 2015

Abstract

In this study we aim at providing an analytical quest for Turkey to study the true social costs of the existing coal subsidization scheme and identifying viable alternative policy instruments and economic measures to complement its efforts of further greening and de-carbonizing its economy. To this end we develop an applied general equilibrium model and utilize both macro and micro level data to assess the impact of the current arsenal of energy policy instruments (in particular coal subsidies) and public policy intervention mechanisms to accelerate technology adoption and achieve higher employment, energy security, and sustainable growth patterns.

Spanning over 2015-2030, our analytical apparatus focuses exclusively on considering the fiscal implications as well as the environmental repercussions of the CO2 and other gaseous emissions and the relevant market instruments of abatement. With the aid of a set of alternative policy scenarios against a "business as usual" path, we study the aggregate and sectorial performances of growth, employment, investment and capital accumulation, consumption/welfare and trade balance.

JEL: C68, O44, Q56, Q58

Keywords: coal subsidization, climate change, renewable energy sources, computable general equilibrium, Turkey

*Paper prepared for presentation at the 18th Annual Conference of the GTAP, Melbourne, June 2015. This study has been supported by a grant from the Turkish Sciences Association (TUBITAK) under project No: 114K941. We are grateful, without implicating, to Ebru Voyvoda and Bengisu Vural for their comments and suggestions.

1 Introduction

As a developing middle-income country, Turkey is in a transition phase with respect to its increased utilization of electricity and primary energy sources. The Ministry of Energy and Natural Resources (MENR) estimates indicate that per capita energy use rose from 1,276 kgoe (kilograms of oil equivalent) in 2005 to 1,663 kgoe in 2013. Total energy demand currently stands at 135.3 millions toe (tons of oil equivalent). These signal a significant projected expansion of energy demand in the next decade. Official figures project substantial pressures for continued increase in energy demand, with installed capacity expected to grow from 64 GW in 2014 to approximately 120 GW in 2023. The implication of these expectations is that Turkey has not attained stability with respect to its energy demand per capita. Supporting the expected level of growth in demand is in itself a challenge, requiring significant investments in generation capacity and energy infrastructure, as well as continuation of the energy market reforms initiated in the 2000s. However, Turkey is also grappling with the challenges of ensuring a cost-competitive energy supply for its population and the industrial sectors, attaining energy security, and realizing emissions reduction.

Our proposed analysis looks at how current policy meets these challenges, focusing on plans for expansion of coal-fired power and renewable energy generation, and asking what role the existing coal subsidies play in the broad policy mix. Available rudimentary data reveal that subsidies to coal mining and coal-fired electricity generation amount to 730 million USD in 2013, or 11 USD per MWh of generation (GSI, 2015). This corresponds roughly to 0.1% of the aggregate GDP. By contrast, subsidies to renewable energy sources are dwarfed against the coal subsidization programme.

In this study, we aim at providing an analytical quest for Turkey to study the effects of the existing coal subsidization scheme on the domestic economy, and identify viable alternative policy instruments and economic measures to complement its efforts of greening and de-carbonizing its economy. To this end we develop an applied general equilibrium model and utilize both macro and micro level data. Spanning over the 2015-2030 growth trajectory of the Turkish economy, our analytical apparatus focuses exclusively on considering the fiscal implications as well as the environmental repercussions of the gaseous pollutants and the relevant market instruments of abatement. The CGE apparatus exclusively takes into account the direct and indirect incentivization scheme of coal mining together with its waste and gaseous pollution. It then aims to contrast these environmental costs against alternative energy policy schemes. With the aid of a set of alternative policy scenarios against a business as usual path, we study the aggregate and sectorial performances of growth, employment, investment and capital accumulation, consumption/welfare, trade balance, and emissions.

The paper is organized as follows: In section 2, we document the extent and characteristics of Turkey's energy policy, the subsidization of coal, in particular. In section 3, we introduce the salient features of the algebraic equations of the CGE model along with the data sources. Next, we report on the results of our policy analysis, using the CGE apparatus as a social laboratory in section 4, while section 5 concludes. We reserve two Appendixes for discussions of our data sources and the calibration procedure, together with estimates of coal subsidies and their parameterization in our analytical model.

2 Aspects of Turkey's Energy Policy and CO2 Emissions

Turkey has been experiencing a dramatic structural change with respect to its escalated utilization of electricity and primary energy sources. In line with its growing population and GDP, it has been facing increased energy demand in the recent decades. In 2013, installed electricity capacity reached a level of 64,000 MW, more than twelve times the 1980 capacity level (TEIAS, 2013). The bulk of electricity generation stems from the utilization of fossil fuels, comprised of mainly natural gas and coal. In 2013, gross electricity generation was composed of 44 per cent natural gas, 27 per cent hard coal and lignite, 25 per cent hydro, 3 per cent wind, and a negligible share of geothermal power. Since the country does not own any significant oil or gas reserves, it is highly dependent on energy imports. IEA (2014) reports that, in 2012, energy imports accounted for more than 80 per cent of total primary energy supply. Within this composition, 99 per cent of total gas demand, 93 per cent of oil and 55 per cent of coal were imported from various countries.

In order to decrease the reliance on foreign energy sources, ensure energy security, and meet the growing energy demand, Turkey has pursued strong commitment to utilization of all the domestic coal resources, together with its plans to install three nuclear power plants in the near future. On the other hand, the potential of renewable resources such as solar, geothermal, and wind remains hugely untapped in producing energy. The focus on coal has gone so far as to announce the year 2012 as “the year of coal”. In all the ten-year development plans as well as strategy documents of the MENR, boosting coal mining and coal-fired electricity generation appears to be among the priorities of the country, with a strong emphasis on the need to increase investments, extend exploration and rehabilitation budgets, and introduce new incentives to the coal sector. For instance, in the 2015-2019 Strategic Plan of the MENR, coal resources are targeted to be utilized to the most efficient extent possible and generation of electricity from domestic coal is aimed to reach an annual level of 60 billion kWh in the end of the plan period. In order to attain these targets, investments in the sector will be accelerated and new reserves will have to be explored. Similarly, in the Tenth Development Plan, the desire to intensify the efforts to explore new lignite reserves (as well as oil and gas) is repeated. As part of the program, available coal fields that are ready to be operated will be transferred to the private sector via the “royalty tender system”, public coal-fired plants will be rehabilitated and investments to build new coal-fired power plants will be facilitated (pg. 196).

Coal is still a widely used energy source in the international arena. Data from IEA (2014) reveal that the share of coal in world electricity production rose from 37.4 per cent in 1990 to 40.3 per cent in 2012. Some of this production owes to the availability of generous subsidies provided by governments to the coal sector in many countries. These subsidies are usually designed in order to lower the cost of coal-fired electricity production, increase the price received by energy producers, or decrease the price paid by energy consumers. They take several forms ranging from direct financial transfers and tax exemptions to market price support and provision of services below market rates (provision of land, water, infrastructure, permissions, etc.) based on the WTO definition (WTO, 1994). The cost of fossil fuel subsidies, covering oil, gas and coal subsidies, globally totalled US$ 548 billion, which was four times more than renewable energy subsidies in 2013 according to IEA (2014).

Fossil fuel subsidies in Turkey are mainly comprised of coal subsidies. The most substantial of producer subsidies to coal are direct transfers from the Undersecretariat of Treasury to the hard coal sector in the form of capital and duty loss payments. These transfers are provided with the aims of subsidizing local employment in the hard coal mining regions and amounted up to around US$ 300 million in 2013. Besides, the government supports the coal sector with R&D expenditures, funding for the rehabilitation of hard coal mines and coal power stations, exploration budgets, funding of new coal power plants and investment guarantees to some coal power plants as well as distribution of free coal to poor families as a support to consumers. Yet, some of the support measures remain unquantifiable since they are not purely financial transfer mechanisms. For instance, exemptions from environmental regulation including temporary exemptions for existing coal plants and permissive environmental impact assessment procedures enable most of the coal projects to be implemented although they are harmful to the environment (GSI, 2015: 8- 11). Besides, in 2012, Turkey introduced a new investment incentive scheme which is comprised of various instruments, ranging from VAT and customs duty exemption, income or corporate tax reduction to social security premium support to the employer, interest support and land allocation. Defined as “priority areas”, new coal mining and power generation projects are subsidized within the regional investment incentive scheme with the most generous measures of Region V and VI.

Using the data for quantifiable incentives in 2013, GSI (2015) estimates a producer subsidy for coal of around US$0.01 per kWh, which increases to US$0.02 per kWh when coal aid to consumers is included. In 2013, total amount of subsidies to the coal sector reaches 0.1 per cent of GDP. Needless to say, these figures serve as an underestimate of the total subsidy amount since they do not cover incentives such as investment guarantees, ease of access to credit, exemption from value-added tax and import duties (within the regional investment incentive scheme), or any of the other subsidies identified, which are expected to be significant. Moreover, based purely on production costs, coal is currently only marginally cheaper than onshore wind and significantly cheaper than solar PV. Adding in per kWh subsidies and the external costs (such as health and environmental damages), coal becomes more expensive than the alternative renewables such as wind and solar power (GSI, 2015). It has to be noted that this assessment is still based on highly incomplete data on coal subsidies and the failure to estimate full social costs of coal. Extending the analysis to include the dynamic effects towards 2030, a recent report by the WWF-Turkey together with Bloomberg New Energy Finance (BNEF, 2014) argues that accounting for decreases in financial costs of renewable technologies and associated declines in subsidies; both solar PV and wind will likely become much cheaper than coal-fired power generation in Turkey. Estimates from various scientific reports (see e.g. Fraunhofer ISE, 2013) confirm that coal power will remain behind renewable energy technologies as an expensive technology, whereas renewable technologies are expected to get cheaper in the next few decades. However, taking advantage of this fall in costs is likely to prove difficult if the energy sector has already configured its technical and institutional structure to support coal-fired generation, and where financial support to the coal industry has become part of the established status quo. This may lead to the danger of, what is termed by Aghion and others as, path dependence; that is, firms might be "locked" in dirty technologies. Given the distorted price signals, firms with a history of dirty innovations may be further led to innovate towards maintaining dirty technologies and creating path-dependence in the long run (Aghion, 2011, 2014).

As a natural consequence of its energy and subsidy policy, Turkey is simultaneously grappling with the challenge of combating climate change. Although the country does not contribute much to the global level of emissions (around 1% of the world's greenhouse gas (GHG) emissions according to UNFCCC, 2013), it experiences the fastest increase in GHG emissions with respect to its counterparts in the OECD. Aggregate CO2 emissions have increased by 2.8 times since 1990, reaching a level of 403.55 million tons of CO2(eq) in 2010. Figure 1 demonstrates that over half of these emissions arise from energy combustion, followed by industrial processes, household waste and agriculture respectively. The fact that energy combustion in electricity production releases the highest amount of emissions is because electricity is mainly generated from fossil fuels. Among various industries, cement and iron and steel sectors are the most emission-intensive ones.

<Figure 1 here>

These figures reveal that the structure of the current energy and industrial sectors and the existing coal subsidies in Turkey exacerbate the climate change problem triggering higher levels of GHG emissions. As a result of the rapid increase in energy supply embodying a coal-biased composition, the already high rate of increase in emissions will get even worse.

To test this hypothesis, we make use of an applied CGE model. We study the economic and environmental impacts of the current coal subsidy scheme, test various scenarios for the impact of the removal of these subsidies, and identify viable alternative instruments.

3 The Analytical Model

The model is composed of twelve production sectors spanned over two regionalization bodies for the Turkish economy as *High* versus *Low Income*; a representative private household to carry out savings-consumption decisions; a government to implement public policies towards environmental abatement; and a "rest of the world" account to resolve balance of payments transactions. Antecedents of the model rest on the seminal contributions of the CGE analyses on gaseous pollutants, energy utilization, and economics of climate change for Turkey as narrated in Lise (2006), Kumbaroglu (2003), Sahin (2004), Vural (2009), Telli et. al. (2008); Akin-Okcum and Yeldan (2012) and Bouzaher *et. al.* (2015). All these, however, were based on *national* aggregates. Yet, given our focus on regional investment and subsidization programme of Turkey together with our focus on the priorities of regional industrialization and employment strategy, we find it pertinent to work with a regional diversification. Such an exercise was implemented in Yeldan *et. al.* (2013, 2014) in the context of duality of *middle income* versus *poverty traps* of the Turkish socio-economic structure. Here, we follow their procedure for compilation of data at the regional level. More details of this procedure is narrated in the Appendix.

3.1 Commodity Structure and Regional Commodity Markets

In this modeling attempt, in the absence of an official *regional* I/O Data, we follow the precedure of Yeldan *et. al.* (2013, 2014) in setting a regional differentiation of the components of final demand. Aggregate national accounts are decomposed into two regions: *High* and *Low Income*. Based on this decomposition, we generate a "final good aggregate" in macroeconomic demand based on product differentiation and imperfect substitution a la Armington(1969). The *Armingtonian composite good* structure is utilized in setting the demand for the domestically produced good versus imports of total absorption $(Q^S + M - X)$. We extend this notion accross regions, and decompose the sectoral domestically-produced good aggregate, DC_i, into the regional sources as,

$$DC_i = BC_i \left[\gamma_i DC_{i,RH}^{-\rho_i} + (1-\gamma_i) DC_{i,RL}^{-\rho_i}\right]^{-1/\rho_i} \tag{1}$$

Thus, $DC_{i,R}$ $(R = RH, RL)$ forms the aggregate domestic good along an imperfect substitution specification of the Armington aggregate. Aggregate composite good (absorption) is then given as a

CES aggregation of imports M_i and domestic good aggregate DC_i,

$$CC_i = AC_i \left[\delta_i DC_i^{-\phi_i} + (1-\delta_i) M_i^{-\phi_i}\right]^{-1/\phi_i} \tag{2}$$

On the production side, production activities are differentiated given regional data on production, employment, and exports.

