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Fiscal Implications and Macroeconomic Impact Analysis of the Gas Price Pooling Policy of the Government of India

Prepared for

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List of Abbreviations

APM	Administered Price Mechanism
CST	Central Sales Tax
DES	Delivered Ex Ship
FRBM	Fiscal Responsibility Budget Management
FY	Financial Year
GDP	Gross Domestic Product
KGD6	Krishna-Godavari Basin D-6 block
LNG	Liquefied Natural Gas
PLF	Plant Load Factor
RLNG	Re-gasified Liquefied Natural Gas
VAT	Value Added Tax

List of Units

$	United States Dollar
1 Billion	10^9 or one thousand Million.
1 Crore	10^7 or hundred thousand
1 Million	10^6 or one thousand thousand.
BU	Billion Unit
kwh	Kilowatt Hour
MMBTU	Million Metric British thermal units
MMSCMD	Million Standard Cubic Metres Per Day
MMTPA	Million Metric Tonne Per Annum
MU	Million Unit
MW	1000 Kilowatts
MW	Megawatt
SCM	Standard Cubic Metres

Executive Summary

Natural gas based power plants are facing acute shortages of natural gas due to a fall in domestic production of natural gas and operating at zero to 40 percent capacity levels. Imported liquefied natural gas to augment domestic supply is both more costly than domestically produced natural gas as well as constrained by the regasification capacity at port terminals.

Gas price pooling policy would involve the pooling of available domestic gas with imported natural gas. This would result in the cost of power going up due to the higher prices of imported natural gas. It would also result in substantial revenue outflows for the government due to the administratively capped power prices to the utilities and a reduction in tax rates for a few years till the power plants start covering operating costs. As against this, the benefits of such a policy would be to get the presently idle gas based power plants start operating at higher capacity levels. This would in turn lead to greater power generation in the economy and greater output in other sectors of the economy through inter linkages and the multiplier effects.

The methodologies currently in practice to price domestically produced gas consists broadly of two pricing regimes – one for gas priced under the Administered Pricing Mechanism (APM), and the other for the non-APM gas. Currently, 30% of gas based power plants operate on APM gas, 61% on non-APM gas, and 9% are off-grid. This Study analyses the fiscal implications, macroeconomic impact and benefit-cost analysis of gas price pooling policy over a medium-term time horizon in both the above cases in the following three scenarios of capacity utilization of the natural gas based power plants:

- *Scenario 1*: Plants operating at 30% PLF
- *Scenario 2*: Plants operating at 40% PLF
- *Scenario 3:* Plants operating at 50% PLF

Simulations are made based on projections of domestic gas availability made by the Ministry of Petroleum and Natural Gas. However, a counterfactual of zero domestic availability of natural gas over the medium term is simulated in the case of 30% PLF to take account of this possibility. It is also to be noted that at 30% PLF and 40% PLF, the simulations are only in the case of non-APM plants, as no additional power is generated by APM plants which are already operating at an average of 40% PLF. At 50% PLF, both APM and non-APM plant projections are analysed.

Some of the main findings are below. It is to be noted that the projections below are made in nominal terms.

Fiscal implications

- As the pooled price of natural gas is greater than the domestic price there is an increase in the cost of production of power. However, as the per unit selling price electricity has been administratively capped at Rs 5.50 per kwh, the difference between the selling price and the price of production leads to a revenue shortfall
- The total revenue shortfall can be divided into three main groups: subsidies, potential tax revenue forgone by government, and the potential revenue losses to be borne by other sectors taking cuts in their marketing, transportation and regasification costs.
- For instance, in 2015-16, the revenue shortfalls are the following
    - With a 30% PLF, if domestic gas is available, for non-APM plants, the total revenue shortfall of Rs 10,165 crores can be divided as follows:
        - Rs 4,531 crore subsidies borne by the central government
        - Rs 3,162 crore loss due to tax concessions (VAT/CST/ Customs)
        - Rs 2,472 crore potential revenue losses to be borne by other sectors
    - With a 30% PLF in 2015-16, if we assume that there is no domestic production of gas and 100 percent of the gas requirement is imported, the revenue shortfall will be higher at Rs 15,270 crores.
    - With a 40% PLF, the revenue shortfall for non-APM plants is Rs 15,255 crores. With 50% PLF, the revenue shortfall for both APM and non-APM plants is Rs 22,423 crores.
    - Details for other years and the breakdown of total revenue shortfall into subsidies, tax concessions and other costs are in Section 5 of the report.
- The impact of the gas price pooling policy will lead to an increase in fiscal deficits.
    - If the central and state governments cover the entire total revenue shortfalls, then fiscal deficits are likely to rise. Fiscal deficits as a percent of GDP in 2015-16 are projected to increase from a baseline of 3.89% to 3.96% with 30% PLF, 4.00% with 40% PLF and 4.05 with 50% PLF (both APM and non-APM plants).
    - If the government proposes to apportion part of the total revenue shortfalls to other sectors (marketing, transportation, and regasification), the increase in fiscal deficits is slightly lower. Full details are in section 5 of this study.

Macroeconomic impact

- The methodology involved using a 130 sector Input-Output table aggregated to 18 broad sectors and forward linkages were used to estimate the multiplier and employment effects.
    - A high forward linkage or a high diffusion effect implies that by expanding the output of a sector, a powerful stimulus is generated in other sectors, by way of absorbing the output of the specific sector as inputs to other sectors
    - Among the 18 broad sectors, natural gas has the highest diffusion effect of 7.05. This means that a unit increase in natural gas output triggers the overall production in the economy by 7.05 units.
    - The diffusion effect for the electricity sector is 3.08

- The input multipliers and the employment multipliers were used to assess the change in economy's GDP and employment with the given increase in electricity output.
- In 2015-16, the gas price pooling policy leads to an increase in GDP as below when domestic gas is available. Details for other years are in section 6 of this study.
    - 0.50 % with a PLF of 30%
    - 0.70 % with a PLF of 40%
    - 0.98 % with a PLF of 50%
- The increased power generation in 2015-16 will also increase employment as below when domestic gas is available. Details for other years are in section 6 of this study.
    - 0.31 % with a 30% PLF or 13 lakh new jobs
    - 0.43% with a 40% PLF or 18 lakh new jobs
    - 0.61% with a 50% PLF or 23 lakh new jobs

Benefit-Cost Analysis

- The GDP multipliers and growth rates (section 6) and the fiscal costs (section 5) are used with the GDP and fiscal forecasts made using a general equilibrium model (section 7) to calculate the benefit-cost of the gas price pooling policy
- The increase in GDP and the fiscal costs of the gas price pooling policy are below. As before, with 30% PLF and 40% PLF, the change is due to greater capacity utilization of non-APM plants only. At 50% PLF, the change is due to both APM and non-APM plants.
    - 30% PLF: The increase in GDP is Rs 69,431 crores and the fiscal cost is Rs 10,165 crores. This is when domestic gas is available
    - 30% PLF: The increase in GDP is Rs 80,027 crores and the fiscal cost is Rs 15,270 crores. This is when domestic gas is not available and all gas is imported
    - 40% PLF: The increase in GDP is Rs 96,107 crores and the fiscal cost is Rs 15,255 crores
    - 50% PLF: The increase in GDP is Rs 1,35,139 crores and the fiscal cost is Rs 22,423 crores
- With the gas price pooling policy, net benefits in 2015-16 are projected below.
    - 30% PLF: The net benefit is 0.4286% of GDP or Rs 59,266 crores. This is when domestic gas is available
    - 30% PLF: The net benefit is 0.4684% of GDP or Rs 64,758 crores. This is when domestic gas is not available
    - 40% PLF: The net benefit is 0.5848 % of GDP or Rs 80,852 crore.
    - 50% PLF: The net benefit is 0.8152 % of GDP or Rs 1,12,717 crores
- Simulations suggest that the gas price pooling policy yields positive net benefits. However, as discussed in the Conclusion Section, suitable safeguards may be built into this policy so as not to pick up the inefficiencies of the public and private sectors over a longer time period, or to bail out companies for a period more than strictly necessary.

Fiscal Implications and Macroeconomic Impact Analysis of the Gas Price Pooling Policy

SECTION 1

Introduction

Globally, there is a strong correlation between economic growth and energy consumption and India is no exception. In recent years, India's growing economy has led to led to increased consumption of primary energy resources such as coal, oil and natural gas which have grown at an annual compounded growth rate (CAGR) of 6% between 2007 and 2012. The share of natural gas in its primary energy mix has increased from 8% in 2008 to 11% in 2012, and is expected to grow to 20% by 2025. Natural gas is generally preferred in the energy mix as burning natural gas produces 30% and 40% less carbon dioxide as compared to petroleum and coal respectively. However, supply-side constraints have led to both a low percent of natural gas in the energy mix as well as low per capita consumption of natural gas.

India has currently 27,123 MW of natural gas based power generation capacity which includes 563 MW of capacity that is ready to be commissioned but not connected to the grid. Hence, the effective capacity is 26,560 MW of which 21,211 MW capacity is operational and the balance capacity of 5,349 MW is ready to be commissioned. However, the existing plants are operating at very low capacity levels of 0 to 40% due to a decline in supply of domestic natural gas, while the remaining capacity is yet to be commissioned due to the non-availability of gas. With sub-optimal capacity utilisation and supply side bottlenecks, the present sunk investment in these gas based power plants of over Rs. 64,000 crores is in danger of turning into non-performing assets. The Gas Price Pooling Policy would result in increased capacity utilization and power generation and is foreseen to meet the unmet demand for power, as well as partly address the future energy needs of the country.

The Gas Price Pooling Policy involves the pooling of available domestic gas with imported natural gas. This would result in the cost of power going up due to the higher prices of imported natural gas. It would also result in substantial revenue outflows for the government due to the administratively capped power prices to the utilities and a reduction in tax rates for a few years. This study analyses the macroeconomic impact of the increased power generation in the economy due to greater availability of natural gas as well as the fiscal cost to the government over a medium-term time horizon.

This study is divided into eight sections:

(1) Introduction

(2) India's current energy scenario

(3) The natural gas based power plant industry in India

(4) Methodology for economic impact analysis

(5) Fiscal impact of gas pooling for the government

(6) Macroeconomic impact analysis

(7) Economic benefit-cost analysis

(8) Summary and conclusion

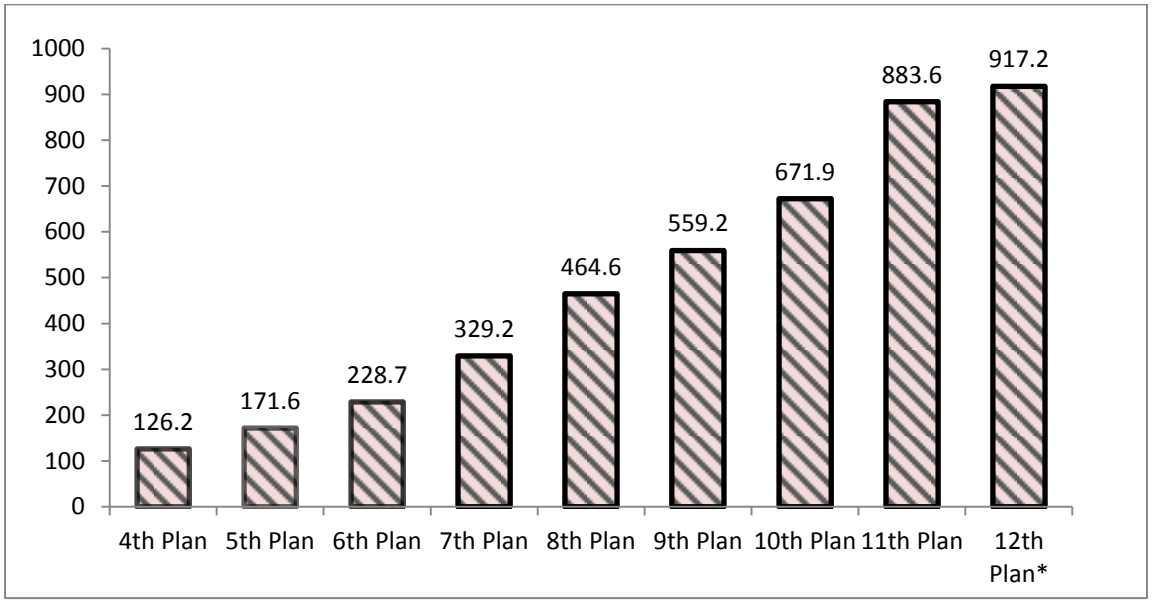
SECTION 2

India's Current Energy Scenario

2(i) Energy consumption in India

India is the fourth largest consumer of energy in the world after USA, China and Russia. During the past four decades India has seen a rapid growth in energy consumption with its per capita energy consumption increasing from 126 kWh over the Fourth Five Year Plan period to 917 kWh (estimated) over the Twelfth Five Year Plan period at a CAGR of 4.06%. (Figure 1.1)

Figure 2.1: Per capita energy consumption in India (kWh)



*End of first year of 12th plan

Source: Central Electricity Authority

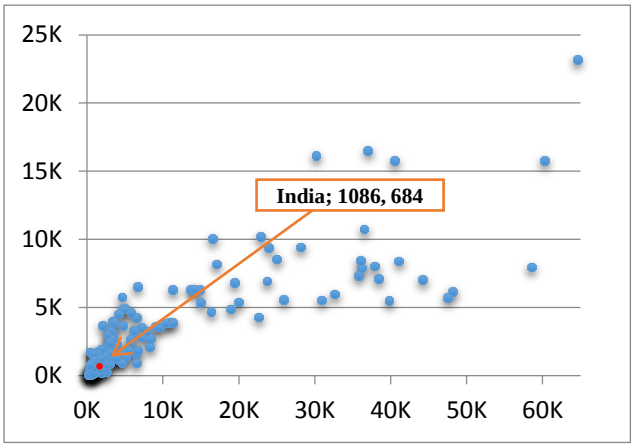
India has a fifth of the world's population, and hence, in per capita terms its energy consumption is still amongst the lowest in the world even though it is today the third largest power producer in the world (after USA and China). Figure A.1 in Appendix A illustrates that in per capita terms in 2013, India consumed 7% of the energy consumed by USA, 22% of China and 26% of the average of the World. In the case of natural gas the average per capita consumption in India is just 9% of the average per capita consumption of natural gas for the World as a whole, 2% of USA and 33% of China.

2(ii) Energy and economic growth

There is a direct linkage between a country's energy consumption and its GDP per capita (Figure 2.1). For instance, in the USA, electricity consumption per capita in 2011 was 13,246 kWh and its GDP per capita was $44,342, while the corresponding figures for India in 2011

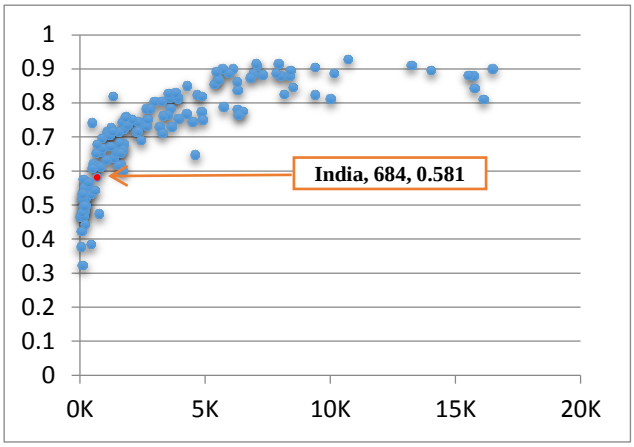
was 684 kWh and $1086, and for China was 3298kWh and $3122. There is also a strong correlation between the Human Development Index (HDI) and GDP per capita (Figure 2.3). Nations having a low per capita energy consumption are also seen to have a low level of human development. In India, in 2011 the HDI is 0.581 and the per capita electricity consumption is 684 kWh.

Figure 2.2: GDP Per Capita (PPP) & Electricity Per Capita (kwh): World, 2011



Source: World Bank national accounts data, and OECD National Accounts data files, International Energy Agency.

Figure: 2.3: HDI & Electricity per capita (kwh): World, 2011



Source: World Development Indicators & UNDP

2(iii) The energy mix in India

The annual average growth rate of the total energy requirement increased by 5.1 per cent per year in the Eleventh Plan, and is expected to increase by 5.7 per cent per year in the Twelfth Plan and by 5.4 per cent per year in the Thirteenth Plan[1]. Over 50 percent of the commercial energy supply is presently met by coal. Natural gas contributed to about 11 percent of the energy mix in 2012 (Figure 2.4). The Planning Commission estimates its share in the energy mix is expected to grow to 13 percent by 2022, while the Working Group Report for the 12th Five Year Plan, MoPNG estimates its share to reach 20 percent by 2025. Renewable energy sources were less than one percent of the energy mix in 2012, and is projected to reach two percent by 2022.

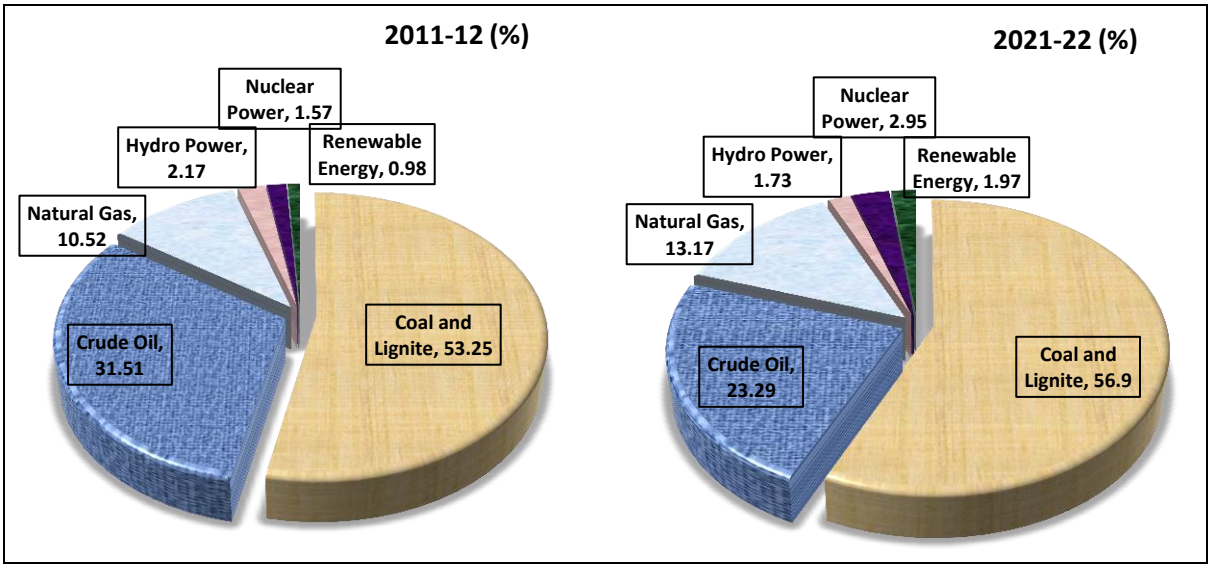
The energy mix projections on the basis of energy consumption are quite different from that based on installed power capacity mainly because the wide variation in the Plant Load Factors (PLF). For instance, the PLF of renewable energy plants are much lower than PLF of thermal, gas, nuclear and hydro-power based power plants, and even among the latter, the PLFs vary substantially. According to the Ministry of Power, in terms of the total installed capacity of 190,592 MW of energy in India in 2012, 9% is natural gas, 12 % is Renewable Energy Resources (RES) and 55% is coal. However, by 2030, the share of natural gas is expected to fall to 3 percent while the share of renewable energy is expected to reach 33 percent as the government focuses on the National Solar Energy Mission and other forms of

[1] Planning Commission

renewable energy. However, it is difficult to pin down exact projections, particularly of renewable energy, as different agencies project diverse figures that are not in agreement.

A significant part of India's energy needs are met through imports. In 2013-14, India's net energy imports were at 6.3% of GDP. India's dependence on oil imports is close to 80 percent, and its dependence on natural gas imports has been increasing from 20 percent in 2010 to 37 percent in 2014, mainly due to domestic gas production not keeping pace with rising demands. According to Goldman Sachs estimates, the country's annual energy imports in the next decade could go up significantly from $120 billion in 2013-14 to $230 billion in 2023-24 unless the economy switches from oil to natural gas and uses alternative forms of energy.

Figure 2.4: Share in Total Commercial Energy Supply (Energy Mix) in 2012 and 2022



Source: Planning Commission

2(iv) Demand and supply of natural gas in India

Natural gas in India is available from domestic sources and as imported Re-gasified Liquefied Natural Gas (R-LNG). The demand for natural gas has always exceeded the supply in recent years. The supply deficit is in part due to low domestic production of natural gas as well as supply constraints due to the high price of R-LNG as well as regasification terminals and gas pipeline infrastructure. With the discovery of the KG-D6 located on the east coast in 2002, domestic gas production has steadily increased. However, the output from the KG-D6 fields have been steadily declining, leading to a greater degree of import dependency.

