GCISC Research Report
GCISC-RR–19

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Kaleem Anwar Mir
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Global Change Impact Studies Centre,
Ministry of Climate Change, Islamabad, Pakistan

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PREFACE

Climate change is now generally accepted as the biggest socio-economic challenge faced by the world today. The underlying cause is the increasing concentration of carbon dioxide (CO_2) and other greenhouse gases (GHG) in the atmosphere due to ever increasing use of fossil fuels since the advent of the Industrial Revolution in the 18th Century and increased agricultural activities associated with the growing world population. As per findings of the Intergovernmental Panel on Climate Change (IPCC), the atmospheric concentration of CO_2 in 2011 exceeded its pre-industrial level by about 40%. As a result, the globally averaged surface temperature in the year 2000 was about 0.65 °C higher than the pre-industrial level. It increased further by about 0.2 °C during the first 12 years of this century.

Since global warming is the main driver of climate change, United Nations Framework Convention on Climate Change (UNFCCC) is striving hard for not allowing the global average temperature to rise beyond 2°C above the pre-industrial level in order to prevent unmanageable adverse impacts of climate change. In this regard Kyoto Protocol, with binding commitments by industrialized countries to reduce their GHG emissions, was signed in 1997 and came into force in 2005. Its first commitment period (with 37 industrialized countries and the European Community committed to reduce GHG emissions to an average of five percent against 1990 levels) started in 2008 and ended in 2012. However, these targets were not satisfactorily achieved. Recently the UNFCCC at its 21st Conference of Parties (COP-21) held in Paris in December 2015, have yielded an international agreement (called The Paris Climate Agreement) pledging to keep warming well below 2°C, and endeavoring to limit it to 1.5°C. Indeed this is a breakthrough and the ambitious nature of the agreement is laudable but the real work has yet to begin.

An essential element of the UNFCCC effort for stabilizing GHG concentrations and to prevent reaching unmanageable levels of climatic changes is to have a systematic record of the GHG emissions of various countries so that their time trends may be properly monitored. In order to contribute towards this objective, Pakistan worked out its GHG emissions Inventory for the year 1993-94 covering various socio-economic sectors as per guidelines of IPCC and submitted it along with its Initial National Communication to UNFCCC in 2003. Another such effort was made in 2009 in relation to the work of Pakistan Planning Commission's Task Force on Climate Change, when the GHG Inventory for the year 2008 was worked out. The present report provides updated information on Pakistan's GHG emissions for the year 2012. It is hoped that the GHG emissions reported in this Inventory together with those provided in the country's previous two GHG Inventories (for 1994 and 2008) will serve a useful purpose in systematically working out Pakistan's Intended Nationally Determined Contributions (INDCs) as per requirement of UNFCCC in connection with the COP-21 deliberations.

I very much appreciate the efforts of Mr. Kaleem Anwar Mir (Scientific Officer) and Mr. Muhammad Ijaz (Senior Scientific Officer) in bringing out this report under kind supervision of Dr. Arshad Muhammad Khan (Former Executive Director, GCISC). I hope it will serve as a useful document for the Ministry of Climate Change and other relevant organizations while preparing Pakistan's future National Communications to UNFCCC as well as other reports.

Syed Mahmood Nasir
Executive Director (GCISC)

TABLE OF CONTENTS

Acknowledgement

First and foremost, we offer our sincere gratitude to Mr. Syed Mehmood Nasir, Executive Director, Global Change Impact Studies Centre (GCISC) for his keenness in concluding this report. We are greatly indebted to Dr. Arshad Muhammad Khan, Former Executive Director, Global Change Impact Studies Centre (GCISC) for his initiative to carry out such analysis and continued technical support in completing the final report whilst allowing us the room to work in our own way. We are also thankful Mr. Irfan Tariq, Director General (Environment), Ministry of Climate Change, for his constant encouragement throughout the research work. We generously acknowledge Mr. Ghulam Rasool Athar, Director and Mr. Ijaz Ahmad, Principle Engineer, Applied System and Analysis Division (ASAD), Pakistan Atomic Energy Commission (PAEC) for their valuable technical comments to improve the quality of this document. Also, we are particularly obliged to Mr. Jongikhaya Witi (Independent Climate Change Expert), Director, Climate Change Monitoring and Evaluation, Department of Environmental Affairs, South Africa for providing necessary technical suggestions and appreciation to this report. Sincere thanks to Ministry of Foreign Affairs (Government of Pakistan) and Dr. Muhammad Aslam, Food Security Commissioner, Ministry of National Food Security and Research (Government of Pakistan), for their appreciation of the research effort described in this report. We are grateful to Mr. Shahbaz Mehmood (Head Climatology & Environment, GCISC) and Dr. Muhammad Zia-ur-Rahman Hashmi (Head Water Resources & Glaciology, GCISC) for their continuous support throughout the report finalization process. Last but not the least; we would like to extend our gratitude to Honorable Vice-Chairman BoG-GCISC / Secretary, Ministry of Climate Change, for his encouragement and approval of this research document for publication.

About the Authors

Kaleem Anwar Mir is working as a Scientific Officer at Global Change Impact Studies Centre (GCISC) in Ministry of Climate Change, Islamabad. He is also a qualified member of UNFCCC (United Nations Framework Convention on Climate Change) expert review teams participating in the annual reviews of greenhouse gas inventories of parties included in Annex I to the convention. His research work mainly involves: (i) preparation and review of national GHG inventories under the UNFCCC; (ii) energy and environment (air pollution & GHGs) modeling that includes projection, impacts and mitigation of air pollutants and GHGs emission. Mr. Mir holds master's degree in Environmental Management (on ADB - Japan scholarship programme) from National University of Singapore (Singapore) and bachelor's degree in Chemical Engineering (with specialization in Environmental Engineering) from University of the Punjab, Lahore, Pakistan.

Muhammad Ijaz is a Senior Scientific Officer at Global Change Impact Studies Centre (GCISC) in Ministry of Climate Change, Islamabad. He got foreign trainings on GHG inventory for Asian region, REDD+ GHG reporting, and GHG emissions statistics (FAOSTAT database orientation). He has research interests in: (i) Greenhouse Gas (GHG) emission inventory development with focus on Agriculture, Forestry, Land Use Change and Waste sector using UNFCCC certified procedures; (ii) assessing climate change impacts on agriculture, forestry and land degradation using crop simulation modeling, remote sensing & GIS techniques. Mr. Ijaz holds MSc (Hons) degree in Agricultural Entomology from University of Arid Agriculture, Rawalpindi, Pakistan.

Greenhouse Gas Emission Inventory of Pakistan for the Year 2011-2012

Executive Summary

As per Article 4, paragraph 1 (a), and Article 12, paragraph 1(a) of the United Nations Framework Convention on Climate Change (UNFCCC), all non-Annex I Parties are required to communicate to the Conference of the Parties a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, to the extent its capacities permit, following the guidelines contained in annex to decision 17/CP.8. In order to facilitate non-Annex I Parties in developing and reporting their GHG inventories as a part of their national communications, the secretariat developed an Excel-based software which incorporated all the elements of a national GHG inventory prescribed by decision 17/CP.8. The software is based on the IPCC inventory software version 1.1 which used the Tier 1 methodologies for estimating GHG emissions and removals for all source categories described in the Revised 1996 IPCC Guidelines for National GHG Inventories, and further complimented by Good Practice Guidance's (GPG's). Since its release in 2005, most non-Annex I Parties have been using that software for development of their national GHG inventories.

In Pakistan, the first effort on preparing the GHG inventory was undertaken by Asian Development Bank (ADB) during 1995-98 under its project, the Asia Least-cost Greenhouse Gas Abatement Strategy (ALGAS). The inventory was developed by M/s Hagler Bailly for the fiscal year 1989-90 (herein called as 1990) and used the Intergovernmental Panel on Climate Change (IPCC) 1995 guidelines for inventory development. Total GHG emissions estimated in 1990 inventory were 212.9 million tonnes of CO_2 equivalents (Hagler Baily, 1995). That inventory was not submitted to the UNFCCC. The principal source of CO_2 was energy sector (62%) followed by land use change and forestry (34%). The principal source of methane was agriculture sector.

The second GHG inventory for the country was also prepared by M/s Hagler Bailly during 1999-2003, with the support of Global Environment Facility (GEF) through United Nations Environment Programme (UNEP) under the project GF/2200-97-57, for preparing Initial National Communication to UN Framework Convention on Climate Change (UNFCCC). The inventory was developed for the fiscal year 1993-94 (herein called as 1994) based on IPPC 1996 guidelines for inventory development. Total GHG emissions estimated in 1994 inventory were 181.7 million tonnes of CO_2 equivalents (Pakistan's Initial National Communication on Climate Change, 2003). Sector wise emissions estimated in 1994 Inventory were: 47.2% Energy, 39.4% Agriculture, 7.3% Industrial Processes, 3.6% Land Use, Land Use Change and Forestry (LUCF) and 2.5% Wastes. This inventory was formally submitted to UNFCCC being a part of initial national communication of Pakistan.