3.2 Production Technology and Gaseous Pollutants

In each sector i, production of gross output is modelled as a two-stage activity. At the top stage gross output of region R, sector i is given by an expanded Cobb-Douglas functional of the form:

$$Q_{i,R}^S = A_{i,R} \left[K_{i,R}^{\lambda_{K,i,R}} LF_{i,R}^{\lambda_{LF,i,R}} LI_{i,R}^{\lambda_{LI,i,R}} E_{i,R}^{\lambda_{E,i,R}} \left(\prod_{j \notin CO,PG,EL} IN_{j,i,R}^{\lambda_{IN,j,i,R}} \right) \right] \tag{3}$$

In (3), A denotes exogenously determined total factor productivity (TFP) parameter; and K, LF, and LI are the physical capital, formal labor and informal (vulnerable) labor, respectively. The sector uses intermediate inputs $IN_{j,i}$ as derived from the I/O data. The E denotes the energy composite aggregate comprised of out three environmentally-sensitive activities of energy generation, *viz.* coal, petroleum and gas, and electricity. At the lower end of the two-stage characterization of sectoral output, this energy composite is determined by a CES function of its components:

$$E_{i,R} = A_{i,R}^E \left[\varphi_{CO,i,R} IN_{CO,i,R}^{-\varrho_{i,R}} + \varphi_{PG,i,R} IN_{PG,i,R}^{-\varrho_{i,R}} + \varphi_{EL,i,R} IN_{EL,i,R}^{-\varrho_{i,R}}\right]^{-1/\varrho_{i,R}} \tag{4}$$

Under the given energy production technology, optimum mix of inputs of *CO, PG,* and *EL* are determined by equating their marginal rate of technical substitution to their respective (input) prices, as to be affected by possible fiscal policy:

$$\frac{IN_{CO,i,R}}{IN_{EL,i,R}} = \left[\left(\frac{\varphi_{CO,i,R}}{(1-\varphi_{CO,i,R}-\varphi_{PG,i,R})} \right) \left(\frac{P_{EL,i,R}}{(1+t^{ENV}_{CO,i,R})P_{CO,i,R}} \right) \right]^{\sigma_{i,R}} \tag{5}$$

$$\frac{IN_{PG,i,R}}{IN_{EL,i,R}} = \left[\left(\frac{\varphi_{PG,i,R}}{(1-\varphi_{CO,i,R}-\varphi_{PG,i,R})} \right) \left(\frac{P_{EL,i,R}}{(1+t^{ENV}_{PG,i,R})P_{PG,i,R}} \right) \right]^{\sigma_{i,R}} \tag{6}$$

where t^{ENV} is the relevant tax instrument on the pollutant activity, and σ is the elasticity of substitution with $\sigma = 1/(1+\varrho)$.

Sectoral demands for capital, labor, and the remaining intermediate inputs follow the conventional opitmization rules with equating marginal products with their respective input prices. The production technology for gross output in (3) is of constant returns; thus,

$$\lambda_{K,i,R} + \lambda_{LF,i,R} + \lambda_{LI,i,R} + \sum_j \lambda_{ID,j,i,R} + \lambda_{E,i,R} = 1 \tag{7}$$

We capture the aggregate $CO2$ emissions in each sector (and region) from three sources of origin: primary energy combustion (EE), secondary energy combustion (SE), and industrial processes (IND). In our specification, secondary energy combustion is due from utilization of refined petroleum (RP) and emissions from industrial processes are dervied exclusively from iron and steel (IS) and cement (CE). Making use of the aggregate energy material balances data we map each sector's $CO2$ emisions to these major sources with the aid of the following summary table:

<Insert Table 1>

Depending on the source of origin of the gaseous $CO2(eq)$ emissions we specify distinct mechanisms.

For capturing emissions from the primary energy combustion activities we set

$$CO2^{EE}_{j,i,R} = \epsilon_{j,i,R} \cdot a_{j,i,R} \cdot IN_{j,i,R} \tag{8}$$

and for the combustion of secondary energy source (refined petroleum) we implement,

$$CO2^{SE}_{RP,i,R} = z_{RP,i,R} \cdot a_{RP,i,R} \cdot IN_{RP,i,R} \tag{9}$$

The parameter $\epsilon_{j,i,R}$ in (8) summarizes the energy use coefficients as calibrated from the Material Energy Balances Tables to set the composition of emissions from primary energy via combustion of coal and petroleum and gas in each sector. The $z_{RP,i,R}$ parameter in (9) similarly narrates the emission coefficient due to combustion of RP. The tradiitonal input-output coefficient, $a_{j,i} = \frac{IN_{j,i}}{Q^S_i}$ is esponsive to price signals via optimizaton on costs, given technology (3). This is in contrast to tradional CGE analyses where $a_{j,i}$ is typically regarded fixed as in a Leontieff technology.

Emissions from industrial processes are recognized within iron and steel (IS) and cement (CE). These emissions are simply regarded as proportional to respective real output:

$$CO2^{IND}_{i,R} = \eta_{i,R} Q^S_{i,R} \qquad i \in \{IS, CE\} \tag{10}$$

Emissions from agricultural processes are similarly set proportional to agricultural gross output. Emissions of non-CO2 gasses (CH4, F and NO2) are set proportional to the primary energy combustion activities. Thus, $CO2(eq)$ emissions of CH4 become:

$$CO2^{CH4}_{j,i,R} = \varepsilon_{j,i,R} \cdot a_{j,i,R} \cdot Q^S_{i,R} \qquad \text{for } j = \{CO, PG\} \tag{11}$$

as for CH4 from waste,

$$CO2^{WST}_{j,i,R} = \varpi_{j,i,R} \cdot Q^{S}_{i,R} \tag{12}$$

Households' demand for energy results in a further source of $CO2(eq)$ emissions. This is regarded as proportional to the household consmption of basic fuels, *viz.* coal and refined petroleum. Thus,

$$CO2^{HH} = \sum_{i \in CO,RP} \kappa_i C^{D}_{i} \tag{13}$$

Aggregate $CO2(eq)$ emissions is the sum of each of these sources:

$$CO2^{TOT} = \sum_{j,i,R} \left(CO2^{EE}_{j,i,R} + CO2^{SE}_{j,i,R} + CO2^{CH4}_{j,i,R} + CO2^{WST}_{j,i,R} \right) + \sum_{i \in IS,CE} CO2^{IND}_{i,R} + \sum_{R} CO2^{AGR}_{R} + CO2^{HH} \tag{14}$$

3.3 Labor Markets, Income Generation and General Equilibrium

We distinguish two types of labor: *formal* and *informal/vulnerable.* Based on ILO's specification[1], vulnerable employment is characterized by informal/unregistered employees without any social security coverage; self-employed, and unpaid family workers. The two labor categories obey different labor market characteristics. We set the formal wage rates exogenously given, calibrated above the otherwise market clearing wage rate to generate the level of regional unemployment rates as of 2010. Thus, for formal labor the market clears by quantity adjustments on employment,

$$U_{LF,R} = L^{S}_{LF,R} - \sum_{i} LF^{D}_{i,R} \tag{15}$$

[1] ILO, *World of Work,* various issues, Geneva.

The informal/vulnerable labor market, on the other hand, operates with fully flexible wages. The low level of informal wages is a symptomatic proxy for poverty of vulnerable labor.

Over periods, the regional labor markets are linked by migration. This is based on (expected) wage differences across the high income versus low income Turkey, and is driven along the classic *Harris-Todaro* (1970) specification. Thus, given the migrants from each labor type, *l=LF,LI*

$$MIG_l(t) = \mu_l \left[\frac{(E\left[W_{l,RH}\right] - W_{l,RL})}{W_{l,RL}} \right] L^S_{l,RL} \tag{16}$$

where $E\left[W_{l,RH}\right]$ is the expected wage rate of labor type-l (=*LF, LI*) in the high income region, and μ_l is a calibration parameter.

Given $MIG_l(t)$, based on wage expectations from region-*High*, labor supplies evolve according to,

$$\begin{aligned} L^S_{l,RL}(t+1) &= (1+n_{l,RL})L^S_{l,RL}(t) - MIG_l(t) \qquad (17) \\ L^S_{l,RH}(t+1) &= (1+n_{l,RH})L^S_{l,RH}(t) + MIG_l(t) \end{aligned}$$

Capital stocks evolve given fixed investments net of depreciation. Given the aggregate physical capital stock supply in each period, the regional capital market equilibrium implies a regional equilibrium profit rate r . Consequently, sectoral physical capital is mobile and responds to the difference in profit rates to allocate the total investment funds across "time".

Private household income is composed of labor wage incomes, and remittances of profits from the enterprise sector. In turn, the public sector revenues comprise tax revenues from wage and profit incomes, and non tax sources of income from various exogenous flows . The income flow of the public sector is further augmented by indirect taxes and environmental taxes. The model follows the fiscal budget constraints closely. Given public earnings, government's "transfer expenditures to households" is adjusted endogenously to sustain other components of public demand (public investment and consumption expenditures) as fixed ratios to national income.

The overall model is brought into Walrasian equilibrium via endogenous settling of commodity prices. Informal wage rates across regions clear regional labor markets. The balance of payments is cleared through flexible adjustments on the real exchange rate (ratio of domestic good price to imports in the CGE folklore) while the *nominal* conversion factor across domestic and world prices serves as the *numéraire* of the system.

"Dynamics" into the model is integrated via sequentially updating of the annual "solutions" of the model up to 2030. Economic growth is the end result of (i) exogenous growth of labor supplies; (ii) investments on physical capital net of depreciation; and (iii) total factor productivity (TFP) growth, which in turn is regarded exogenous. In-between periods, we first update the capital stocks with new investment expenditures net of depreciation. Regional labor supplies are augmented by respective population growth rates, and the migration process (see equation (16). Technical factor productivity rates are updated in a Hicks-neutral manner. Formal real wage rates are updated by the cost of living level index (endogenously solved).

4 Policy Analysis

4.1 The "Business-As-Usual" Base Path

Following the general CGE tradition, we start by integrating a “business-as-usual” base path into our analysis. This will be used as a reference path to assess the macroeconomic and environmental performance of our policy scenarios.

Over this path we first introduce the projections of the exogenously specified flows and parameters. “Population” growth rates for the two labor types across regions are adapted from the UN projections and TurkStat data, and are set at 2% per annum for low income region; and 0.8% for the high income region. The migration elasticity parameter in equation (16) is taken as 0.05 for both labor types. Capital stocks are updated by new (fixed) investments net of depreciation. Both the depreciation rate and sectoral/regional total factor productivity (TFP) growth rates (growth rate of A in equation (3) above) are adjusted to obtain the projected growth of the domestic economy over 2015-2030, at the rate of 3.8% per annum. Detailed official growth projections are given for Turkey, albeit on a very rough analytical backing, and for a short duration. The Medium Term Programme, for instance, follows a 5% target in its macroeconomic projections over 2014-2017. In contrast, OECD (2014) and IMF's World Economic Outlook (2015, April) projections suggest that the Turkish growth rates will likely be on the order of 3.5 – 4.0% over the next decade. Stockholm Environment Institute's Climate Equity Reference Calculator (C-EQR) also uses a 3.6% rate of growth per annum in its projections for the Turkish economy towards 2030. Given these international evidence and data, we adopted the average annual growth target of 3.8% as our base path rate over the 2015-2030 horizon. This assumption brings the aggregate real GDP to 2,181 billion TRY (in fixed 2010 prices), with an aggregate gross production of 3,543 billion TRY in the high income region, and of 1,081 billion TRY in the low income region (See Table 2 below). Throughout this exercise, TFP growth rates were implemented at an average of 0.1% for rural low income; 1% for rural high income; 0.5% for non-agricultural low income; and 0.9% for non-agricultural high income.

Exogenous foreign flows are set at their historical ratios to GDP, and were gradually reduced to yield a current account deficit of 3.5% by 2030. Currently this deficit stands at 6.5% and is regarded as an important source of fragility for the Turkish economy, raising concerns over its sustainability. In the labor markets, formal wage rates were maintained at their real levels by continuously updating with the "price level" as solved endogenously by the model. Finally, government's fiscal parameters are left intact at their current (historically realized) levels.

The model is solved sequentially up to 2030 with each "solution" referring to a calendar year. We document a summary of macro and environment indicators of this base path in the first part of Figures 2 and 3 below. With an average annual rate of growth of 3.8% over 2015-2030, Turkish aggregate CO2 emissions reach to 644.9 million tons (Figure 2) (to 734.8 million tons of CO2(eq) gaseous emissions in total). This is reported to stand at 439 million tons of CO2(eq) in 2012 by the TurkStat.

<Figure 2 here>

In terms of energy efficiency, we observe that total CO2 emissions per unit of GDP first rise to 0.547 kg per US$ GDP until 2020, and recede to 0.532 kg/$GDP by the end of 2030 (Figure 3). This fall is due to the gains in efficiency implicitly attained by applications of the (exogenous) gains in sectoral/regional TFPs.

<Figure 3 here>

It has to be noted from the outset that this procedure by no means gives a projection of the domestic economy to be read from a crystal ball; but rather, should be regarded as a historically trended future path against which alternative policy environments can be contrasted.

4.2 Investigating Alternative Policy Scenarios

Given our policy questions we first intervene to the coal market and study implications of eliminating the existing subsidization scheme. To this end we first investigate the macro and environmental implications of eliminating the subsidies on coal production. As discussed in section II, the existing scheme of coal subsidization amounts to 730m US$, on the average of 0.1% as a ratio to the GDP. In the first scenario we reduce this subsidy to zero.