The domestic production of natural gas has declined by 12.96% from 40.68 Billion Cubic Meters (BCM) in 2012-13 to 35.41 BCM in 2013-14. The output is expected to pick marginally up to 36 BCM in 2014-15 including 24 BCM from state-run Oil and Natural Gas Corporation, 2.8 BCM from Oil India and 9.7 BCM from production-sharing contracts regime blocks. The shortfalls in supply of gas have left several natural gas based power plants

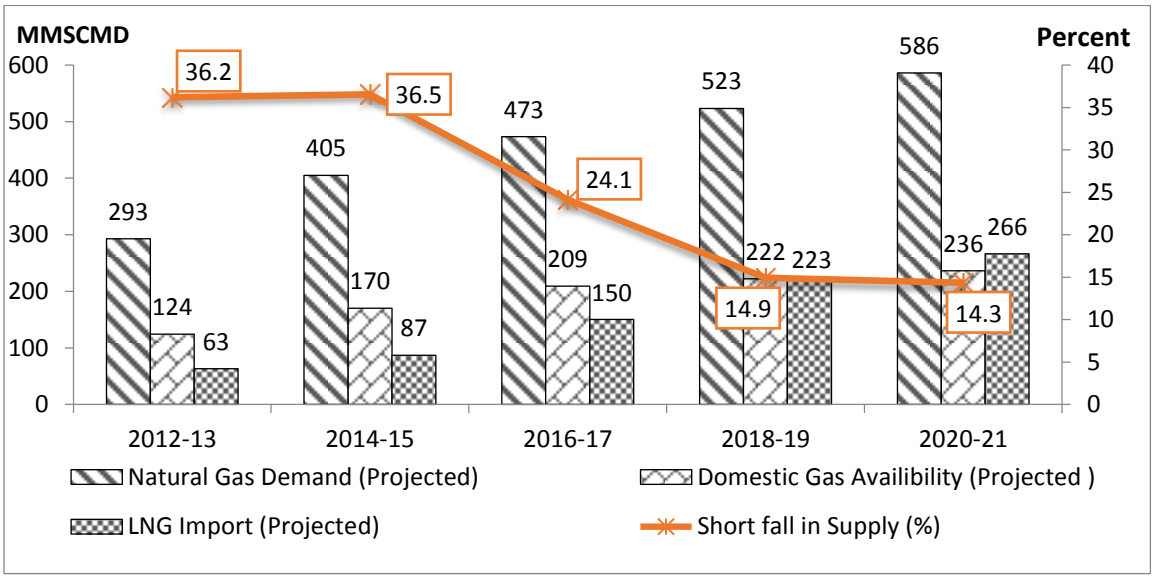
operating at zero or very low capacities. Domestic production shortfalls are now being met by an increased reliance on imports which are more costly.

Interestingly, the projections for the demand for natural gas vary across different reports. For instance, as seen in Table A.1 in Appendix A, in 2018-19 the Ministry of Petroleum and Natural Gas projected a demand of 523 MMSCMD while Vision 2030 projected demand at 438 MMSCMD. There are also differences in projections across reports for both domestic supply and imports. In this Study, the Ministry of Petroleum and Natural Gas and the Planning Commission's data have been used as far as possible.

The demand for natural gas has always outstripped the supply. The Planning Commission[2] has estimated the shortfall in supply to peak at 37% in 2014-2015 (Figure 2.5). However, the shortfall in supply is expected to fall in the coming years due to an increase in the planned production of domestic natural gas at a CAGR of 12%[3] by private and public agencies as well as greater imports due to increased regasification capacity. The shortfall in demand is expected to be only 14% by 2020-21.

The Ministry of Petroleum and Natural Gas have projected that domestic gas production will increase over the next five years and to reach 59 BCM by 2019. The projections on increase in domestic production by the Ministry of Petroleum and Natural Gas have been taken into account in Sections 5 and 6 when calculating the fiscal impact and macroeconomic impact of the gas price pooling policy. In particular, the subsidy support from the government is envisaged to decrease over the years as the domestic production starts picking up.

Figure 2.5 : Estimated demand, availability, and supply shortfalls of natural gas



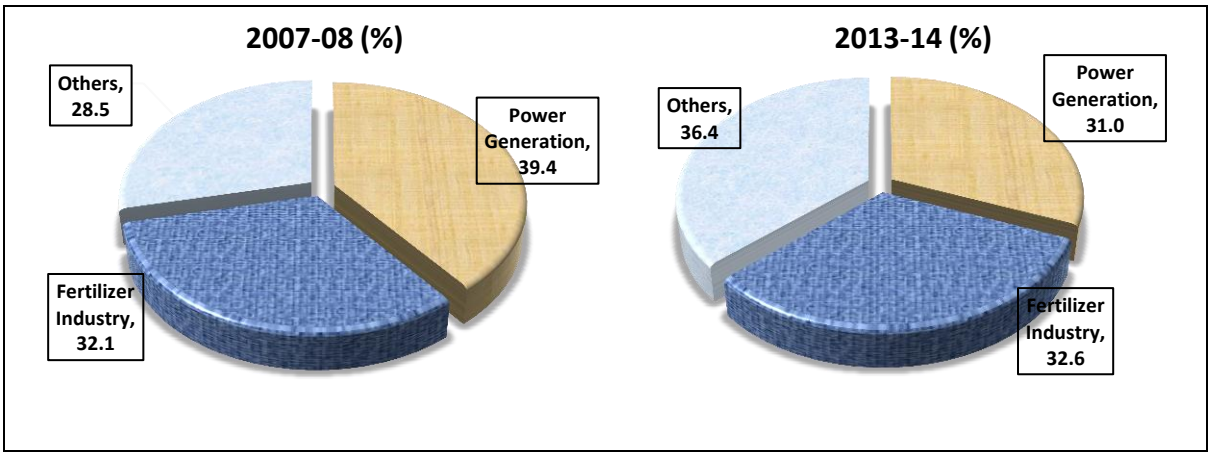
Note : The above projected gas availability excludes gas sources like Shale gas, gas hydrates etc.
Source: Working Group Report for the 12th Five Year Plan, MoPNG

[2] Planning Commission of India *Twelfth Five Year Plan-Volume II* (2012-17).
[3] Ministry of Petroleum and Natural Gas. *Indian Petroleum and natural Gas Statistics* 2013-14

2(v) Sectoral use of natural gas

The major consumers of natural gas in India are the fertilizer sector and the power sector which account for close to 64% of the consumption in FY 2013. The demand for natural gas is increasing in these sectors both due to the pace of economic growth as well as the fact that natural gas is a greener alternative to petroleum and coal. The increased demand has led to greater led to greater reliance on imports of LNG. According to the BP Statistical Review of World Energy (2013), India is the fourth largest importer of LNG in the world, and in FY 2013, almost 37 percent of the natural gas consumption was met by imports of LNG.

Figure 2.6: Sectoral demand of natural gas in India - 2013-14



Source: Indian Petroleum and Natural Gas Statistics, Ministry of Petroleum & Natural Gas, GOI

SECTION 3

The Gas Based Power Plant Sector in India

3(i) Natural gas plant capacity and utilization

At present, the total grid connected gas based capacity in India is 26,560 MW. Of this, 80 percent have been commissioned, while 20% are yet to be commissioned, mainly due to lack of availability of natural gas. Plants are also distinguished on the basis of whether they operate with APM gas or with non-APM gas (discussed in section 3(iv) below). Plants that operate on non-APM gas are supplied gas mainly from the KG-D6 gas fields.

Table 3.1 below shows that 8,042 MW or 30% of the total installed capacity operates using APM gas, while 16,107 MW or 61% operate using non-APM gas, and 2,411 or 9% of the installed capacity are off-grid. Of the 16,107 MW of non-APM gas, 5,349 MW are ready for commissioning. Currently, APM plants operate at 40% PLF and non-APM plants are operating at zero percent PLF. Plants that operate at zero percent PLF have been labelled as "stranded capacity"[4]. The off-grid plants are operating at 62% PLF. The analysis in this study is restricted to stranded capacity and plants with low capacity utilization. The analysis excludes off-grid power plants.

Table 3.1: Gas based power plants: Installed capacity and Plant Load Factor (PLF)

	Gas based power plants			**MW**	**% of Total**	**PLF**
1	Stranded capacity			**16,107**	**61**	**0**
	of which					
	1(a)	KG D6		6997	26	0
	1(b)	No gas		3761	14	0
	1(c)	Ready for commissioning		5349	20	0
2	Low utilization	APM		**8042**	**30**	**40**
3	Off-grid	Off-grid		**2411**	**9**	**62**
	READY TO GO CAPACITY (1+2+3)			**26560**	**100**	**20**

Source: Central Electricity Authority; Government of India. "Rajya Sabha Starred question No. 276 to be answered on 15.12.2014". p37

The power sector accounts for almost one third of the natural gas consumption in FY 2014. Due to the recent unavailability of natural gas, the power sector is beleaguered by high generation costs and low plant load factor (PLF). Currently, close to 16,107 MW of commissioned and ready to be commissioned plants are not able to operate due to non-availability of gas. The gas price pooling strategy is aimed to increase capacity utilization of

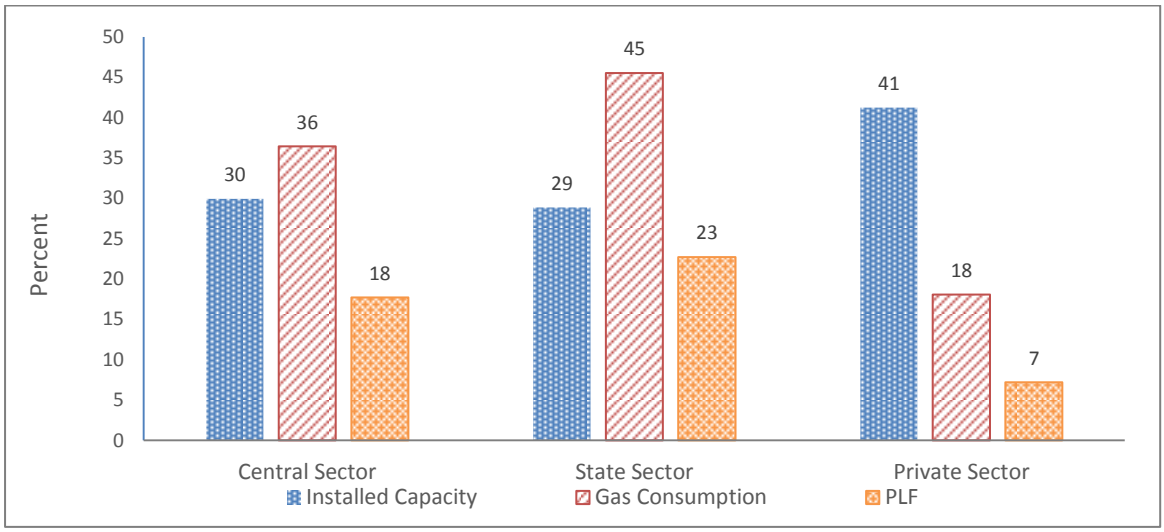
[4] Government of India. "Rajya Sabha Starred question No. 276 to be answered on 15.12.2014". p37

the existing plants, and section 6 below analyzes the macro economic impact of increased electricity generation under different scenarios of PLF for these power plants using an Input-Output (I-O) Model.

3(ii) Ownership structure

There are 66 power plants of which 30% are in the central sector, 29% in the state sector and the remaining 41% in the private sector. Figure 7 shows that the central sector power plants consume 36% of the natural gas and operate at 18% PLF, while the state sector consumes 45% of the power and operates at 23% PLF, and the private sector consumes 18% of the power and operates at 7% PLF. While the proposed gas price pooling policy will benefit all plants, plants in the private sector will stand to gain more under this policy.

Figure 3.1: **Grid Connected Power Plants: Ownership, Consumption and PLF**



Source: Central Electricity Authority

3(iii) State-wise distribution

Of the grid-connected gas power plant capacity, 85% is located in the 4 states of Gujarat, Andhra Pradesh, Maharashtra and Delhi (Figure 3.2). The states relying on natural gas power plants for their energy are in power deficits due to zero or low capacity utilization of already existing plants. For instance, in Andhra Pradesh, which accounts for 31% of the total natural gas based power plant capacity in India, 83% of the power plants are stranded and 17% operate at 32% PLF (Figure 3.3). With 61% of all gas based power plants in India being stranded (Section 3i above), an increase in capacity utilization of these plants due to the proposed gas price pooling policy will have multiplier effects across the economy through forward and backward linkages. The impact of these multipliers on GDP growth and employment is simulated in Section 6 of this Study.

Figure 3.2: State-wise distribution of gas based power plants

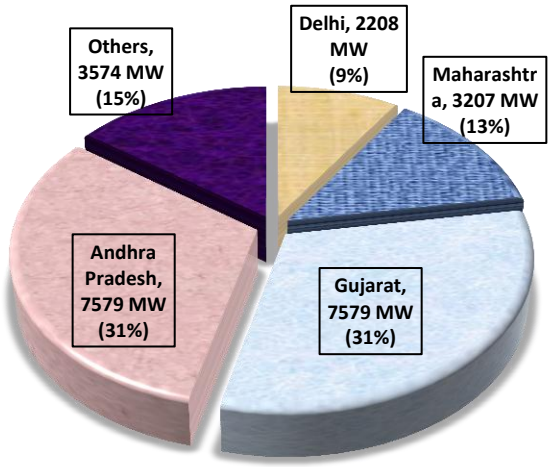
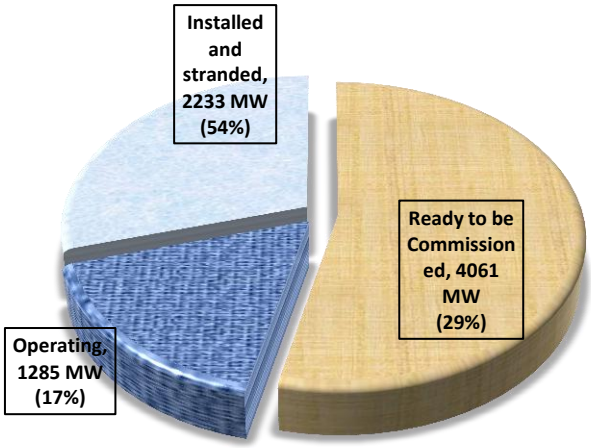


Figure 3.3: Capacity utilization in Andhra Pradesh



Source: Central Electricity Authority

3(iv) Infrastructure constraints

Natural gas demand far exceeds natural gas supply. While the supply gap can be filed to some measure by R-LNG, the demand for this is both price sensitive as well as constrained by the regasification capacity. There are four regasification terminals in India (Dahej, Hazira, Kochi, and Dhabol) with a capacity of 101 MMSCMD in 2014-15, which is expected to increase to 184 MMSCMD by 2016-17. This infrastructure constraint is likely to be eased in the future with the regasification terminals being planned on the eastern and western coasts. As indicated in table 2, the regasification capacity is expected to increase to 258 MMSCMD during the 13th Plan period, which will greatly ease the infrastructure constraint on imports.

In addition, natural gas is not easily available all over India due to lack of gas pipelines. This has resulted in a strong regional imbalance in the use of natural gas. A few states like Gujarat, Maharashtra and UP together consume more than 65% of the available gas.

3(v) Gas pricing methodologies in India

The methodologies currently in practice to price domestically produced gas consists broadly of two pricing regimes – one for gas priced under the Administered Pricing Mechanism (APM), and the other for the non-APM gas. The price of APM gas has been set by the Government principally on a cost-plus basis. As regards non-APM gas, this can be broadly divided into two categories, namely, (i) imported Liquefied Natural Gas (LNG), where prices are market determined and (ii) domestically produced gas from New Exploration Licensing Policy (NELP) and pre-NELP fields.

The MoP&NG has detailed guidelines on each of these pricing mechanisms. The APM gas is produced from existing fields of the nominated blocks of National Oil Companies (NOCs), viz.OIL& ONGC. The gas produced here is being supplied predominantly to fertilizer plants, power plants, court-mandated customers, and customers having a requirement of less than 50,000 standard cubic metres per day at APM rates.

As per the earlier Domestic Natural Gas Pricing Guidelines, 2014, there was a wide variation in the price of non-APM gas. Non-APM gas is currently produced by NOCs, viz., ONGC & OIL; by the Pre-NELP Discovered Fields under Production Sharing Contracts (PSCs) viz., Panna-Mukta, Tapti (PMT) and Ravva; and by Production Sharing Contracts (PSC) signed under the New Exploration Licensing Policy (NELP). However, under the New Gas Pricing Policy recently announced by the government on October 18, 2014, the gas price has been revised based on a modification to the Rangarajan formula and applied uniformly to all sectors of the economy, along with the prevailing gas allocation policy of the Government. The new revised gas price, which would now be determined half-yearly, this would now be applicable to all gas produced from nomination fields given to the NOCs, viz ONGC and OIL India, NELP blocks, and Pre-NELP blocks where PSC provides for Government approval of gas prices.

3(vi) Gas Price Pooling Policy

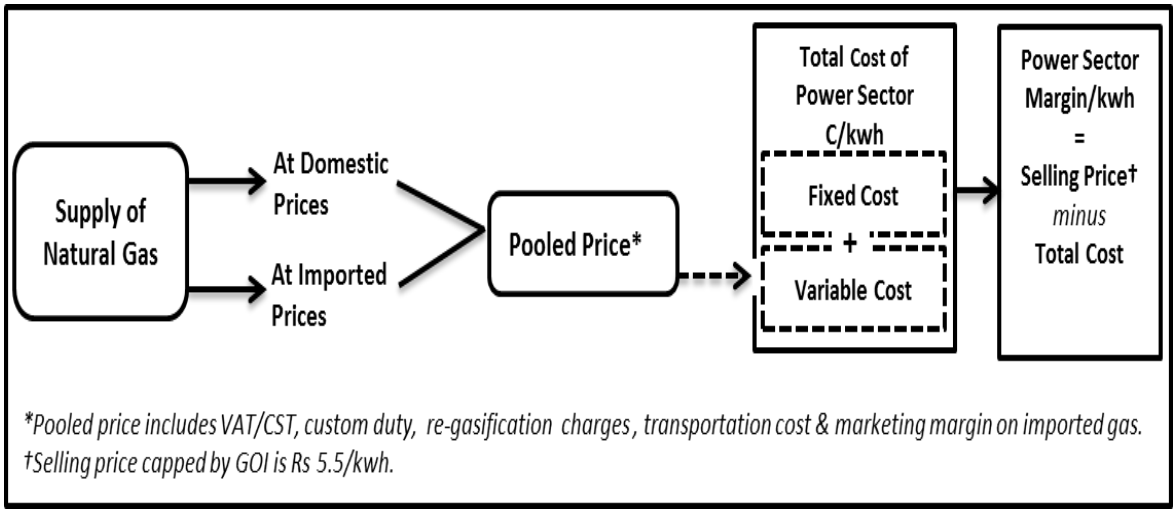
The gas price pooling policy is a plan to pool the existing limited supply of domestic gas with imported R-LNG to help operationalise stranded gas-based power plants with a cumulative capacity of 16,107 MW to operate at 40% PLF[5]. The gas price pooling policy also includes a waiver of the 12.5%VAT/ CST and other levies on natural gas by the states, customs duty exemption for R-LNG, and a 50% cut in pipeline tariff, 50% cut in R-LNG regasification charges, and a 75% cut in marketing margins by GAIL (India), which is the designated gas pool operator.[6] These measures directly affect the input price of natural gas to the industry.

In addition, the policy also proposes that the gas based power plants would get financial relief from the banks. These include extending the commercial operation date (for units not commissioned) by one year, extending the repayment schedule from 10 years up to 25 years, extending the moratorium on principal payment by 3 years, having greater flexibility in project cost overrun funding, and the waiver of penal interest. These measures directly affect the profitability of the gas based power plants. As this Study focuses only on the economic impact of increased power generation and not the financial viability or profitability of the gas based power plants, the implications of the proposed financial relief have not been computed in Section 7.

[5] Business Standard. "Gas price pooling subsidies to help stranded power plants". Dec 26, 2014
[6] Financial Chronicle. "Gas price pooling, sops to resuscitate 16,000MW". Dec 23, 2014

The pooling mechanism involves mixing of available domestic gas with imported RLNG to arrive at a price that would be the weighted average of the two sources. Currently, domestic gas is priced at $5.05[7] per MMBTU on Gross Calorific Value basis while the imported LNG price varies between $10 and $14 per MMBTU. The increase in the cost of power generation using imported gas would make it unaffordable to the end-uses. As such, under the proposed gas price pooling policy, the selling price of gas has been capped at Rs 5.50 per kWh. The difference between the selling price of gas and the cost price of gas is the revenue shortfall. This revenue shortfall is proposed to be covered by various agencies including the central and state governments, gas transporters, power developers and the banks. Figure 3.4 below is a flow chart illustrating the proposed gas price pooling policy. Section 5 calculates both the increased power generated due to this policy as well as the total revenue shortfalls under three alternative scenarios of 30% PLF, 40% PLF and 50% PLF.

Figure 3.4: Proposed model for gas price pooling policy



Source: NCAER Study Team

[7] Ministry of Petroleum and Natural Gas. Ref PPAC/Gas Pricing/Nov 2014-March 2015, dated 26.10.2014

SECTION 4

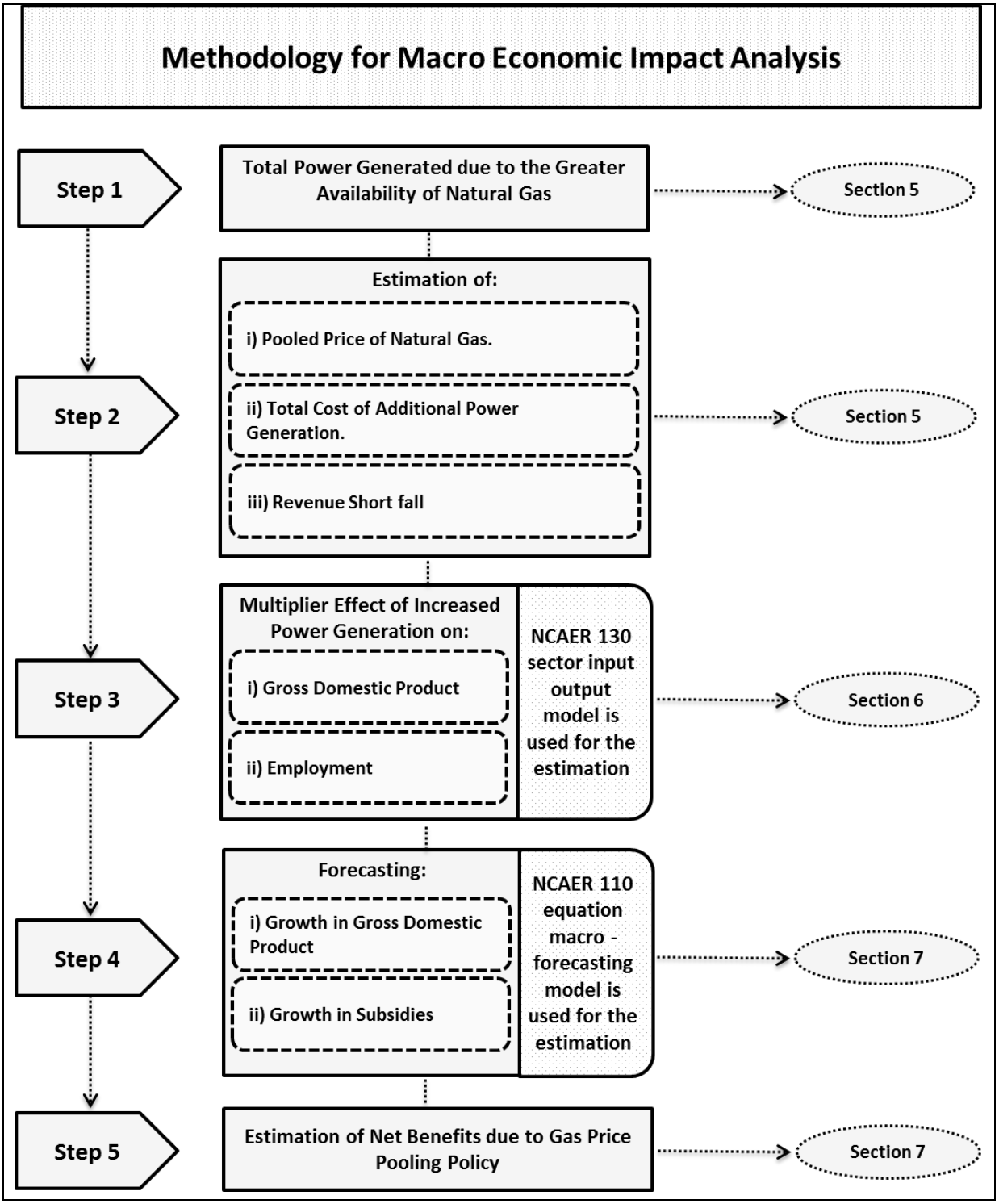
Methodology for Economic Impact Analysis and net benefits calculations

The macro economic impact and net benefits of the gas price pooling policy was calculated in the following way. First, in section 5, the total power generated due to the greater availability of natural gas was calculated. As the price of natural gas supplied to power plants is a function of domestic and imported prices, the weighted average of these prices was calculated. The final price of gas inclusive of indirect taxes (VAT/CST/Customs) and costs of transportation, regasification and marketing margins is called the "pooled price". Section 5 also makes an estimate of the total cost per of additional power generated and the revenue shortfalls.