The third GHG inventory of Pakistan was prepared voluntarily by the Applied System Analysis Division (ASAD), Pakistan Atomic Energy Commission (PAEC) in 2009 on the request of the Pakistan Planning Commission's Task Force on Climate Change (GoP-2010). This GHG inventory was completed for the year 2007-08 (herein called as 2008) using 2006 IPCC guidelines. The results are available in the form of a draft report. In 2008 inventory, estimated GHG emissions were 309.4 million tonnes of CO_2 equivalents comprising sector-wise share of 50.7% of Energy, 38.8% of

Agriculture, 5.8% of Industrial Processes, 2.9% of LULUCF and 1.8% of Waste sector. This GHG inventory was also not submitted to UNFCCC.

This report presents the national GHG inventory of Pakistan for the year 2011-12 (herein called as 2012). It has been prepared by Global Change Impact Studies Centre (GCISC), Ministry of Climate Change, using UNFCCC Non-Annex I National Greenhouse Gas Inventory Software, Version 1.3.2 in accordance with Revised 1996 IPCC Guidelines. In these estimates, Tier-1 approach (which includes default emission factors) of Revised 1996 IPCC Guidelines has been used depending on national circumstances and the availability of data in Pakistan. The main data sources used in this inventory are Pakistan Energy Year Book 2011-12, Agricultural Statistics of Pakistan 2011-12 and Pakistan Economic Survey 2011-12.

The total estimated emissions in terms of million tonnes of CO_2 equivalent for year 2012 shows an increase in total GHG emissions when compared with inventories of 1994 and 2008. The total estimated GHG emissions of the year 2012 are 374.1 million tonnes of CO_2 equivalents with 45.8% share of Energy sector, 5.2% share of Industrial Processes, 43.5% share of Agriculture, 2.6% share of LUCF and 2.8% share of Waste sector. Furthermore, in 2012, the CO_2 emission estimate (from fuel combustion only) by reference and sectoral approaches differs by 1.70 % which is not substantial. According to IPCC Good Practice Guidance (IPCC, 2000) the difference between both approaches should not be significant, whereas according to 2006 IPCC Guidelines typically the gap between the two approaches must be relatively small (5 per cent or less).

This report consists of a number of Tables presented in the form of nine Annexures. **Annexure 1** shows summary tables and pie charts of emissions for 1994, 2008 and 2012 inventories. **Annexure 2** presents summary tables of 1994, 2008 and 2012 GHG emission inventory estimates. **Annexure 3** shows emission factors used in 1994, 2008 and 2012 GHG inventories for emissions estimations. **Annexure 4** displays fossil fuel consumption data of Pakistan for the years 1994, 2008 and 2012. **Annexure 5 - 9** provides detailed worksheets of emission estimates of energy sector, industrial processes, agriculture sector, land use change and forestry sector, waste sector respectively.

Annexure 1:

Summary tables and pie charts of Pakistan's emissions in 1994, 2008 and 2012 inventories

Table 1(a). National emissions in 1994, 2008 and 2012, by pollutant (thousand tonnes)

Pollutants	1994	2008	2012
Carbon Dioxide (CO_2)	94,572	166,631	178,805
Methane (CH_4)	2,891	4,448	5,109
Nitrous Oxide (N_2O)	37	96	260
Oxides of Nitrogen (NO_x)	410	739	770
Carbon Monoxide (CO)	732	1,068	3,127
Non-Methane Volatile Organic Compound (NMVOC)	657	291	443
Sulphur Dioxide (SO_2)	775	1,065	844

Table 1(b). Compound Annual Growth Rates (CAGR) of national emissions for periods 1994-2008, 2008-2012 and 1994-2012, by pollutant

Pollutants	1994-2008	2008-2012	1994-2012
Carbon Dioxide (CO_2)	4.1	1.8	3.6
Methane (CH_4)	3.1	3.5	3.2
Nitrous Oxide (N_2O)	7.0	28.3	11.4
Oxides of Nitrogen (NO_x)	4.3	1.0	3.6
Carbon Monoxide (CO)	2.7	30.8	8.4
Non-Methane Volatile Organic Compound (NMVOC)	-5.7	11.1	-2.2
Sulphur Dioxide (SO_2)	2.3	-5.6	0.5

Table 2(a). National GHG emissions in 1994, 2008 and 2012, by sector (thousand tonnes of CO_2 equivalent)

Sectors	1994	2008	2012
Energy	85,816	156,821	171,440
Industrial Processes	13,297	17,866	19,595
Agriculture	71,632	120,284	162,860
Land Use Change and Forestry (LUCF)	6,527	8,920	9,671
Wastes	4,454	5,505	10,554
TOTAL (Mt CO_2 eq.)	**181.7**	**309.4**	**374.1**

NOTE: All GHG emissions due to fossil fuel burning/use/combustion in Agriculture sector are covered under Energy sector.

Table 2(b). Compound Annual Growth Rates (CAGR) of national GHG emissions for periods 1994-2008, 2008-2012 and 1994-2012, by sector

Sectors	1994-2008	2008-2012	1994-2012
Energy	4.4	2.3	3.9
Industrial Processes	2.1	2.3	2.2
Agriculture	3.8	7.9	4.7
Land Use Change and Forestry (LUCF)	2.3	2.0	2.2
Wastes	1.5	17.7	4.9

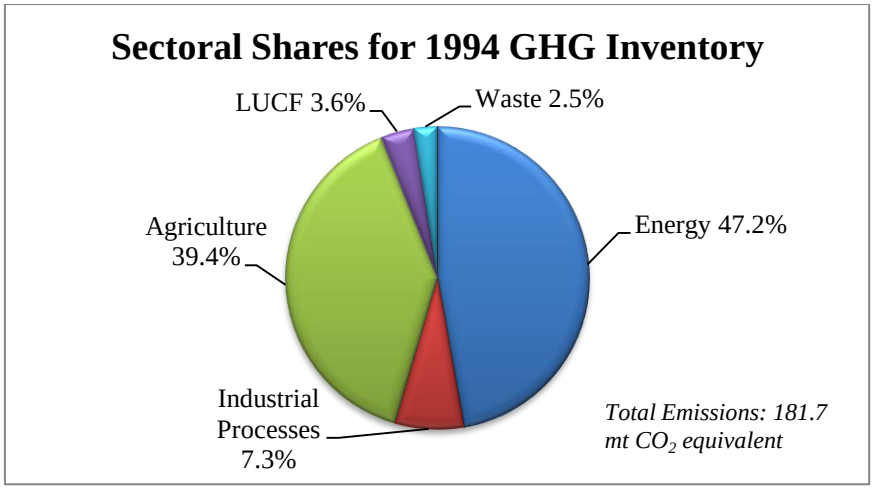
Table 3(a). Total GHG emissions per capita & per $GDP in 1994, 2008 and 2012 inventories

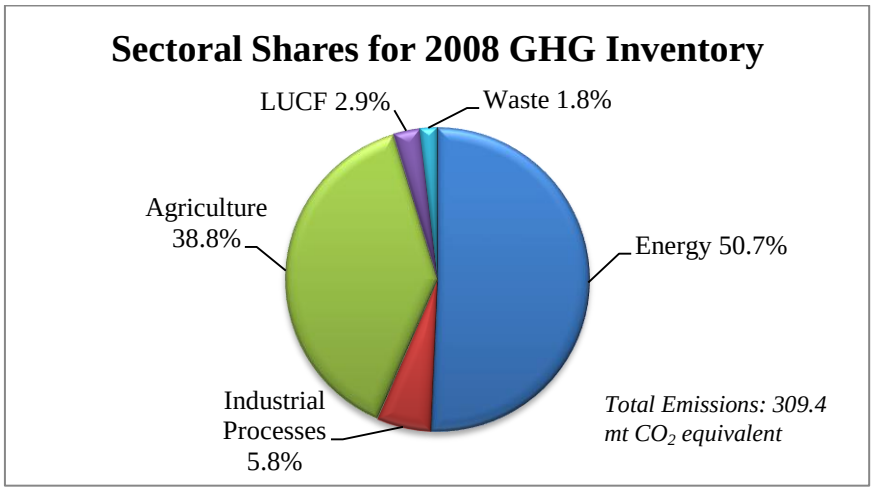
	1994	2008	2012
Total GHG emissions (million tonnes of CO2 equivalent)	181.7	309.4	374.1
Population (million)	117.93	160.97	179.2
Total GHG emissions (tonnes of CO_2 equivalent per capita)	1.54	1.92	2.09
Gross Domestic Product at constant factor cost in billion US$ of 2000	60.022	107.570	122.340
Total GHG emissions (kilogram of CO_2 equivalent) per $ GDP in US$ of 2000	3.03	2.88	3.06

NOTE (Data sources for GDP): SBP (State Bank of Pakistan) Annual Report-Statistical Supplement FY 11, FY12 & FY 13; Pakistan Statistical year Book 2012; World Bank National Accounts Data