4.2.1 Eliminate Subsidies on Coal Production

Elimination of the coal subsidies generate contractionary pressures in coal production. As of 2030 coal production falls by 29% in the high income region, and by 28% in the low income region. These imply a reduction of 0.2% in the aggregate real gross domestic product by 2030, or a total 4 billion TRY in fixed 2010 prices. Gains in total CO2(eq) are on the order of 2.5% (18.7 million tons) over the base path by 2030. The bulk of these gains originate from reductions of emissions from coal combustion –3.9 million tons in low income; 12.1 million tons in the high income region. There is a further reduction of 3.2% (3.1 million tons) of energy related emissions from the household sector. These numbers imply that CO2 emissions from energy per $ of GDP falls to 0.405 kg under the scenario, from 0.419 kg of he base path (see Figures 4, 5 and 6).

<Figure 4>

<Figure 5>

<Figure 6>

Clearly, all these findings are the end-result of the reallocation of resources due to the general equilibrium dynamics across sectors and regions. We find that labor demand is adversely affected and there is a slight increase in the average unemployment rate. Unemployment rate in both regions rise by about 0.2 percentage points. Due to the deceleration of the economic activity, there is a fall in aggregate investment and consumption expenditures, yet these effects are found to be comparably small. These observations suggest that owing to substitution effects, domestic production activity helps recovery of the aggregate economy; and in the final analysis, the gains in pollution abatement are relatively noteworthy. More detailed summary of these results are documented in Tables 2 through 7.

<Table 2 here>

<Table 3 here>

<Table 4 here>

<Table 5 here>

<Table 6 here>

<Table 7 here>

4.2.2 Eliminate Investment Subsidies on Coal

Coal mining is further subsidized under the Regional Investment Incentives Scheme (see Appendix 2 for a detailed outline of the scheme). Accordingly, investment expenditures on coal mining are supported by the central government to boost coal production across regions. Via reduced income or corporate taxes, the existing scheme subsidizes the cost of investments at a rate of 30% in the high income region, and by 35% in the low income region. In this scenario, we eliminate the programme. The results are tabulated under the "scenario 2" part of Tables 2 through 7, and also portrayed in Figures 4 through 6 above.

We find the macro effects of the scenario quite small. GDP level is almost maintained suggesting that substitution effects on the reallocation of capital across the remaining sectors dominate. Yet, the abatement on CO2 emissions continue and in comparison to the base path the scenario achieves 2.9% reduction in aggregate CO2(eq) emissions (in 2030). In the high income region reduction of CO2 emissions from coal burning reach to 22.6% and in the low income region it reaches to 22.3%. Total abatement of energy related CO2 emissions reach to 20.4 million tons, and the ratio of CO2 from energy to GDP is reduced further to 0.403 kg/$.

5 Conclusion

In this paper we assessed the impact of the current arsenal of energy policy instruments (in particular coal subsidies) on macro indicators and environmental outcomes, specifically CO2 emissions in Turkey.

Consequently, the implications of the removal of coal subsidies are explored. The findings suggest that elimination of production and investment subsidies to coal results in a slight reduction of GDP but a substantial decrease in CO2 emissions both in the low and high income regions. Considering that such a small coal sector benefits from significant subsidies, the elimination of these motives alone will considerably benefit the environment.

Apart from the ambitions to increase coal utilization in the country, Turkish environmental policies currently rely on gasoline and fuel taxes. However, given the lack of an adequate modeling paradigm for environmental policy analysis in Turkey, the effectiveness of such policy interventions and their economic impacts are not well-known. In fact, in the absence of any viable substitute energy sources, it is clear that polices based only on the fiscal motives of excise taxation will not suffice to achieve significant results for mitigation, and they will need to be expanded to include other forms of policy measures such as earmarking of the pollution tax monies and encouraging abatement investment towards reduced energy intensities (Acar, Challe, Christopoulos and Christo, 2014). Hence, there is a strong need for the construction and utilization of analytical models that can account for the general equilibrium effects for environmental policy analysis, especially under the discipline of dynamic general equilibrium. We believe that our model sheds light on the effectiveness of such policies and their potential impacts in the future.

On the other hand, while Turkey has ambitious plans for deployment of renewable energy, these are likely to be compromised by the continued existence of subsidies to coal-fired power generation and coal mining including the recently introduced regional development package with investment support and loan guarantees. Debate over subsidy reform is hindered by lack of transparent data in the magnitude and impacts of these subsidies. Since coal subsidies work against the competitiveness of renewable energy technologies, locks the energy sector in to the continuation of fossil-fuel-based systems, and jeopardizes investment decisions of renewable energy investors (IISD, 2014), elimination of coal subsidies and redirecting these funds towards renewable energy, green jobs, or CO2 mitigation in general will likely prove efficiency and social welfare improvement.

As an extension of this work, viable policy alternatives can be put forward in order to help the greening of the economy. Coal subsidies could be transferred to the development of renewable energy and green jobs while the environmentally harmful impacts could be mitigated. Coal subsidy phase-out would decrease CO2 emissions, decrease the fiscal burden, and has the potential to generate green jobs and green energy. Switching from subsidization of coal to development of renewables promises a win-win-win strategy for a cleaner environment, for decreased dependence on fuel imports, and expansion of renewables. Besides, alternative public policy intervention mechanisms could be developed to accelerate technology adoption and achieve higher employment, energy security, and sustainable growth patterns.

References

Acar, S., Challe, S., Christopoulos, S. and Christo, G. (2014). Fossil Fuel Subsidies as a Lose-Lose: Fiscal and Environmental Burdens in Turkey. Paper presented at the 14th IAEE European Energy Conference, October 28-31, 2014, Rome, Italy.

Aghion P, Dechezlepretre A, Hemous D, Martin R, Reenen J.(2010)" Carbon Taxes, Path Dependency and Directed Technical Change : Evidence from the Auto Industry".

Aghion, P. (2014) "Industrial Policy for Green Growth", Paper presented at the 17th World Congress of the International Economics Association, Jordan.

Aghion, P., Julian Boulanger and Elie Cohen (2011) "Rethinking Industrial Policy" Bruegel Policy Brief No 04, June.

Akin Olcum, Gokce and Yeldan, Erinc, 2013. "Economic impact assessment of Turkey's post-Kyoto vision on emission trading," *Energy Policy*, Elsevier, vol. 60(C), pages 764-774.

Ambec S., M.A. Cohen, S. Elgie, and P. Lanoie (2011). "The Porter Hypothesis at 20: Can Environmental Innovation Enhance Innovation and Competitiveness?" Resources for the Future Discussion Paper 11-01.

Arli-Yilmaz, Selen (2014) "Green Jobs and their potential in renewable energy in Turkey" (in Turkish) Expert Thesis, TR Ministry of Development, May.

Armington, P. (1969) "A Theory of Demand for Products Distinguished by Place of Production" *IMF Staff Papers*, 16(1): 159-178.

Bekmez, S, I. Genc, L. Kennedy (2002) "A Computable General Equilibrium Model for the Organized and Marginal Labor Markets in Turkey" *Southwestern Economic Review*, pp. 97-114.

BNEF. (2014). Turkey's Changing Power Markets - White Paper. Bloomberg New Energy Finance.

Bouzaher, Aziz, Şahin, Şebnem and A. Erinç Yeldan (2015) "How to Go Green? A General Equilibrium Investigation of Environmental policies for Sustained Growth with an Application to Turkey". *Letters in Spatial and Resource Sciences*, Vol 8, No 1: 49-76.

Bovenberg, A. and de Mooij, Ruud A., (1994). "Environmental taxes and labor-market distortions," *European Journal of Political Economy*, Elsevier, vol. 10(4), pages 655-683, December.

Braanlund, R. and T. Lundgren (2009). "Environmental Policy without Costs? A Review of the Porter Hypothesis", *International Review of Environmental and Resources Economics* 3(2), 75-117.

Buonanno, P, C. Carraro and M. Galeotti (2001) "Endogenous Induced Technical Change and Costs of Kyoto" Nota di Lavoro No 64. FEEM, Milan Italy.

Fraunhofer ISE. (2013). Levelized Cost of Electricity- Renewable Energy Technologies. Study Edition: November 2013. Retrieved from http://www.ise.fraunhofer.de/en/publications/studies/cost-of-electricity

GSI. (March, 2015). Acar, S., Kitson, L. and Bridle, R. Subsidies to Coal and Renewable Energy in Turkey. International Institute for Sustainable Development (IISD)-Global Subsidies Initiative Report.

Goulder, L. H. and S. Schneider (1999) "Induced Technological Change, Crowding Out and the

Attractiveness of CO_2 Emissions Abatement", *Resource and Environmental Economics* 21(3-4): 211-253.

Goulder, L.H. (1995) "Effects of Carbon Taxes in an Economy with Prior Tax Distortions: An Intertemporal General Equilibrium Analysis", *Journal of Environmental Economics and Management*, 29: 271-297.

IEA. (2014). World energy outlook 2014. Retrieved from http://www.iea.org/publications/freepublications/pul

IISD. (December, 2014) Richard Bridle and Lucy Kitson. The Impact of Fossil-Fuel Subsidies on Renewable Electricity Generation. Retrieved from http://www.iisd.org/sites/default/files/publications/impact-fossil-fuel-subsidies-renewable-electricity-generation.pdf

Kammen, Daniel, Kamal Kapadia and Matthias Fripp (2004) "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?" University of California Berkeley, mimeo.

Kumbaroglu, Selcuk G. (2003) "Environmental Taxation and Economic Effects: A Computable General Equilibrium Analysis for Turkey", *Journal of Policy Modeling*, 25: 795-810.

Lise, Wietze (2005) "Decomposition of CO_2 Emissions over 1980-2003 in Turkey", Working Papers No. 2005.24, Fondazione Eni Enrico Mattei.

Lozschel, Andreas (2002) "Technological Change in Economic Models of Environmental Policy: A Survey" *Ecological Economics* 43: 105-126.

Nordhaus, W. and J. Boyer (1999) *Roll the DICE again: The Economics of Global Warming*, New Haven: Yale University Press.

OECD (2013) "Climate and carbon: aligning prices and policies" OECD Environment Policy Paper, October, No 1.

Porter M., and C. van der Linde (1995). "Toward a New Conception of the Environment-Competitiveness Relationship", *Journal of Economic Perspectives,* 9(4), 97-118.

Rodrik, Dani (2013) "Green Industrial Policy" Institute for Advanced Study, Princeton, N. J. unpublished mimeo.

Sahin, Sebnem (2004) “An Economic Policy Discussion of the GHG Emission Problem in Turkey from a Sustainable Development Perspective within a Regional General Equilibrium Model: TURCO”, Unpublished PhD Thesis submitted to Université Paris I Panthéon - Sorbonne.

Sarica, K. and G. Kumbaroglu (2006), "Efficiency Assessment of Turkish Power Plants Using DEA", 19th Mini EURO Conference on Operational Research Models and Methods in the Energy Sector (ORMMES06), University of Coimbra, Portugal, September 6-8, 2006.

Stockholm Environment Institute, Climate Equity Reference Project, http://climateequityreference.org/calcula accessed 13 April, 2015.

TEIAS. (2013).Electricity Generation and Transmission Statistics of Turkey, 2013. Retrieved from http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2013/istatistik2013.htm

UNFCCC. (2013). GHG Inventories (Annex I), National Inventory Submissions 2013. National Report for Turkey. Retrieved from http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventor

Telli, Cagatay, Ebru Voyvoda and Erinc Yeldan (2008) "Economics of Environmental Policy in Turkey: A General Equilibrium Investigation of the Economic Evaluation of Sectoral Emission Reduction Policies for Climate Change", *Journal of Policy Modeling*, 30(1), pp. 321-340.

UNDP and World Bank (2003) Energy and Environment Review: Synthesis Report Turkey, Washington, ESM273, 273/03, Energy Sector Management Assistant Programme.

Voyvoda, Ebru and Erinc Yeldan (2011) "Investigation of the Rational Steps towards National Programme for Climate Change Mitigation" (in Turkish) TR Ministry of Development, Ankara, *mimeo.*

Vural, Bengisu (2009) “General Equilibrium Modeling of Turkish Environmental Policy and the Kyoto Protocol” Unpublished MA Thesis Submitted to the Bilkent University.

World Bank (2013). "Turkey Green Growth Policy Paper: Towards a Greener Economy", April. Washington, DC, USA.

World Bank (2014a) "Turkey in Transitions" Washington DC: The World Bank

World Bank (2014b) "Putting a price on carbon with a tax"

(http://www.worldbank.org/content/dam/Worldbank/document/SDN/background-note_carbon-tax.pdf)

access date: January 15, 2015.

WTO. (1994). Agreement on Subsidies and Countervailing Measures. Article 1. Uruguay Round Agreements.

Yeldan, A. Erinc (2015) "Impact Analysis of Turkey's Employment Subsidization Programme" (in Turkish), Bilkent University, *mimeo.*

Yeldan, A. Erinç, Kamil Taşçı, Ebru Voyvoda and Emin Özsan (2014), "Planning for Regional Development: A General Equilibrium Analysis for Turkey" pp. 291-331 in Yülek, M. (ed) *Advances in General Equilibrium Modeling*, Springer.

Yeldan, A. Erinç, Kamil Taşçı, Ebru Voyvoda and Emin Özsan(2013) *Escape from the Middle Income Trap: Which Turkey?* TURKONFED, Istanbul. March.