The value of the additional power generated has been used in section 6 to calculate its multiplier effects on the rest of the economy. For this the NCAER 130 sector input-output model has been used. Knowing the multipliers and the rate of growth is not enough to get its impact on GDP, total revenue shortfalls, and subsidies in the future. Hence, it is necessary to forecast the nominal GDP and subsidies from 2014-15 to 2018-19. Section 7 forecasts the growth in GDP and subsidies using the NCAER's 110 equation macro-forecasting model.

Finally, the net benefits of the gas price pooling policy are calculated. To do this, information on revenue shortfalls from section 5, GDP multipliers and growth rates from Section 6, and forecasted GDP and subsidies from section 7 have been used. A flow chart outlining these steps are in Figure 4.1 below.

Figure 4.1



Source: NCAER Study Team

SECTION 5

Fiscal Impact Analysis

5(i) Scenario analysis

The gas price pooling policy is envisaged to enable greater capacity utilization of existing power plants. As the pooled price of natural gas is greater than the domestic price this will lead to increasing costs in production of power. However, as the per unit selling price electricity has been administratively capped at Rs 5.50 per kwh, the difference between the selling price and the price of production would lead to revenue shortfalls for the gas based power plants. The quantum of additional power generated due to the availability of natural gas and the level of total revenue shortfall depends on a variety of factors which include the PLF and the volume of imported gas. The current report hence develops three scenarios. This section calculates this revenue shortfall over the medium term, viz from 2015-16 to 2017-18 under the following three scenarios:

(a) *Scenario 1*: This assumes a PLF of 30%. Due to constraints in RLNG capacity as seen in Section 3 (iii), the present proposal would have the stranded plants up and running with a PLF of at least 30%[8] (the average of 20% for the 5 Monsoon months and 35% for the remaining 7 months). This average of 30% PLF is also consistent with the international average in recent years. In the UK, the PLF in 2012 and 2013 was 30.3 and in 27.9 respectively[9].

Two cases are considered here.
Scenario 1(i) assumes a mix of domestic and imported gas
Scenario 1(ii) assumes 100% of the required natural gas is imported[10]

(b) *Scenario 2*: This scenario assumes a PLF of 40%, which is the benchmark scenario and the average PLF of APM gas-based plants[11].

(c) *Scenario 3*: This scenario assumes a PLF of 50%. This assumes an incremental approach over the next three years to increasing domestic gas production capacity given the constraints to R-LNG infrastructure[12].

[8] Source: Infraline
[9] Digest of United Kingdom Energy Statistics (DUKES) 2013. Chapter 5 – Electricity. However, in 2008 the gas based power plants in UK operated at a 71% PLF, which is the maximum it has reached over the past decade and currently regarded as the best practice.
[10] Source: The Economic Times. Jan 16, 2015. "Power Ministry reworking Gas price pooling proposal".
[11] Source: Section 3(i), Table 3.1.
[12] Ultimately, in the long term and as per the decision of the Empowered Group of Ministers (EGoM) for allocation and pricing of NELP gas, a PLF of 75%/70% has been suggested as being optimal (75% for Andhra Pradesh projects and 70% for others). This is consistent with the international best practices. In 2008 the gas

The following assumptions are made in the three scenario analysis:

(i) All plants are assumed to run at the same efficiency level. It is assumed that no new capacity is added over the medium term. Under each of the three scenarios, the plants are assumed to operate at the same PLF over all the years under consideration.

(ii) There will be a lead time for industries (that includes time for import arrivals, enhanced storage capacities, plant operations, transportation, and users) to gear up to operate under the steady-state PLF conditions assumed in this Study. However, it is assumed that this lead time is zero years for the fiscal impact and benefit-cost analysis below. If we assume that plants do take time to start operations, then the benefit-cost analysis is to be adjusted accordingly.

(iii) At 30% PLF and 40% PLF, the gas pooled price is restricted to only the non-APM capacity of 16,107 MW. This is because APM plants are already operating at 40% PLF (Table 3.1). At higher capacity utilizations (50% PLF), the gas pooled price is extended to both non-APM as well as APM plants.

(iv) Full capacity utilization of plants assumes that the plants will operate for 365 days in a year. A 40% PLF assumes that they operate at 40 percent capacity.

(v) The cost of natural gas supplied to the power plants has been taken as a weighted average of domestic and international prices to which VAT/CST at 12.5% has been added, as well as transportation, regasification, and marketing margins. This is called the "pooled price". The pooled price is lower if the domestic production of natural gas is higher.

(vi) The indirect tax rates as well as the costs for transportation, regasification and marketing are assumed to remain constant over the projection period in this Study.

(vii) As per various estimates, it is expected that domestic production of natural gas increases both in the medium term as well as the long term. This leads to a lower pooled price, and assuming a fixed selling price of Rs 5.50 per kwh, the total revenue shortfalls decreases over the medium term.

5(ii) Results

The quantum of additional power generated due to the availability of natural gas and the level of subsidies is calculated separately in two cases. The first case is when only non-APM gas based power plants are considered. This is when plants operate at 30% PLF and 40% PLF. APM plants are not covered with 30% or 40% PLFs as they are already operating at 40% PLF. The second case is when all gas based power plants, both non-APM and APM are considered. This arises at 50% PLF as additional power is generated by the APM plants also.

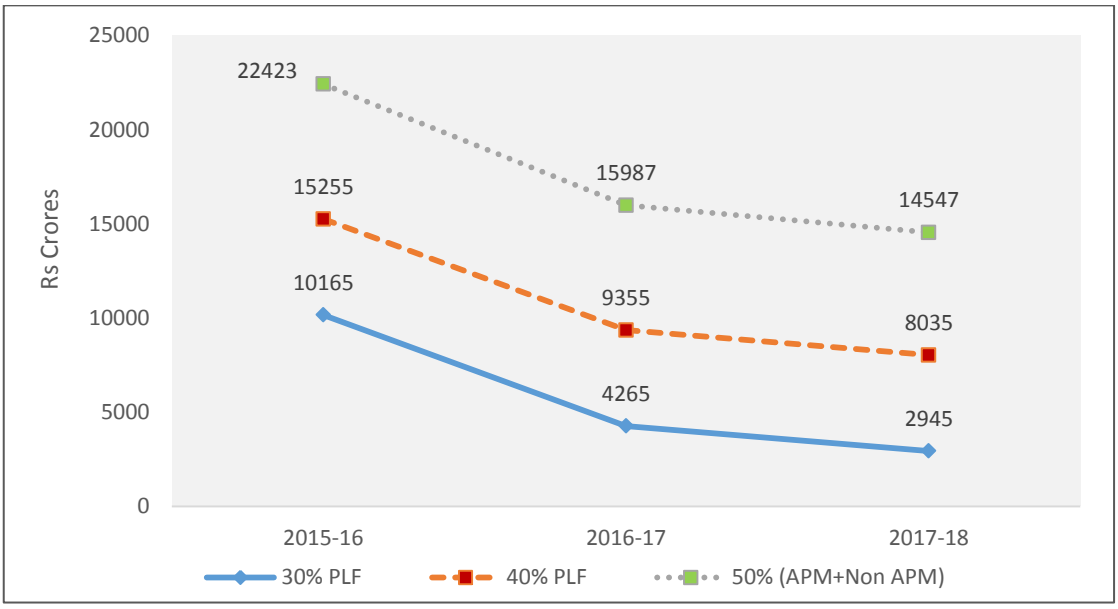
based power plants in UK operated at a 71% PLF, which is the maximum it has reached over the past decade (Digest of United Kingdom Energy Statistics (DUKES) 2012. Chapter 5 – Electricity)

Table 5.1 below calculates the total additional units of power generated the pooled price and the revenue shortfalls. Under Scenario 1(i) with a 30% PLF, the revenue shortfall is Rs 10,165 in 2015-16 and decreases over the years as it is assumed that the domestic production of natural gas increase over the years. However, under Scenario 1(b) where it is assumed that there is zero domestic gas availability, with a 30% PLF, the revenue shortfalls are higher at Rs 15,270 (Appendix B, Table B1).

Under Scenarios 2 and 3, where a PLF of 40% and 50% are assumed, revenue shortfalls in 2015-16 for non-APM plants are at Rs 15,255 crores and Rs 20,345 crores respectively. If all plants are considered, both APM and non-APM, then the revenue shortfall in 2015-16 with a 50% PLF is higher at Rs 22,423 crores. Appendix B, Table B2 and Table B3 has details for all the years with a PLF of 40% and 70%.

Section 6 below evaluates the macroeconomic impact of the increased power generated by operating the existing power plants at higher PLFs as calculated in this section, and section 7 computes the cost-benefit analysis of the gas price pooling policy using the multiplier effects on GDP calculated in section 6 and the revenue shortfalls calculated in this section.

Figure 5.1: Total revenue shortfalls under gas price pooling policy: All plants



Note: At 30% PLF and 40% PLF, the revenue shortfalls are only for non-APM plants as APM plants already operating at 40% PLF.
Source: NCAER calculations

The total revenue shortfalls can be further divided into three main groups[13]. As the cost of natural gas includes taxes and other costs (marketing margin, transportation and regasification), these costs can be calculated and subtracted from the total revenue shortfalls. As discussed in section 7, under the proposed gas price pooling policy, the power sector will

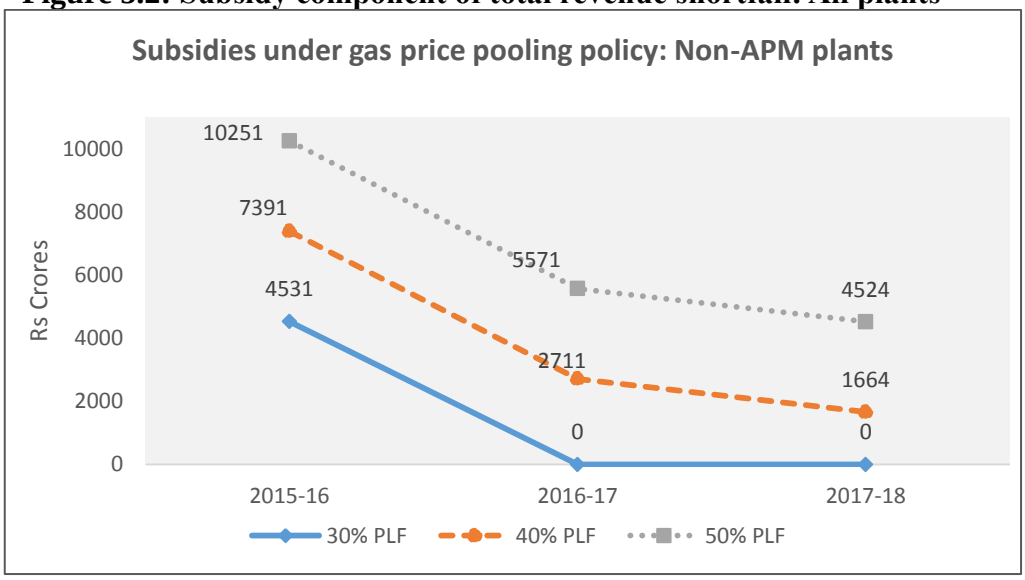
[13] Total revenue shortfall = Subsidies + tax relief + losses to be borne by other sectors

get relief from paying indirect taxes (VAT/CST/Customs), 50% of transportation costs, 50% of regasification costs, and 75% of marketing margins. The pure subsidy element is calculated by deducting these costs from the total revenue shortfall for a given year.

The breakup of the total revenue shortfall into subsidies, potential tax revenue that the government has to forego, and the potential losses that are to be borne by other sectors is given in detail in Table 7.1 in, section 7. For instance, in 2015-16 with a 30% PLF, in Scenario 1(a) where domestic gas is available, the total revenue shortfall of Rs 10,165 crores can be divided into Rs 4,531 crore subsidies borne by the central government, Rs 3,162 crore loss due to tax concessions (VAT/CST/ Customs), and Rs 2,472 crore potential losses to be borne by other sectors taking cuts in their marketing margins, transportation costs and regasification costs.

Figure 5.2 illustrates the subsidies that arise under the gas pooling policy under the three scenarios. The subsidies coming directly from the budget decrease over the years as the proportion of domestic production in total gas supply to the power plants increases.

Figure 5.2: Subsidy component of total revenue shortfall: All plants

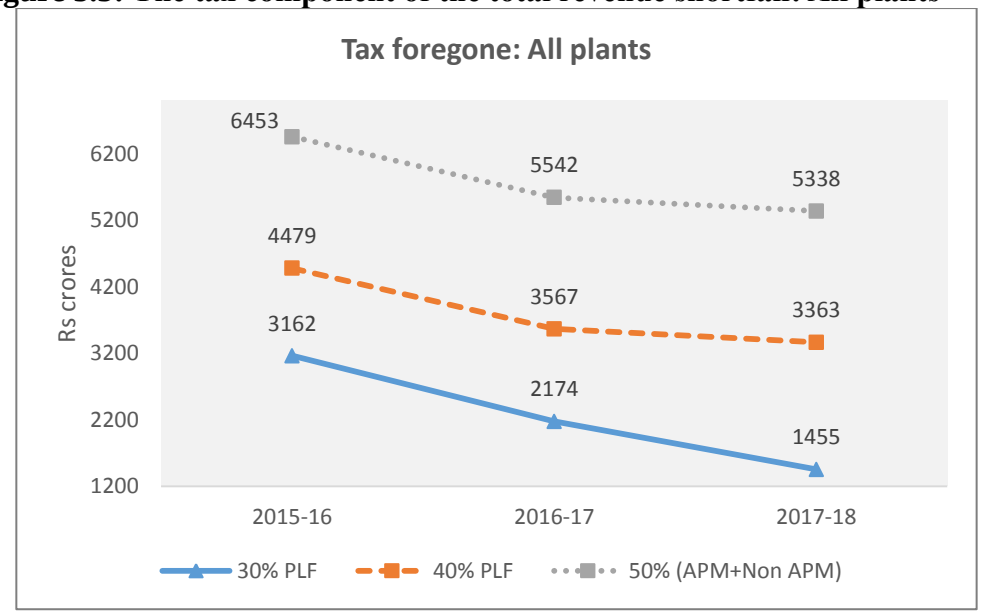


Note: At 30% PLF and 40% PLF, subsidies are only for non-APM plants as APM plants already operating at 40% PLF. Given existing tax rates and proposed cuts, the total revenue shortfall (Figure 5.1) is divided into only tax loss (Figure 5.3) and revenue losses to other sectors (Figure 5.4) in 2016-17 and 2017-18

Source: NCAER calculations

The other components of total revenue shortfall are taxes, and other costs like marketing margin, regasification and transportation costs. Figure 5.3 illustrates the total tax revenue component (VAT/CST/ Customs) of the total revenue shortfalls and Figure 5.4 illustrates the potential revenue loss to other sectors if the government issues directions for these sectors to pick up part of the losses of the entire power industry.

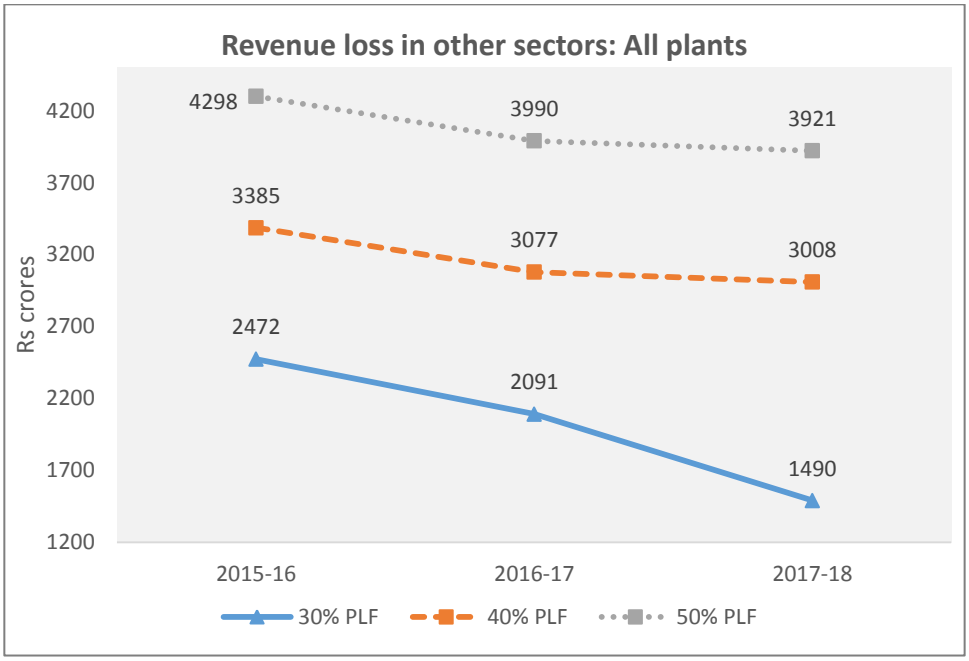
Figure 5.3: The tax component of the total revenue shortfall: All plants



Note: The tax component is calculated as "tax revenue forgone" in the Benefit-Cost Analysis in section 7 At 30% PLF and 40% PLF, it is assumed that tax reliefs are only for non-APM plants as APM plants are already operating at 40% PLF.

. *Source*: NCAER calculations

Figure 5.4: Loss to other sectors component of the total revenue shortfall : All plants



Note: The "other costs" component is calculated as "revenue loss to other sectors" in the Benefit-Cost Analysis in Section 7. This includes cuts in the marketing margins, transportation and regasification costs by other agencies

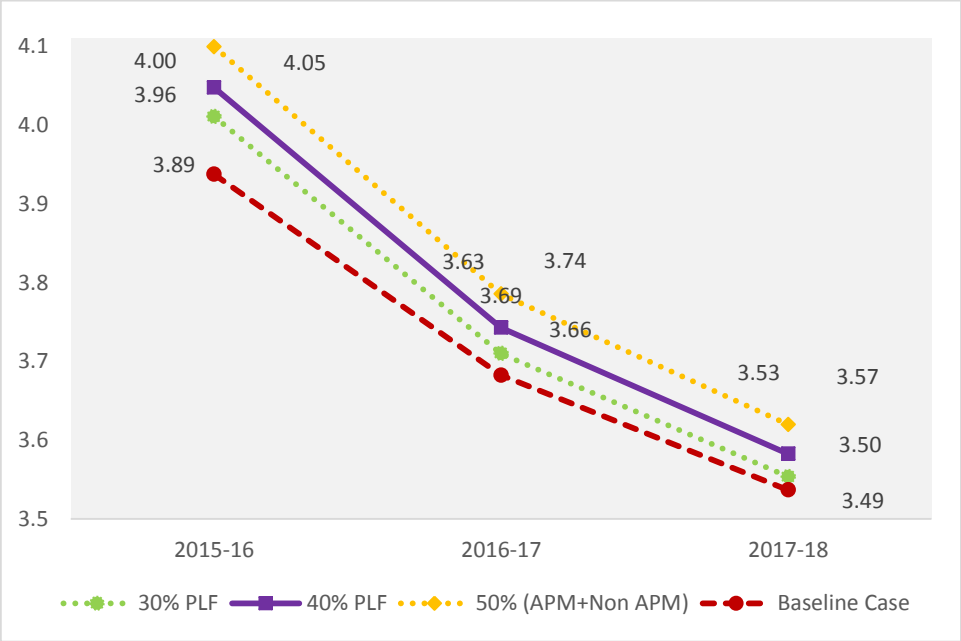
At 30% PLF and 40% PLF, it is assumed that tax reliefs are only for non-APM plants as APM plants are already operating at 40% PLF.

Source: NCAER calculations

The NCAER Macro Forecasting model was used to forecast the GDP for 2015-16 to 2017-2018. Details of this macro-model are in Section 7 below and Appendix D. The increase in subsidies and the potential tax foregone by the government (VAT/CST/ Customs) have an impact on fiscal deficits. While fiscal deficits have been decreasing from 5.7 percent of GDP in 2011-12 to 4.5 percent in 2013-14, the government is keen to bring about further fiscal consolidation by reducing the fiscal deficit to 3.6 percent in 2015-16 and 3 percent for 2016-17 and 2017-18. These are indicated as Fiscal Responsibility and Budget Management (FRBM) targets laid out by the Ministry of Finance. The NCAER macro forecasting model (details in Appendix D), suggests that it will be difficult to achieve the fiscal policy targets as laid out in the Medium Term Fiscal Policy Statement in any of the years.