Table 3(b). Compound Annual Growth Rates (CAGR) of above estimates for periods 1994-2008, 2008-2012 and 1994-2012

	1994-2008	2008-2012	1994-2012
Total GHG emissions (million tonnes of CO2 equivalent)	3.9	4.9	4.1
Population 2012 (million)	2.2	2.7	2.4
Total GHG emissions (tonnes of CO2 equivalent per capita)	1.6	2.1	1.7
Gross Domestic Product at constant factor cost in billion US$ of 2000	4.3	3.3	4.0
Total GHG emissions (kilogram of CO_2 equivalent) per $ GDP in US$ of 2000	- 0.4	1.5	0.05





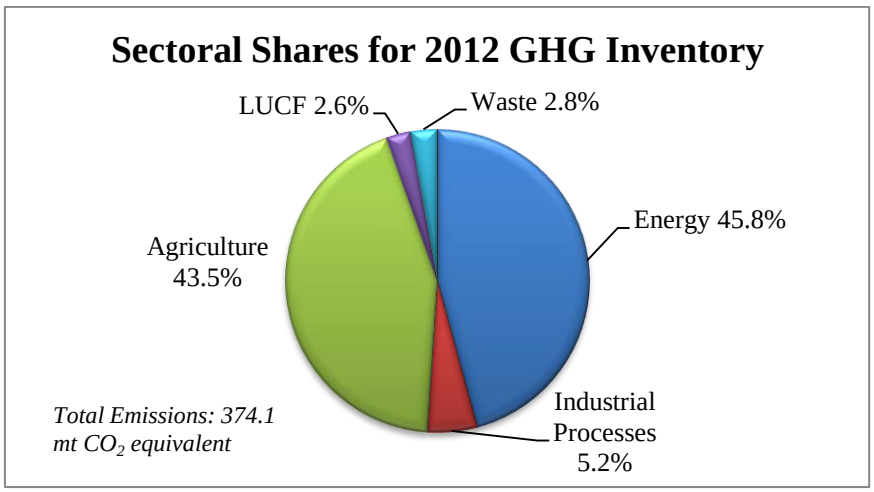


Figure 1. Sectoral emissions (%) in 1994, 2008 & 2012 GHG inventories

Annexure 2:

Summary tables of 1994, 2008 and 2012 GHG emission inventory estimates

Country	**Pakistan**
Inventory Year	**1994**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	**94,571.9**	**0**	**2,891.2**	**36.9**	**410.26**	**732.13**	**656.88**	**775.46**
1. Energy	**77,171.8**	**0**	**281.4**	**0.61**	**409.91**	**706.13**	**34.27**	**764.49**
A. Fuel combustion (sectoral approach)	77,171.8		4.1	0.61	409.51	705.53	30.19	755.57
1. Energy Industries	21,600.9		0.9	0.052	75.72	6.552	0.014	260.78
2. Manufacturing industries and construction	24,895.9		0.5	0.21	60.48	67.79	3.50	375.35
3. Transport	18,584.4		1.9	0.17	172.76	592.15	11.79	94.52
4. Other sectors	12,090.6		0.8	0.17	100.56	39.04	14.89	24.93
5. Other (please specify)	0		0	0	0	0	0	0
B. Fugitive emissions from fuels	0		277.2		0.39	0.59	4.08	8.91
1. Solid fuels			47.2		0	0	0	0
2. Oil and natural gas			229.5			0	0	0
3. Ozone precursors & SO_2					0.39	0.59	4.08	8.91
2. Industrial processes	**11,269.6**	**0**	**0**	**0**	**0**	**15.75**	**622.61**	**10.97**
A. Mineral products	4,350.3				0	0	578.12	2.43
B. Chemical industry	2,990.5		0	0	0	15.75	9.37	1.85
C. Metal production	3,928.8		0	0	0	0	0	0
D. Other production	0		0	0	0	0	35.12	6.69
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	0	0	0	0
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**2,507.9**	**29.92**	**0.35**	**10.25**	**0**	**0**
A. Enteric fermentation			2,093.0					
B. Manure management			191.8	0			0	
C. Rice cultivation			222.6				0	
D. Agricultural soils				29.91			0	
E. Prescribed burning of savannahs			0	0	0	0	0	
F. Field burning of agricultural residues			0.5	0.01	0.35	10.25	0	
G. Other (please specify)			0	0	0	0	0	
5. Land-use change and forestry [1]	**6,527.1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Changes in forest and other woody biomass stocks	6,527.1	0						
B. Forest and grassland conversion	0	0	0	0	0	0		
C. Abandonment of managed lands		0						
D. CO_2 emissions and removals from soil	0	0						
E. Other (please specify)	0	0	0	0	0	0		
6. Waste			**101.9**	**6.40**	**0**	**0**	**0**	**0**
A. Solid waste disposal on land			92.0		0		0	
B. Waste-water handling			9.9	0	0	0	0	
C. Waste incineration					0	0	0	0
D. Other (human sewage)			0	6.40	0	0	0	0

(Source: Pakistan's Initial National Communication on Climate Change (2003), Ministry of Environment, Islamabad-Pakistan)

Country	**Pakistan**
Inventory Year	**1994**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors, (in Gg / kt of CO_2 equivalent)

Greenhouse gas source and sink categories	CO_2 emissions		CH_4	N_2O		CO	NMVOCs	Total
Total national emissions and removals	**94,572**		**72,265**	**11,002**		**1,390**	**2,100**	**181,726**
1. Energy	**77,172**		**7,020**	**181**		**1,341**	**103**	**85,816**
A. Fuel combustion (sectoral approach)	77,172		103	181		1,341	103	78,898
1. Energy Industries	21,601		23	15		12	0	21,651
2. Manufacturing industries and construction	24,896		13	64		129	12	25,113
3. Transport	18,584		48	51		1,125	40	19,848
4. Other sectors	12,091		20	51		74	51	12,286
5. Other (please specify)	0		0	0		0	0	0
B. Fugitive emissions from fuels	0		6,918			0	0	6,918
1. Solid fuels			1,180			0	0	1,180
2. Oil and natural gas			5,738			0	0	5,738
2. Industrial processes	**11,270**		**0**	**0**		**30**	**1,997**	**13,297**
A. Mineral products	4,350					0	1,966	6,316
B. Chemical industry	2,991		0	0		30	32	3,052
C. Metal production	3,929		0	0		0	0	3,929
D. Other production	0		0	0		0	119	119
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0		0	0	
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**62,698**	**8,915**		**19**	**0**	**71,632**
A. Enteric fermentation			52,325					52,325
B. Manure management			4,795	0			0	4,795
C. Rice cultivation			5,565				0	5,565
D. Agricultural soils				8,912			0	8,912
E. Prescribed burning of savannahs			0	0		0	0	0
F. Field burning of agricultural residues			13	3		19	0	35
G. Other (please specify)			0	0		0	0	0
5. Land-use change and forestry [1]	**6,527**		**0**	**0**		**0**	**0**	**6,527**
A. Changes in forest and other woody biomass stocks	6,527							6,527
B. Forest and grassland conversion	0		0	0		0		
C. Abandonment of managed lands								
D. CO_2 emissions and removals from soil	0							
E. Other (please specify)	0		0	0		0		
6. Waste			**2,548**	**1,906**		**0**	**0**	**4,454**
A. Solid waste disposal on land			2,300				0	2,300
B. Waste-water handling			248	0		0	0	248
C. Waste incineration						0	0	0
D. Other (human sewage)			0	1,906		0	0	1,906

Country	**Pakistan**
Inventory Year	**2008**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	**166,631**	**0**	**4,448**	**96**	**739**	**1,067**	**291**	**1,065**
1. Energy	**140,160**	**0**	**473**	**8**	**735**	**898**	**199**	**1,048**
A. Fuel combustion (sectoral approach)	140,160		285	8	734	897	183	1033
1. Energy Industries	44,310		1	0	113	11	5	505
2. Manufacturing industries and construction	42,408		2	0	204	49	13	368
3. Transport	30,693		10	2	302	807	149	121
4. Other sectors	20,604		271	6	115	30	16	39
5. Other (please specify)	2,145		0	0	0	0	0	0
B. Fugitive emissions from fuels	0		188		1	1	15	16
1. Solid fuels			55		0	0	0	0
2. Oil and natural gas			133		1	1	15	16
2. Industrial processes	**17,551**	**0**	**0**	**0**	**0**	**0**	**93**	**17**
A. Mineral products	13,776				0	0	93	0
B. Chemical industry	3,612		0	0	0	0	0	0
C. Metal production	163		0	0	0	0	0	0
D. Other production	0		0	0	0	0	0	17
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	0	0	0	0
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**3,785**	**85**	**5**	**169**	**0**	**0**
A. Enteric fermentation			3,206					
B. Manure management			268	1			0	
C. Rice cultivation			306				0	
D. Agricultural soils				84			0	
E. Prescribed burning of savannahs			0	0	0	0	0	
F. Field burning of agricultural residues			5	0	5	169	0	
G. Other (please specify)			0	0	0	0	0	
5. Land-use change and forestry [1]	**8,920**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Changes in forest and other woody biomass stocks	8,920	0						
B. Forest and grassland conversion	0	0	0	0	0	0		
C. Abandonment of managed lands		0						
D. CO_2 emissions and removals from soil	0	0						
E. Other (please specify)	0	0	0	0	0	0		
6. Waste			**189**	**3**	**0**	**0**	**0**	**0**
A. Solid waste disposal on land			113		0		0	
B. Waste-water handling			76	3	0	0	0	
C. Waste incineration					0	0	0	0
D. Other (please specify)			0	0	0	0	0	0
7. Other (please specify)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo items								
International bunkers	**921**		**0**	**0**	**0**	**0**	**0**	**0**
Aviation	504		0	0	0	0	0	0
Marine	417		0	0	0	0	0	0
CO_2 emissions from biomass	**93,021**							