Appendix 1: Data Sources and Calibration Methodology

Construction of the Regional Social Accounting Data Base

Input-Output (I/O) data at the regional level are not present in Turkey. The most recent I/O data is tabulated in 2002 by TurkStat. Given the lack of official regional data, we strive to differentiate regional economic activities based on the standart tools of CGE applications. We first update the 2002 I-O data to 2010 using the national income data on macro aggregates. Then using the RAS's on sectoral shares, we obtained sectoral components of final demand. Labor remunerations are obtained from ILO and TurkStat Hosehold Labor Force Surveys (HLFS) data (see below for details).

The aggregated I/O table for 2010 and the regional SAM are displayed below.

<Insert Table A-1 here>

<Insert Table A-2 here>

In reaching the regional SAM, we decomposed the national macro aggregates via the shares of gross regional value added (RGVA). Based on our differentiation of the *level-2* NACE-1 data, we distinguish 9 regions as "High-Income" and 17 regions are classified under "Low Income". Data reveal that regions host about half of the total population of 73.7 million persons, and about a third of total land is covered by region *Low Income*. We further observe that about 70% of aggregate value added is captured by the *High Income* region, and the rest 20% is originated in the *Low Income* region. For further specifics of the regional macro data, see Table below.

<Insert Table A-3>

The SAM tabulates the micro level I/O data along with the aggregate macro data on public sector balances and resolution of the saving-investment equilibrium. The latter discloses a current account deficit (foreign savings) of TL72.5 billion (roughly 6.5% to the GDP). The two regions identified, *High* versus *Low Income* Turkey yield the production activities; while components of aggregate national demand are revealed by way of imperfect substitution in demand, and are calibrated through standard methods of the Armingtonian composite system (see text for explanation).

Parametrization of Gaseous Pollutants

A total of 403.5 million tons of $CO2(eq)$ is reportedly released in Turkey in 2010. TurkStat data distinguish this sum into four sources: energy combustion (295.1 mtons), industrial processes (55.7 mtons), agricultural processes (27.1 mtons), and waste (35.5 mtons). At a different level of aggregation, 326.8 mtons of this sum is due to emissions of $CO2$, 57.3 mtons is due to emissions of CH4; 14.2 mtons to N_2O, and 5.2 mtons to F-gasses.

In order to direct these data into sectoral sources of origin, we make use of the TurkStat data as reported to the UNFCCC inventory system. The original data on greenhouse gas source and sink categories are used whenever it was possible to make a direct connection between the sectors recognized in the official data table and the sectors distinguished in the model: Agriculture, refined petroleum, cement, iron and steel, and electricity. We have allocated the remaining unaccounted CO2 emissions by the share of sectoral intermediate input demand to the aggregate (the total being 277 mtons). This exercse yields the following summarization of $CO2(eq)$ emissions across production sectors and other activities.

<Insert Table A-4 here>

Usimng data in the above table we first calculate total sectoral emissions, $CO2_i^{TOT}$. Then this sum is decomposed into three main sources of origin, emissions from combustion of primary energy (EE) and of secondary energy (SE), and from industrial processes (IND). This is done with the aid of the Table 1 in the text (origin source table). Let $\pi_{S,i}$ ($s \in EE, SE, IND$) be a typical element of the Table 1, then

$$CO2_{S,i} = \pi_{S,i} \cdot CO2_i^{TOT}$$

The coefficient $z_{RP,i}$ is then calibrated by

$$z_{RP,i} = \frac{CO2_{RP,i}^{SE}}{IN_{RP,i}}$$

For distinguishing this aggregate into the regional activities, regional shares of sectoral output had been used. Ideally the source of $CO2(eq)$ emissions ought to be used for regions. However, in the absence of precise data across regional measurements, we had to abstain from making ad hoc specifications. For the EE sources of $CO2(eq)$ emissions across sectors (for $j \in CO$ and PG) we follow a similar procedure and find $CO2_{j,i}^{EE}$ from data displayed in Table xx by applying the $\varepsilon_{j,i}$ for $j \in CO$ and PG.

Calibration of the Labor Markets

Two types of labor are distinguished in the model: formal (LF) and informal/vulnerable (LI). The characterization is based on the ILO's definition of vylnerable employment as: informal (unregistered employment that is under any social security coverage) + self-employed + unpaid family labor. Based on this criteria, total employment of 22,594 thousand workers is distributed across regions and sectors using the HLFS data of TurkStat. See Table (labor) for parametrization of the labor markets.

<Insert Table A-5 here>

In setting the aggregate labor share in national income, ILO's 2014 Report *The Word of Work* is used. ILO estimates the share of labor income as 0.29 for Turkey, for 2010. Using this point data, aggregate labor income is first derived from national income accounts; and then, using th formal/ vulnerable employment shares from the HLFS data aggregate wage income data of both labor types are found. Finally, by using the sectoral income shares of the I/O table sectoral/regional wage remunerations across labor types are obtained. Full data is summarized in table 5 above.

Appendix 2. Support Measures of the Regional Investment Incentive Scheme

SUPPORT MEASURES		REGIONS					
		1	2	3	4	5	6
VAT Exemption[1]		Yes	Yes	Yes	Yes	Yes	Yes
Customs Duty Exemption[2]		Yes	Yes	Yes	Yes	Yes	Yes
Tax Deduction[3]	Tax Reduction Rate (%)	**30**	**40**	**50**	**60**	**70**	**90**
	Reduced Tax Rate (%)	**14**	**12**	**10**	**8**	**6**	**2**
	Rate of Contribution (%)	**10**	**15**	**20**	**25**	**30**	**35**
Social Security Premium (SSP) Support (Employer`s Share) [4]	Term of Support (years)	**-**	**-**	**3**	**5**	**6**	**7**
	Cap for Support (Certain Portion of Investment Amount - %)	**-**	**-**	**20**	**25**	**35**	**No Limit**
Land Allocation[5]		Yes	Yes	Yes	Yes	Yes	Yes
Interest Rate Support[6]	TL Denominated Loans (points)	-	-	**3**	**4**	**5**	**7**
	FX Loans (points)			**1**	**1**	**2**	**2**
	Cap for Support(Thousand TL)	-	-	500	600	700	900
SSP Support (Employee's Share) (years)[7]		-	-	-	-	-	**10**
Income Tax Withholding Support (years)[8]		-	-	-	-	-	**10**

Source: Ministry of Economy (Table and notes retrieved from http://www.ekonomi.gov.tr/portal/faces/home/yatirim/yatirimTesvik/yatirimTesvik-Genel_Bilgi)

Notes: For investments starting as of January 1, 2015. The new investment incentives system defines certain investment areas including coal mining and coal fired power generation as "priority" areas and grants them with the regional support measures defined for Region 5, regardless of the region of investment. If the fixed investment amount in priority investments is TRY 1 billion or more, tax reduction will be applied by adding 10 points on top of the "rate of contribution to investment" available in Region 5. If priority investments are made in Region 6, the regional incentives available for this particular region shall apply.

1) In accordance with the measure, VAT is not paid for imported and/or domestically provided machinery and equipment within the scope of the investment encouragement certificate.

2) Customs duty is not paid for the machinery and equipment provided from abroad (imported) within the scope of the investment encouragement certificate.

3) Calculation of income or corporate tax with reduced rates until the total value reaches to the amount of contribution to the investment according to envisaged rate of contribution.

4) The measure stipulates that for the additional employment created by the investment, employer's share of social security premium on portions of labor wages corresponding to amount of legal minimum wage, will be covered by the Ministry.

5) Refers to allocation of land to the investments with investment incentive certificates, if any in that province in accordance with the rules and principles determined by the Ministry of Finance.

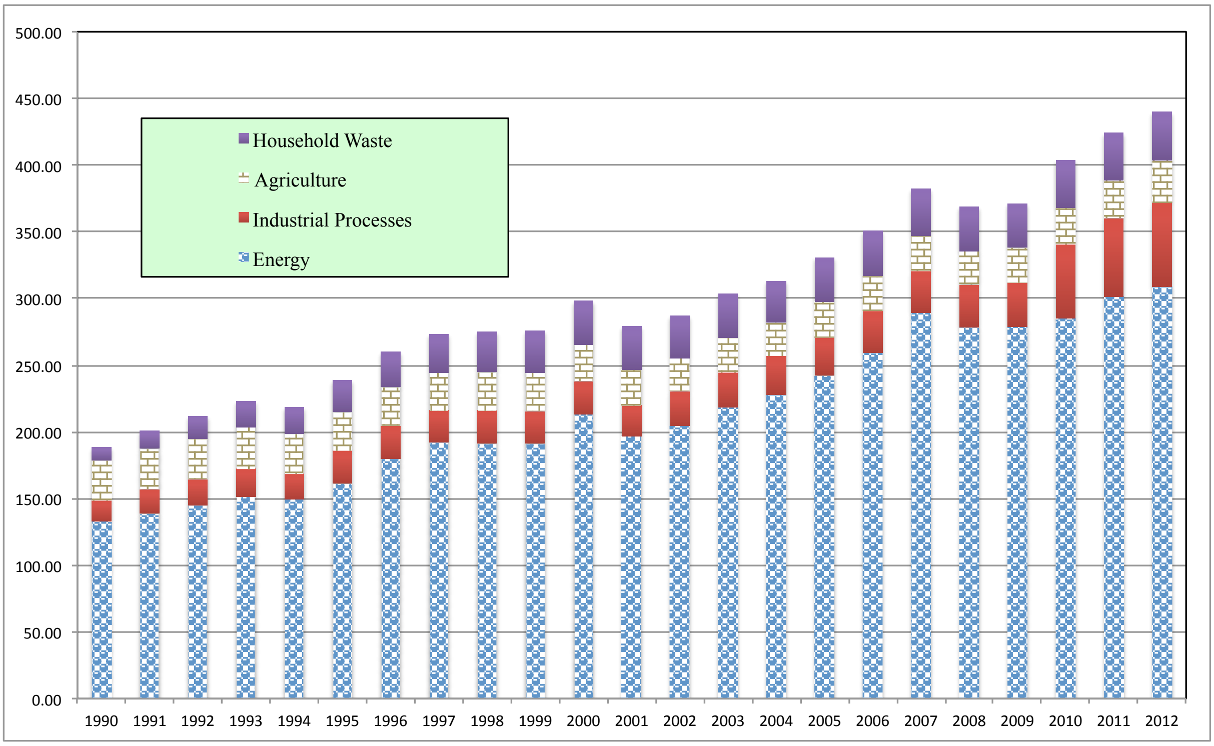
6) Interest support, is a financial support instrument, provided for the loans with a term of at least one year obtained within the frame of the investment encouragement certificate. The measure stipulates

that a certain portion of the interest/profit share regarding the loan equivalent of at most 70% of the fixed investment amount registered in the certificate will be covered by the Ministry.

7) The measure stipulates that for the additional employment created by the investment, employee's share of social security premium on portions of labor wages corresponding to amount of legal minimum wage, will be covered by the Ministry. The measure is applicable only for the investments to be made in Region 6 within the scope of an investment encouragement certificate.

8) The measure stipulates that the income tax regarding the additional employment generated by the investment within the scope of the investment encouragement certificate will not be liable to withholding. The measure is applicable only for the investments to be made in Region 6 within the scope of an investment encouragement certificate.

Figure 1. GHG emissions by sectors (million tons of CO_2 eq.) 1990 - 2012



Source: TurkStat

Table 1

Distribution of CO2 Emissions From Sectoral Production Activities By Source of Origin				
		Industrial Processes	Primary Energy Utilization	Secondary Energy Utilization
AG	Agriculture	0.00	0.00	1.00
CO	Coal	0.00	0.30	0.70
PG	Crude Oil and Natural Gas	0.00	0.80	0.20
PE	Refined Petroleum	0.00	0.88	0.12
CE	Cement	0.66	0.16	0.18
IS	Iron and Steel	0.67	0.15	0.18
MW	Machinery and White Goods	0.00	0.00	1.00
ET	Electronics	0.00	0.75	0.25
AU	Auto Industry	0.00	0.30	0.70
EL	Electricity Production	0.00	1.00	0.00
CN	Construction	0.00	0.00	1.00
OE	Other Economy	0.00	0.40	0.60

Source: Adopted from Energy Balances Tables, Min of Energy and Natural Resources.