In 2015-16, as against the FRBM target of 3.6, the fiscal deficits as projected in this study using the macro forecasting model is likely to reach 3.89 percent of GDP. The impact of the gas price pooling policy will lead to an increase in fiscal deficits. If the central and state governments cover the entire revenue shortfalls, then fiscal deficits are likely to rise to 3.96% in 2015-16 with a 30% PLF. Figure 5.5 below indicates that with higher PLFs of 40% and 50%, fiscal deficits increase to 4.00% and 4.05% respectively (APM plus non-APM plants). Under the gas price pooling policy, the government proposes to apportion part of the total revenue shortfalls to other sectors (marketing, transportation, and regasification). In this case, the increase in fiscal deficits is slightly lower. The details on the change in fiscal deficits are in tables B.4.1 and B.4.2 in Appendix B.

Figure 5.5: Increase in fiscal deficits due to total revenue shortfalls: All plants



Source: NCAER calculations

Table 5.1: Power generation capacity and cost at 30% PLF: Scenario 1(i)

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
A	**1. Non APM**					
	Gas Capacity [1]	1(a)	Non-APM (KGD6)	6997	6997	6997
		1(b)	Without Gas Allocation	3761	3761	3761
		1(c)	Ready for commissioning	5349	5349	5349
		1(a+b+c)	Total Non-APM	16107	16107	16107
	PLF% [2]			**30**	**30**	**30**
	Effective Gas Capacity	*1(a)*	Non-APM (KGD6)	2099	2099	2099
		1(b)	Without Gas Allocation	1128	1128	1128
		1(c)	Ready for commissioning	1605	1605	1605
		1(a+b+c)	Total Non-APM	**4832**	**4832**	**4832**
	2. APM [1]					
	Gas Capacity	2	APM Gas	8042	8042	8042
	PLF%			**40**	**40**	**40**
	Net PLF% (additional required minus existing capacity (40%))			**0**	**0**	**0**
	Effective Gas Capacity	*2*	APM Gas	**0**	**0**	**0**
B	**GAS REQUIRED (MMSCMD)[3]**	1(a)	Non-APM (KGD6)	8.67	8.67	8.67
		1(b)	Without Gas Allocation	4.66	4.66	4.66
	Conversion	1(c)	Ready for commissioning	6.63	6.63	6.63
	1 MW =	1(a+b+c)	*Total Non-APM*	19.97	19.97	19.97
	0.004132231	2	APM Gas	0.00	0.00	0.00
	MMSCMD	1(a+b+c) +2	**TOTAL ALL PLANTS**	**19.97**	**19.97**	**19.97**
C	**UNITS GENERATED [4]**	1(a)	Non-APM (KGD6)	18388	18388	18388
	kwh for 1 year	1(b)	Without Gas Allocation	9884	9884	9884
	(Million units)	1(c)	Ready for commissioning	14057	14057	14057
		1(a+b+c)	*Total Non-APM*	42329	42329	42329

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL UNITS ALL PLANTS**	42329	42329	42329
D	**ADDITIONAL GAS SUPPLY (MMSCMD) AND PRICE ($/MMBTU)**	*For Non APM only*	Domestic Availability [5]	5.9	12.8	14.3
			Domestic Price [5]	5.05	5.05	5.05
			Imported gas [6]	14.0	7.2	5.7
			Imported Price [7]	10.9	10.9	10.9
			Share of Imported Gas (%)	70.4	36.1	28.4
			Pooled Price [8]	**13.05**	**10.29**	**9.67**
E	**COST PRICE** *(For non APM only)* Rs/kwh		Fixed Cost [9]	1.31	1.31	1.31
			Variable cost [10]	6.6	5.2	4.9
			TOTAL COST	**7.9**	**6.5**	**6.2**
F	**TOTAL COST OF POWER [11]** *(Rs crore)*	1(a)	Non-APM (KGD6)	14529.2	11966.4	11392.8
		1(b)	Without Gas Allocation	7809.7	6432.1	6123.8
		1(c)	Ready for commissioning	11107.2	9148.0	8709.4
		1(a+b+c)	*Total Non-APM*	33446.1	27546.5	26226.0
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**33446.1**	**27546.5**	**26226.0**
G	**SELLING PRICE (Rs./kwh)**		Capped Price [12]	5.5	5.5	5.5
	REVENUE FROM SALES [13] *(Rs. Crore)*	1(a)	Non-APM (KGD6)	10113	10113	10113
		1(b)	Without Gas Allocation	5436	5436	5436
		1(c)	Ready for commissioning	7731	7731	7731
		1(a+b+c)	*Total Non-APM*	23281	23281	23281
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**23281**	**23281**	**23281**
H	**Revenue Shortfall [14]** *(Rs. Crore)*	1(a)	Non-APM (KGD6)	4415.8	1852.9	1279.3
		1(b)	Without Gas Allocation	2373.6	996.0	687.6

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
		1(c)	Ready for commissioning	3375.7	1416.5	978.0
		1(a+b+c)	Total Non-APM	10165.1	4265.4	2944.9
		2	APM Gas	0.0	0.0	0.0
		1(a+b+c) +2	**Total Revenue Shortfall**	**10165.1**	**4265.4**	**2944.9**

Note: [1]Central Electricity Authority of India
[2] See Section 5(i). This is as per present proposal (the average of 20% for the 5 Monsoon months and 35% for the remaining 7 months)
[3] GAIL Conversion factor is used (i.e. Power generation from one MMSCMD gas is equal to 242MW).
[4] Units generated (Billion/per year) = Capacity (MW)*365 days*24 hours*1000kwh*10^6
[5] *"Gas price pooling", Financial Chronicle*, Dec 23 2014
[6] Imported gas = Gas required - Domestic availability
[7] *"Gas price pooling", Financial Chronicle*, Dec 23 2014. IMF forecasted world commodity prices are used to adjust the prices of imported natural gas from FY 15-16 onwards.
[8] Pooled price is the weighted average of domestic price and imported price. Both domestic and imported price have been increased by VAT @ 12.5%, transport charges @ 1.5 $/MMBTU, marketing margin @ .2 $/MMBTU. Imported price have an additional costs due to re-gasification charges @ 0.88 $/MMBTU & custom duty @ 5.2015%.
[9] *"Revival plan on cards for gas-based power plants", Economic times*, Oct 20, 2014.
[10] Variable cost = (Plant Heat Rate*Gas Cost*Exchange Rate)/ (Net Calorific Value of a Fuel*25.2SCM); Plant heat rate = 1900, calorific value of a fuel = 9500, exchange rate = 63.3 (as on 23.12.14); Source: GAIL Conversion Matrix & Discussion with industry experts.
[11] Total cost of power = (Units in year) * (Cost Price).
[12] Price capped by Ministry of Petroleum & Power; Source: *"Gas price pooling, subsidies to help stranded power firms", Indian Express*, October 4, 2014.
[13] Revenue from sales = Number of units generated in a year * Capped price.
[14] Revenue Shortfall = Total cost of power generation - Total Revenue from sales.

SECTION 6

Macroeconomic Impact Analysis

6(i) Methodology

The Input-Output (I-O) Model, based on the Input-Output Table, is a widely used model to capture the inter-relationships among the production sectors of an economy. Its usage comes from the fact that every economic activity of an economy has both direct and indirect effects. The direct effects relate to a unit increase in production of a sector when the demand or inputs for this sector increase by one unit. These are, therefore, the immediate effects of the additional demand or inputs. However, the suppliers of this additional demand require additional inputs from other producers and those producers in turn would need additional inputs from their input suppliers and so on. Thus, the initial additional demand or inputs that generate direct effects also induces a chain of activities in the entire production system of the economy. Hence, the overall economic impact of a particular sector far exceeds the direct impact due to the inter-linkages among all the sectors of economy.

The Input-Output (IO) model measures these inter-linkages and hence arrives at direct as well as indirect impact of an economic sector. With the quantification of these inter-linkages, it is possible to see how an additional demand in a particular sector or additional inputs of a sector affects the production of other sectors of the economy. The advantage of the IO model is that it quantifies the impact through a value of the multiplier by which a particular sector is expected to grow following such changes in a sector.

From the IO table it is possible to get backward linkages or forward linkages. For the present study, which aims to assess the impact of increased production in Electricity sector on the overall economy by way of the resultant increase in production of its user sectors, we propose to work out the forward linkages of electricity sector. The additional generation of electricity means that additional inputs from this sector are available to be used by its using sectors. A high forward linkage implies that by expanding the output of a sector, a powerful stimulus is generated in other sectors, by way of absorbing the output of the specific sector as inputs to other sectors.

The detailed IO table consists of 130 sectors, but for a meaningful input-output analysis, it is desirable that the sectors are aggregated such that the aggregation scheme is aligned to the purpose of the analysis. Evidently, the sectors of interest and the ones which these sectors are closely related to are kept separately, subject to the availability of their data.

For the present study, the CSO's 130 sectors of 2007-08 IO table are aggregated to 18 broad sectors. The list of sectors and their aggregation scheme are given in Table C.1 in Appendix C.

Regarding employment, CSO's IO tables do not provide such information. To arrive at the number of persons employed in each sector, the unit level data of NSSO large scale survey on "Employment and Unemployment" for 2009-10 was analyzed. The 18 sectors were mapped with the NIC 5-digit codes, the industrial codes used to identify the sector of engagement of each employed person. The employment numbers for 2007-08, the IO reference year, has been estimated using the employment to output ratio of 2009-10 and applied on output of 2007-08.

The key aggregates for the 18 sectors are obtained from the 18-sector IO table and NSSO's employment data and are presented in Table C.2 in Appendix C This shows that the "electricity" sector accounts for 1.8 per cent of total output, 1.5 per cent of Gross Value Added and 0.17 per cent of total jobs in the economy for the reference year 2007-08.

The direct effects of a unit increase in output on sector's value added and employment are its direct coefficients. These are obtained as the ratios of sector's value added and employment to its value of output. These are given in 6.1 below.

Table 6.1: Sectors' Direct Coefficients

		GVA	Employment (per lakh output)
1	Agriculture	0.6790	1.8802
2	Coal and Lignite	0.7075	0.1176
3	Natural Gas	0.8134	0.0120
4	Textiles	0.2494	0.3790
5	Petroleum Products	0.1407	0.0028
6	Chemicals	0.2330	0.0388
7	Fertilisers	0.1345	0.0211
8	Cement	0.3029	0.0364
9	Iron & Steel	0.2140	0.0462
10	Electrical Industrial Machinery	0.1631	0.0890
11	Other Electrical Equipments and Machinery	0.1755	0.0733
12	Other Industry	0.2391	0.1507
13	Construction	0.3477	0.4257
14	**Electricity**	**0.3951**	**0.0407**
15	Transport Services	0.3877	0.2024
16	Trade	0.7985	0.3537
17	Banking	0.8339	0.0846
18	Other Services	0.7412	0.2314

Hence, a unit increase in output of, say, electricity sector results in 0.39 units of value added generated in this sector. The direct and indirect forward linkage coefficients or the input multipliers are presented in Table 6.2.

Table 6.2: Sectors' Direct and Indirect Linkage Coefficients

		Multipliers		
		Input	GVA	Employment
1	Agriculture	1.9936	1.0945	2.5000
2	Coal and Lignite	4.9188	1.9073	0.8780
3	**Natural Gas**	**7.0497**	**2.6404**	**1.4630**
4	Textiles	1.5825	0.4370	0.6003
5	Petroleum Products	2.3981	0.6507	0.4152
6	Chemicals	3.2774	0.9522	0.5828
7	Fertilisers	4.4301	1.5898	2.7568
8	Cement	2.3286	0.7706	0.5505
9	Iron & Steel	2.8402	0.7649	0.4792
10	Electrical Industrial Machinery	1.6961	0.3794	0.2211
11	Other Electrical Equipment and Machinery	2.6910	0.7520	0.4321
12	Other Industry	2.6490	0.7579	0.5220
13	Construction	1.3204	0.4745	0.5436
14	**Electricity**	**3.0816**	**1.1666**	**0.6600**
15	Transport Services	2.0725	0.7838	0.5384
16	Trade	2.2009	1.2198	0.7893
17	Banking	2.6425	1.4904	0.5809
18	Other Services	1.4879	0.9488	0.3620

A high value of input multiplier means that the sector has stronger forward linkages. This further means that its additional production induces greater production activity in the economy. Hence, the sector is said to have high diffusion effect. Natural gas has the highest input multiplier of 7.05 which means that a unit increase in its output triggers the overall production in the economy by 7.05 units. This is because the sectors that use natural gas as an input increase their production, eg. petroleum products, iron and steel industry, electricity, other industry etc. The increased production of these sectors, in turn, results in increased production of their user sectors and so on.

An input multiplier of 3.0816 for electricity sector means that a given unit increase in output of electricity (arising from a unit increase in its inputs) results in 3.0816 units of increase in overall output of the economy. The sectoral increase in output or the breakup of 3.0816 is given in the Table C.4 on Annexure C.

6(ii) Macroeconomic impact

Using the electricity input multiplier and employment multiplier, we can assess the change in economy's GDP and employment with the given increase in electricity output. The present study aims to estimate the impact of additional electricity generation on GDP and

employment under three different scenarios – electricity generation at 30% PLF, 40% PLF and 50% PLF. It is to be noted that at 30% PLF and 40% PLF the macroeconomic impact is due to increased power generation by only non-APM plants as APM plants are already operating at 40% PLF. Further, the impact is estimated for the years 2015-16, 2016-17 and 2017-18. The following tables present the impact estimated for 2015-16 under the three given scenarios. The impact for the latter two years are presented in Tables C.5 to C.10 in Appendix C.

It may be noted that since the multipliers are for 2007-08, the estimated values of additional electricity generation for the years 2015-16 to 2017-18 have been deflated to arrive at the values at 2007-08 prices. However, the resultant per cent increase, as seen at 2007-08 prices, may be assumed to hold good for the later years as well, since this per cent increase is due only to the inter-linkages of industries that is captured through IO model. Unless there are significant structural changes in the production processes, these inter-linkages are assumed to remain stable.

***Scenario 1(i)*: 30% PLF, 2015-16**

The results of this simulation are presented in Table 6.3 below. The original value of output of electricity sector is 1.77 per cent of the Gross Value of Output. With this simulation, about 11.5 per cent of additional electricity output is expected to be generated. The additional electricity generation, amounting Rs. 19720 crore at 2007-08 prices, is expected to increase the overall GDP of the economy by 0.50 per cent. The Gross value of output of all the sectors increases by 0.63 per cent. Also, the total employment (number of jobs) in the economy is expected to increase by 0.31 per cent.

In Scenario 1(ii), the simulation is made under the assumption of no domestic availability of natural gas. The results of this simulation are in Table C.4 in Appendix C.

Table 6.3: Increase in sectors' values of GVA and employment with increase in electricity output at 30% PLF (2015-16)

		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
1	Agriculture	292118	198338	549228
2	Coal and Lignite	27473	19437	3231
3	Natural Gas	4724	3842	57
4	Textiles	231008	57606	87541
5	Petroleum Products	213495	30037	601
6	Chemicals	242364	56463	9414
7	Fertilisers	37444	5037	792
8	Cement	49280	14925	1795
9	Iron & Steel	247782	53035	11439

		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
10	Electrical Industrial Machinery	38143	6222	3396
11	Other Electrical Equipments and Machinery	81143	14240	5952
12	Other Industry	972124	232459	146475
13	Construction	463798	161263	197434
14	**Electricity**	**2379089**	**939867**	**96877**
15	Transport Services	270332	104795	54714
16	Trade	143687	114730	50824
17	Banking	47111	39287	3984
18	Other Services	335930	248985	77748
	Total increase	6077045	2300568	1301501
	Original Total Values	971102123	458142212	416318427
	Per cent increase	**0.63**	**0.50**	**0.31**

***Scenario 2*: 40% PLF, 2015-16**

The results of this simulation are presented in Table 6.4 below. At 40% PLF, the additional electricity generated is expected to increase the overall GDP of the economy by 0.7 per cent. The Gross value of output of all the sectors increases by 0.87 per cent. Also, the total employment (number of jobs) in the economy is expected to increase by 0.43 per cent.

Table 6.4: Increase in sectors' values of GVA and employment with increase in electricity output at 40% PLF (2015-16)

		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
1	Agriculture	404352	274540	760245
2	Coal and Lignite	38028	26905	4473
3	Natural Gas	6539	5319	78
4	Textiles	319763	79738	121175
5	Petroleum Products	295521	41577	832
6	Chemicals	335482	78157	13031
7	Fertilisers	51830	6972	1096
8	Cement	68213	20659	2484
9	Iron & Steel	342981	73412	15834
10	Electrical Industrial Machinery	52797	8613	4701
11	Other Electrical Equipments and Machinery	112319	19711	8239
12	Other Industry	1345620	321771	202751
13	Construction	641992	223222	273290
14	**Electricity**	3293151	1300970	134098

15	Transport Services	374196	145057	75735
16	Trade	198892	158811	70350
17	Banking	65211	54382	5515
18	Other Services	464997	344646	107620
		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
	Total increase	8411884	3184461	1801546
	Original Total Values	971102123	458142212	416318427
	Per cent increase	**0.87**	**0.70**	**0.43**

***Scenario 3*: 50% PLF, 2015-16**

The results of this simulation are presented in Table 6.5 below. At 50% PLF, the additional electricity generated is expected to increase the overall GDP of the economy by 0.98 per cent. The Gross value of output of all the sectors increases by 1.22 per cent. Also, the total employment (number of jobs) in the economy is expected to increase by 0.61 per cent.

Table 6.5: Increase in sectors' values of GVA and employment with increase in electricity output at 50% PLF (2015-16)

		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
1	Agriculture	568575	386041	1069009
2	Coal and Lignite	53472	37832	6289
3	Natural Gas	9194	7479	110
4	Textiles	449631	112123	170389
5	Petroleum Products	415543	58463	1170
6	Chemicals	471733	109899	18324
7	Fertilisers	72881	9804	1541
8	Cement	95917	29050	3493
9	Iron & Steel	482279	103227	22265
10	Electrical Industrial Machinery	74240	12111	6610
11	Other Electrical Equipments and Machinery	157935	27716	11584
12	Other Industry	1892128	452454	285096
13	Construction	902729	313881	384283
14	**Electricity**	4630624	1829343	188561
15	Transport Services	526171	203971	106494
16	Trade	279670	223309	98922
17	Banking	91696	76468	7754
18	Other Services	653850	484620	151328
	Total increase	11828269	4477792	2533223

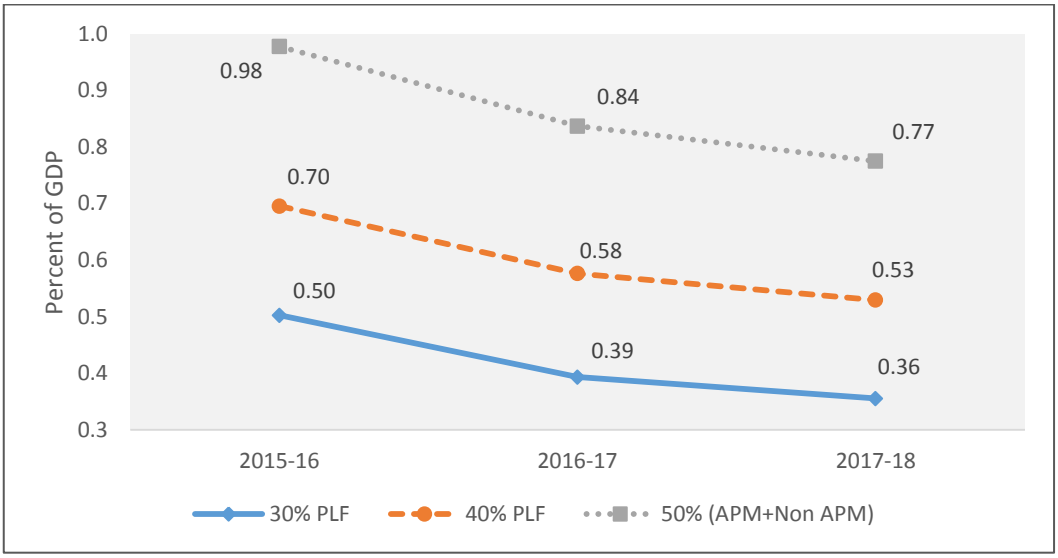
		Value of Output (Rs. lakh)	GVA (Rs. lakh)	Employment (numbers)
	Original Total Values	971102123	458142212	416318427
	Per cent increase	1.22	0.98	0.61

Similar tables for the years 2016-17 to 2017-18 and a summary table of the overall growth in GDP and employment under the three scenarios and for all the three years are presented in Tables C.5 to C.11 in Appendix C.

6(iii) Summary of findings

Using forward linkages and the employment multiplier, the change in economy's GDP and employment with the given increase in electricity output is assessed. It is seen a greater capacity utilization of the existing gas based power plants leads to a greater increase in GDP. As seen in Figure 6.1, the gas price pooling policy leads to an increase in GDP of 0.50 % in 2015-16 with a PLF of 30%. The increase in GDP with a PLF of 40% and 50% is higher at 0.70% and 0.98% respectively.

Figure 6.1: Macroeconomic impact: Percent increase in GDP (All plants)



Note: At 30% PLF and 40% PLF, the increase in GDP is only because of the increased capacity utilization

of non-APM plants as APM plants already are operating at 40% PLF.

