An assessment of carbon pricing and new energy technologies for achieving low carbon growth in India

Basanta K Pradhan
Development Planning Centre, Institute of Economic Growth, Delhi, India
Email: basanta@iegindia.org
and
Joydeep Ghosh (presenter)
Institute for Economic Modeling Studies, Delhi, India
Email: contact@iems.org.in

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INTRODUCTION

As part of its Intended Nationally Determined Contribution (INDC) submitted to UNFCCC, India has committed to achieve about 40 percent cumulative electric power installed capacity from non fossil fuel based energy resources by 2030.

According to estimates about 300,000 to 350,000 MW of renewable energy would have to be set up to meet this target. As of now about 37,000 MW of renewable energy capacity exists in the country which is about 15 percent of the total power capacity.

Solar and wind power capacity have grown rapidly; installed capacity of solar power increased from 3.7 MW in 2005 to about 4060 MW in 2015, at a CAGR of over 100 percent.

Similarly, wind power installed capacity rose from 1716.17 MW in 2005 to 3471.95 MW in 2015.

INTRODUCTION (contd.)

Declining costs of energy technologies provide an opportunity to transform the energy system and meet climate related targets.

Cost of solar modules have reduced by 4/5 since 2008 and the forecast is that it will further fall by 1/3 by 2025. The levelized cost of energy (LCOE) of onshore wind fell by 14 percent over the past six years and the forecast is that it will further fall 18 percent over the next ten years (UNEP and Bloomberg New Energy Finance, 2016). Similarly, LCOE of coal fired CCS plants are predicted to fall 20 percent by 2025 (Rubin et al, 2015).

The importance of low carbon technologies to reduce emissions in the Indian electricity sector has been stressed by IEA (2011). Further, IPCC (Synthesis Report, Fifth Assessment Report (AR5), 2014) has highlighted the role of CCS in reducing mitigation costs.

INTRODUCTION (contd.)

Government intervention is crucial to address the issue of externalities in the context of energy pricing. According to IRENA (2012) the failure to account for externalities in energy pricing is an important reason for low uptake of renewable energy across the world.

Carbon pricing in the form of the coal cess is an important step towards addressing the issue of externalities in energy pricing in India, and it could play an important role in stimulating investments in renewables and other clean energy technologies in the country.

In this paper we assess the coal cess in light of India's Intended Nationally Determined Contribution (INDC), and try to understand the implications of interactions between the coal cess and technological developments in renewables (wind and solar) and CCS (electricity) using a dynamic computable general equilibrium (CGE) model.

LITERATURE

There is a growing number of studies that look at the role of carbon pricing to achieve climate/renewable energy target related goals.

According to the World Bank (2016) while implementation of INDCs will rely on a range of policies and programs, carbon pricing initiatives will play an increasing role in decarbonisation.

However, in reality policy driven price incentives to reduce emissions are largely ineffective. According to OECD (2015) 90% of emissions are priced below the low end estimate of the climate cost of CO2-emissions, being EUR 30 per tonne, and 70% of CO2-emissions are priced at a rate of less than EUR 5.

LITERATURE (contd.)

A number of studies have been conducted to estimate the economic impacts of renewables uptake.

A study in Mexico to assess the impact on GDP of developing 20 gigawatts (GW) of wind power capacity by 2020 concluded that achieving this target is estimated to lead to an increase in GDP between USD 7.9 billion and USD 28.5 billion, depending on the level of domestic manufacturing of components (AMDEE, 2013a).

A CGE analysis (Dannenberg et al., 2008) for the European Union (EU-15) has found that support policies for renewable energy technologies that aim to reach 30% renewable energy-based electricity by 2020 lead to negative effects on welfare (-0.08%) and GDP (-0.8%).

For South Korea, a CGE assessment (KEIS, 2012) shows the impact of renewable energy policy and related public expenditure leads to GDP increase by 0.16% in the short run. In the long run the growth rate of GDP increases by 0.58%.

MODEL

Single country, multi-sectoral, neoclassical-type, price-driven, recursive dynamic CGE model (Pradhan and Ghosh, 2012)

The static part of the model is based on Lofgren et al. (2002). The structure of the energy sector is based on models like DART (Klepper et al. 2003), EPPA (Paltsev et al. 2005) and EMPAX-CGE (RTI International 2008).