Figure 2

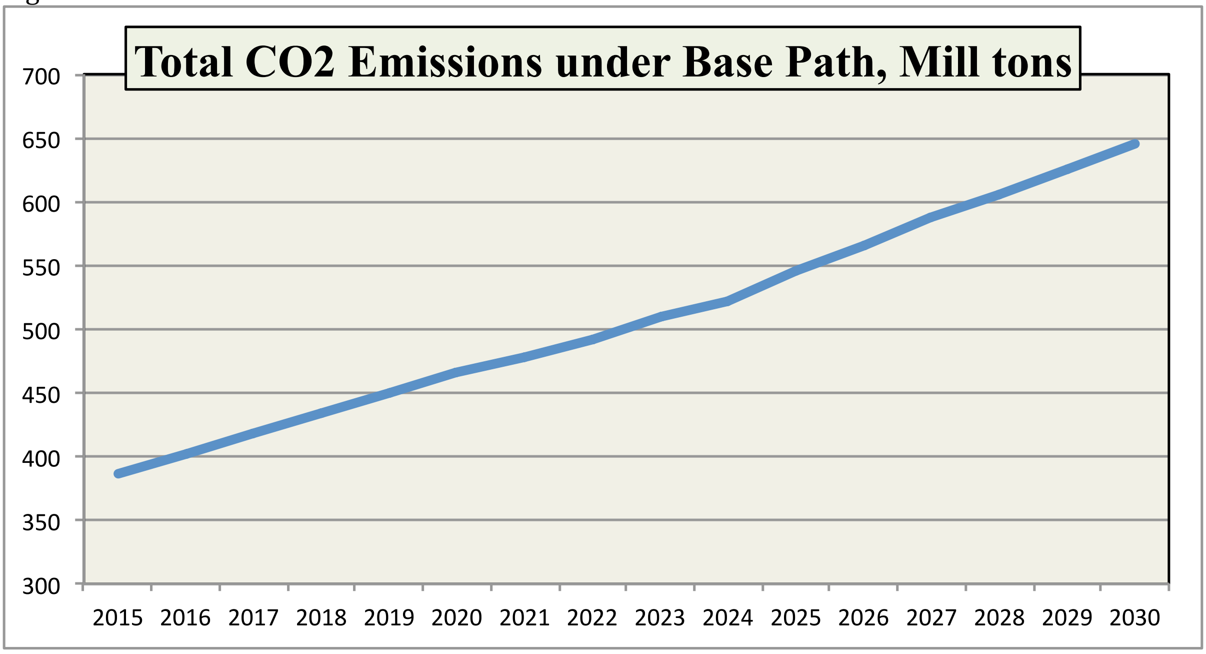


Figure 3

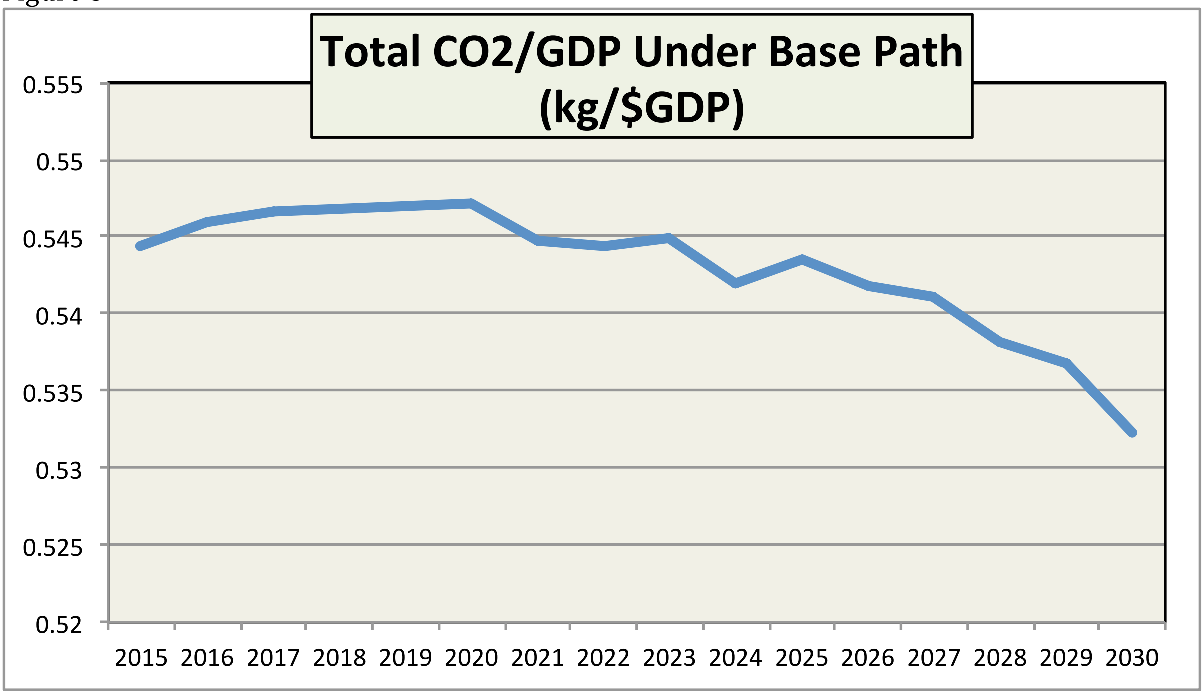


Figure 4

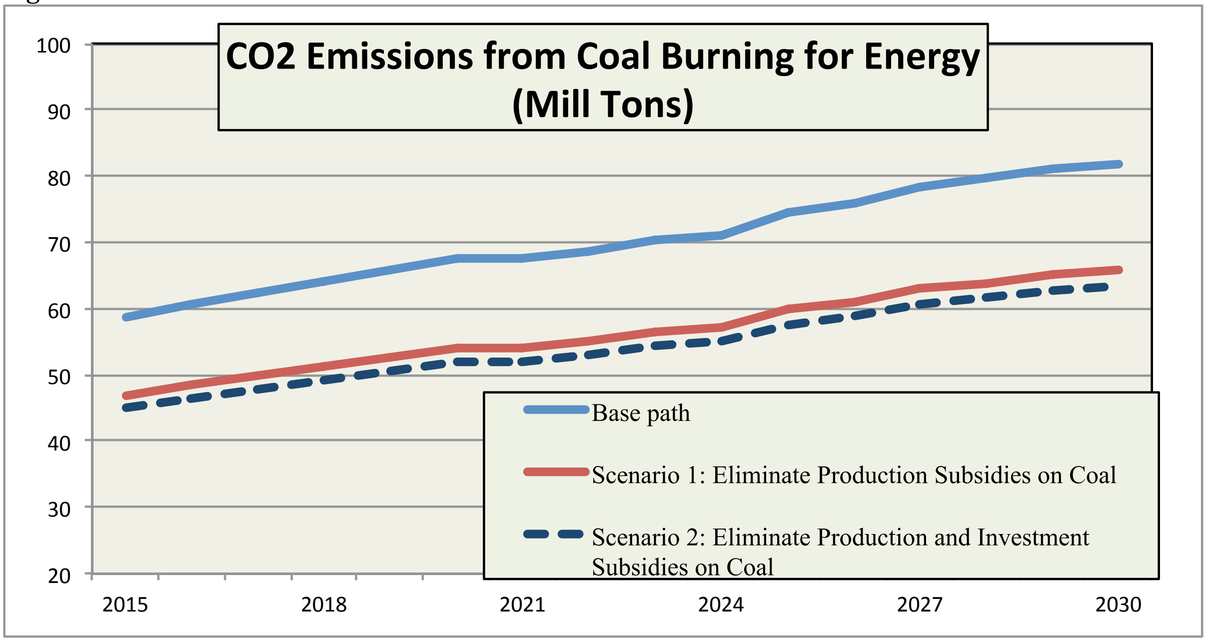


Figure 5

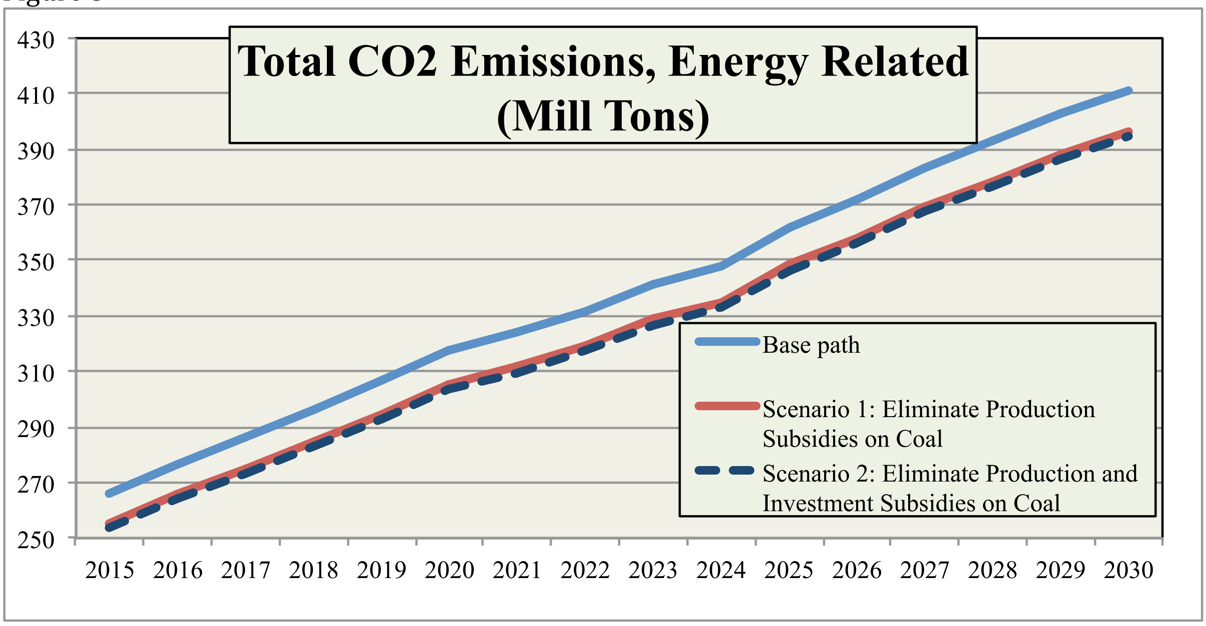


Figure 6

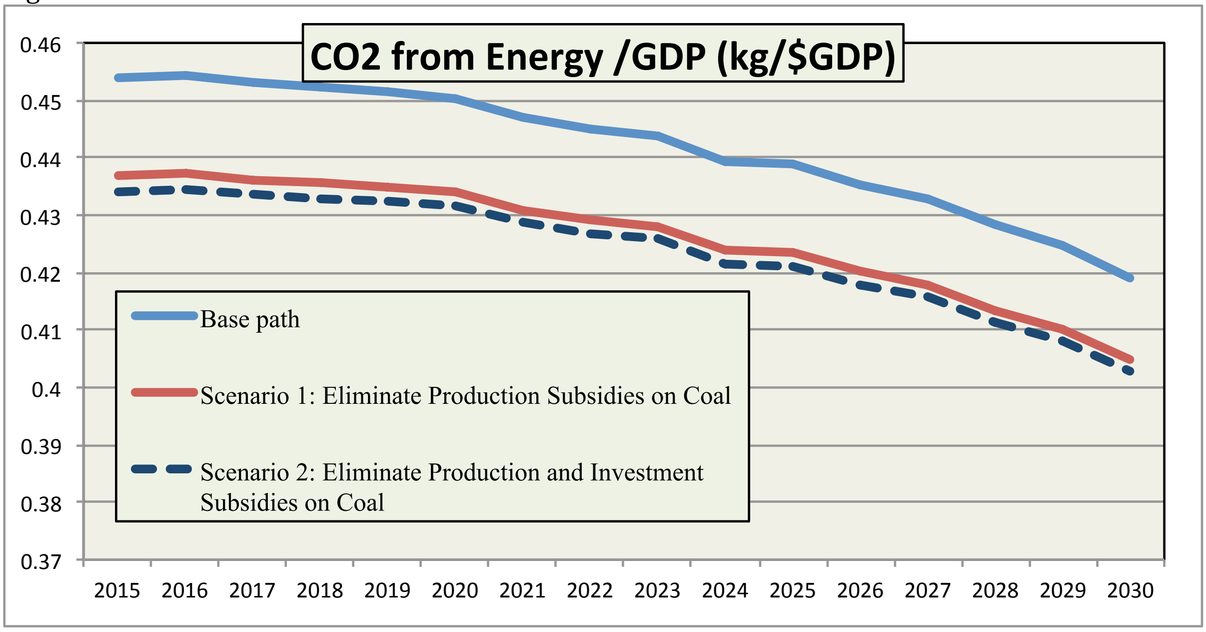

CO2 from Energy /GDP (kg/$GDP)
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
0.38
0.37
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Base path
Scenario 1: Eliminate Production Subsidies on Coal
Scenario 2: Eliminate Production and Investment Subsidies on Coal

Table 2

Macroeconomic Results (Bill TL, 2010 fixed Prices)

	Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
High Income Region Total Supply	2,048.3	2,445.4	2,891.1	3,543.9	2,044.7	2,441.0	2,885.7	3,537.1	2,044.5	2,440.7	2,885.5	3,536.9
Low Income Region Total Supply	589.3	746.0	908.5	1,081.6	588.5	744.9	907.1	1,079.9	588.4	744.9	907.1	1,079.9
Total GDP	1,277.5	1,534.8	1,809.9	2,181.2	1,275.7	1,532.4	1,807.0	2,177.4	1,275.5	1,532.3	1,806.8	2,177.2
Real rate of Growth GDP	4.1	3.7	4.4	3.8	4.1	3.7	4.4	3.8	4.1	3.7	4.4	3.8
High Income Region Value Added	837.0	993.7	1,175.6	1,437.4	835.0	991.2	1,172.7	1,433.8	834.8	991.0	1,172.4	1,433.5
Low Income Region Value Added	227.9	280.8	339.0	408.0	227.4	280.2	338.2	407.0	227.4	280.2	338.1	406.9
Formal Labor Employment in High Income Region (Mill Per)	10.2	10.5	10.9	11.7	10.1	10.5	10.9	11.6	10.1	10.5	10.9	11.6
Formal Labor Employment in Low Income Region (Mill Per)	3.2	3.7	4.1	4.5	3.2	3.7	4.1	4.5	3.2	3.7	4.1	4.5
Formal Labor Employment, TOTAL (Mill Per)	13.4	14.2	15.0	16.2	13.3	14.1	15.0	16.1	13.3	14.1	15.0	16.1
InFormal Labor Employment in High Income Region (Mill Per)	8.0	8.6	9.2	9.7	8.0	8.6	9.2	9.7	8.0	8.6	9.2	9.7
InFormal Labor Employment in lOW Income Region (Mill Per)	3.1	3.2	3.3	3.4	3.1	3.2	3.3	3.4	3.1	3.2	3.3	3.4
Informal Labor Employment, TOTAL (Mill Per)	11.1	11.8	12.4	13.1	11.1	11.8	12.4	13.1	11.1	11.8	12.4	13.1
Total Labor Employment (Mill Per)	24.5	25.9	27.4	29.2	24.5	25.9	27.4	29.2	24.5	25.9	27.4	29.2
Informal Labor Migration (1,000s)	81.3	57.4	48.1	47.4	81.2	57.4	48.1	47.4	81.2	57.4	48.1	47.4
Unemployment Rate High Income	8.0	8.0	7.8	6.7	8.1	8.1	7.9	6.8	8.1	8.1	7.9	6.8
Unemployment Rate Low Income	12.0	11.0	11.2	9.9	12.1	11.1	11.4	10.1	12.1	11.2	11.4	10.1
Average Unemployment Rate	9.1	8.8	8.7	7.6	9.2	8.9	8.9	7.7	9.2	8.9	8.9	7.7
Pivate Disposable Income	993.5	1,173.2	1,389.5	1,688.9	991.4	1,170.5	1,386.1	1,684.8	991.2	1,170.2	1,385.8	1,684.4
Government Revenues/GDP	23.4	23.3	23.2	23.1	23.5	23.3	23.2	23.2	23.5	23.3	23.3	23.2
PSBR/GDP	-0.9	0.4	0.4	0.2	-0.9	0.4	0.4	0.2	-0.9	0.4	0.4	0.2
Aggregate Investment	262.3	307.8	351.7	415.3	262.1	307.6	351.4	414.9	262.1	307.5	351.4	414.9
Aggregate Consumption	878.7	1,039.7	1,218.8	1,462.1	876.7	1,037.2	1,215.7	1,458.3	876.5	1,037.0	1,215.5	1,458.0
Private Foreign Debt / GDP	58.9	72.8	80.9	82.5	58.9	72.8	81.0	82.6	58.9	72.9	81.0	82.6
Government Foreign Debt / GDP	26.1	21.7	18.2	14.9	26.1	21.8	18.3	14.9	26.1	21.8	18.3	14.9
Government Domestic Debt / GDP	21.4	12.9	12.5	11.8	21.5	12.9	12.6	11.8	21.5	12.9	12.6	11.8
Current Account Deficit / GDP	5.7	4.7	4.0	3.3	5.7	4.7	4.0	3.3	5.7	4.7	4.0	3.3

Table 3

Environmental Results

	Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
CO2 Total, Mill tons	386.4	466.5	546.5	644.9	373.4	451.6	529.8	626.4	371.5	449.5	527.5	623.8
Total CO2 (Eq), Mill tons, Mill tons	465.7	546.5	630.1	734.8	451.9	531.1	613.1	716.1	450.0	528.9	610.7	713.5
High Income, CO2 Emissions from Coal Burning for Energy	46.0	52.0	56.8	61.8	36.7	41.6	45.5	49.7	35.3	40.1	43.8	47.8
Low Income, CO2 Emissions from Coal Burning for Energy	12.7	15.5	17.9	20.1	10.2	12.4	14.3	16.2	9.8	11.9	13.8	15.6
High Income, CO2 Energy Related	205.4	240.8	270.7	304.9	197.0	231.3	260.3	293.8	195.8	230.0	258.9	292.2
Low Income, CO2 Energy Related	60.6	76.6	91.4	106.5	58.2	73.7	88.2	102.8	57.9	73.3	87.7	102.3
High Income, CO2 Industrial Processes	50.3	64.4	82.2	108.5	50.1	64.1	81.8	108.0	50.1	64.1	81.8	108.0
Low Income, CO2 Industrial Processes	13.8	18.2	23.1	28.8	13.7	18.1	23.0	28.7	13.7	18.1	23.0	28.7
High Income, CO2 eq: Agriculture	16.0	18.6	21.1	24.9	16.0	18.6	21.0	24.9	16.0	18.6	21.0	24.9
Low Income, CO2 eq: Agriculture	14.1	16.9	19.4	21.9	14.1	16.9	19.4	21.8	14.1	16.9	19.4	21.8
CO2 Households	56.3	66.6	79.1	96.2	54.3	64.4	76.5	93.1	54.0	64.0	76.1	92.6
Total CO2 Energy Related	322.3	384.0	441.2	507.6	309.5	369.4	425.0	489.7	307.7	367.3	422.7	487.2
Total CO2/GDP (kg/$GDP)	0.544	0.547	0.544	0.532	0.527	0.530	0.528	0.518	0.524	0.528	0.526	0.516
CO2 from Energy /GDP(kg/$GDP)	0.454	0.450	0.439	0.419	0.437	0.434	0.423	0.405	0.434	0.431	0.421	0.403
Intermediate Demand Coal in Low Income	1.349	1.579	1.827	2.108	1.077	1.264	1.466	1.696	1.035	1.216	1.410	1.633
Intermediate Demand Coal in High Income	5.017	5.699	6.501	7.623	4.006	4.562	5.217	6.134	3.852	4.388	5.020	5.906
Intermediate Demand Petr&Gas in Low Income	7.035	8.592	10.331	12.504	7.081	8.645	10.389	12.570	7.090	8.656	10.402	12.585
Intermediate Demand Petr&Gas in High Income	26.963	32.490	39.047	48.281	27.133	32.677	39.253	48.516	27.168	32.718	39.300	48.571
Intermediate Demand Ref Petr in Low Income	33.035	41.361	50.751	61.946	32.979	41.288	50.657	61.829	32.977	41.287	50.656	61.828
Intermediate Demand Ref Petr in High Income	122.442	148.752	180.197	224.888	122.202	148.448	179.822	224.418	122.192	148.438	179.812	224.411

Table 4

Real Output By Sectors, Low Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
AG	Agriculture	42.028	50.186	57.603	64.979	42.024	50.173	50.173	64.945	42.029	50.178	57.584	64.952
CO	Coal	1.889	2.213	2.577	2.948	1.347	1.577	1.577	2.098	1.255	1.469	1.710	1.955
PG	Crude Oil and Natural Gas	0.747	0.982	1.207	1.425	0.754	0.989	0.989	1.435	0.755	0.991	1.217	1.437
PE	Refined Petroleum	28.884	36.250	44.454	54.089	28.848	36.201	36.201	54.008	28.849	36.202	44.391	54.011
CE	Cement	9.697	12.281	14.870	17.637	9.657	12.229	12.229	17.563	9.652	12.222	14.799	17.555
IS	Iron and Steel	15.346	21.449	29.293	38.896	15.295	21.376	21.376	38.761	15.292	21.371	29.184	38.754
MW	Machinery and White Goods	18.851	24.154	29.643	35.554	18.836	24.131	24.131	35.514	18.837	24.134	29.615	35.518
ET	Electronics	10.318	13.735	17.661	21.873	10.309	13.722	13.722	21.850	10.310	13.724	17.646	21.853
AU	Auto Industry	11.960	16.899	23.940	31.889	11.970	16.918	16.918	31.946	11.974	16.925	23.987	31.965
EL	Electricity Production	16.406	21.002	26.244	32.640	16.432	21.029	21.029	32.666	16.443	21.041	26.286	32.684
CN	Construction	30.268	37.121	43.287	50.228	30.270	37.118	37.118	50.211	30.272	37.121	43.280	50.215
OE	Other Economy	402.864	509.731	617.740	729.477	402.713	509.465	509.465	728.894	402.746	509.510	617.365	728.962

Real Output By Sectors, High Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
AG	Agriculture	155.883	181.166	205.072	242.714	155.786	181.029	204.897	242.483	155.792	181.036	204.905	242.492
CO	Coal	5.419	5.994	6.674	7.640	3.866	4.273	4.756	5.440	3.640	4.022	4.476	5.119
PG	Crude Oil and Natural Gas	2.353	2.734	3.076	3.592	2.370	2.753	3.096	3.614	2.374	2.757	3.101	3.619
PE	Refined Petroleum	109.251	135.806	168.324	213.629	109.087	135.589	168.047	213.270	109.085	135.589	168.048	213.274
CE	Cement	34.929	42.615	51.023	62.809	34.777	42.428	50.801	62.538	34.758	42.405	50.775	62.507
IS	Iron and Steel	57.043	78.472	109.035	155.985	56.838	78.183	108.626	155.391	56.823	78.163	108.599	155.353
MW	Machinery and White Goods	66.293	81.482	98.581	122.964	66.207	81.368	98.436	122.778	66.208	81.370	98.440	122.784
ET	Electronics	37.279	48.532	63.184	84.393	37.230	48.466	63.097	84.274	37.231	48.468	63.101	84.281
AU	Auto Industry	39.855	54.806	79.048	119.089	39.865	54.827	79.107	119.234	39.874	54.844	79.138	119.293
EL	Electricity Production	61.346	76.295	94.546	120.558	61.424	76.372	94.620	120.625	61.460	76.416	94.672	120.689
CN	Construction	112.166	132.219	151.186	178.984	112.128	132.158	151.098	178.862	112.131	132.161	151.103	178.868
OE	Other Economy	1,366.472	1,605.298	1,861.393	2,231.550	1,365.141	1,603.506	1,859.137	2,228.634	1,365.141	1,603.518	1,859.159	2,228.672

Table 5

Capital Stocks By Sectors, Low Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	18.815	23.929	28.286	32.150	18.824	23.935	28.285	32.144	18.828	23.941	28.291	32.151
CO	Coal	0.228	0.286	0.338	0.385	0.163	0.205	0.241	0.275	0.117	0.147	0.173	0.197
PG	Crude Oil and Natural Gas	0.419	0.561	0.683	0.792	0.423	0.566	0.688	0.798	0.423	0.567	0.689	0.799
PE	Refined Petroleum	4.171	5.440	6.577	7.688	4.172	5.441	6.576	7.686	4.173	5.442	6.578	7.689
CE	Cement	2.141	2.821	3.387	3.897	2.139	2.818	3.382	3.892	2.139	2.818	3.382	3.892
IS	Iron and Steel	2.199	3.169	4.227	5.344	2.196	3.165	4.221	5.336	2.197	3.166	4.222	5.337
MW	Machinery and White Goods	3.792	5.031	6.072	7.003	3.794	5.033	6.074	7.004	3.796	5.035	6.076	7.006
ET	Electronics	1.489	2.052	2.586	3.062	1.490	2.053	2.588	3.063	1.491	2.054	2.589	3.064
AU	Auto Industry	1.227	1.797	2.489	3.158	1.230	1.802	2.496	3.168	1.231	1.803	2.498	3.170
EL	Electricity Production	3.883	5.091	6.209	7.366	3.914	5.129	6.251	7.412	3.920	5.137	6.260	7.424
CN	Construction	9.154	11.631	13.426	15.120	9.167	11.645	13.437	15.131	9.170	11.648	13.441	15.135
OE	Other Economy	138.726	181.757	219.202	253.223	138.839	181.863	219.271	253.267	138.879	181.916	219.333	253.338

Capital Stocks By Sectors, High Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	62.125	69.230	73.796	82.493	62.096	69.184	73.738	82.417	62.104	69.193	73.747	82.426
CO	Coal	0.663	0.720	0.754	0.824	0.474	0.515	0.539	0.588	0.356	0.387	0.404	0.441
PG	Crude Oil and Natural Gas	1.276	1.428	1.510	1.670	1.287	1.439	1.520	1.681	1.289	1.441	1.523	1.683
PE	Refined Petroleum	13.864	15.976	17.651	20.300	13.856	15.964	17.637	20.282	13.858	15.967	17.641	20.286
CE	Cement	6.868	7.839	8.480	9.590	6.857	7.825	8.464	9.571	6.856	7.825	8.464	9.571
IS	Iron and Steel	7.159	9.052	11.100	14.253	7.145	9.033	11.076	14.220	7.145	9.034	11.076	14.220
MW	Machinery and White Goods	11.941	13.668	14.816	16.822	11.937	13.662	14.808	16.812	11.940	13.665	14.811	16.816
ET	Electronics	4.736	5.694	6.572	7.916	4.735	5.692	6.570	7.913	4.736	5.694	6.572	7.915
AU	Auto Industry	3.619	4.592	5.846	7.908	3.624	4.598	5.855	7.925	3.625	4.600	5.859	7.930
EL	Electricity Production	12.914	14.838	16.364	18.836	13.006	14.936	16.465	18.943	13.027	14.959	16.489	18.970
CN	Construction	30.216	33.401	34.639	37.791	30.231	33.412	34.646	37.793	30.237	33.418	34.653	37.800
OE	Other Economy	432.882	482.252	514.692	575.428	432.790	482.061	514.426	575.055	432.859	482.138	514.509	575.146

Table 6

Exports By Sectors, Low Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	1.984	2.354	2.542	2.607	1.989	2.359	2.547	2.612	1.990	2.360	2.548	2.613
CO	Coal	0.002	0.003	0.003	0.003	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001
PG	Crude Oil and Natural Gas	0.005	0.007	0.009	0.010	0.005	0.007	0.009	0.010	0.005	0.007	0.009	0.010
PE	Refined Petroleum	3.737	4.895	6.163	7.498	3.736	4.892	6.159	7.493	3.736	4.893	6.160	7.494
CE	Cement	1.969	2.597	3.192	3.712	1.956	2.580	3.170	3.688	1.954	2.577	3.167	3.685
IS	Iron and Steel	5.023	7.440	10.628	14.370	5.003	7.410	10.585	14.312	5.001	7.408	10.582	14.308
MW	Machinery and White Goods	4.322	5.821	7.371	8.825	4.322	5.820	7.368	8.821	4.323	5.821	7.370	8.823
ET	Electronics	3.765	5.269	7.036	8.802	3.763	5.266	7.032	8.796	3.763	5.267	7.033	8.797
AU	Auto Industry	6.101	9.041	13.372	18.120	6.110	9.056	13.400	18.164	6.113	9.061	13.409	18.177
EL	Electricity Production	0.024	0.033	0.043	0.054	0.024	0.033	0.043	0.054	0.024	0.033	0.043	0.054
CN	Construction	1.326	1.708	2.028	2.306	1.327	1.709	2.030	2.307	1.328	1.710	2.030	2.308
OE	Other Economy	42.237	56.178	68.598	78.125	42.279	56.224	68.638	78.162	42.294	56.243	68.661	78.187