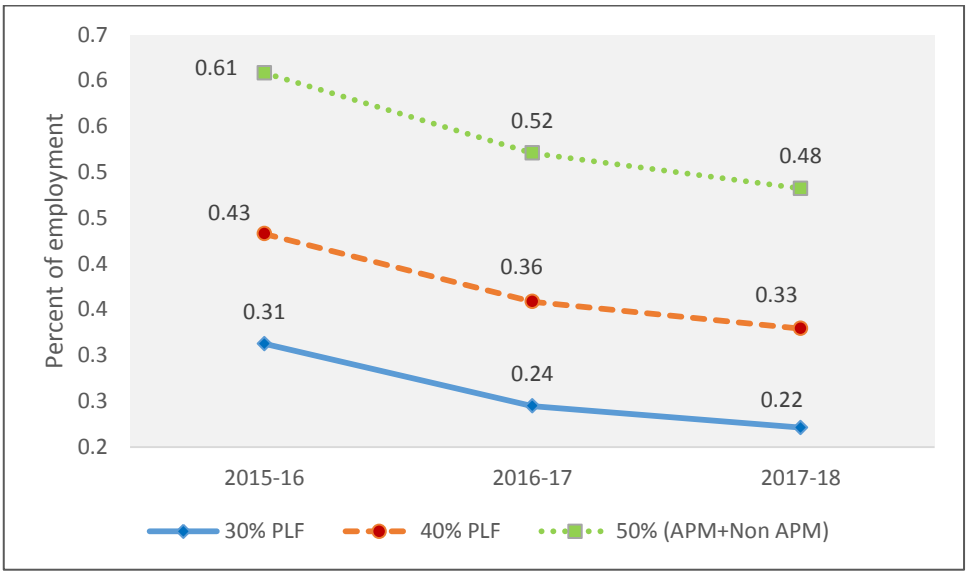
Source: NCAER calculations

The increase in employment is also significant. Due to the multiplier effects of increased production in other sectors due to increased generation of power, the total employment in the economy increases. In 2015-16, employment increased by 0.31 % with a 30% PLF, 0.43% with 40% PLF, and 0.61% with 50% PLF. With slower rates of growth of GDP over the projected period, it is seen that rate of increase in employment rate also drops.

It is hence seen that the enhanced supply of natural gas under the gas price pooling policy leads to greater capacity utilization of the power plants and, through its forward linkages and multiplier effects, results in an increase in GDP and employment in the economy. However, this is the gross macroeconomic impact of this policy.

A benefit-cost analysis is carried out in section 7 below to see whether there is a net positive impact after taking into account the costs due to increased revenue shortfalls in the power sector arising out of the gas price pooling policy. In the benefit-cost analysis, the increase in GDP has been factored in specifically, while the increase in employment has not. This is because the increase in GDP is calculated by the value added method, and the value added of all inputs, including labour, goes towards increased value added in GDP.

Figure 6.2: Macroeconomic impact: Percent increase in employment (All plants)



Note: At 30% PLF and 40% PLF, the increase in employment is only because of the increased capacity utilization of non-APM plants as APM plants already are operating at 40% PLF.
Source: NCAER calculations

SECTION 7

Economic Benefit-Cost Analysis

The effect of gas price pooling in value terms on GDP can be calculated after making projections for GDP for the next four years. The effect of such a pooling on subsidies in the medium term also requires projections on subsidies. To make forecasts on the GDP and the subsidies, the NCAER's Macro Forecasting model has been used. This model is a general equilibrium model with 295 variables and 110 equations. There are five main blocks which include the output sector (includes electricity, gas, and water supply), determinants of sectoral output, determinants of aggregate demand, the fiscal block, and the monetary block. Details for this model and the assumptions and results are in Appendix D.

It is to be noted that GDP projections and fiscal projections are made with certain underlying assumptions in mind. However, there is an explicit recognition that the economic climate is uncertain and these targets may not be met if certain assumptions are not met. For instance, the future growth of India is affected by a variety of factors – the US tapering off, oil prices volatility, introduction of structural reforms in India like the Goods and Services Tax, implementation of the Seventh Pay Commission recommendations, rationalization of subsidies, disinvestment and revenues from auctioning of various national assets like the telecom spectrum and coal, investor confidence etc. All these factors directly and indirectly affect the GDP and fiscal scenario of the country and in turn have implications for economic growth. In this study, the projections made for GDP and subsidies from 2015-16 to 2018-19 using the macro forecasting model have been used to analyze the impact on the macro economy in the three scenarios outlined in section 5, viz. at 30% PLF, at 40% PLF, and at 70% PLF.

To evaluate the benefits of the gas price pooling policy, the results using the input-output model in section 6 above have been used. The additional power generated has multiplier effects across the economy and leads to an increase in GDP. The value of the additional power generated varies across the years due to the availability of domestic and imported gas and the cost of imports. As such, the GDP multipliers and growth rates have been computed for each year from FY16 to FY19. The projected increase in GDP due to the additional power generated are used along with the GDP forecasts to obtain the value of GDP increase due to the additional units of power. Table 7.1 below indicates that in 2015-16, the GDP will increase by Rs 69,431 crores with 30% PLF assuming that domestic gas is available. Tables B.6 in Appendix B indicate that for the same year, GDP will increase by Rs 96,107 crores with 40% PLF. As discussed in section 5, at 30% PLF and 40% PLF, the increase in GDP is due to the operation of only non-APM plants increasing their PLF from zero percent to 30% or 40%, as no additional power is generated by APM plants which are assumed to be already operating at 40% PLF.

In 2015-16, GDP will increase by and Rs 1,22,783 crores with 50% PLF if only non-APM plants are considered and by Rs 135,139 crores if both APM and non-APM plants are considered (Table B.7 and B.8 in Appendix B). At the higher PLF of 50% PLF, the increase in GDP is due to the greater capacity utilization of both APM and non-APM plants. The additional power generated by APM plants is the difference between the higher 50% PLF and their current 40% PLF. The details of all the gas based power industry in India and their capacity utilization is discussed in section 3 above.

The gas price pooling policy will result in revenue shortfalls for the power sector as discussed in section 5 above. This revenue shortfall is proposed to be divided in the following way:

- Revenue losses for the government
  - Foregone indirect tax revenue
    - @ 12.5% VAT/ CST
    - @ 5% customs duty exemption for R-LNG[14]
  - Subsidies: Depending on the units generated and the cost of pooled price
- Revenue losses to other sectors:
  - 50% cut in pipeline tariff
  - 50% cut in R-LNG regasification charges, and
  - 75% cut in marketing margins by GAIL (India), which is the designated gas pool operator[15]

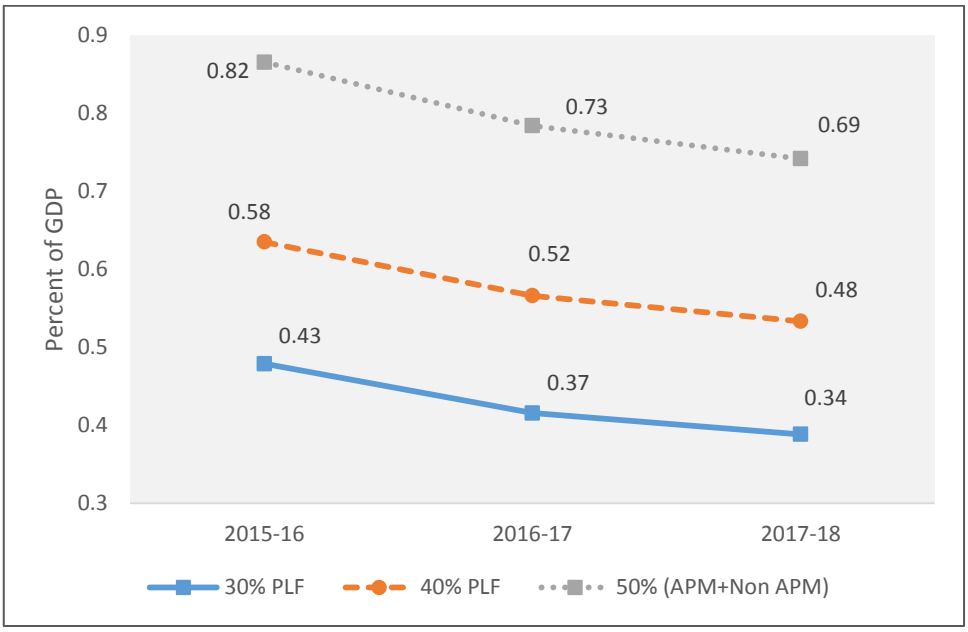
The breakup of the total revenue shortfall into subsidy cost, potential tax revenue foregone cost, and the potential losses to be borne by other sectors is given in detail in Table 7.1 below.

The net benefit is calculated by deducting the total costs from the total benefits. Based on the benefit-cost analysis, it is seen that in 2015-16, the gas price pooling policy leads to a net benefit of 0.4286% of GDP or Rs 59,266 crores with 30% PLF, 0.5848 % of GDP or Rs 80,852 crore with 40% PLF, and 0.8152% of GDP or Rs 112,717 crores with 50% PLF. The net benefits to GDP increase with increasing PLF due to greater multiplier effects of the additional power generated. Complete details of the net benefits due to additional power generated are in Table 7.1 below and in Tables B.5 to B.8 in Appendix B.

[14] This is not a new concession. This policy only streamlines the procedure to facilitate the sector to avail this concession.

[15] Financial Chronicle. "Gas price pooling, sops to resuscitate 16,000MW". Dec 23, 2014

Figure 7.1: Net benefits as percent of GDP for all gas based power plants



Note: At 30% PLF and 40% PLF, the net benefits are only because of the increased capacity utilization of non-APM plants as APM plants already are operating at 40% PLF.
Source: NCAER calculations

The benefit-cost analysis in this study would be more comprehensive if the following were taken into account:

- Environmental externalities: This would involve a comparison of the effects on the environment of alternate sources of power. However, as a first pass, it can be said that as burning natural gas produces 30% and 40% less carbon dioxide as compared to petroleum and coal respectively, there would be a net positive benefit on the environment of using natural gas as a source of power generation.
- Financial analysis and impact:
    - Non-performing assets (NPA):The benefits of not letting the Rs 64,000 crores invested in stranded power plants become non-performing assets (NPA) has not been calculated. This Study does not go into these details as this is part is the financial analysis for a power plant, and will vary from one plant to another. The financial relief that the power plants get from the banks will affect the bottom line of natural gas based power plants, and is a separate financial analysis impact by itself. However, de-facto, this has been considered in the economic impact analysis which is based on the assumption that the Rs 64,000 crores invested in the power sector is now being used to generate more power. So the implicit assumption is that NPA has now become

operational and that the power generated in the three Scenarios in this Study has multiplier effects

  - Return on Equity (RoE): The Study also does not calculate the return on equity (RoE) that the power plants will have to forego in lieu of being compensated for a fixed cost equivalent to meet the operation costs and interest under the gas price pooling policy. The expected RoE will again vary across the power plants and will impact the profitability of the power developers. However, this Study is limited to analysing the macroeconomic impact and not the profitability of the industry, and so this has aspect has not been gone into detail.

- Monetization of non-market impacts: The most frequently used method is the willingness-to-pay (WTP) approach, which allows the estimation of a money value through users' revealed preferences or stated preferences. In this case, the price that the consumer is willing to pay for power on a regular basis rather than be without has not been calculated.
- Shadow prices and social discount rate: This would involve a deeper analysis and surveys
- Market distortions: The administratively capped selling price crates market distortions the cost of which has not been calculated.
- Depletion of reserves: Depletion of reserves of natural gas and other fossil fuels and potential costs of relying 100% on imports have not been factored in.

However, taking into account these additional factors, while making the benefit-cost analysis more comprehensive, would require a more detailed analysis that is beyond the scope of the present Study.

Table 7.1: Benefit-cost analysis: All plants

Assumption all plants are operating at 30% PLF	2015-16	2016-17	2017-18
Benefits			
GDP at Market Price (Nominal)[1]	13826701	15521994	17512005
Increase in GDP (%)[2] due to additional power generation	0.5022	0.3929	0.3550
Increase in GDP	69431	60987	62175
New GDP[4] *(inclusive of multiplier effect)*	13896132	15582982	17574180
Cost			
a) Subsidy[5]	4531	0*	0*
b) Tax Forgone[6]			
(i) Sales Tax	2345	1770	1220
(ii) Custom Duty	817	405	235
Total	**3162**	**2174**	**1455**
c) Revenue Loss for other sectors[7]			
(i) Marketing Margin	307	296	218
(ii) Transportation	1533	1481	1090
(iii) Re-gasification	633	314	182
Total	**2472**	**2091**	**1490**
Cost (b+c)	**5634**	**4265**	**2945**
Total Cost (a+b+c)**	**10165**	**4265**	**2945**
Net Benefits[8]	**59266**	**56722**	**59230**
Net Benefits as a % of GDP	**0.4286**	**0.3654**	**0.3382**

Note: All the figures are in Rs. Crore (except Increase in GDP).
At 100% efficiency 1 MMBTU = 293.30 kwh. As per discussion with industry experts it is assumed that on an average with 45% efficiency, natural gas based power plants in India are generating 131.85 kwh of energy using one MMBTU of gas.
*In 2016-17 and 2017-18, the Total Cost (or the total revenue shortfall) is divided among Tax Foregone and Revenue Loss for Other sectors only based on calculations on VAT and revenue cuts to other sectors. As a result the remaining portion of the cost to be picked up as subsidies in the Budget comes down to zero.
** Same as Total Revenue Shortfall in Section 5.
[1] NCAER estimation based on 110 macro forecasting model, "Report Prepared for the Public Expenditure Management Commission of India".
[2] NCAER estimation based on 130 equation from input output table (detailed are mentioned in section 4 of this report).
[3] For FY 2014-15, same multipliers as for FY 2015-16 is used as only 3 months are remaining in FY 2014-15.
[4] New GDP = Original GDP + Increase in GDP due to addition of power
[5] The revenue shortfall under gas price pooling includes (i)subsidy cost directly picked up by the central govt., (ii) the revenue foregone by the central & state government on tax concessions, & (iii) losses borne by other sectors. Hence Subsidy = Revenue shortfall - tax foregone - loss of other sectors.
[6] As per proposed gas price pooling policy, power plants will be exempt from indirect taxes. Sales tax range from 0 to 25%; an average of 12.5% is used to estimate tax foregone by the states.
[7] As per proposed gas price pooling policy, other sectors also haves to bear losses due to reduction in marketing margin by 75%, transportation charges by 50% & re-gasification charges by 50%.
[8] Net Benefit = Total benefit - Total cost

SECTION 8

Summary and Conclusion

India's growing economy has led to led to increased consumption of primary energy resources such as coal, oil and natural gas which have grown at an annual compounded growth rate (CAGR) of 6% between 2007 and 2012. With the pace of growth expected to increase over the next decade, the demand for energy is also expected to increase rapidly. While India is the fourth largest consumer of energy in the world after USA, China and Russia, in per capita terms in 2013, India consumed just 7% of the energy consumed by USA, 22% of China and 26% of the average of the World. There is a need to increase energy production and consumption in India, as historically there is a strong correlation between an increase in per capita energy consumption and improvement in GDP per capita and human development outcomes.

The share of natural gas in India's primary energy mix was 11% in 2012 but is expected to grow to 20% by 2025. The present installed capacity of natural gas based power plants is 27,123 MW. However, the effective installed capacity is 26,560 MW as 563 MW capacity is not connected to the grid. Of the 26,560 MW installed capacity, 30% operate using APM gas, 61% operate using non-APM gas, and 9% of the installed capacity are off-grid.

Natural gas in India is available from domestic sources and as imported Re-gasified Liquefied Natural Gas (R-LNG). With the discovery of the KG-D6 located on the east coast in 2002, domestic gas production has steadily increased. However, the output from the KG-D6 fields have been steadily declining in recent years. The shortfalls in supply of gas have left several non-APM based power plants operating at zero or very low capacities. In India, the plants that run on APM gas too have less than optimal capacity utilization at 40% PLF. The analysis in this Study is restricted to stranded capacity and plants with low capacity utilization. The analysis excludes off-grid power plants.

With over 61% of installed capacity non-operational due to the non-availability of natural gas, the gas price pooling policy plans to pool the existing limited supply of domestic gas with imported R-LNG to help operationalize stranded gas-based power plants. Domestic production shortfalls will now be met by an increased reliance on imports which are more costly as well as constrained by the regasification capacity at port terminals. The gas price pooling policy also includes a mix of reliefs to the power sector in the form of waiver of indirect taxes, lower transportation and regasification costs and financial relief packages negotiated with banks the details of which are in Section 3 (v) of this report.

The enhanced supply of natural gas under the gas price pooling policy will lead to greater capacity utilization of the power plants and, through its multiplier effects, result in an increase in GDP and employment. This policy, however, will have fiscal implications.

Section 5 calculates the value of additional power generated due to this policy, the total revenue shortfalls that arise, and its fiscal impact. The value of the additional power generated in Section 5 has been used in section 6 to calculate its multiplier effects on the rest of the economy. For this the NCAER 130 sector input-output model has been used. Section 7 computes the net benefits of this policy using the NCAER's 110 equation macro-forecasting model.

In this Study, the fiscal implications, and the macroeconomic impact of the total revenue shortfalls under the gas price pooling policy are analysed in three scenarios - 30% PLF, 40% PLF and 50% PLF over three years (2015-16 to 2017-18). As APM plants are already operating at 40% PLF (compared to zero percent for non-APM plants), at 30% PLF and 40% PLF, the gas pooled price is restricted to only the non-APM plants. At higher capacity utilizations (50% PLF), the gas pooled price is extended to both non-APM as well as APM plants in this analysis.

The impact of an increase in domestic production projections made by the MoPNG have been taken into account in the analysis too. However, as a counterfactual, in the case of 30% PLF, two scenarios are projected. The first assumes that domestic gas production is available at per the projections made by the Ministry. The second case assumes that the total supply of natural gas needed to operate plants at 30% PLF is imported.

It is found that under Scenario 1, when domestic gas is available, then with a 30% PLF, the revenue shortfall is Rs 10,165 in 2015-16. However, if domestic gas is not available, then the revenue shortfalls are higher at Rs 15,270. Under Scenarios 2 and 3, where a PLF of 40% and 50% are assumed, revenue shortfalls in 2015-16 for non-APM plants are at Rs 15,255 crores and Rs 20,345 crores respectively. If all plants are considered, both APM and non-APM, then the revenue shortfall in 2015-16 with a 50% PLF is higher at Rs 22,423 crores. Under the gas price pooling mechanism, the total revenue shortfalls can be divided into subsidies, tax relief (VAT/CST/Customs), and concessions which are picked up by other agencies in the form of reduced transportation costs, regasification costs, and marketing margins. Details of this breakup are discussed in Section 7. The increases revenue shortfalls also lead to a rise in fiscal deficits, the details of which are in Section 5.

Using forward linkages and the employment multiplier, the change in economy's GDP and employment with the given increase in electricity output is assessed. It is seen a greater capacity utilization of the existing gas based power plants leads to a greater increase in GDP and employment. In 2015-16, the increase in GDP is 0.50 % with a PLF of 30%. 0.70% with a PLF of 40% and 0.98% with a PLF of 50%. During the same year, employment increased by 0.31 % with a 30% PLF, 0.43% with 40% PLF, and 0.61% with 50% PLF.

The net positive impact is calculated after taking into account the costs due to increased revenue shortfalls in the power sector in Section 7. It is seen that the gas price pooling policy

has a net positive impact on the economy in all the three years under consideration. For instance, on the assumption of availability of both domestic and imported gas, it is seen that in 2015-16, the gas price pooling policy leads to a net benefit of 0.43% of GDP or Rs 59,266 crores with 30% PLF, 0.58 % of GDP or Rs 80,852 crore with 40% PLF, and 0.82% of GDP or Rs 112,717 crores with 50% PLF.

The question then arises of whether the gas price pooling mechanism is worth it. With population growing at 1.76 %, the increase in per capita GDP is not very significant. However, since the electricity sector has strong forward linkages as seen in Section 6, there will be an overall increase in growth of GDP in the economy.

A simple back of the envelope calculation can also roughly indicate whether the enhancement of GDP due to the gas subsidy is worth it. For instance, if we take the average real GDP to increase by 6.93% over 2015-16 to 2017-18 (from the NCAER macro forecasts) and the elasticity of energy supply to GDP as 0.8 (Planning Commission estimates), then the energy supply growth rate (from all sources of energy) would be 0.8 x 6.93% = 5.54%. Since natural gas accounts for 11% of the total energy consumed (as per the Ministry of Petroleum and Natural Gas statistics), then the contribution of natural gas to GDP growth rate will be 11% of 5.41% = 0.61%. As long as the increase in GDP due to gas price pooling policy is higher than the minimum of 0.61% to sustain a growth rate of 6.93% (for instance, in this study at 40% PLF, the increase in GDP growth rate in 2015-16 is 0.58), then the gas price pooling policy of picking up the revenue shortfalls of the power sector should lead to net positive benefits. Simulations in this Study suggest that the gas price pooling policy should aim at a minimum of 40% PLF to ensure net positive impacts to the economy on a more sustainable basis.

Tables B.10 and Figures B.1 and B.2 in Appendix B explore this idea further with different PLFs (30%, 40%, 50%, 60% and 70%), energy elasticities (ranging from 0.70 to 0.95 as per Planning Commision's projections), and growth rate projections (6% to 8%). These scenario analysis and extrapolations (all of them made with the assumption of availability of domestic gas as per MoPNG projections), also suggest that the net benefit to the nation in terms of GDP growth rate increase due to a policy of subsidized prices of natural gas would be more achievable starting at 40% PLF.