(Source: GHG Emission Inventory of Pakistan for the year 2007-2008 (2009), ASAD, PAEC, Islamabad-Pakistan)

Country	**Pakistan**
Inventory Year	**2008**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors, (in Gg / kt of CO_2 equivalent)

Greenhouse gas source and sink categories	CO_2 emissions		CH_4	N_2O		CO	NMVOCs	Total
Total national emissions and removals	**166,631**		**111,208**	**28,538**		**2,028**	**990**	**309,395**
1. Energy	**140,160**		**11,838**	**2,440**		**1,706**	**675**	**156,821**
A. Fuel combustion (sectoral approach)	140,160		7,128	2,440		1,704	623	152,056
1. Energy Industries	44,310		30	0		21	16	44,440
2. Manufacturing industries and construction	42,408		69	0		93	46	42,735
3. Transport	30,693		243	0		1,533	508	33,474
4. Other sectors	22,750		6,786	1,761		57	53	31,407
5. Other (please specify)	0		0	0		0	0	0
B. Fugitive emissions from fuels	0		4,710			2	52	4,765
1. Solid fuels			1,378			0	0	1,378
2. Oil and natural gas			3,332			2	52	3,387
2. Industrial processes	**17,551**		**0**	**0**		**0**	**315**	**17,866**
A. Mineral products	13,776					0	315	14,091
B. Chemical industry	3,612		0	0		0	0	3,612
C. Metal production	163		0	0		0	0	163
D. Other production	0		0	0		0	0	
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0		0	0	
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**94,636**	**25,326**		**322**	**0**	**120,284**
A. Enteric fermentation			80,154					80,154
B. Manure management			6,706	333			0	7,039
C. Rice cultivation			7,651				0	7,651
D. Agricultural soils				24,995			0	24,955
E. Prescribed burning of savannahs			0	0		0	0	
F. Field burning of agricultural residues			125	38		322	0	485
G. Other (please specify)			0	0		0	0	
5. Land-use change and forestry [1]	**8,920**		**0**	**0**		**0**	**0**	**8,920**
A. Changes in forest and other woody biomass stocks	8,920							8,920
B. Forest and grassland conversion	0		0	0		0		
C. Abandonment of managed lands								
D. CO_2 emissions and removals from soil	0							
E. Other (please specify)	0		0	0		0		
6. Waste			**4,733**	**772**		**0**	**0**	**5,505**
A. Solid waste disposal on land			2,832				0	2,832
B. Waste-water handling			1,901	772		0	0	2,673
C. Waste incineration						0	0	
D. Other (please specify)			0	0		0	0	

(Source: GHG Emission Inventory of Pakistan for the year 2007-2008 (2009), ASAD, PAEC, Islamabad-Pakistan)

Country	**Pakistan**
Inventory Year	**2012**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	**178,805**	**0**	**5,109**	**260**	**770**	**3,127**	**443**	**844**
1. Energy	**149,724**	**0**	**704**	**2**	**749**	**2,626**	**389**	**819**
A. Fuel combustion (sectoral approach)	149,724		76	2	749	2,626	377	807
1. Energy Industries	47,251		1	0	103	10	3	587
2. Manufacturing industries and construction	37,651		3	0	110	35	5	156
3. Transport	37,181		9	0	367	1,300	240	46
4. Other sectors	25,944		62	1	169	1,280	129	18
5. Other (please specify)	1,697		0	0	0	0	0	0
B. Fugitive emissions from fuels	0		628		1	1	12	12
1. Solid fuels			50		0	0	0	0
2. Oil and natural gas			579		1	1	12	12
2. Industrial processes	**19,411**	**0**	**0**	**0**	**0**	**0**	**54**	**25**
A. Mineral products	15,535				0	0	54	9
B. Chemical industry	3,278		0	0	0	0	0	0
C. Metal production	598		0	0	0	0	0	0
D. Other production	0		0	0	0	0	0	16
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	0	0	0	0
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**3,990**	**252**	**21**	**500**	**0**	**0**
A. Enteric fermentation			3,511					
B. Manure management			327	12			0	
C. Rice cultivation			129				0	
D. Agricultural soils				239			0	
E. Prescribed burning of savannahs			0	0	0	0	0	
F. Field burning of agricultural residues			24	1	21	500	0	
G. Other (please specify)			0	0	0	0	0	
5. Land-use change and forestry [1]	**9,671**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Changes in forest and other woody biomass stocks	9,671	0						
B. Forest and grassland conversion	0	0	0	0	0	0		
C. Abandonment of managed lands		0						
D. CO_2 emissions and removals from soil	0	0						
E. Other (please specify)	0	0	0	0	0	0		
6. Waste			**414**	**6**	**0**	**0**	**0**	**0**
A. Solid waste disposal on land			367		0		0	
B. Waste-water handling			47	6	0	0	0	
C. Waste incineration					0	0	0	0
D. Other (please specify)			0	0	0	0	0	0
7. Other (please specify)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo items								
International bunkers	**928**		**0**	**0**	**0**	**0**	**0**	**0**
Aviation	613		0	0	0	0	0	0
Marine	315		0	0	0	0	0	0
CO_2 emissions from biomass	**23,071**							

Country	**Pakistan**
Inventory Year	**2012**

National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors, (in Gg / kt of CO_2 equivalent)

Greenhouse gas source and sink categories	CO_2 emissions		CH_4	N_2O		CO	NMVOCs	Total
Total national emissions and removals	**178,805**		**107,289**	**80,600**		**5,941**	**1,506**	**374,142**
1. Energy	**149,724**		**14,784**	**620**		**4,989**	**1,323**	**171,440**
A. Fuel combustion (sectoral approach)	149,724		1,596	620		4,989	1,282	158,211
1. Energy Industries	47,251		21	0		19	10	47,301
2. Manufacturing industries and construction	37,651		63	0		67	17	37,798
3. Transport	37,181		189	0		2,470	816	40,656
4. Other sectors	25,944		1,302	310		2,432	439	30,427
5. Other (please specify)	1,697		0	0		0	0	1,697
B. Fugitive emissions from fuels	0		13,188			2	41	13,231
1. Solid fuels			1,050			0	0	1,050
2. Oil and natural gas			12,159			2	41	12,202
2. Industrial processes	**19,411**		**0**	**0**		**0**	**184**	**19,595**
A. Mineral products	15,535					0	184	15,719
B. Chemical industry	3,278		0	0		0	0	3,278
C. Metal production	598		0	0		0	0	598
D. Other production	0		0	0		0	0	
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0		0	0	
3. Solvent and other product use	**0**			**0**			**0**	
4. Agriculture			**83,790**	**78,120**		**950**	**0**	**162,860**
A. Enteric fermentation			73,731					73,731
B. Manure management			6,867	3,720			0	10,587
C. Rice cultivation			2,709				0	2,709
D. Agricultural soils				74,090			0	74,090
E. Prescribed burning of savannahs			0	0		0	0	
F. Field burning of agricultural residues			504	310		950	0	1,764
G. Other (please specify)			0	0		0	0	
5. Land-use change and forestry [1]	**9,671**		**0**	**0**		**0**	**0**	**9,671**
A. Changes in forest and other woody biomass stocks	9,671							9,671
B. Forest and grassland conversion	0		0	0		0		
C. Abandonment of managed lands								
D. CO_2 emissions and removals from soil	0							
E. Other (please specify)	0		0	0		0		
6. Waste			**8,694**	**1,860**		**0**	**0**	**10,554**
A. Solid waste disposal on land			7,707				0	7,707
B. Waste-water handling			987	1,860		0	0	2,847
C. Waste incineration						0	0	
D. Other (please specify)			0	0		0	0	

Annexure 3:

Emission factors used for emissions estimation in 1994, 2008 and 2012 GHG inventories