Exports By Sectors, High Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	6.867	7.734	8.125	9.134	6.878	7.745	8.136	9.146	6.881	7.748	8.139	9.149
CO	Coal	0.005	0.005	0.005	0.006	0.002	0.003	0.003	0.003	0.002	0.002	0.002	0.002
PG	Crude Oil and Natural Gas	0.012	0.013	0.014	0.015	0.012	0.013	0.014	0.015	0.012	0.013	0.014	0.015
PE	Refined Petroleum	13.541	17.451	22.401	29.338	13.529	17.434	22.378	29.306	13.531	17.436	22.381	29.310
CE	Cement	6.616	8.216	9.919	12.258	6.568	8.157	9.849	12.174	6.561	8.149	9.840	12.164
IS	Iron and Steel	18.000	26.111	38.339	57.690	17.921	25.995	38.167	57.429	17.914	25.986	38.154	57.409
MW	Machinery and White Goods	14.020	17.701	21.958	28.007	14.008	17.685	21.936	27.978	14.010	17.687	21.940	27.982
ET	Electronics	12.981	17.652	24.061	33.488	12.966	17.631	24.033	33.448	12.967	17.633	24.035	33.452
AU	Auto Industry	19.191	27.625	42.088	66.624	19.205	27.649	42.142	66.742	19.212	27.661	42.163	66.783
EL	Electricity Production	0.084	0.109	0.140	0.186	0.083	0.108	0.139	0.184	0.083	0.108	0.139	0.184
CN	Construction	4.581	5.471	6.259	7.393	4.583	5.473	6.260	7.394	4.584	5.474	6.262	7.395
OE	Other Economy	125.213	145.732	164.158	191.747	125.209	145.706	164.113	191.673	125.235	145.736	164.147	191.710

Table 7

Aggregate Energy Demand By Sectors, Low Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	0.206	0.252	0.304	0.365	0.204	0.249	0.301	0.361	0.203	0.249	0.300	0.360
CO	Coal	0.086	0.103	0.123	0.148	0.060	0.072	0.086	0.102	0.058	0.069	0.083	0.099
PG	Crude Oil and Natural Gas	0.036	0.046	0.057	0.070	0.036	0.047	0.057	0.070	0.036	0.047	0.058	0.070
PE	Refined Petroleum	4.165	5.126	6.202	7.543	4.155	5.113	6.187	7.524	4.155	5.113	6.186	7.523
CE	Cement	0.514	0.643	0.778	0.935	0.496	0.621	0.753	0.906	0.493	0.618	0.749	0.902
IS	Iron and Steel	0.834	1.157	1.571	2.096	0.824	1.142	1.551	2.071	0.822	1.140	1.549	2.068
MW	Machinery and White Goods	0.288	0.368	0.453	0.553	0.286	0.366	0.450	0.549	0.286	0.365	0.450	0.549
ET	Electronics	0.319	0.421	0.539	0.672	0.316	0.418	0.535	0.667	0.316	0.417	0.534	0.666
AU	Auto Industry	0.103	0.145	0.204	0.274	0.102	0.144	0.204	0.273	0.102	0.144	0.204	0.273
EL	Electricity Production	9.309	11.684	14.449	18.034	9.287	11.655	14.411	17.986	9.287	11.655	14.411	17.986
CN	Construction	0.087	0.107	0.125	0.149	0.086	0.105	0.123	0.147	0.086	0.105	0.123	0.146
OE	Other Economy	5.783	7.248	8.860	10.760	5.681	7.124	8.714	10.588	5.665	7.105	8.691	10.562

Aggregate Energy Demand By Sectors, High Income Region (Bill TL, 2010 Fixed Prices)

		Base Path				Scenario 1: Eliminate Production Subsidies on Coal				Scenario 2: Eliminate Both Production and Investment Subsidies on Coal			
		2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
AG	Agriculture	0.791	0.955	1.142	1.408	0.782	0.943	1.129	1.392	0.780	0.942	1.127	1.390
CO	Coal	0.292	0.341	0.397	0.475	0.202	0.236	0.275	0.330	0.196	0.229	0.267	0.320
PG	Crude Oil and Natural Gas	0.128	0.155	0.182	0.222	0.129	0.155	0.183	0.222	0.129	0.155	0.183	0.222
PE	Refined Petroleum	16.096	19.684	23.971	29.932	16.056	19.634	23.908	29.854	16.053	19.630	23.904	29.849
CE	Cement	1.915	2.336	2.803	3.459	1.849	2.258	2.713	3.351	1.839	2.246	2.699	3.334
IS	Iron and Steel	3.159	4.320	5.939	8.400	3.118	4.265	5.865	8.299	3.112	4.258	5.855	8.285
MW	Machinery and White Goods	1.054	1.308	1.593	1.996	1.046	1.298	1.581	1.982	1.045	1.297	1.580	1.981
ET	Electronics	1.179	1.529	1.973	2.612	1.168	1.515	1.956	2.591	1.167	1.514	1.954	2.588
AU	Auto Industry	0.353	0.484	0.691	1.031	0.351	0.482	0.689	1.028	0.351	0.482	0.688	1.027
EL	Electricity Production	35.997	44.531	54.838	69.307	35.907	44.416	54.691	69.116	35.906	44.415	54.690	69.114
CN	Construction	0.335	0.400	0.465	0.559	0.330	0.394	0.458	0.551	0.329	0.393	0.457	0.550
OE	Other Economy	20.982	25.151	29.958	36.748	20.603	24.712	29.452	36.149	20.544	24.645	29.375	36.058

Table A-1

Input-Output Table, 2010 (at basic prices) (Millions TL)

	AG	CO	PG	PE	CE	IS	MW	ET	AU	EL	CN	OE	*Total Intermediate Exp*
AG: Agriculture	25,614.800	67.481	0.897	1,405.056	15.659	9.832	105.001	11.710	9.907	25.964	32.107	77,442.838	**104,741.251**
CO: Coal	49.489	81.947	0.003	51.805	513.335	153.587	14.271	44.415	2.497	1,778.488	32.032	2,801.273	**5,523.143**
PG: Oil and Gas	0.387	0.000	44.432	15,593.164	347.095	153.455	23.208	229.109	36.199	9,590.807	0.767	3,410.723	**29,429.345**
PE: Petroleum Prod Chemicals	9,879.887	323.164	37.078	31,591.743	2,614.506	1,007.931	3,058.065	2,571.708	3,202.099	296.015	5,059.616	71,856.071	**131,497.883**
CE: Cement	199.739	15.532	3.899	886.104	5,012.698	1,591.391	817.311	280.956	539.854	11.199	11,333.485	11,001.081	**31,693.249**
IS: Iran and Steel	7.422	146.704	55.897	1,579.797	229.833	20,994.608	15,992.953	3,145.276	4,776.962	320.216	9,025.592	12,898.080	**69,173.340**
MW: Machinery, White Goods	1,973.396	348.448	16.550	1,578.608	925.739	1,190.378	7,216.930	1,211.597	2,792.033	804.082	9,659.331	15,460.026	**43,177.117**
ET: Electronics	88.738	102.878	6.593	99.412	35.144	18.452	1,639.666	10,203.164	257.943	1,435.500	2,559.128	8,149.167	**24,595.785**
AU: Automative	333.440	0.558	19.221	96.052	63.983	28.459	290.058	64.989	8,040.339	48.060	153.254	8,451.327	**17,589.741**
EL: Electricity	823.915	245.720	96.009	1,570.230	1,092.475	2,527.124	998.247	852.472	277.948	26,862.293	300.334	16,959.532	**52,606.300**
CN: Construction	474.112	23.563	0.426	25.172	6.480	7.567	31.049	11.392	7.420	16.311	1,893.239	6,670.128	**9,166.858**
OE: Other economy	20,568.361	783.729	383.044	29,157.980	11,567.470	10,761.159	12,388.789	7,530.604	6,912.122	3,498.792	21,551.685	508,553.757	**633,657.491**
TOTALS													
Compensation of Employees	17,832.221	3,180.220	467.135	11,301.358	4,879.441	4,555.176	9,203.587	3,859.999	4,766.325	4,829.762	15,088.017	243,023.324	**322,986.564**
Gross Payments to Capital	96,714.344	836.303	1,565.165	16,322.858	7,825.744	7,232.312	13,237.117	5,072.384	3,655.798	15,363.998	33,857.034	536,220.974	**737,904.030**
Net Taxes	6,960.333	214.285	13.395	3,169.442	579.151	570.320	672.224	245.702	186.064	191.325	2,810.758	27,246.207	**42,859.207**
Total VA	121,506.899	4,230.808	2,045.695	30,793.658	13,284.335	12,357.807	23,112.929	9,178.085	8,608.187	20,385.084	51,755.810	806,490.505	**1,103,749.801**
Total Production Supply	181,520.585	6,370.531	2,709.743	114,428.781	35,708.751	50,801.751	65,688.477	35,335.476	35,463.511	65,072.811	113,356.380	1,550,144.508	2,256,601.305
Total supply	185,783.349	10,340.011	29,443.928	187,955.607	40,271.114	84,240.406	113,988.455	62,086.340	53,940.919	65,765.859	113,356.380	1,601,909.049	2,550,633.692

PCE: Private Consumption Exp	GGCE: Government Consumpiton Exp.	GFCF: Gross Fixed Capital Formation	EXP: Exports	IMP: Imports (-)	*Total Exp on Value Added*	Total Expenditures
72,183.835	332.187	87.141	8,438.935	4,262.764	76,779.334	181,520.585
4,569.355	241.183	0.000	6.329	3,969.479	847.388	6,370.531
0.000	0.000	0.000	14.583	26,734.185	-26,719.601	2,709.743
40,367.858	2,541.310	0.000	13,548.556	73,526.826	-17,069.103	114,428.781
2,001.362	0.000	4.112	6,572.392	4,562.364	4,015.502	35,708.751
29.054	0.000	0.000	15,038.012	33,438.655	-18,371.589	50,801.751
8,838.840	25.228	48,549.527	13,397.743	48,299.978	22,511.360	65,688.477
10,718.725	0.000	15,140.130	11,631.699	26,750.864	10,739.691	35,335.476
9,105.060	0.000	11,250.165	15,995.953	18,477.408	17,873.770	35,463.511
13,074.364	0.000	0.000	85.194	693.048	12,466.511	65,072.811
188.191	0.000	99,455.197	4,546.134	0.000	104,189.522	113,356.380
633,273.970	154,311.370	36,865.130	143,801.088	51,764.540	916,487.017	1,550,144.508
787,269.557	**157,451.278**	**219,984.734**	**233,076.618**	**294,032.387**	**1,103,749.801**	2,256,601.305

Table A-2

Social Accounting Matrix, Turkey, 2010, Millions TL

		ACTIVITIES - HIGH INCOME												FACTORS - HIGH INCOME				
		AG	CO	PG	PE	CE	IS	MW	ET	AU	EL	CN	OE	LF	LI	NRF	NIR	KP
ACTIVITIES-HIGH INCOME	AG																	
	CO																	
	PG																	
	PE																	
	CE																	
	IS																	
	MW																	
	ET																	
	AU																	
	EL																	
	CN																	
	OE																	
FACTORS-HIGH INCOME	LF	2554.959	2084.772	306.227	6401.523	2435.174	2580.227	5213.266	2186.452	2917.351	3166.117	5967.620	137458.228					
	LI	11199.827	42.450	6.235	1359.258	981.344	547.869	1106.951	464.257	312.240	64.469	4909.269	29468.785					
	NRF	10832.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
	NIR	4642.289	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
	KP	61897.180	669.042	1252.132	13058.286	6260.595	5785.849	10589.694	4057.907	2924.638	12291.198	27085.627	428976.779					
ACTIVITIES-LOW INCOME	AG																	
	CO																	
	PG																	
	PE																	
	CE																	
	IS																	
	MW																	
	ET																	
	AU																	
	EL																	
	CN																	
	OE																	
FACTORS-LOW INCOME	LF																	
	LI																	
	NRF																	
	NIR																	
	KP																	
COMMODITIES	AG	20491.840	53.985	0.718	1124.044	12.527	7.866	84.001	9.368	7.926	20.771	25.686	61954.271					
	CO	39.591	65.557	0.002	41.444	410.668	122.870	11.417	35.532	1.998	1422.790	25.626	2241.019					
	PG	0.309	0.000	35.545	12474.531	277.676	122.764	18.566	183.287	28.959	7672.645	0.614	2728.578					
	PE	7903.910	258.531	29.662	25273.394	2091.605	806.345	2446.452	2057.366	2561.679	236.812	4047.693	57484.857					
	CE	159.791	12.425	3.120	708.883	4010.158	1273.113	653.849	224.765	431.883	8.959	9066.788	8800.865					
	IS	5.938	117.363	44.717	1263.837	183.866	16795.687	12794.362	2516.221	3821.570	256.173	7220.474	10318.464					
	MW	1578.717	278.758	13.240	1262.886	740.591	952.302	5773.544	969.278	2233.626	643.265	7727.465	12368.021					
	ET	70.991	82.302	5.274	79.530	28.115	14.762	1311.733	8162.531	206.355	1148.400	2047.302	6519.334					
	AU	266.752	0.446	15.377	76.842	51.187	22.767	232.047	51.991	6432.271	38.448	122.603	6761.062					
	EL	659.132	196.576	76.807	1256.184	873.980	2021.699	798.598	681.977	222.359	21489.835	240.267	13567.626					
	CN	379.290	18.850	0.341	20.138	5.184	6.054	24.839	9.114	5.936	13.049	1514.591	5336.102					
	OE	16454.688	626.983	306.435	23326.384	9253.976	8608.927	9911.031	6024.483	5529.697	2799.033	17241.348	406843.006					
HOUSEHOLDS														173271.914	50462.955	10832.007	4642.289	
ENTERPRISES																		574848.929
SOC SEC INST.		510.992	416.954	61.245	1280.305	487.035	516.045	1042.653	437.290	583.470	633.223	1193.524	27491.646					
GOVERNMENT		5568.267	171.428	10.716	2535.554	463.321	456.256	537.779	196.561	148.851	153.060	2248.607	21796.966					
VAT																		
IMPTAX																		
PROTAX		5568.267	171.428	10.716	2535.554	463.321	456.256	537.779	196.561	148.851	153.060	2248.607	21796.966					
HHINCTAX																		
FACINC																		
ENTTAX																		
CAPITAL Acc	Total Sav																	
REST OF THE WORLD																		
Total Expenditures		145216.468	5096.425	2167.795	91543.024	28567.001	40641.401	52550.782	28268.381	28370.809	52058.249	90685.104	1240115.607	173271.914	50462.955	10832.007	4642.289	574848.929