The model consists of 34 sectors, two factors of production (capital and labour), nine types of households, two types of enterprises (private and public), government, and rest of the world.

Further, there is a distinction between the production structures of the fossil fuel sectors (coal, oil, and gas) and the non-fossil fuel sectors (sectors other than coal, oil, and gas).

Figure 1: Production structure of fossil fuel sectors (Coal, Oil, and Gas)

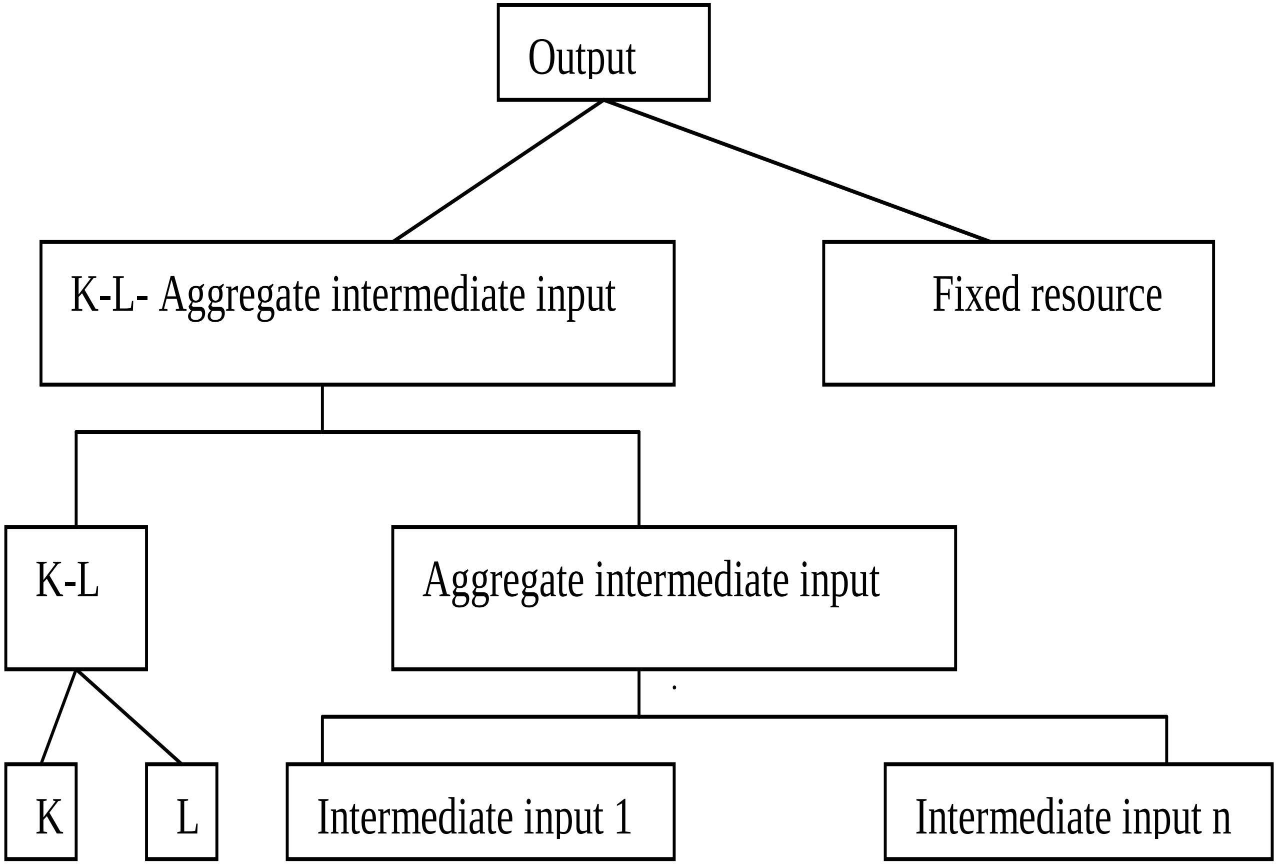
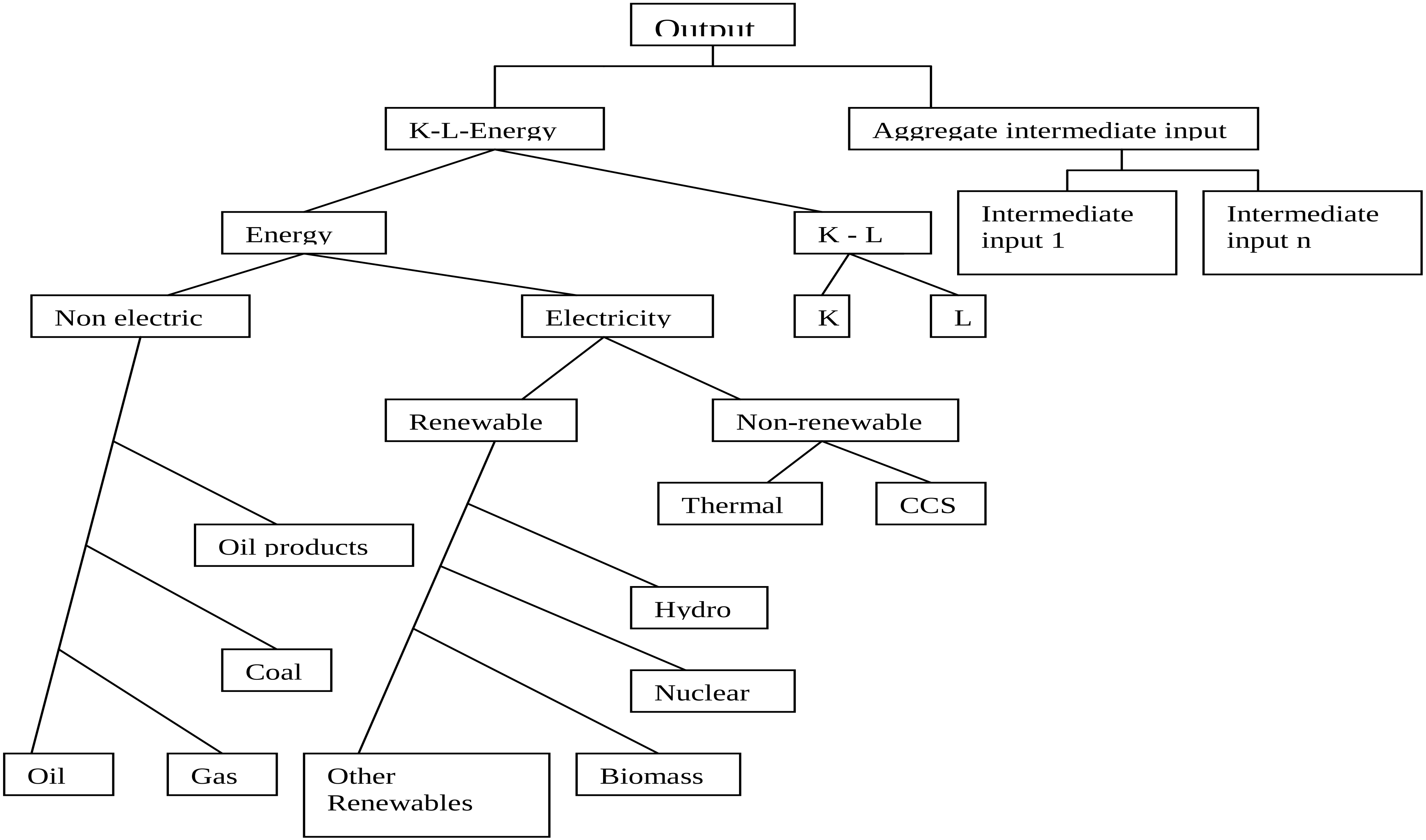


Figure 2: Production structure of non fossil fuel sectors



SCENARIOS

BAU: growth in total factor productivity (TFP), government consumption expenditure, aggregate investment, energy efficiency, productivity increase in wind and solar, and coal cess at the current level.

SIM 1 and SIM 2: coal cess is increased annually at the rate of 10 and 15 percent, respectively, over the time horizon.