Emission factors used for estimation of national emissions from various sectors

1. Energy sector (fuel combustion)

1.1 CO_2 emission factors from fuels

Fuel	Unit	Conversion Factor (TJ/Unit)	Carbon Content (tC/TJ)	Oxidized Fraction	CO_2 Emissions (tCO_2/TJ)
Crude Oil	TOE	0.0420	20.0	0.99	72.5
Gasoline	TOE	0.0420	18.9	0.99	68.5
Jet Kerosene	TOE	0.0420	19.5	0.99	70.7
Other Kerosene	TOE	0.0420	19.6	0.99	71.0
Gas/Diesel Oil	TOE	0.0420	20.2	0.99	73.2
Furnace oil	TOE	0.0420	21.1	0.99	76.5
LPG	TOE	0.0420	17.2	0.99	62.3
Naphtha	TOE	0.0420	20.0	0.99	72.5
Coking Coal	TOE	0.0420	25.8	0.98	92.5
Sub-bit. Coal	TOE	0.0420	26.2	0.98	94.0
Natural Gas	TOE	0.0398	15.3	0.995	55.7

2. Energy industries

2.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Diesel Oil	0.9	0.4	200	16	NA
Furnace Oil	0.9	0.3	200	15	NA
Coal	0.7	1.6	380	09	NA
Natural Gas	6.0	NA	250	18	NA
Revised 1996 IPCC Guidelines					
Diesel Oil	3	0.6	200	15	5
Furnace Oil	3	0.6	200	15	5
Coal	1	1.5	300	20	5
Natural Gas	1	0.1	150	20	5
2006 IPCC Guidelines					
Diesel Oil	3	0.6	180	12	10
Furnace Oil	3	0.6	180	15	10
Coal	1	1.5	150	20	5
Natural Gas	1	0.1	180	19	5

2.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor kg/TJ
Local Coal	11.9	3	30%	3529
Furnace Oil	40.4	4	0%	1980
Diesel Oil	43.0	0.3	0%	139

3. Manufacturing industries

3.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Diesel Oil	0.2	0.4	65.0	16.0	5.0
Furnace Oil	3.0	0.3	170.0	208.0	5.0
Coking Coal	1.0	1.4	35.0	211.0	20.0
Local Coal	1.0	1.6	130.0	211.0	20.0
Natural Gas	1.4	0.1	64.0	180.0	5.0
Revised 1996 IPCC Guidelines					
Diesel Oil	2.0	0.6	200.0	10.0	5.0
Furnace Oil	2.0	0.6	200.0	10.0	5.0
Coal	10.0	1.4	300.0	150.0	20.0
Natural Gas	5.0	0.1	150.0	30.0	5.0
2006 IPCC Guidelines					
Diesel Oil	3.0	0.6	1100.0	370.0	160.0
Furnace Oil	3.0	0.6	165.0	15.0	10.0
Coal	10.0	1.5	300.0	150.0	20.0
Natural Gas	1.0	0.1	250.0	18.0	5.0

3.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor kg/TJ
Diesel Oil	43.0	0.3	0%	139
Furnace Oil	40.4	4	0%	1980
Coking Coal	25.8	0.5	5%	368
Local Coal	18.8	3	30%	2234

4. Transport sector

4.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Gasoline	20	0.6	600	8000	200
Jet Kerosene	0.5	2	300	100	0
Diesel Oil	5	0.6	800	1000	5
Furnace Oil	5	0.6	1200	1000	200
Coal	10	1.4	300	150	200
Natural Gas (CNG)	50	0.1	600	400	20
Revised 1996 IPCC Guidelines					
Gasoline	20	0.6	600	8000	1500
Jet Kerosene	0.5	2	300	100	50
Diesel Oil	5	0.6	800	1000	200
Furnace Oil	5	0.6	1200	1000	200
Coal	10	1.4	300	150	20
Natural Gas (CNG)	50	0.1	600	400	5
2006 IPCC Guidelines					
Gasoline	33	3.2	600	800	300
Jet Kerosene	0.5	2	250	150	30
Diesel Oil	3.9	3.9	800	350	200
Furnace Oil	4.15	28.6	1800	610	130
Natural Gas (CNG)	92	3	600	400	5

4.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor kg/TJ
Diesel Oil	43.0	0.3	0%	139
Furnace Oil	40.4	4	0%	1980
Gasoline	44.3	0.1	0%	45
Jet Kerosene	44.1	0.05	0%	22

5. Commercial / Service sector

5.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Kerosene	1.4	0.3	170	15	NA
LPG	NA	NA	70.5	10.2	NA
Coal	10	NA	240	200	200
Natural Gas	1.2	2.3	45	9.4	5
Revised 1996 IPCC Guidelines					
Kerosene	10	0.6	100	20	5
LPG	NA	NA	NA	NA	NA
Coal	10	1.4	100	2000	200
Natural Gas	5	0.1	50	50	5
2006 IPCC Guidelines					
Kerosene	10	0.6	100	20	5
LPG	5	0.1	47	10	5
Natural Gas	5	0.1	47	10	5

5.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor kg/TJ
Diesel Oil	43.0	0.3	0%	139
Furnace Oil	40.4	4	0%	1980

6. Residential sector

6.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Kerosene	1.4	NA	170	15	NA
LPG	1.1	NA	47	10	NA
Coal	150	1.4	55	2000	200
Natural Gas	1	0.1	47	10	5
Revised 1996 IPCC Guidelines					
Kerosene	10	0.6	100	20	5
LPG	NA	NA	NA	NA	NA
Coal	300	1.4	100	2000	200
Natural Gas	5	0.1	50	50	5
2006 IPCC Guidelines					
Kerosene	10	0.6	100	20	5
LPG	5	0.1	47	10	5
Coal	300	1.5	NA	NA	NA
Natural Gas	5	0.1	47	10	5

6.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor Kg/TJ
Local Coal	18.8	3	30%	2234

7. Agriculture sector

7.1 Non-CO_2 emission factors

Fuel	CH_4 kg/TJ	N_2O kg/TJ	NO_x kg/TJ	CO kg/TJ	NMVOC kg/TJ
Initial Communication 1994					
Diesel Oil (Stationary)	5	0.6	1200	1000	200
Diesel Oil (Mobile)					
Revised 1996 IPCC Guidelines					
Diesel Oil (Stationary)	10	0.6	100	20	5
Diesel Oil (Mobile)	5	0.6	1200	1000	200
2006 IPCC Guidelines					
Diesel Oil (Stationary)	10	0.6	1100	370	160
Diesel Oil (Mobile)	4.5	28.6	1200	320	170

7.2 SO_2 emission factors

Fuel	Conversion factor TJ/k tonnes	S content (%)	Retained in Ash (%)	Emission Factor Kg/TJ
Diesel Oil	43.0	0.3	0%	139

8. Fugitive emissions from fuels

8.1 Methane emission factors for coal mining and handling (m^3 CH_4/Tonne)

Activity	Initial Communication 1994	Revised 1996 IPCC Guidelines	2006 IPCC Guidelines
Coal Mining (underground)	17.5	18	17.5
Post Mining	2.45	2.5	2.45

8.2 Methane emission factors for oil & natural gas activities (kg/PJ)

Activity	Initial Communication 1994	Revised 1996 IPCC Guidelines	2006 IPCC Guidelines	Used in 2012 GHG Inventory
OIL				
Production	2650	300 – 5000	20000-	2750
Transport	745	745	116500	745
Refining	140	90 – 1400	70-1100	240
			145-670	
GAS				
Production/Processing	288000	221000 – 305000		298000
Transmission & Distribution	118000	118000 – 288000	10400-63000 38000-81000	128000

8.2.1 Ozone precursors and SO_2 emission factor from oil refining

Gases	Emission Factors (kg/Tonne)
CO	0.09
NOx	0.06
NMVOC	0.62
SO2	0.93

8.2.2 SO_2 emission factor from sulphur recovery plants (oil refinery)

Gas	Emission Factor (kg/Tonne)
SO_2	139.0

8.2.3 NMVOC emission factor from storage & handling (oil refinery)

Gas	Emission Factor (kg/Tonne)
NMVOC (Primary Seals)	0.7

9. Industrial processes

Processes 2011-2012 Production (million Tonnes)	2011-12 Production (Mt)	Emission Factors		
		CO2 (t CO_2/Tonne)	NMVOC (t NMVOC/tonne)	SO2 (t SO_2/tonne)
Cement	21.41	0.498		
Lime Stone Used	1.005	0.440		
Dolomite Used	0.077	0.440		
Soda Ash Production & Use	0.27	0.415		
Asphalt Use	0.17		0.32	
Urea Consumption	3.3	1.5		
Steel Production	0.19	1.6		
Pulp and Paper	0.35			0.030

10. Agriculture sector

10.1 Livestock data for year 2012

Livestock Type	Number of Animals	Methane Emission Factors	
		Enteric Fermentation	Manure Management
	(thousands)	(kg/head/yr)	(kg/head/yr)
Dairy Cattle	10888	46	6
Non-dairy Cattle	26012	25	2
Buffalo	32700	55	5
Sheep	28418	5	0.21
Goats	63147	5	0.22
Camels	1000	46	2.56
Horses	400	18	2.18
Mules & Asses	5029	10	1.19
Poultry	721000	-	0.023

10.2 Methane emission factor of rice fields

Harvested Area (2012) (1000 ha)	Scaling Factor for Methane Emissions	Correction Factor for Organic Amendment	Emission Factor (g/m^2)
2571	0.5	1	10

10.3 Crops residue burning in year 2012*

Measure	Unit	Sugar Cane	Rice	Wheat	Emission Ratios	
Annual Production	(Gg crop)	58396	6160	23473	CH_4	0.05
Residue to Crop Ratio		0.1	1.4	1.3		
Quantity of Residue	(Gg biomas)	5840	8624	30515	CO	0.06
Dry Matter Fraction	(fraction)	0.9	0.83	0.83		
Quantity of Dry Residue	(Gg dm)	5256	7158	25327	N_2O	0.07
Fraction Burned in Fields	(fraction)	0.4	0.58	0.10		
Fraction Oxidized	(fraction)	0.9	0.9	0.9	NO_x	0.121
Total Biomass Burned	(Gg dm)	1892	4832	11625		

*detailed approach for derivation of this information is presented on page 101.