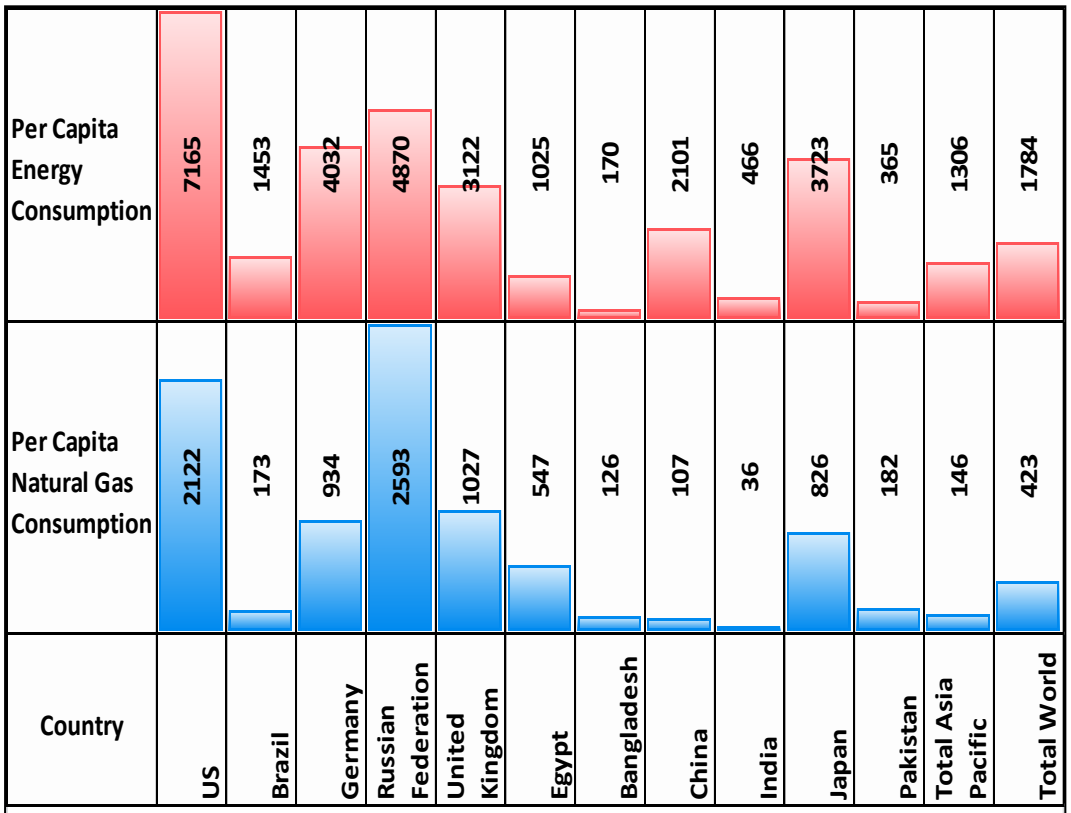
Any government policy of administered pricing mechanisms and subsidies is invariably fraught with picking up inefficiencies in both the public and private sector. Lessons from past policies often play a role in shaping new policies. For instance, the subsidy policy in the fertilizer industry, particularly in urea production, which evolved to deliver affordable farm gate price of fertilizers to poor farmers, soon picked up inefficiencies in the production process of fertilizers and benefitted the producers. With the MRP of fertilizers fixed, and the government stepping in to pay the difference between the cost plus price of fertilizers and the

MRP, there remained no incentives for fertilizer companies to cut costs and become more efficient.

The gas price pooling policy which caps the selling price of power to make it more affordable to end users, and proposes to pick up the revenue shortfalls in the power sector and distribute this among the central and state governments, the financial sector, and other sectors, is similar in intention to the subsidies to the fertilizer sector. Any such policy should be wary of the pitfalls of such a policy in the long term though it might be justifiable in the short time. Suitable safeguards may be built in which may include setting upper limits on revenue shortfalls that can be distributed to the government or other agencies, by setting PLF floors up to which the revenue shortfall can be compensated, or setting a time frame for the gas price pooling policy to end so that power companies are encouraged to make use of efficient production processes in the long run.

APPENDIX A

Figure A.1: Country wise consumption of natural gas and energy in 2013



* In this Review, primary energy comprises commercially traded fuels including modern renewables used to generate electricity.

Notes: Oil consumption is measured in million tonnes; other fuels in million tonnes of oil equivalent.

Source: Indian Petroleum And Natural Gas Statistics, Ministry of Petroleum & Natural Gas, GOI

Table A. 1: Various Gas Demand Forecasts (In MMSCMD)

Source	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Ministry of petroleum & Natural gas	405	446	473	494	523	552	586	606
Vision 2030	290	326	378	409	438	465	491	517
Planning Commission	398	439	466	-	-	-	-	-

Source: Vision 2030, Planning Commission & Working Group Report for the 12th Five Year Plan, MoPNG

Table A.2: Regasification Capacity During 12th & 13th Five Year Plan Period

LNG Terminal	2014-15	2015-16	2016-17	13th Plan
Dahej	12.5	15	15	15
HLPL Hazira	5	7.5	10	10
Dabhoi	5	5	5	5
Kochi	5	5	5	10
Ennore	0	5	5	5
Mundra	0	5	5	10
East Coast	-	-	5	15
Total capacity (In MMTPA)	27.5	42.5	50	70
Total capacity (In MMSCMD)	101	156	184	258

Source: Working Group Report (2012-17), MoPNG

APPENDIX B

Table B.1: Power generation capacity and cost at 30% PLF: Scenario 1(ii)

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
A	**1. Non APM**					
	Gas Capacity [1]	1(a)	Non-APM (KGD6)	6997	6997	6997
		1(b)	Without Gas Allocation	3761	3761	3761
		1(c)	Ready for commissioning	5349	5349	5349
		1(a+b+c)	Total Non-APM	16107	16107	16107
	PLF% [2]			**30**	**30**	**30**
	Effective Gas Capacity	*1(a)*	Non-APM (KGD6)	2099	2099	2099
		1(b)	Without Gas Allocation	1128	1128	1128
		1(c)	Ready for commissioning	1605	1605	1605
		1(a+b+c)	Total Non-APM	**4832**	**4832**	**4832**
	2. APM [1]					
	Gas Capacity	2	APM Gas	8042	8042	8042
	PLF%			**40**	**40**	**40**
	Net PLF% (additional required minus existing capacity (40%))			**0**	**0**	**0**
	Effective Gas Capacity	*2*	APM Gas	**0**	**0**	**0**
B	**GAS REQUIRED (MMSCMD)[3]**	1(a)	Non-APM (KGD6)	8.67	8.67	8.67
		1(b)	Without Gas Allocation	4.66	4.66	4.66
	Conversion	1(c)	Ready for commissioning	6.63	6.63	6.63
	1 MW =	1(a+b+c)	*Total Non-APM*	19.97	19.97	19.97
	0.004132231	2	APM Gas	0.00	0.00	0.00
	MMSCMD	1(a+b+c) +2	**TOTAL ALL PLANTS**	**19.97**	**19.97**	**19.97**
C	**UNITS GENERATED [4]**	1(a)	Non-APM (KGD6)	18388	18388	18388
	kwh for 1 year	1(b)	Without Gas Allocation	9884	9884	9884

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
	(Million units)	1(c)	Ready for commissioning	14057	14057	14057
		1(a+b+c)	*Total Non-APM*	42329	42329	42329
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL UNITS ALL PLANTS**	42329	42329	42329
D	**ADDITIONAL GAS SUPPLY (MMSCMD) AND PRICE ($/MMBTU)**	*For Non APM only*	Domestic Availability [5]	0	0	0
			Domestic Price [5]	5.05	5.05	5.05
			Imported gas [6]	20.0	20.0	20.0
			Imported Price [7]	10.9	10.9	10.9
			Share of Imported Gas (%)	100.0	100.0	100.0
			Pooled Price [8]	**15.43**	**15.43**	**15.43**
E	**COST PRICE** *(For non APM only)* Rs/kwh		Fixed Cost [9]	1.31	1.31	1.31
			Variable cost [10]	7.8	7.8	7.8
			TOTAL COST	**9.1**	**9.1**	**9.1**
F	**TOTAL COST OF POWER [11]** *(Rs crore)*	1(a)	Non-APM (KGD6)	16746.7	16746.7	16746.7
		1(b)	Without Gas Allocation	9001.6	9001.6	9001.6
		1(c)	Ready for commissioning	12802.3	12802.3	12802.3
		1(a+b+c)	*Total Non-APM*	38550.6	38550.6	38550.6
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**38550.6**	**38550.6**	**38550.6**
G	**SELLING PRICE (Rs./kwh)**		Capped Price [12]	5.5	5.5	5.5
	REVENUE FROM SALES [13] *(Rs. Crore)*	1(a)	Non-APM (KGD6)	10113	10113	10113
		1(b)	Without Gas Allocation	5436	5436	5436
		1(c)	Ready for commissioning	7731	7731	7731
		1(a+b+c)	*Total Non-APM*	23281	23281	23281
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**23281**	**23281**	**23281**

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
H	**Revenue Shortfall** [14]	1(a)	Non-APM (KGD6)	6633.2	6633.2	6633.2
	(Rs. Crore)	1(b)	Without Gas Allocation	3565.5	3565.5	3565.5
		1(c)	Ready for commissioning	5070.9	5070.9	5070.9
		1(a+b+c)	Total Non-APM	15269.6	15269.6	15269.6
		2	APM Gas	0.0	0.0	0.0
		1(a+b+c) +2	**Total Revenue Shortfall**	**15269.6**	**15269.6**	**15269.6**

Note: [1]Central Electricity Authority of India
[2] See Section 5(i). This is as per present proposal (the average of 20% for the 5 Monsoon months and 35% for the remaining 7 months)
[3] GAIL Conversion factor is used (i.e. Power generation from one MMSCMD gas is equal to 242MW).
[4] Units generated (Billion/per year) = Capacity (MW)*365 days*24 hours*1000kwh*10^6
[5] *"Gas price pooling", Financial Chronicle*, Dec 23 2014
[6] Imported gas = Gas required - Domestic availability
[7] *"Gas price pooling", Financial Chronicle*, Dec 23 2014. IMF forecasted world commodity prices are used to adjust the prices of imported natural gas from FY 15-16 onwards.
[8] Pooled price is the weighted average of domestic price and imported price. Both domestic and imported price have been increased by VAT @ 12.5%, transport charges @ 1.5 $/MMBTU, marketing margin @ .2 $/MMBTU. Imported price have an additional costs due to re-gasification charges @ 0.88 $/MMBTU & custom duty @ 5.2015%.
[9] *"Revival plan on cards for gas-based power plants", Economic times*, Oct 20, 2014.
[10] Variable cost = (Plant Heat Rate*Gas Cost*Exchange Rate)/(Net Calorific Value of a Fuel*25.2SCM); Plant heat rate = 1900, calorific value of a fuel = 9500, exchange rate = 63.3 (as on 23.12.14); Source: GAIL Conversion Matrix & Discussion with industry experts.
[11] Total cost of power = (Units in year) * (Cost Price).
[12] Price capped by Ministry of Petroleum & Power; Source: *"Gas price pooling, subsidies to help stranded power firms", Indian Express*, October 4, 2014.
[13] Revenue from sales = Number of units generated in a year * Capped price.
[14] Revenue Shortfall = Total cost of power generation - Total Revenue from sales.

Table B.2: Power generation capacity and cost at 40% PLF

	POWER GENERATION CAPACITY AND COST					
				2015-16	2016-17	2017-18
A	**1. Non APM**					
	Gas Capacity [1]	1(a)	Non-APM (KGD6)	6997	6997	6997
		1(b)	Without Gas Allocation	3761	3761	3761
		1(c)	Ready for commissioning	5349	5349	5349
		1(a+b+c)	Total Non-APM	16107	16107	16107
	PLF% [2]			**40**	**40**	**40**
	Effective Gas Capacity	*1(a)*	Non-APM (KGD6)	2799	2799	2799
		1(b)	Without Gas Allocation	1504	1504	1504
		1(c)	Ready for commissioning	2140	2140	2140
		1(a+b+c)	Total Non-APM	**6443**	**6443**	**6443**
	2. APM [1]					
	Gas Capacity	2	APM Gas	8042	8042	8042
	PLF%			**40**	**40**	**40**
	Net PLF% (additional required minus existing capacity (40%))			**0**	**0**	**0**
	Effective Gas Capacity	*2*	APM Gas	**0**	**0**	**0**
B	**GAS REQUIRED (MMSCMD)[3]**	1(a)	Non-APM (KGD6)	11.57	11.57	11.57
		1(b)	Without Gas Allocation	6.22	6.22	6.22
	Conversion	1(c)	Ready for commissioning	8.84	8.84	8.84
	1 MW =	1(a+b+c)	*Total Non-APM*	26.62	26.62	26.62
	0.004132231	2	APM Gas	0.00	0.00	0.00
	MMSCMD	1(a+b+c) +2	**TOTAL ALL PLANTS**	**26.62**	**26.62**	**26.62**
C	**UNITS GENERATED [4]**	1(a)	Non-APM (KGD6)	24517	24517	24517
	kwh for 1 year	1(b)	Without Gas Allocation	13179	13179	13179
	(Million units)	1(c)	Ready for commissioning	18743	18743	18743
		1(a+b+c)	*Total Non-APM*	56439	56439	56439
		2	APM Gas	0	0	0

	POWER GENERATION CAPACITY AND COST					
				2015-16	2016-17	2017-18
		1(a+b+c) +2	**TOTAL UNITS ALL PLANTS**	56439	56439	56439
D	**ADDITIONAL GAS SUPPLY (MMSCMD)**	*For Non APM only*	Domestic Availability [5]	5.9	12.8	14.3
			Domestic Price [5]	5.1	5.1	5.1
	AND PRICE ($/MMBTU)		Imported gas [6]	20.7	13.9	12.3
			Imported Price [7]	10.9	10.9	10.9
			Share of Imported Gas (%)	77.8	52.1	46.3
			Pooled Price [8]	**13.6**	**11.6**	**11.1**
E	**COST PRICE** *(For non APM only)*		Fixed Cost [9]	1.31	1.31	1.31
	Rs/kwh		Variable cost [10]	6.9	5.8	5.6
			TOTAL COST	**8.2**	**7.2**	**6.9**
F	**TOTAL COST OF POWER [11]** *(Rs crore)*	1(a)	Non-APM (KGD6)	20111.5	17548.6	16975.0
		1(b)	Without Gas Allocation	10810.2	9432.7	9124.3
		1(c)	Ready for commissioning	15374.6	13415.4	12976.9
		1(a+b+c)	*Total Non-APM*	46296.3	40396.7	39076.2
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**46296.3**	**40396.7**	**39076.2**
G	**SELLING PRICE (Rs./kwh)**		Capped Price [12]	5.5	5.5	5.5
	REVENUE FROM SALES [13]	1(a)	Non-APM (KGD6)	13485	13485	13485
	(Rs. Crore)	1(b)	Without Gas Allocation	7248	7248	7248
		1(c)	Ready for commissioning	10309	10309	10309
		1(a+b+c)	*Total Non-APM*	31041	31041	31041
		2	APM Gas	0	0	0
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**31041**	**31041**	**31041**
H	**Revenue Shortfall [14]**	1(a)	Non-APM (KGD6)	6626.9	4064.0	3490.4
	(Rs. Crore)	1(b)	Without Gas Allocation	3562.0	2184.5	1876.1

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
		1(c)	Ready for commissioning	5066.0	3106.8	2668.3
		1(a+b+c)	Total Non-APM	15254.9	9355.3	8034.8
		2	APM Gas	0.0	0.0	0.0
		1(a+b+c) +2	**Total Revenue Shortfall**	**15254.9**	**9355.3**	**8034.8**

Note: [1]Central Electricity Authority of India
[2] See Section 5(i). Benchmark scenario, which is the average of APM plants.
[3] GAIL Conversion factor is used (i.e. Power generation from one MMSCMD gas is equal to 242MW).
[4] Units generated (Billion/per year) = Capacity (MW)*365 days*24 hours*1000kwh*10^6
[5] *"Gas price pooling", Financial Chronicle*, Dec 23 2014
[6] Imported gas = Gas required - Domestic availability
[7] *"Gas price pooling", Financial Chronicle*, Dec 23 2014. IMF forecasted world commodity prices is used to adjust the prices of imported natural gas from FY 15-16 onwards.
[8] Pooled price is the weighted average of domestic price and imported price. Both domestic and imported price have been increased by VAT @ 12.5%, transport charges @ 1.5 $/MMBTU, marketing margin @ .2 $/MMBTU. Imported price have an additional costs due to re-gasification charges @ 0.88 $/MMBTU & custom duty @ 5.2015%.
[9] *"Revival plan on cards for gas-based power plants", Economic times*, Oct 20, 2014.
[10] Variable cost = (Plant Heat Rate*Gas Cost*Exchange Rate)/(Net Calorific Value of a Fuel*25.2SCM); Plant heat rate = 1900, calorific value of a fuel = 9500, exchange rate = 63.3 (as on 23.12.14); Source: GAIL Conversion Matrix & Discussion with industry experts.
[11] Total cost of power = (Units in year) * (Cost Price).
[12] Price capped by Ministry of Petroleum & Power; Source: *"Gas price pooling, subsidies to help stranded power firms", Indian Express*, October 4, 2014.
[13] Revenue from sales = Number of units generated in a year * Capped price.
[14] Revenue Shortfall = Total cost of power generation - Total Revenue from sales.

Table B.3: Power generation capacity and cost at 50% PLF

	POWER GENERATION CAPACITY AND COST					
				2015-16	2016-17	2017-18
A	**1. Non APM**					
	Gas Capacity [1]	1(a)	Non-APM (KGD6)	6997	6997	6997
		1(b)	Without Gas Allocation	3761	3761	3761
		1(c)	Ready for commissioning	5349	5349	5349
		1(a+b+c)	Total Non-APM	16107	16107	16107
	PLF% [2]			**50**	**50**	**50**
	Effective Gas Capacity	*1(a)*	Non-APM (KGD6)	3499	3499	3499
		1(b)	Without Gas Allocation	1881	1881	1881
		1(c)	Ready for commissioning	2675	2675	2675
		1(a+b+c)	Total Non-APM	**8054**	**8054**	**8054**
	2. APM [1]					
	Gas Capacity	2	APM Gas	8042	8042	8042
	PLF%			**50**	**50**	**50**
	Net PLF% (additional required minus existing capacity (40%))			**10**	**10**	**10**
	Effective Gas Capacity	*2*	APM Gas	**804**	**804**	**804**
B	**GAS REQUIRED (MMSCMD)[3]**	1(a)	Non-APM (KGD6)	14.46	14.46	14.46
		1(b)	Without Gas Allocation	7.77	7.77	7.77
	Conversion	1(c)	Ready for commissioning	11.05	11.05	11.05
	1 MW =	1(a+b+c)	*Total Non-APM*	33.28	33.28	33.28
	0.004132231	2	APM Gas	3.32	3.32	3.32
	MMSCMD	1(a+b+c) +2	**TOTAL ALL PLANTS**	**36.60**	**36.60**	**36.60**
C	**UNITS GENERATED [4]**	1(a)	Non-APM (KGD6)	30647	30647	30647
	kwh for 1 year	1(b)	Without Gas Allocation	16473	16473	16473
	(Million units)	1(c)	Ready for commissioning	23429	23429	23429
		1(a+b+c)	*Total Non-APM*	70549	70549	70549
		2	APM Gas	7045	7045	7045

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
		1(a+b+c) +2	**TOTAL UNITS ALL PLANTS**	77593	77593	77593
D	**ADDITIONAL GAS SUPPLY (MMSCMD)**		Domestic Availability [5]	5.9	12.8	14.3
			Domestic Price [5]	5.05	5.05	5.05
	AND PRICE ($/MMBTU)	*For Non APM only*	Imported gas [6]	27.4	20.5	19.0
			Imported Price [7]	10.9	10.9	10.9
			Share of Imported Gas (%)	82.2	61.7	57.1
		For Apm+Non Apm	Share of Imported Gas (%)	83.8	65.1	61.0
		For Apm+Non Apm	**Pooled Price [8]**	**14.1**	**12.6**	**12.3**
		For Non APM only	**Pooled Price [8]**	**14.0**	**12.3**	**12.0**
E	**COST PRICE** *(For non APM only)*		Fixed Cost [9]	1.31	1.31	1.31
	Rs/kwh	For Non APM only	Variable cost [10]	7.1	6.2	6.1
		For Apm+Non Apm	Variable cost [10]	7.1	6.4	6.2
		For Non APM only	**TOTAL COST**	**8.4**	**7.5**	**7.4**
		For Apm+Non Apm	**TOTAL COST**	**8.4**	**7.7**	**7.5**
F	**TOTAL COST OF POWER [11]** *(Rs crores)*	1(a)	Non-APM (KGD6)	25693.7	23130.9	22557.2
		1(b)	Without Gas Allocation	13810.8	12433.2	12124.9
		1(c)	Ready for commissioning	19642.1	17682.9	17244.3
		1(a+b+c)	*Total Non-APM*	59146.6	53246.9	51926.4
		2	APM Gas	5952	5417	5297
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**65099.0**	**58663.8**	**57223.4**
G	**SELLING PRICE (Rs./kwh)**		Capped Price [12]	5.5	5.5	5.5
	REVENUE FROM SALES [13]	1(a)	Non-APM (KGD6)	16856	16856	16856

	POWER GENERATION CAPACITY AND COST					
				2015-16	**2016-17**	**2017-18**
	(Rs. Crore)	1(b)	Without Gas Allocation	9060	9060	9060
		1(c)	Ready for commissioning	12886	12886	12886
		1(a+b+c)	*Total Non-APM*	38802	38802	38802
		2	APM Gas	3875	3875	3875
		1(a+b+c) +2	**TOTAL COST ALL PLANTS**	**42676**	**42676**	**42676**
H	**Revenue Shortfall [14]**	1(a)	Non-APM (KGD6)	8837.9	6275.1	5701.4
	(Rs. Crore)	1(b)	Without Gas Allocation	4750.5	3373.0	3064.6
		1(c)	Ready for commissioning	6756.3	4797.1	4358.6
		1(a+b+c)	Total Non-APM	20344.8	14445.2	13124.7
		2	APM Gas	2077.9	1542.2	1422.3
		1(a+b+c) +2	**Total Revenue Shortfall**	**22422.6**	**15987.4**	**14547.0**

Note: [1]Central Electricity Authority of India
[2] See Section 5(i). Incremental increase to 50% due to constraints on R-LNG infrastructure.
[3] GAIL Conversion factor is used (i.e. Power generation from one MMSCMD gas is equal to 242MW).
[4] Units generated (Billion/per year) = Capacity (MW)*365 days*24 hours*1000kwh*10^6
[5] *"Gas price pooling", Financial Chronicle*, Dec 23 2014
[6] Imported gas = Gas required - Domestic availability
[7] *"Gas price pooling", Financial Chronicle*, Dec 23 2014. IMF forecasted world commodity prices are used to adjust the prices of imported natural gas from FY 15-16 onwards.
[8] Pooled price is the weighted average of domestic price and imported price. Both domestic and imported price have been increased by VAT @ 12.5%, transport charges @ 1.5 $/MMBTU, marketing margin @ .2 $/MMBTU. Imported price have an additional costs due to re-gasification charges @ 0.88 $/MMBTU & custom duty @ 5.2015%.
[9] *"Revival plan on cards for gas-based power plants", Economic times*, Oct 20, 2014.
[10] Variable cost = (Plant Heat Rate*Gas Cost*Exchange Rate)/(Net Calorific Value of a Fuel*25.2SCM); Plant heat rate = 1900, calorific value of a fuel = 9500, exchange rate = 63.3 (as on 23.12.14); Source: GAIL Conversion Matrix & Discussion with industry experts.
[11] Total cost of power = (Units in year) * (Cost Price).
[12] Price capped by Ministry of Petroleum & Power; Source: *"Gas price pooling, subsidies to help stranded power firms", Indian Express*, October 4, 2014.
[13] Revenue from sales = Number of units generated in a year * Capped price.
[14] Revenue Shortfall = Total cost of power generation - Total Revenue from sales.