Social Accounting Matrix, Turkey, 2010, Millions TL

		ACTIVITIES-LOW INCOME												FACTORS-LOW INCOME				
		AG	CO	PG	PE	CE	IS	MW	ET	AU	EL	CN	OE	LF	LI	NRF	NIR	KP
ACTIVITIES-HIGH INCOME	AG																	
	CO																	
	PG																	
	PE																	
	CE																	
	IS																	
	MW																	
	ET																	
	AU																	
	EL																	
	CN																	
	OE																	
FACTORS-HIGH INCOME	LF																	
	LI																	
	NRF																	
	NIR																	
	KP																	
ACTIVITIES-LOW INCOME	AG																	
	CO																	
	PG																	
	PE																	
	CE																	
	IS																	
	MW																	
	ET																	
	AU																	
	EL																	
	CN																	
	OE																	
FACTORS-LOW INCOME	LF	638.740	521.193	76.557	1600.381	608.793	645.057	1303.316	546.613	729.338	791.529	1491.905	34364.557					
	LI	2799.957	10.613	1.559	339.815	245.336	136.967	276.738	116.064	78.060	16.117	1227.317	7367.196					
	NRF	2708.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
	NIR	1160.572	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
	KP	15474.295	167.261	313.033	3264.572	1565.149	1446.462	2647.423	1014.477	731.160	3072.800	6771.407	107244.195					
COMMODITIES	AG	5122.960	13.496	0.179	281.011	3.132	1.966	21.000	2.342	1.981	5.193	6.421	15488.568					
	CO	9.898	16.389	0.001	10.361	102.667	30.717	2.854	8.883	0.499	355.698	6.406	560.255					
	PG	0.077	0.000	8.886	3118.633	69.419	30.691	4.642	45.822	7.240	1918.161	0.153	682.145					
	PE	1975.977	64.633	7.416	6318.349	522.901	201.586	611.613	514.342	640.420	59.203	1011.923	14371.214					
	CE	39.948	3.106	0.780	177.221	1002.540	318.278	163.462	56.191	107.971	2.240	2266.697	2200.216					
	IS	1.484	29.341	11.179	315.959	45.967	4198.922	3198.591	629.055	955.392	64.043	1805.118	2579.616					
	MW	394.679	69.690	3.310	315.722	185.148	238.076	1443.386	242.319	558.407	160.816	1931.866	3092.005					
	ET	17.748	20.576	1.319	19.882	7.029	3.690	327.933	2040.633	51.589	287.100	511.826	1629.833					
	AU	66.688	0.112	3.844	19.210	12.797	5.692	58.012	12.998	1608.068	9.612	30.651	1690.265					
	EL	164.783	49.144	19.202	314.046	218.495	505.425	199.649	170.494	55.590	5372.459	60.067	3391.906					
	CN	94.822	4.713	0.085	5.034	1.296	1.513	6.210	2.278	1.484	3.262	378.648	1334.026					
	OE	4113.672	156.746	76.609	5831.596	2313.494	2152.232	2477.758	1506.121	1382.424	699.758	4310.337	101710.751					
HOUSEHOLDS														43317.979	12615.739	2708.002	1160.572	
ENTERPRISES																		143712.232
SOC SEC INST.		127.748	104.239	15.311	320.076	121.759	129.011	260.663	109.323	145.868	158.306	298.381	6872.911					
GOVERNMENT		1392.067	42.857	2.679	633.888	115.830	114.064	134.445	49.140	37.213	38.265	562.152	5449.241					
VAT																		
IMPTAX																		
PROTAX		1392.067	42.857	2.679	633.888	115.830	114.064	134.445	49.140	37.213	38.265	562.152	5449.241					
HHINCTAX																		
FACINC																		
ENTTAX																		
CAPITAL Acc																		
REST OF THE WORLD																		

Social Accounting Matrix, Turkey, 2010, Millions TL

		COMMODITIES												HOUSEHOLDS	ENTERPRISES	SOCIAL SECURITY INST.
		AG	CO	PG	PE	CE	IS	MW	ET	AU	EL	CN	OE			
ACTIVITIES-HIGH INCOME	AG	138465.320														
	CO		5091.362													
	PG			2156.128												
	PE				80704.180											
	CE					23309.087										
	IS						28610.991									
	MW							41832.587								
	ET								18963.021							
	AU									15574.046						
	EL										51990.093					
	CN											87048.197				
	OE												1125074.736			
FACTORS-HIGH INCOME	LF															
	LI															
	NRF															
	NIR															
	KP															
ACTIVITIES-LOW INCOME	AG	34616.330														
	CO		1272.841													
	PG			539.032												
	PE				20176.045											
	CE					5827.272										
	IS						7152.748									
	MW							10458.147								
	ET								4740.755							
	AU									3893.512						
	EL										12997.523					
	CN											21762.049				
	OE												281268.684			
FACTORS-LOW INCOME	LF															
	LI															
	NRF															
	NIR															
	KP															
COMMODITIES	AG													72183.835		
	CO													4569.355		
	PG													0.000		
	PE													40367.858		
	CE													2001.362		
	IS													29.054		
	MW													8838.840		
	ET													10718.725		
	AU													9105.060		
	EL													13074.364		
	CN													188.191		
	OE													633273.970		
HOUSEHOLDS															661795.212	
ENTERPRISES																
SOC SEC INST.																
GOVERNMENT														88299.984	88299.984	43317.979
VAT																
IMPTAX																
PROTAX																
HHINCTAX														88299.984		
FACINC																
ENTTAX															88299.984	
CAPITAL Acc														110374.980		
REST OF THE WORLD		4262.764	3969.479	26734.185	73526.826	4562.364	33438.655	48299.978	26750.864	18477.408	693.048	0.000	51764.540		12615.957	

Social Accounting Matrix, Turkey, 2010, Millions TL

		GOVERNMENT	*PUBCONS*	*HHTRA*	*PROSUB*	*DOMINT*	*FORINT*	*SSITRA*	*PUBSAV*	CAPITAL Account	REST OF THE WORLD	Row SUMS
										Total Investment		
ACTIVITIES-HIGH INCOME	AG										6751.148	145216.468
	CO										5.063	5096.425
	PG										11.667	2167.795
	PE										10838.845	91543.024
	CE										5257.914	28567.001
	IS										12030.410	40641.401
	MW										10718.194	52550.782
	ET										9305.360	28268.381
	AU										12796.762	28370.809
	EL										68.155	52058.249
	CN										3636.907	90685.104
	OE										115040.870	1240115.607
FACTORS-HIGH INCOME	LF											173271.914
	LI											50462.955
	NRF											10832.007
	NIR											4642.289
	KP											574848.929
ACTIVITIES-LOW INCOME	AG										1687.787	36304.117
	CO										1.266	1274.106
	PG										2.917	541.949
	PE										2709.711	22885.756
	CE										1314.478	7141.750
	IS										3007.602	10160.350
	MW										2679.549	13137.695
	ET										2326.340	7067.095
	AU										3199.191	7092.702
	EL										17.039	13014.562
	CN										909.227	22671.276
	OE										28760.218	310028.902
FACTORS-LOW INCOME	LF											43317.979
	LI											12615.739
	NRF											2708.002
	NIR											1160.572
	KP											143712.232
COMMODITIES	AG	332.187	332.187							87.141		177344.414
	CO	241.183	241.183							0.000		10333.682
	PG	0.000	0.000							0.000		29429.345
	PE	2541.310	2541.310							0.000		174407.051
	CE	0.000	0.000							4.112		33698.722
	IS	0.000	0.000							0.000		69202.394
	MW	25.228	25.228							48549.527		100590.712
	ET	0.000	0.000							15140.130		50454.641
	AU	0.000	0.000							11250.165		37944.966
	EL	0.000	0.000							0.000		65680.664
	CN	0.000	0.000							99455.197		108810.246
	OE	154311.370	154311.370							36865.130		1458107.961
HOUSEHOLDS		32218.912		32218.912							0.000	993025.579
ENTERPRISES		44149.992				44149.992					0.000	762711.153
SOC SEC INST.		0.000										43317.979
GOVERNMENT												262777.153
VAT												
IMPTAX												
PROTAX												42859.207
HHINCTAX												
FACINC												
ENTTAX												
CAPITAL Acc		28956.971							28956.971		72019.450	211351.401
REST OF THE WORLD												305096.068
Total Expenditures		262777.153								211351.401	305096.068	

Table A-3

Table xx. Economic Indicators Across Regions (Bill TL, 2010)

Region	Population (Millions)	Gross Regional Value Added	Regional Exports	Regional Imports	Tax Revenues	Public Investment
High-Income (1)	40.43	745.40	83.27	111.71	130.62	12,399.20
Low-Income (2)	33.31	355.30	18.87	29.22	40.70	10,318.78

(1) High Income region: TR10, TR21, TR22, TR31, TR32, TR33, TR41, TR42, TR51, TR52, TR61

(2) Low-Income region: TR62, TR63, TR71, TR72, TR81, TR82, TR83, TR90, TRA1, TRA2, TRB1, TRB2, TRC1, TRC2, TRC3

Source: TurkStat

Table A-4

Aggregate CO2 (Eq) Emissions, 2010, Millions Tons

TOTAL CO2 emissions from Energy Combustion:		**226.98**
AG	Agriculture	13.69
CO	Coal	2.57
PG	Crude Oil and Natural Gas	13.86
PE	Refined Petroleum	5.58
CE	Cement	16.36
IS	Iron and Steel	8.27
MW	Machinery and White Goods	1.16
ET	Electronics	2.08
AU	Auto Industry	0.07
EL	Electricity Production	112.41
CN	Construction	0.02
OE	Other Economy	50.90
TOTAL CO2 emissions by Households		**50.47**
TOTAL CO2 emissions from Industrial Processes		**49.06**
	Cement	31.74
	Iron and Steel	17.32
TOTAL CO2 Emissions from Agri Processes		**27.13**
TOTAL GHG emissions (CO2 eq)		**49.92**
	CH4 From Energy	7.70
	CH4 rom Industrial Production	6.62
	CH4 From Waste	16.20
	N2O From Transportation	14.20
	F Gasses	5.20
TOTAL CO2 (eq).		**403.55**

Table A-5

Parameters of the Labor Market (2010)										
		Labor Employment (Thousand Workers)					Total Wages (Millions 2010 TL)			
			High Income Region		Low Income Region		High Income Region		Low Income Region	
		Total Labor Emp	Informal Labor emp	Formal Labor emp	Informal Labor emp	Formal Labor emp	Informal Labor	Formal labor	Informal Labor	Formal Labor
AG	Agriculture	5683.000	2048.865	1645.085	1699.950	289.100	11199.827	2554.959	2799.957	638.740
CO	Coal	50.994	12.361	28.435	3.841	6.358	42.450	2084.772	10.613	521.193
PG	Crude Oil and Natural Gas	5.543	1.885	2.549	0.586	0.523	6.235	306.227	1.559	76.557
PE	Refined Petroleum	9.942	1.665	6.288	0.517	1.471	1359.258	6401.523	339.815	1600.381
CE	Cement	287.739	78.009	152.183	24.241	33.307	981.344	2435.174	245.336	608.793
IS	Iron and Steel	154.034	10.291	112.936	3.198	27.609	547.869	2580.227	136.967	645.057
MW	Machinery and White Goods	672.376	39.053	498.848	12.136	122.340	1106.951	5213.266	276.738	1303.316
ET	Electronics	210.957	74.834	93.931	23.255	18.937	464.257	2186.452	116.064	546.613
AU	Auto Industry	201.108	94.737	66.149	29.439	10.782	312.240	2917.351	78.060	729.338
EL	Electricity Production	165.000	50.049	81.951	15.553	17.447	64.469	3166.117	16.117	791.529
CN	Construction	1431.000	250.682	894.118	77.899	208.301	4909.269	5967.620	1227.317	1491.905
OE	Other Economy	13722.383	4592.899	6385.007	1427.231	1317.246	29468.785	137458.228	7367.196	34364.557
	TOTAL	**22594.074**	**7255.330**	**9967.480**	**3317.845**	**2053.420**	**50462.955**	**173271.914**	**12615.739**	**43317.979**