Annexure 4:

Fossil fuel consumption data of Pakistan for the years 1994, 2008 and 2012

Fossil fuel supply data of Pakistan for the Year 1994

Fossil Fuel Consumption (by sector/fuel): Unit: Tonne of Oil Equivalent (TOE)*

Sector	Motor Spirit	Kerosene	Diesel	LDO	Fuel Oil	Aviation Fuel	Total Oil Products	Natural Gas	LPG	Coal	Total
Household		608,490					608,490	1,929,582	103,694	1481	2,643,247
Agriculture			1,345,308	320,722			1,666,030				1,666,030
Transport	1,246,576	1,070	3,992,846	2,075	66,305	441,298	5,750,170	1,006			5,751,176
Industries			191,742	1,161	1,431,304		1,624,207	3,700,663		1,560,065	6,884,935
Services		17,860					17,860	356,595	34,565		409,020
Power			355,907		3,469,935		3,825,842	4,264,102		19,508	8,109,452
Total	1,246,576	156,757	5,885,803	323,958	4,967,544	441,298	13,492,599	10,251,948	138,259	1,581,054	25,463,860

Non-Energy Uses:

1. Fertilizer Feed Stocks (Natural Gas)	TOE	1,661,274
2. Coke	TOE	719,743
3. Oil	Tonne	337,836
4. Total	TOE	2,718,853
5. Bunkers	TOE	150,306

Fossil Fuel Based Primary Energy:

Gas	TOE	13,212,438
Oil	TOE	14,273,521
LPG	TOE	94,630
Coal	TOE	2,300,797
Total	TOE	29,881,386

Oil and Gas Diversions: Unit: TOE

	Oil	Gas
Auxiliary Consumption	54,597	1,128,362
T & D Losses	218,200	170,854
Transfer Consumption	-	
Refining/Processing Losses	75,209	-
LPG Production from Refineries	43,629	-
LPG Consumption in Refineries	-	-
Statistical Difference	(51,451)	-

*On Gross Calorific Values, 1 TOE = 44.20 GJ.

(Source: (i) Pakistan Energy Year Book 1994 (1994), Hydrocarbon Development Institute of Pakistan (HDIP), Islamabad-Pakistan. (ii) GHG Emission Inventory of Pakistan for the year 2007-2008 (2009), ASAD, PAEC, Islamabad-Pakistan)

Fossil fuel supply data of Pakistan for the Year 2008

Fossil Fuel Consumption (by sector/fuel): Unit: Tonne of Oil Equivalent (TOE)*

Sector	Motor Spirit	Kerosene	Diesel	LDO	Fuel Oil	Aviation Fuel	Total Oil Products	Natural Gas	LPG	Coal	Total
Household		124,737			44		124,781	4,774,412	401,786	447	5,301,426
Agriculture			1,903,778	113,418	471		2,017,667				2,017,667
Transport	1,550,986	497	6,119,459		14,780	596,674	8,282,396	1,685,232	9,779		9,977,407
Industries	8,138	89,607	462,778		522,362		1,082,885	8,628,978		5,404,267	15,116,130
Services		20,993					20,993	793,367	208,378		1,022,738
Power			168,449		6,741,614		6,910,063	8,492,919		72,568	15,475,550
Total	1,559,124	235,834	8,654,464	113,418	7,279,271	596,674	18,438,785	24,374,908	619,943	5,477,282	48,910,918

Non-Energy Uses:

1. Fertilizer Feed Stocks (Natural Gas)	TOE	3,145,626
2. Coke	TOE	306,560
3. Oil	Tonne	447,921
4. Total	TOE	3,900,107
5. Bunkers	TOE	299,763

Fossil Fuel Based Primary Energy:

Gas	TOE	29,872,104
Oil	TOE	19,137,541
LPG	TOE	413,272
Coal	TOE	5,783,842
Total	TOE	55,206,759

Oil and Gas Diversions: Unit: TOE

	Oil	Gas
Auxiliary Consumption	102,664	1,283,173
T & D Losses	-	709,703
Transfer Consumption	-	358,694
Refining/Processing Losses	238,548	-
LPG Production from Refineries	232,382	-
LPG Consumption in Refineries	33,764	-
Statistical Difference	(356,523)	-

*On Gross Calorific Values, 1 TOE = 44.20 GJ.

(Source: (i) Pakistan Energy Year Book 2008 (2008), Hydrocarbon Development Institute of Pakistan (HDIP), Islamabad-Pakistan. (ii) GHG Emission Inventory of Pakistan for the year 2007-2008 (2009), ASAD, PAEC, Islamabad-Pakistan)

Fossil fuel supply data of Pakistan for the Year 2012

Fossil Fuel Consumption (by sector/fuel): Unit: Tonne of Oil Equivalent (TOE)*

Sector	Motor Spirit	Kerosene	Diesel	LDO	Fuel Oil	Aviation Fuel	Total Oil Products	Natural Gas	LPG	Coal	Total
Household		81,930			27		81,957	6,128,822	251,356	0	6,462,135
Agriculture			2,725,729	24,271			2,750,000				2,750,000
Transport	2,930,230	354	3,641,678	620	4,638	656,900	7,234,420	2,784,591	40,096		10,059,107
Industries	38,802	50,089	479,639		854,892		1,423,422	7,777,513		4,057,678	13,258,613
Services		24,384	103,138	466			127,988	927,272	189,614		1,244,874
Power			203,072		7,206,839		7,409,911	6,732,876		46,800	14,189,587
Total	2,969,032	156,757	7,153,256	25,357	8,066,396	656,900	19,027,701	24,351,074	481,066	4,104,478	47,964,316

Non-Energy Uses:

1. Fertilizer Feed Stocks (Natural Gas)	TOE	3,157,367
2. Coke	TOE	180,923
3. Oil	Tonne	312,285
4. Total	TOE	3,650,574
5. Bunkers	TOE	304,413

Fossil Fuel Based Primary Energy:

Gas	TOE	32,033,074
Oil	TOE	19,958,843
LPG	TOE	321,214
Coal	TOE	4,285,400
Total	TOE	56,598,531

Oil and Gas Diversions: Unit: TOE

	Oil	Gas
Auxiliary Consumption	132,377	3,681,747
T & D Losses	-	648,009
Transfer Consumption	-	194,876
Refining/Processing Losses	131,534	-
LPG Production from Refineries	182,847	-
LPG Consumption in Refineries	35,743	-
Statistical Difference	(19,355)	-

*On Gross Calorific Values, 1 TOE = 44.20 GJ.

(Source: (i) Pakistan Energy Year Book 2012 (2012), Hydrocarbon Development Institute of Pakistan (HDIP), Islamabad-Pakistan. (ii) Pakistan Integrated Energy Model (Pak-IEM) Reference Energy Scenario (2011), Ministry of Planning & Development, Islamabad-Pakistan)

Annexure 5:

Energy Sector: Worksheets of emission estimates for the year 2012

This spreadsheet contains sheet 1 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

			MODULE	**ENERGY**				
			SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
			WORKSHEET	**1-1**				
			SHEETS	**1 OF 5**				
			COUNTRY	**Pakistan**				
			YEAR	**2012**				
				A	B	C	D	E	F
				Production (TOE)	Imports (TOE)	Exports (TOE)	International Bunkers (TOE)	Stock Change (TOE)	Apparent Consumption (TOE)
FUEL TYPES									F=(A+B -C-D-E)
Liquid Fossil	Primary Fuels	Crude Oil		3296661	6319342	0		53663	9,562,340.00
		Orimulsion							0.00
		Natural Gas Liquids							0.00
	Secondary Fuels	Gasoline			1660294	863			1,659,431.00
		Jet Kerosene			282634	122157	206239		-45,762.00
		Other Kerosene							0.00
		Shale Oil							0.00
		Gas / Diesel Oil			3430392	27734	9441		3,393,217.00
		Residual Fuel Oil			6250180	595	88733		6,160,852.00
		LPG			86916			526	86,390.00
		Ethane							0.00
		Naphtha				775739			-775,739.00
		Bitumen							0.00
		Lubricants							0.00
		Petroleum Coke							0.00
		Refinery Feedstocks							0.00
		Other Oil							0.00
Liquid Fossil Totals									
Solid Fossil	Primary Fuels	Anthracite [(a)]							0.00
		Coking Coal			2669033				2,669,033.00
		Other Bit. Coal							0.00
		Sub-bit. Coal		1616368					1,616,368.00
		Lignite							0.00
		Oil Shale							0.00
		Peat							0.00
	Secondary Fuels	BKB & Patent Fuel							0.00
		Coke Oven/Gas Coke							0.00
Solid Fuel Totals									
Gaseous Fossil		Natural Gas (Dry)		32039523				6449	32,033,074.00
Total									
Biomass total									
		Solid Biomass							0.00
		Liquid Biomass							0.00
		Gas Biomass							0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.