Table B.4.1: New fiscal deficits if total revenue shortfall is considered: All plants

Old fiscal deficit	2015-16	2016-17	2017-18
FRBM targets	3.60	3.00	3.00
NCAER Projections	3.89	3.63	3.49
New fiscal deficit with total revenue shortfalls			
30% PLF - Scenario 1(i)	3.96	3.66	3.50
30% PLF -Scenario 1(ii)	4.00	3.73	3.57
40% PLF	4.00	3.69	3.53
50% (APM+Non APM)	4.05	3.74	3.57

Table B.4.2: New fiscal deficits if only the subsidy and tax relief components are considered: All plants

Old fiscal deficit	2015-16	2016-17	2017-18
FRBM targets	3.60	3.00	3.00
NCAER projections	3.89	3.63	3.49
New fiscal deficit with only increased subsidies and foregone revenue			
30% PLF - Scenario 1(i)	3.94	3.65	3.49
30% PLF -Scenario 1(ii)	3.98	3.71	3.56
40% PLF	3.97	3.67	3.52
50% (APM+Non APM)	4.02	3.71	3.54

Table B.5: Benefit-cost analysis at 30% PLF - Scenario 1(ii): *Only non-APM plants*

Assumption all plants are operating at 30% PLF (No Domestic Gas)	**2015-16**	**2016-17**	**2017-18**
Benefits			
GDP at Market Price (Nominal)[1]	13826701	15521994	17512005
Increase in GDP (%)[2] due to additional power generation	0.5788	0.5499	0.5219
Increase in GDP	80027	85350	91394
New GDP[4] *(inclusive of multiplier effect)*	13906728	15607345	17603399
Cost			
a) Subsidy[5]	8580	8580	8580
b) Tax Forgone[6]			
(i) Sales Tax	2790	2790	2790
(ii) Custom Duty	1161	1161	1161
Total	**3951**	**3951**	**3951**
c) Revenue Loss for other sectors[7]			
(i) Marketing Margin	307	307	307
(ii) Transportation	1533	1533	1533
(iii) Re-gasification	899	899	899

Assumption all plants are operating at 30% PLF (No Domestic Gas)	2015-16	2016-17	2017-18
Total	**2739**	**2739**	**2739**
Cost (b+c)	**6689**	**6689**	**6689**
Total Cost (a+b+c)**	**15270**	**15270**	**15270**
Net Benefits[8]	**64758**	**70081**	**76124**
Net Benefits as a % of GDP	**0.4684**	**0.4515**	**0.4347**

Note: All the figures are in Rs. Crore (except Increase in GDP).
At 100% efficiency 1 MMBTU = 293.30 kwh. As per discussion with industry experts it is assumed that on an average with 45% efficiency, natural gas based power plants in India are generating 131.85 kwh of energy using one MMBTU of gas.
** Same as Total Revenue Shortfall in Section 5.
[1] NCAER estimation based on 110 macro forecasting model, "Report Prepared for the Public Expenditure Management Commission of India".
[2] NCAER estimation based on 130 equation from input output table (detailed are mentioned in section 4 of this report).
[3] For FY 2014-15, same multipliers as for FY 2015-16 is used as only 3 months are remaining in FY 2014-15.
[4] New GDP = Original GDP + Increase in GDP due to addition of power
[5] The revenue shortfall under gas price pooling includes (i)subsidy cost directly picked up by the central govt., (ii) the revenue foregone by the central & state government on tax concessions, & (iii) losses borne by other sectors. Hence Subsidy = Revenue shortfall - tax foregone - loss of other sectors.
[6] As per proposed gas price pooling policy, power plants will be exempt from indirect taxes. Sales tax range from 0 to 25%; an average of 12.5% is used to estimate tax foregone by the states.
[7] As per proposed gas price pooling policy, other sectors also haves to bear losses due to reduction in marketing margin by 75%, transportation charges by 50% & re-gasification charges by 50%.
[8] Net Benefit = Total benefit - Total cost

Table B.6: Benefit-cost analysis at 40% PLF: *Only non-APM plants*

Assumption all plants are operating at 40% PLF	2015-16	2016-17	2017-18
Benefits			
GDP at Market Price (Nominal)[1]	13826701	15521994	17512005
Increase in GDP (%)[2] due to additional power generation	0.6951	0.5762	0.5290
Increase in GDP	96107	89437	92640
New GDP[4] *(inclusive of multiplier effect)*	13922808	15611432	17604645
Cost			
a) Subsidy[5]	7391	2711	1664
b) Tax Forgone[6]			
(i) Sales Tax	3275	2761	2646
(ii) Custom Duty	1204	806	717
Total	**4479**	**3567**	**3363**
c) Revenue Loss for other sectors[7]			
(i) Marketing Margin	409	409	409
(ii) Transportation	2044	2044	2044
(iii) Re-gasification	932	624	555
Total	**3385**	**3077**	**3008**
Cost (b+c)	**7864**	**6644**	**6371**
Total Cost (a+b+c)**	**15255**	**9355**	**8035**

Assumption all plants are operating at 40% PLF	2015-16	2016-17	2017-18
Net Benefits[8]	**80852**	**80082**	**84605**
Net Benefits as a % of GDP	**0.5848**	**0.5159**	**0.4831**

Note: All the figures are in Rs. Crore (except Increase in GDP).
At 100% efficiency 1 MMBTU = 293.30 kwh. As per discussion with industry experts it is assumed that on an average with 45% efficiency, natural gas based power plants in India are generating 131.85 kwh of energy using one MMBTU of gas.
** Same as Total Revenue Shortfall in Section 5.
[1] NCAER estimation based on 110 macro forecasting model, "Report Prepared for the Public Expenditure Management Commission of India".
[2] NCAER estimation based on 130 equation from input output table (detailed are mentioned in section 4 of this report).
[3] For FY 2014-15, same multipliers as for FY 2015-16 is used as only 3 months are remaining in FY 2014-15.
[4] New GDP = Original GDP + Increase in GDP due to addition of power
[5] The revenue shortfall under gas price pooling includes (i)subsidy cost directly picked up by the central govt., (ii) the revenue foregone by the central & state government on tax concessions, & (iii) losses borne by other sectors. Hence Subsidy = Revenue shortfall - tax foregone - loss of other sectors.
[6] As per proposed gas price pooling policy, power plants will be exempt from indirect taxes. Sales tax range from 0 to 25%; an average of 12.5% is used to estimate tax foregone by the states.
[7] As per proposed gas price pooling policy, other sectors also haves to bear losses due to reduction in marketing margin by 75%, transportation charges by 50% & re-gasification charges by 50%.
[8] Net Benefit = Total benefit - Total cost

Table B.7: Benefit-cost analysis at 50% PLF: *Only non-APM plants*

Assumption all plants are operating at 50% PLF	2015-16	2016-17	2017-18
Benefits			
GDP at Market Price (Nominal)[1]	13826701	15521994	17512005
Increase in GDP (%)[2] due to additional power generation	0.8880	0.7595	0.7030
Increase in GDP	122783	117887	123105
New GDP[4] *(inclusive of multiplier effect)*	13949484	15639882	17635110
Cost			
a) Subsidy[5]	10251	5571	4524
b) Tax Forgone[6]			
(i) Sales Tax	4205	3691	3576
(ii) Custom Duty	1591	1193	1104
Total	**5796**	**4884**	**4680**
c) Revenue Loss for other sectors[7]			
(i) Marketing Margin	511	511	511
(ii) Transportation	2555	2555	2555
(iii) Re-gasification	1232	924	855
Total	**4298**	**3990**	**3921**
Cost (b+c)	**10093**	**8874**	**8601**
Total Cost (a+b+c)	**20345**	**14445**	**13125**
Net Benefits[8]	**102438**	**103442**	**109980**
Net Benefits as a % of GDP	**0.7409**	**0.6664**	**0.6280**

Assumption all plants are operating at 50% PLF	2015-16	2016-17	2017-18
Note: All the figures are in Rs. Crore (except Increase in GDP). At 100% efficiency 1 MMBTU = 293.30 kwh. As per discussion with industry experts it is assumed that on an average with 45% efficiency, natural gas based power plants in India are generating 131.85 kwh of energy using one MMBTU of gas. 1 NCAER estimation based on 110 macro forecasting model, "Report Prepared for the Public Expenditure Management Commission of India". 2 NCAER estimation based on 130 equation from input output table (detailed are mentioned in section 4 of this report). 3 For FY 2014-15, same multipliers as for FY 2015-16 is used as only 3 months are remaining in FY 2014-15. 4 New GDP = Original GDP + Increase in GDP due to addition of power 5 The revenue shortfall under gas price pooling includes (i)subsidy cost directly picked up by the central govt., (ii) the revenue foregone by the central & state government on tax concessions, & (iii) losses borne by other sectors. Hence Subsidy = Revenue shortfall - tax foregone - loss of other sectors. 6 As per proposed gas price pooling policy, power plants will be exempt from indirect taxes. Sales tax range from 0 to 25%; an average of 12.5% is used to estimate tax foregone by the states. 7 As per proposed gas price pooling policy, other sectors also haves to bear losses due to reduction in marketing margin by 75%, transportation charges by 50% & re-gasification charges by 50%. 8 Net Benefit = Total benefit - Total cost			

Table B.8: Benefit-cost analysis at 50% PLF: *All plants*

Assumption all plants are operating at 50% PLF	2015-16	2016-17	2017-18
Benefits			
GDP at Market Price (Nominal)[1]	13826701	15521994	17512005
Increase in GDP (%)[2] due to additional power generation	0.9774	0.8367	0.7747
Increase in GDP	135139	129880	135662
New GDP[4] *(inclusive of multiplier effect)*	13961840	15651875	17647667
Cost			
a) Subsidy[5]	11216	6000	4833
b) Tax Forgone[6]			
(i) Sales Tax	4669	4155	4041
(ii) Custom Duty	1784	1386	1297
Total	**6453**	**5542**	**5338**
c) Revenue Loss for other sectors[7]			
(i) Marketing Margin	562	562	562
(ii) Transportation	2810	2810	2810
(iii) Re-gasification	1382	1074	1005
Total	**4754**	**4445**	**4377**
Cost (b+c)	**11207**	**9987**	**9714**
Total Cost (a+b+c)	**22423**	**15987**	**14547**
Net Benefits[8]	**112717**	**113893**	**121115**
Net Benefits as a % of GDP	**0.8152**	**0.7338**	**0.6916**

Assumption all plants are operating at 50% PLF	2015-16	2016-17	2017-18

Note: All the figures are in Rs. Crore (except Increase in GDP).
At 100% efficiency 1 MMBTU = 293.30 kwh. As per discussion with industry experts it is assumed that on an average with 45% efficiency, natural gas based power plants in India are generating 131.85 kwh of energy using one MMBTU of gas.
[1] NCAER estimation based on 110 macro forecasting model, "Report Prepared for the Public Expenditure Management Commission of India".
[2] NCAER estimation based on 130 equation from input output table (detailed are mentioned in section 4 of this report).
[3] For FY 2014-15, same multipliers as for FY 2015-16 is used as only 3 months are remaining in FY 2014-15.
[4] New GDP = Original GDP + Increase in GDP due to addition of power
[5] The revenue shortfall under gas price pooling includes (i)subsidy cost directly picked up by the central govt., (ii) the revenue foregone by the central & state government on tax concessions, & (iii) losses borne by other sectors. Hence Subsidy = Revenue shortfall - tax foregone - loss of other sectors.
[6] As per proposed gas price pooling policy, power plants will be exempt from indirect taxes. Sales tax range from 0 to 25%; an average of 12.5% is used to estimate tax foregone by the states.
[7] As per proposed gas price pooling policy, other sectors also haves to bear losses due to reduction in marketing margin by 75%, transportation charges by 50% & re-gasification charges by 50%.
[8] Net Benefit = Total benefit - Total cost

Table B9: Net benefits under the gas price pooling policy

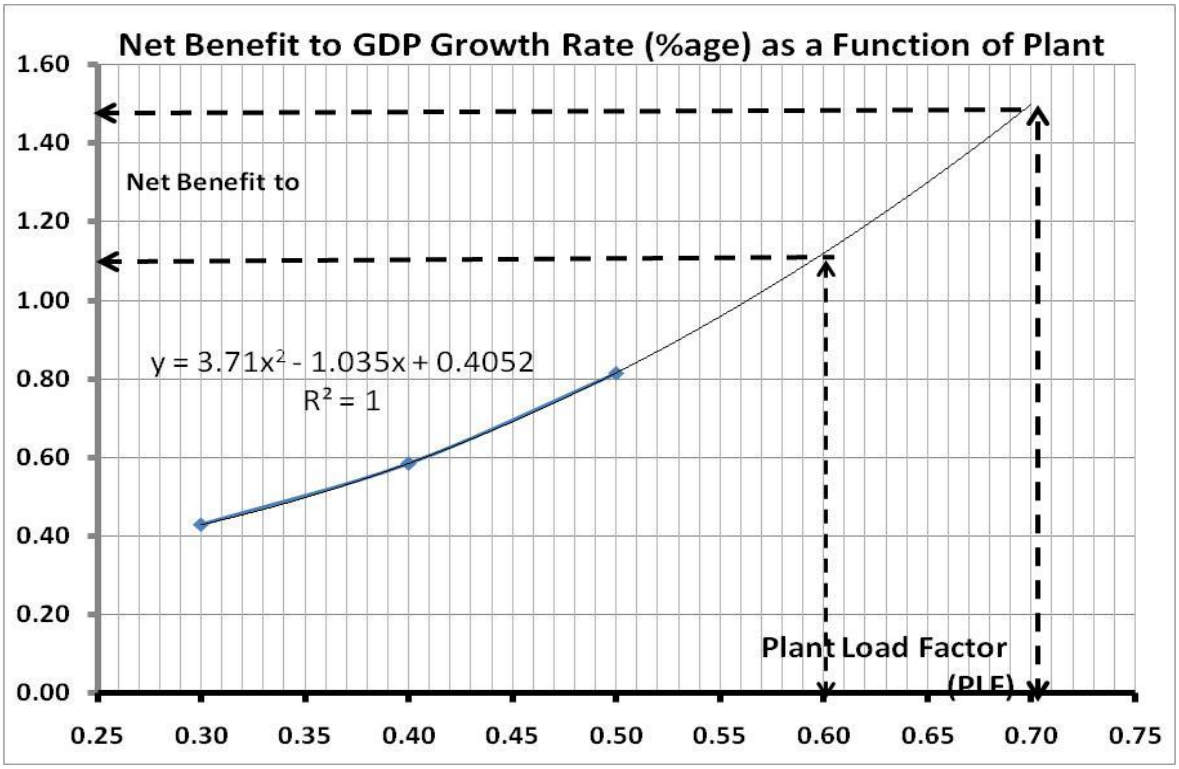
Net Benefits as a % of GDP	2015	2016	2017
	At 30% PLF		
Non APM	0.4286	0.3654	0.3382
	At 40% PLF		
Non APM	0.5848	0.5159	0.4831
	At 50% PLF		
Non APM	0.7409	0.6664	0.6280
APM + Non APM	0.8152	0.7338	0.6916

Table B.10 Impact of PLF on gas-industry linked net benefit to GDP growth rate

PLF	Net benefit to GDP (%age)
0.30	0.43 (From Study Results)
0.40	0.58 (From Study Results)
0.50	0.82 (From Study Results)
0.60	1.1 (By Extrapolation R^2 =1.0)
0.70	1.50 (By Extrapolation R^2 =1.0)

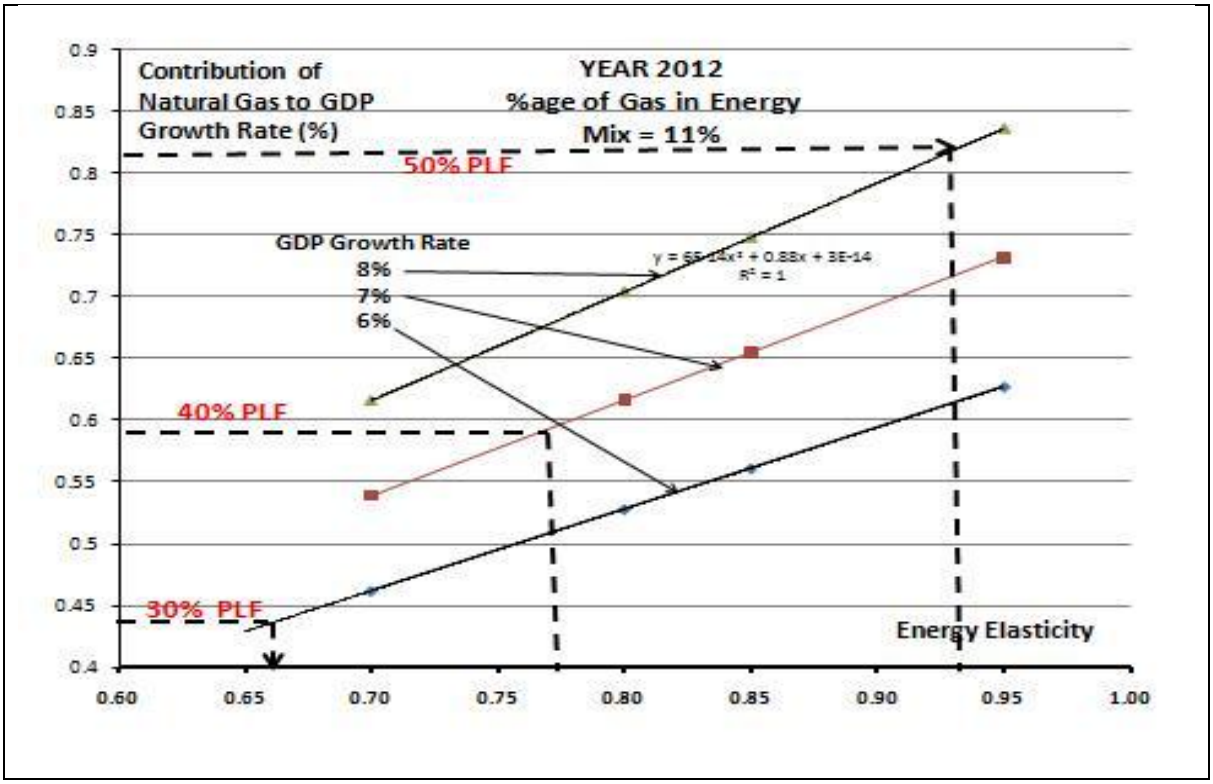
Source: NCAER calculations

Figure B.1: Impact of PLF on gas-industry linked net benefit to GDP growth rate



Source: NCAER calculations

Figure B.2: Scenario analysis: Contribution of natural gas to GDP growth rate



Source: NCAER calculations

APPENDIX C

INPUT-OUTPUT MODEL

The I-O table, on which the IO model is based, is the matrix representation of a nation's economy and depicts how the output of one industry is used as input in other industries, thereby making each industry dependent on other industries both as the user and as supplier. A row in an I-O table shows the values in which an economic sector provides inputs to various other sectors and final uses. Final use refers to the sector's sales to households and government as their consumption expenditure; sector's use in fixed investment; and its net exports. On the other hand, a column shows the sector's inputs from other sectors and its primary inputs consisting of taxes less subsidies on production and the gross value added comprising payments for labour, capital, land and imported inputs. The row total and the column total of a sector give its total value of output and hence are equal. The IO table with, say, 3 sectors is shown below:

	Sectors				
Sectors	1	2	3	Final Demand	Gross Value of Output
1	x_{11}	x_{12}	x_{13}	F_1	X_1
2	x_{21}	x_{22}	x_{23}	F_2	X_2
3	x_{31}	x_{32}	x_{33}	F_3	X_3
Primary Inputs	P_1	P_2	P_3		
Gross Value of Output	X_1	X_2	X_3		

The above matrix represents the following set of 6 balance equations, 3 representing the sector's sales to other sectors and final users and 3 representing its purchases from other sectors and primary inputs:-

$$\left.\begin{aligned} x_{11} + x_{12} + x_{13} + F_1 &= X_1 \\ x_{21} + x_{22} + x_{23} + F_2 &= X_2 \\ x_{31} + x_{32} + x_{33} + F_3 &= X_3 \end{aligned}\right\} \quad \text{---------- (1)}$$

$$\left.\begin{aligned} x_{11} + x_{21} + x_{31} + P_1 &= X_1 \\ x_{12} + x_{22} + x_{23} + P_2 &= X_2 \\ x_{13} + x_{23} + x_{33} + P_3 &= X_3 \end{aligned}\right\} \quad \text{---------- (2)}$$

where F_i is the final use or final demand and P_i is the Primary Input.

Further, if a_{ij} is the input coefficient and is denoted by x_{ij}/X_j , we get,

$$\left.\begin{aligned} a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + F_1 &= X_1 \\ a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + F_2 &= X_2 \\ a_{31}X_1 + a_{32}X_2 + a_{33}X_3 + F_3 &= X_3 \end{aligned}\right\} \quad \text{---------- (3)}$$

And, if b_{ij} is the output coefficient and is denoted by x_{ij}/X_i, we get,

$$\left.\begin{aligned} b_{11}X_1 + b_{21}X_2 + b_{31}X_3 + P_1 &= X_1 \\ b_{12}X_1 + b_{22}X_2 + b_{32}X_3 + P_2 &= X_2 \\ b_{13}X_1 + b_{23}X_2 + b_{33}X_3 + P_3 &= X_3 \end{aligned}\right\} \quad \text{---------- (4)}$$

The equations (3) can be written in matrix notations as

$$\begin{aligned} AX + F &= X \\ \text{or } (I-A)\,X &= F \\ \text{or } X &= (I-A)^{-1}\,F \qquad \text{---------- (5)} \end{aligned}$$

Similarly, the equations (4) can be written in matrix notations as

$$\begin{aligned} B'X + P &= X \\ \text{or } (I-B')\,X &= P \\ \text{or } X &= (I-B')^{-1}\,P \qquad \text{---------- (6)} \end{aligned}$$

The inverse matrices of equations (5) and (6) are called Leontief inverse matrices after W. Leontief who introduced Input-Output Analysis. These matrices reflect the direct and indirect effects of inter-industry linkages.