SIM 3: productivity improvement in CCS technology

SIM 4 and SIM 5: coal cess is increased at 10 and 15 percent, respectively, along with productivity improvement in CCS technology.

RESULTS

Impact on GDP

The results show that there is GDP loss relative to the BAU in three out of the five scenarios. In SIM 3 and 4 where technological progress in CCS is considered there are GDP gains.

Further, GDP loss is considerably lower in SIM 5 (with technological progress in CCS) than in SIM 2 (without technological progress in CCS). The importance of CCS in reducing mitigations costs has been reported by IPCC (Synthesis Report, Fifth Assessment Report (AR5), 2014) and our results support this observation.

RESULTS (contd.)

Table 1: Impact on GDP for selected years (percent change)

	2010	2020	2030	2040	2050
SIM 1	0.00	-0.01	-0.04	-0.56	-1.80
SIM 2	0.00	-0.02	-0.27	-2.11	-6.68
SIM 3	0.01	0.14	0.70	0.64	-1.16
SIM 4	0.01	0.15	0.93	0.52	-0.69
SIM 5	0.01	0.14	0.91	-0.44	-4.80

RESULTS (contd.)

Impact on CO2 reduction

In terms of CO2 reduction SIM 2 and 5 (higher growth rate in coal cess) show better results compared to the others, thus reflecting the importance of the level of the coal cess in influencing emission reduction. Further, technological progress in CCS leads to relatively higher CO2 reduction.

There is no significant impact on CO2 emissions till the early 2020's implying that emissions will continue to rise in the short/medium run irrespective of the coal cess and technological progress in energy technologies. From the mid 2030's emissions stabilize in the scenarios with higher levels of coal cess (SIM 1, 2, 4 and 5). However, CO2 emissions are considerably lower in scenarios with advances in CCS technology (SIM 3, 4 and 5).

RESULTS (contd.)

Table 2: Impact on CO_2 emissions for selected years (percent change)

	2010	2020	2030	2040	2050
SIM 1	0	-2	-10	-37	-67
SIM 2	0	-3	-23	-58	-76
SIM 3	0	-2	-9	-15	-24
SIM 4	0	-4	-17	-43	-69
SIM 5	0	-5	-26	-59	-76

RESULTS (contd.)

Impact on renewables uptake

Share of renewables remain almost identical in all scenarios till the early 2020's. Share of renewables in scenarios with technological development in CCS are lower because CCS (electricity) is a coal based technology and thus there is some shift towards coal instead of renewables.

In terms of reaching the renewable energy installed capacity target of 40 percent by 2030 SIM 2 is the most promising.

The results suggest that the INDC target can be reached in SIM 2 in the early 2030's. In other scenarios it reaches the target much later. It is important to note that this target is not much relevant in scenarios with CCS (SIM 3, 4 and 5) because there is higher emission reduction without increase in share of renewables.

RESULTS (contd.)

Table 3: Share of renewables for selected years

	2010	2020	2030	2040	2050
BAU	0.14	0.15	0.22	0.24	0.36
SIM 1	0.14	0.16	0.25	0.43	0.77
SIM 2	0.14	0.16	0.32	0.67	0.90
SIM 3	0.14	0.14	0.13	0.19	0.35
SIM 4	0.14	0.15	0.14	0.29	0.72
SIM 5	0.14	0.15	0.15	0.44	0.84

CONCLUSIONS AND POLICY IMPLICATIONS

Under current level of coal cess and trends in technological progress in wind and solar it may not be possible to achieve the INDC target.

The coal cess can play an important role in achieving the INDC target if it is increased over time (by 15 percent annually).

Advances in CCS technology, along with wind and solar, can help to achieve similar CO2 emission reductions as wind and solar at a lower economic cost, although the share of renewables in such a situation is lower because CCS is a coal based technology and the deployment of wind and solar is adversely affected due to higher uptake of CCS.

Although CCS is a very expensive technology with very limited uptake globally, future technological progress could make it a very useful instrument for promoting low carbon growth, and thus should receive more attention.

Thus, the coal cess and technological progress in energy technologies could potentially be key drivers of low carbon growth in India.

THANK YOU