Documentation box:

1. Fossil Fuel related data (Production, Imports, Exports, International Bunkers and Stock Change) is taken from Pakistan Energy Year Book 2012.

This spreadsheet contains sheet 2 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1-1**
SHEETS	**2 OF 5**
COUNTRY	**Pakistan**
YEAR	**2012**

FUEL TYPES			G [b] Conversion Factor (TJ/TOE)	H Apparent Consumption (TJ) H=(FxG)	I Carbon Emission Factor (t C/TJ)	J Carbon Content (t C) J=(HxI)	K Carbon Content (Gg C) K=(J/1000)
Liquid Fossil	Primary Fuels	Crude Oil	0.042	401,618.28	20	8,032,365.60	8,032.37
		Orimulsion		0.00		0.00	0.00
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline	0.042	69,696.10	18.9	1,317,256.33	1,317.26
		Jet Kerosene	0.042	-1,922.00	19.5	-37,479.08	-37.48
		Other Kerosene		0.00		0.00	0.00
		Shale Oil		0.00		0.00	0.00
		Gas / Diesel Oil	0.042	142,515.11	20.2	2,878,805.30	2,878.81
		Residual Fuel Oil	0.042	258,755.78	21.1	5,459,747.04	5,459.75
		LPG	0.042	3,628.38	17.2	62,408.14	62.41
		Ethane		0.00		0.00	0.00
		Naphtha	0.042	-32,581.04	20	-651,620.76	-651.62
		Bitumen		0.00		0.00	0.00
		Lubricants		0.00		0.00	0.00
		Petroleum Coke		0.00		0.00	0.00
		Refinery Feedstocks		0.00		0.00	0.00
		Other Oil		0.00		0.00	0.00
Liquid Fossil Totals				841,710.62		17,061,482.57	17,061.48
Solid Fossil	Primary Fuels	Anthracite [a]		0.00		0.00	0.00
		Coking Coal	0.042	112,099.39	25.8	2,892,164.16	2,892.16
		Other Bit. Coal		0.00		0.00	0.00
		Sub-bit. Coal	0.042	67,887.46	26.2	1,778,651.35	1,778.65
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel		0.00		0.00	0.00
		Coke Oven/Gas Coke		0.00		0.00	0.00
Solid Fuel Totals				179,986.84		4,670,815.51	4,670.82
Gaseous Fossil		Natural Gas (Dry)	0.0398	1,274,916.35	15.3	19,506,220.08	19,506.22
Total				**2,296,613.81**		**41,238,518.16**	**41,238.52**
Biomass total				0.00		0.00	0.00
		Solid Biomass		0.00		0.00	0.00
		Liquid Biomass		0.00		0.00	0.00
		Gas Biomass		0.00		0.00	0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.

(b) Please specify units.

Documentation box:

2. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
3. Carbon emission factors are from Revised 1996 IPCC Guidelines, Volume 2, Module 1, Table 1-2, Page 1.6

This spreadsheet contains sheet 3 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1-1**
SHEETS	**3 OF 5**
COUNTRY	**Pakistan**
YEAR	**2012**

			L	M	N	O	P
			Carbon Stored	Net Carbon Emissions	Fraction of Carbon Oxidised	Actual Carbon Emissions	Actual CO_2 Emissions
			(Gg C)	(Gg C)		(Gg C)	(Gg CO_2)
FUEL TYPES				M=(K-L)		O=(MxN)	P=(Ox[44/12])
Liquid Fossil	Primary Fuels	Crude Oil		8,032.37	0.99	7,952.04	29,157.49
		Orimulsion		0.00		0.00	0.00
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline		1,317.26	0.99	1,304.08	4,781.64
		Jet Kerosene		-37.48	0.99	-37.10	-136.05
		Other Kerosene		0.00		0.00	0.00
		Shale Oil		0.00		0.00	0.00
		Gas / Diesel Oil	0.00	2,878.81	0.99	2,850.02	10,450.06
		Residual Fuel Oil		5,459.75	0.99	5,405.15	19,818.88
		LPG	0.00	62.41	0.99	61.78	226.54
		Ethane	0.00	0.00		0.00	0.00
		Naphtha	0.00	-651.62	0.99	-645.10	-2,365.38
		Bitumen	0.00	0.00		0.00	0.00
		Lubricants	125.54	-125.54		0.00	0.00
		Petroleum Coke		0.00		0.00	0.00
		Refinery Feedstocks		0.00		0.00	0.00
		Other Oil		0.00		0.00	0.00
Liquid Fossil Totals			125.54	16,935.94		16,890.87	61,933.18
Solid Fossil	Primary Fuels	Anthracite [(a)]		0.00		0.00	0.00
		Coking Coal	213.91	2,678.25	0.98	2,624.68	9,623.84
		Other Bit. Coal		0.00		0.00	0.00
		Sub-bit. Coal		1,778.65	0.98	1,743.08	6,391.29
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel		0.00		0.00	0.00
		Coke Oven/Gas Coke		0.00		0.00	0.00
Solid Fuel Totals			213.91	4,456.90		4,367.76	16,015.13
Gaseous Fossil		Natural Gas (Dry)	634.47	18,871.75	0.995	18,777.39	68,850.42
Total			**973.93**	**40,264.59**		**40,036.02**	**146,798.74**
Biomass total			0.00	0.00		0.00	0.00
		Solid Biomass		0.00		0.00	0.00
		Liquid Biomass		0.00		0.00	0.00
		Gas Biomass		0.00		0.00	0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.

Documentation box:

4. Carbon Stored data is estimated from Pakistan Energy Year Book 2012.
5. Fraction of carbon oxidized is from Revised 1996 IPCC Guidelines, Volume 2, Module 1, Table 1-4, Page 1.8

This spreadsheet contains sheet 4 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1-1**
SHEETS	**4 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**
COUNTRY	**Pakistan**
YEAR	**2012**

		A	B	C	D	E	F
		Quantities Delivered[(a)] (TOE)	Conversion Factor (TJ/TOE)	Quantities Delivered (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)
FUEL TYPES				C=(AxB)		E=(CxD)	F=(E/1000)
Solid Fossil	Other Bituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
	Sub-Bituminous Coal	0.00	0.04	0.00	26.20	0.00	0.00
Liquid Fossil	Gasoline	0.00	0.04	0.00	18.90	0.00	0.00
	Jet Kerosene	206,239.00	0.04	8,662.04	19.50	168,909.74	168.91
	Gas / Diesel Oil	9,441.00	0.04	396.52	20.20	8,009.74	8.01
	Residual Fuel Oil	88,733.00	0.04	3,726.79	21.10	78,635.18	78.64
	Lubricants	0.00	0.00	0.00	0.00	0.00	0.00
			Total	**12,785.35**			

(a) Quantities taken from column "International Bunkers" from Worksheet 1-1, Sheet 1 of 5.

Documentation box:

1. Fossil fuel data for international bunkers is taken from Pakistan Energy Year Book 2012.
2. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 5 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1-1**
SHEETS	**5 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**
COUNTRY	Pakistan
YEAR	2012

		G	H	I	J	K	L
		Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions ($Gg\ CO_2$)
FUEL TYPES			H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Solid Fossil	Other Bituminous Coal		0.00	0.00		0.00	0.00
	Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Liquid Fossil	Gasoline		0.00	0.00		0.00	0.00
	Jet Kerosene		0.00	168.91	0.99	167.22	613.14
	Gas / Diesel Oil		0.00	8.01	0.99	7.93	29.08
	Residual Fuel Oil		0.00	78.64	0.99	77.85	285.45
	Lubricants	0.5	0.00	0.00		0.00	0.00
						Total[(a)]	**927.66**

(a) The bunkers emissions are not to be added to national totals.