To be specific, in the framework of input-output analysis, production by a particular sector has two kinds of effects on other sectors in the economy. If a sector j increases its output due to additional demand, more inputs (purchases) are required including more intermediates from other sectors. Such interconnection of a particular sector to other sectors from which it purchases inputs (demand side) is termed as “backward linkage”. Also called “output multiplier”, this is the column sum of inverse matrix given in equation (5) and can be interpreted as the cumulative increase in the output of the economy which is induced by one additional unit of final demand of a certain sector. The higher the multipliers, the larger are the effects on the input-output system of the economy.

On the other hand, increased output of sector j indicates that additional amounts of products are available to be used as inputs by other sectors. There will be increased supplies from sector j for sectors which use product j in their production (supply side). This interconnection of a particular sector to those to which it sells its output is termed as “forward linkages”. These are obtained from the column sum of inverse matrix given in equation (6) and can be interpreted as the cumulative increase in the output of the economy which is induced by one additional unit of primary inputs of a certain sector. While backward linkages are the relationship between the activity in a sector and its purchases, forward linkages are the relationship between the activity in a sector and its sales.

For the present study, which aims to assess the impact of increased production in Electricity sector on the overall economy by way of the resultant increase in production of its user sectors, we propose to work out the forward linkages of electricity sector. The additional generation of electricity means that additional inputs from this sector are available to be used by its using sectors. A high forward linkage implies that by expanding the output of a sector, a powerful stimulus is generated in other sectors, by way of absorbing the output of the specific sector as inputs to other sectors.

The IO impact analysis can also be used to determine the direct and indirect impact of increase in output on employment. The direct employment effect of a rupee worth of increase in final demand in sector j is obtained from jth sector's employment to output ratio or employment coefficient. The total employment change per rupees change of final demand in a sector j is estimated by multiplying the row vector of the employment coefficient with the Leontief Inverse matrix.

It is important to mention here that the impact estimates derived from the IO analysis is based on the economic activity during one specific year, for which IO table is constructed. However, the IO multipliers can be assumed to remain stable during a certain period, typically up to 5 years, unless the economy's structure changes significantly. For the present study, the latest IO table for 2007-08, prepared by Central Statistical Office (CSO), has been used.

For the present study, the CSO's 130 sectors of 2007-08 IO table are aggregated to 18 broad sectors. The list of sectors and their aggregation scheme are given in the in the table below:

Table C.1: Aggregation Scheme

	Sectors for the present study	Sector No. as in CSO's IO Table
1	Agriculture	1 to 26
2	Coal and Lignite	27
3	Natural Gas	28
4	Textiles	46 - 54
5	Petroleum Products	63
6	Chemicals	65-66, 68-73
7	Fertilisers	67
8	Cement	75
9	Iron & Steel	77 - 79
10	Electrical Industrial Machinery	88
11	Other Electrical Equipments and Machinery	89 - 93
12	Other Industry	29-37, 38-45, 55-62, 64, 74, 76, 80-87, 94-105
13	Construction	106
14	Electricity	107
15	Transport Services	109-112
16	Trade	116

	Sectors for the present study	Sector No. as in CSO's IO Table
17	Banking	118
18	Other Services	108, 113-115, 117, 119-130

Table C.2: Key Sectoral Aggregates (Rs. Lakh)

		Value of Output	Gross value Added	Employment (in numbers)
1	Agriculture	124740265	84693997	234530980
2	Coal and Lignite	5138089	3635282	604341
3	Natural Gas	1564577	1272666	18714
4	Textiles	35482386	8848099	13446128
5	Petroleum Products	42041750	5914920	118325
6	Chemicals	31465000	7330348	1222198
7	Fertilisers	4921085	661999	104056
8	Cement	5649320	1710985	205720
9	Iron & Steel	36171938	7742259	1669946
10	Electrical Industrial Machinery	5736585	935848	510773
11	Other Electrical Equipments and Machinery	12076964	2119371	885839
12	Other Industry	184493547	44116906	27798551
13	Construction	111933887	38919631	47649199
14	**Electricity**	**17201749**	**6795606**	**700462**
15	Transport Services	71328652	27650641	14436461
16	Trade	89550061	71503453	31674810
17	Banking	24535622	20461000	2074822
18	Other Services	167070646	123829201	38667101
	Total	971102123	458142212	416318427

Table C.3: Units increase in output of electricity-user sectors with one unit increase in electricity output

	Sectors	
1	Agriculture	0.1481
2	Coal and Lignite	0.0139
3	Natural Gas	0.0024
4	Textiles	0.1171
5	Petroleum Products	0.1083
6	Chemicals	0.1229
7	Fertilisers	0.0190
8	Cement	0.0250
9	Iron & Steel	0.1256
10	Electrical Industrial Machinery	0.0193
11	Other Electrical Equipment and Machinery	0.0411
12	Other Industry	0.4929
13	Construction	0.2352
14	**Electricity**	1.2064
15	Transport Services	0.1371
16	Trade	0.0729

	Sectors	
17	Banking	0.0239
18	Other Services	0.1703
	Electricity multiplier	**3.0816**

Table C.4: Increase in sectors' values of GVA and employment with increase in electricity output at 30% PLF (2015-16). Case of no domestic gas availability

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	336701	228608	633051
2	Coal and Lignite	31665	22404	3724
3	Natural Gas	5445	4429	65
4	Textiles	266264	66397	100902
5	Petroleum Products	246078	34621	693
6	Chemicals	279353	65080	10851
7	Fertilisers	43159	5806	913
8	Cement	56801	17203	2068
9	Iron & Steel	285598	61129	13185
10	Electrical Industrial Machinery	43964	7172	3914
11	Other Electrical Equipments and Machinery	93527	16413	6860
12	Other Industry	1120489	267936	168830
13	Construction	534582	185875	227567
14	**Electricity**	2742184	1083308	111663
15	Transport Services	311590	120788	63064
16	Trade	165616	132240	58580
17	Banking	54301	45283	4592
18	Other Services	387200	286984	89614
	Total increase	7004517	2651679	1500135
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.72	0.58	0.36

Table C.5: Increase in sectors' values of GVA and employment with increase in electricity output at 30% PLF (2016-17). Case of availability of domestic and imported gas

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	228568	155189	429744
2	Coal and Lignite	21496	15209	2528
3	Natural Gas	3696	3006	44
4	Textiles	180753	45074	68497
5	Petroleum Products	167049	23502	470
6	Chemicals	189638	44180	7366
7	Fertilisers	29298	3941	620
8	Cement	38559	11678	1404
9	Iron & Steel	193877	41498	8951
10	Electrical Industrial Machinery	29845	4869	2657
11	Other Electrical Equipments and Machinery	63490	11142	4657
12	Other Industry	760639	181887	114609
13	Construction	362899	126181	154483
14	**Electricity**	1861520	735400	75802

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
15	Transport Services	211522	81997	42811
16	Trade	112428	89771	39767
17	Banking	36862	30740	3117
18	Other Services	262849	194818	60834
	Total increase	4754988	1800081	1018361
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.49	0.39	0.24

Table C.6: Increase in sectors' values of GVA and employment with increase in electricity output at 40% PLF (2016-17)

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	335194	227584	630216
2	Coal and Lignite	31524	22303	3708
3	Natural Gas	5420	4409	65
4	Textiles	265072	66100	100450
5	Petroleum Products	244976	34466	689
6	Chemicals	278102	64789	10802
7	Fertilisers	42966	5780	909
8	Cement	56546	17126	2059
9	Iron & Steel	284319	60856	13126
10	Electrical Industrial Machinery	43767	7140	3897
11	Other Electrical Equipment and Machinery	93108	16339	6829
12	Other Industry	1115471	266736	168074
13	Construction	532188	185043	226548
14	**Electricity**	2729904	1078458	111163
15	Transport Services	310195	120247	62781
16	Trade	164875	131648	58318
17	Banking	54058	45080	4571
18	Other Services	385466	285699	89213
	Total increase	6973152	2639805	1493418
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.72	0.58	0.36

Table C.7: Increase in sectors' values of GVA and employment with increase in electricity output at 50% PLF (2016-17): APM + non-APM plants

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	486765	330496	915194
2	Coal and Lignite	45778	32389	5384
3	Natural Gas	7871	6403	94
4	Textiles	384936	95990	145872
5	Petroleum Products	355753	50051	1001
6	Chemicals	403858	94086	15687
7	Fertilisers	62394	8393	1319
8	Cement	82116	24870	2990
9	Iron & Steel	412886	88374	19062
10	Electrical Industrial Machinery	63558	10369	5659
11	Other Electrical Equipments and Machinery	135211	23728	9918

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
12	Other Industry	1619879	387352	244075
13	Construction	772840	268718	328991
14	**Electricity**	3964346	1566127	161430
15	Transport Services	450463	174622	91171
16	Trade	239430	191179	84689
17	Banking	78502	65466	6638
18	Other Services	559771	414890	129554
	Total increase	10126356	3833503	2168729
	Original Total Values	971102123	458142212	416318427
	Per cent increase	1.04	0.84	0.52

Table C.8: Increase in sectors' values of GVA and employment with increase in electricity output at 30% PLF (2017-18). Case of availability of domestic and imported gas

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	206541	140234	388329
2	Coal and Lignite	19424	13743	2285
3	Natural Gas	3340	2717	40
4	Textiles	163333	40730	61895
5	Petroleum Products	150950	21237	425
6	Chemicals	171362	39922	6656
7	Fertilisers	26475	3561	560
8	Cement	34843	10553	1269
9	Iron & Steel	175193	37498	8088
10	Electrical Industrial Machinery	26969	4400	2401
11	Other Electrical Equipments and Machinery	57372	10068	4208
12	Other Industry	687335	164359	103564
13	Construction	327926	114020	139595
14	**Electricity**	1682123	664528	68497
15	Transport Services	191137	74095	38685
16	Trade	101593	81120	35935
17	Banking	33310	27778	2817
18	Other Services	237518	176043	54972
	Total increase	4296742	1626605	920220
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.44	0.36	0.22

Table C.9: Increase in sectors' values of GVA and employment with increase in electricity output at 40% PLF (2017-18)

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	307742	208945	578602
2	Coal and Lignite	28942	20477	3404
3	Natural Gas	4976	4048	60
4	Textiles	243363	60686	92223
5	Petroleum Products	224913	31643	633
6	Chemicals	255326	59483	9918

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
7	Fertilisers	39447	5306	834
8	Cement	51915	15723	1890
9	Iron & Steel	261034	55872	12051
10	Electrical Industrial Machinery	40183	6555	3578
11	Other Electrical Equipments and Machinery	85483	15001	6270
12	Other Industry	1024116	244891	154309
13	Construction	488603	169888	207994
14	**Electricity**	2506329	990133	102059
15	Transport Services	284790	110399	57640
16	Trade	151372	120866	53542
17	Banking	49631	41388	4197
18	Other Services	353897	262301	81906
	Total increase	6402061	2423609	1371109
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.66	0.53	0.33

Table C.10: Increase in sectors' values of GVA and employment with increase in electricity output at 50% PLF (2017-18)): APM + non-APM plants

		Value of Output (Rs. Lakh)	GVA (Rs. Lakh)	Employment (numbers)
1	Agriculture	450659	305980	847308
2	Coal and Lignite	42383	29986	4985
3	Natural Gas	7287	5928	87
4	Textiles	356382	88870	135052
5	Petroleum Products	329364	46339	927
6	Chemicals	373901	87107	14523
7	Fertilisers	57766	7771	1221
8	Cement	76025	23025	2768
9	Iron & Steel	382259	81819	17648
10	Electrical Industrial Machinery	58844	9600	5239
11	Other Electrical Equipments and Machinery	125181	21968	9182
12	Other Industry	1499720	358620	225970
13	Construction	715512	248785	304587
14	**Electricity**	3670281	1449956	149455
15	Transport Services	417049	161669	84408
16	Trade	221669	176997	78407
17	Banking	72679	60609	6146
18	Other Services	518248	384115	119944
	Total increase	9375209	3549144	2007859
	Original Total Values	971102123	458142212	416318427
	Per cent increase	0.97	0.77	0.48

Table C.11: Estimated growth in GDP and employment for all the years

	2015-16	**2016-17**	**2017-18**
	30 % PLF – With domestic gas. Only non-APM plants		
GVA	0.50	0.39	0.36
Employment	0.31	0.24	0.22
	30 % PLF – Without domestic gas. Only non-APM plants		

GVA	0.58	0.55	0.52
Employment	0.36	0.34	0.32
	40 % PLF: Only non-APM plants		
GVA	0.70	0.58	0.53
Employment	0.43	0.36	0.33
	50 % PLF - Only non-APM plants		
GVA	0.89	0.76	0.70
Employment	0.55	0.47	0.44
	50 % PLF – Both APM and non-APM gas		
GVA	0.98	0.84	0.77
Employment	0.61	0.52	0.48

APPENDIX D

MACRO ECONOMETRIC FORECASTING MODEL

The NCAER Macro Econometric Forecasting model is a general equilibrium model with 295 variables and 110 equations.

Model Structure

Output sectors:

- Agriculture & allied sector with further disaggregation into rice, wheat, other foodgrains, cotton, sugarcane, oilseeds, other non-foodgrain crops sub-sector
- Mining, Quarrying & Manufacturing
- Construction
- Electricity, Gas and Water supply
- Transport, Storage and Communication
- Other Services

Determinants of Sectoral output:

- capital stock, demand conditions, infrastructure, human capital (rainfall in the case of agriculture)
- Capital stock and hence investment plays a prominent role in determining output
- Demand conditions have short-term impact
- Sectoral prices: energy prices, other administered prices, import prices, liquidity

Components of aggregate demand:

- Private final consumption expenditure (real) (sectors corresponding to production sectors); function of real disposable income; relative prices
- Government final consumption expenditure: exogenous
- Private investment: sectoral investment is determined by output, real interest rate, fiscal deficit to GDP ratio, public investment in infrastructure, external factor like stock market
- Public investment: exogenous
- Exports (Goods): external factors (World GDP, international prices)
- Imports (Goods): crude oil, edible oils and others; driven by domestic demand, prices and exchange rate
- Net invisibles: exogenous

Fiscal Block:

- Central government expenditure: wage bill, interest payments, subsidies, capital expenditure (Government support to infrastructure explicit)
- Central government tax revenue: indirect tax (petroleum sector and others); direct taxes
- Central government non-tax revenue (current and non-debt capital)
- Deficit measures
- General government (Centre + States) accounts more aggregated than central accounts

Monetary block:

- Money supply exogenous
- Interest rate adjusts to exchange rate depreciation, external interest rate and domestic inflation

- Interest rate also affects fiscal position which in turn affects investment
- Exchange rate exogenous

Assumptions Made for Forecasting

Global Conditions

- World GDP: From the IMF World Economic October Outlook, it is forecasted that world GDP will grow at 3.3 per cent in 2014–15 and 3.8 per cent in 2015–16. The long-run average growth rate for the World between 1970 and 2013 is three per cent and that is used as an assumption for the period 2016–17.
- International Crude Oil Price Index: This is the UK Brent Price Index taken from the IMF with the index 1995=100. The forecasts i.e. the year-on-year (y-o-y) changes are formed using the World Bank Commodity Price Prospects. This translates to the average price of the UK Brent Crude Oil at $105 a barrel for 2014-15, $99.5 for 2015-16 and $99 for 2016-17.
- International Non-fuel Price Index: This is the price index taken from the IMF with the index 1995=100. The assumptions are formed using the World Bank Commodity Price Prospects.
- LIBOR is assumed to remain at 0.2 per cent for the forecasting period.
- Exchange Rate: Exchange rate is assumed to remain at Rs 60 per dollar for the forecasting period except for 2014–15 when it is assumed to be Rs 60.3 per dollar.
- BSE Sensex: It is assumed that in 2014–15 it will grow at 29 per cent year. This assumption is based on the trends of the past half year when positive sentiments about the investment and political climate have prevailed. And positive perceptions about India have attracted substantial foreign institutional inflows to the country, which have only boosted the BSE. For the rest of the forecasting period, we assume a ten per cent y-o-y change.

Investment Climate:

- FDI: It is assumed that a positive investment climate prevails in the economy. Based on April−August numbers, the y-o-y change was 47 per cent in rupee terms. However, the FDI y-o-y growth has dramatically fallen to 16 per cent in rupee terms during April−September. This only helps highlight the prevailing uncertainties in the Indian economy and this is the value taken in the Low Case scenario. FDI is assumed to grow at 30 per cent in 2015−16 and 2016−17. These assumptions are based on the current government's emphasis on forging trade agreements, attracting FDI, opening up previously closed sectors to FDI and the emphasis on 'Make in India' initiative.
- Net Invisibles (Netinv): This is assumed to grow at five per cent for 2014−15. This is because there is negative y-o-y growth of net services in dollar terms (–6.6%) during the period April to September. Further uneven growth of the rest of the world indicates that this trend may only continue. For the rest of the forecasting period, net invisibles are assumed to grow at 15 per cent. Foreign Institutional Investment is assumed to

grow at 100 per cent on a y-o-y basis in 2014−15 and thereafter it grows at ten per cent.

- Public Gross Fixed Capital Formation in agriculture and non-agriculture sectors are assumed to grow at 12 and 10 per cent, respectively for the period 2014−15 to 2016-17. This assumption is based on previous literature review.

Fiscal Account

- Centre Subsidies: Total subsidies were at 2.3 per cent of GDP in 2013−14 and are budgeted to be at two per cent of GDP in 2014−15. Over the projection period, major subsidies are estimated to reduce to 1.7 and 1.6 per cent of GDP respectively as per the Medium Term Fiscal Policy Statement of the Union Budget 2014−15. Based on these numbers, we assume that subsidies are growing at two per cent on a y-o-y basis for the period 2014−15 to 2019−20.
- General Government Expenditure on Health and Education: Based on the Economic Survey's emphasis on inclusive development agenda, both are assumed to grow by 13.3 per cent during the forecasting period. This is a weighted average rate of growth, the weights being the capital and revenue expenditures.
- Direct Tax Rate (Centre): Statistical evidence suggests that direct taxes between 2008−09 and 2011−12 are not buoyant but they are for longer time periods. This period also coincided with volatile economic growth. The direct tax collection rate was 5.9 per cent in 2008−09 and the average rate of growth between 2008−09 and 2013−14 was −3.3 per cent. If one looks at the ten year average the growth of the direct tax rate is 4.4 per cent. The 2013−14 budget assumed that direct taxes will grow at 18 per cent. In 2013−14, the actual direct taxes grew only by 13.5 per cent. Further, given the lower than expected direct tax revenue collection in the current fiscal, it is assumed that the direct tax rate will grow at one per cent in the current fiscal and at two per cent thereafter.
- Indirect Tax Rate (Centre): Indirect taxes are not as buoyant as direct taxes except for the period 2008−09 to 2011−12. The 2013−14 budget assumed that indirect taxes will grow at 20 per cent. In 2013−14, the actual indirect taxes grew only by 11 per cent. In the current fiscal year, the budget estimates for the y-o-y for indirect taxes are 19 per cent. Therefore, it is assumed that the indirect tax rate at the Centre will experience no growth in the current fiscal but will grow by one per cent for the rest of the forecasting period.
- Disinvestment (Rs crore): Disinvestment is assumed to be at the budget estimate of Rs 63,425 for the current fiscal year. However, only Rs 121 crore has been collected between the period April to September for the current fiscal. For the rest of the forecasting period, it is assumed that a constant stream of Rs 55,000 crore will come in the form of disinvestment receipts.

Other Variables

- Agriculture related: Rainfall is assumed to be normal except for the current fiscal. The gross irrigated area is assumed to grow at two per cent per annum and this assumption

is based on the literature. The rise in minimum support prices for rice, wheat and sugarcane is the average for 2003-2013 removing outliers.

- WPI Energy: Given the weakening of price of crude oil, it is assumed that WPI Energy will grow by five per cent in the current fiscal and 6.5 per cent thereafter for the forecasting period.
- M3: The assumption for the current fiscal is based on the growth rate available based on current trends for the last six months (13%). The ten-year average growth rate is assumed for the rest of the forecasting period.

Results

The results are summarized in Table D.1 below. GDP at constant 2004-05 prices is expected to grow at 5.2 in 2014-15 and pick up from the next fiscal. The average GDP growth for the period 2015-16 to 2017-18 is expected to be 6.93 percent. Across production sectors, the services sector is expected to register higher growth of 8.24 per cent in 2015-16, followed by industry at around three per cent. WPI Inflation rate stays relatively within range at 5.2 per cent over 2015-2018. This is because of moderating and weak crude oil prices. The average current account deficit will be around 2.7 per cent of GDP. It shows an increase due to fall in growth rates of FDI and FII flows. Fiscal deficit shows signs of falling over time but it never really reaches the Medium Term Fiscal Policy Targets as laid out in Budget 2014−15.

Table D.1: Results

Variables	**2014-15**	**2015-16**	**2016-17**	**2017-18**
% yoy change				
Real GDP				
- Agriculture	1.85	3.73	3.08	3.28
- Industry	2.04	3.13	6.06	6.71
- Services	7.38	8.24	8.20	8.60
Total GDP	5.21	6.34	7.00	7.47
Exports ($-term)	5.39	6.46	7.16	6.16
Imports ($-term)	9.90	15.25	10.61	10.76
Inflation (WPI)	4.21	4.94	5.26	5.36
As Percentage of GDPmp				
Current Account_RBI	-1.29	-2.57	-2.74	-2.70
Fiscal Deficit Centre	4.43	3.89	3.63	3.49
Fiscal Deficit Total	6.72	6.07	5.81	5.49

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