This spreadsheet contains Auxiliary Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY**
WORKSHEET	**AUXILIARY WORKSHEET 1-1: ESTIMATING CARBON STORED IN PRODUCTS.**
SHEETS	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

	A	B	C	D	E	F	G	H
	Estimated Fuel Quantities (tonnes)	Conversion Factor (TJ/tonne)	Estimated Fuel Quantities (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)
FUEL TYPES			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)
Naphtha [a]			0.00		0.00	0.00	0.8	0.00
Lubricants	312285	0.0402	12,553.86	20	251,077.14	251.08	0.5	125.54
Bitumen			0.00		0.00	0.00	1	0.00
Coal Oils and Tars (from Coking Coal)	275000	0.0402	11,055.00	25.8	285,219.00	285.22	0.75	213.91
Natural Gas [a]	3157367	0.0398	125,663.21	15.3	1,922,647.06	1,922.65	0.33	634.47
Gas/Diesel Oil [a]			0.00		0.00	0.00	0.5	0.00
LPG [a]			0.00		0.00	0.00	0.8	0.00
Ethane [a]			0.00		0.00	0.00	0.8	0.00
Other Fuels [b]			0.00		0.00	0.00		0.00
			0.00		0.00	0.00		0.00
			0.00		0.00	0.00		0.00

(a) Enter these fuels when they are used as feedstocks.

(b) Use the Other Fuels rows to enter any other products in which carbon may be stored.

Documentation box:

1. Lubricants include all non-energy products of refineries and data is taken from Pakistan Energy Year Book 2012.
2. Coal Oils & Tars include coal used as coke in Pak-steel industries and data is taken from Pakistan Energy Year Book 2012.
3. Natural Gas includes gas consumed in fertilizer sector as feedstock and data is taken from Pakistan energy Year Book 2012.
4. Fraction of carbon stored data is by default given in this sheet.

This spreadsheet contains sheet 1 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**1 OF 16 ENERGY INDUSTRIES**
COUNTRY	**Pakistan**
YEAR	**2012**

ENERGY INDUSTRIES	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil [(a)]			0.00		0.00	0.00
Natural Gas Liquids			0.00		0.00	0.00
Gasoline			0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00
Gas/Diesel Oil	203072	0.042	8,529.02	20.2	172,286.28	172.29
Residual Fuel Oil	7206839	0.042	302,687.24	21.2	6,416,969.45	6,416.97
LPG			0.00		0.00	0.00
Ethane			0.00		0.00	0.00
Naphtha			0.00		0.00	0.00
Lubricants			0.00		0.00	0.00
Petroleum Coke			0.00		0.00	0.00
Refinery Gas			0.00		0.00	0.00
Anthracite			0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00
Lignite	46800	0.042	1,965.60	27.6	54,250.56	54.25
Peat			0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Blast Furnace Gas			0.00		0.00	0.00
Natural gas	6732876	0.0398	267,968.46	15.3	4,099,917.51	4,099.92
Municipal Solid Waste			0.00		0.00	0.00
Industrial Waste			0.00		0.00	0.00
Gas Processing Use	3681747	0.0398	146,533.53	15.3	2,241,963.02	2,241.96
			0.00		0.00	0.00
		Total	**727,683.86**			
Memo items:						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

(a) Include only consumption of crude that is burned, not crude oil which is refined into petroleum products.

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
3. Carbon emission Factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 2 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**2 OF 16 ENERGY INDUSTRIES**
COUNTRY	**Pakistan**
YEAR	**2012**

ENERGY INDUSTRIES	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil (a)		0.00	0.00		0.00	0.00
Natural Gas Liquids		0.00	0.00		0.00	0.00
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	172.29	0.99	170.56	625.40
Residual Fuel Oil		0.00	6,416.97	0.99	6,352.80	23,293.60
LPG		0.00	0.00		0.00	0.00
Ethane		0.00	0.00		0.00	0.00
Naphtha		0.00	0.00		0.00	0.00
Lubricants	(b)	0.00	0.00		0.00	0.00
Petroleum Coke		0.00	0.00		0.00	0.00
Refinery Gas		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	54.25	0.98	53.17	194.94
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Blast Furnace Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	4,099.92	0.995	4,079.42	14,957.87
Municipal Solid Waste		0.00	0.00		0.00	0.00
Industrial Waste		0.00	0.00		0.00	0.00
Gas Processing Use		0.00	2,241.96	0.995	2,230.75	8,179.43
		0.00	0.00		0.00	0.00
					Total	**47,251.23**
Memo items:						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

(a) Include only consumption of crude that is burned, not crude oil which is refined into petroleum products.

(b) Use a value of 0.5 for lubricants.

This spreadsheet contains sheet 3 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-2 STEP BY STEP CALCULATIONS
SHEETS	3 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION
	PROCESS HEAT
COUNTRY	Pakistan
YEAR	2012

MANUFACTURING INDUSTRIES AND CONSTRUCTION	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil			0.00		0.00	0.00
Natural Gas Liquids			0.00		0.00	0.00
Gasoline	38802	0.042	1,629.68	18.9	30,801.03	30.80
Jet Kerosene			0.00		0.00	0.00
Other Kerosene	50089	0.042	2,103.74	19.6	41,233.26	41.23
Gas/Diesel Oil	479639	0.042	20,144.84	20.2	406,925.73	406.93
Residual Fuel Oil	854892	0.042	35,905.46	21.1	757,605.29	757.61
LPG			0.00		0.00	0.00
Ethane			0.00		0.00	0.00
Naphtha			0.00		0.00	0.00
Lubricants			0.00		0.00	0.00
Petroleum Coke			0.00		0.00	0.00
Refinery Gas			0.00		0.00	0.00
Anthracite			0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00
Other Bituminous Coal	2667070	0.042	112,016.94	25.8	2,890,037.05	2,890.04
Sub-Bituminous Coal	1390608	0.042	58,405.54	26.2	1,530,225.04	1,530.23
Lignite			0.00		0.00	0.00
Peat			0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Blast Furnace Gas			0.00		0.00	0.00
Natural gas	7777513	0.0398	309,545.02	15.3	4,736,038.77	4,736.04
Municipal Solid Waste			0.00		0.00	0.00
Industrial Waste			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**539,751.22**			
Memo items:						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
3. Carbon emission Factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 4 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**4 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION**
	PROCESS HEAT
COUNTRY	**Pakistan**
YEAR	**2012**

MANUFACTURING INDUSTRIES AND CONSTRUCTION	G Fraction of Carbon Stored[a]		H Carbon Stored (Gg C)[a]	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
			H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil			0.00	0.00		0.00	0.00
Natural Gas Liquids			0.00	0.00		0.00	0.00
Gasoline			0.00	30.80	0.99	30.49	111.81
Jet Kerosene			0.00	0.00		0.00	0.00
Other Kerosene			0.00	41.23	0.99	40.82	149.68
Gas/Diesel Oil		(b)	0.00	406.93	0.99	402.86	1,477.14
Residual Fuel Oil			0.00	757.61	0.99	750.03	2,750.11
LPG		(b)	0.00	0.00		0.00	0.00
Ethane		(b)	0.00	0.00		0.00	0.00
Naphtha		(b)	0.00	0.00		0.00	0.00
Lubricants	(c)		0.00	0.00		0.00	0.00
Petroleum Coke			0.00	0.00		0.00	0.00
Refinery Gas			0.00	0.00		0.00	0.00
Anthracite			0.00	0.00		0.00	0.00
Coking Coal			0.00	0.00		0.00	0.00
Other Bituminous Coal			0.00	2,890.04	0.98	2,832.24	10,384.87
Sub-Bituminous Coal			0.00	1,530.23	0.98	1,499.62	5,498.61
Lignite			0.00	0.00		0.00	0.00
Peat			0.00	0.00		0.00	0.00
Patent Fuel			0.00	0.00		0.00	0.00
Brown Coal Briquettes			0.00	0.00		0.00	0.00
Coke Oven Coke			0.00	0.00		0.00	0.00
Gas Coke			0.00	0.00		0.00	0.00
Gas Works Gas			0.00	0.00		0.00	0.00
Coke Oven Gas			0.00	0.00		0.00	0.00
Blast Furnace Gas			0.00	0.00		0.00	0.00
Natural gas		(b)	0.00	4,736.04	0.995	4,712.36	17,278.65
Municipal Solid Waste			0.00	0.00		0.00	0.00
Industrial Waste			0.00	0.00		0.00	0.00
			0.00	0.00		0.00	0.00
			0.00	0.00		0.00	0.00
						Total	**37,650.86**
Memo items:							
Wood/Wood Waste			0.00	0.00		0.00	0.00
Charcoal			0.00	0.00		0.00	0.00
Other Solid Biomass			0.00	0.00		0.00	0.00
Liquid Biomass			0.00	0.00		0.00	0.00
Gaseous Biomass			0.00	0.00		0.00	0.00
						Total Biomass	**0.00**

(a) For naphtha, natural gas, gas/diesel oil, LPG and any other fuels used as feedstocks, do not fill out Column G. Complete Column H, using Auxiliary Worksheet 1-2a.
(b) Use Auxiliary Worksheet 1-2a to fill out the cells for these products.
(c) Use a value of 0.5 for lubricants.

This spreadsheet contains Auxiliary Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**AUXILIARY WORKSHEET 1-2: ESTIMATING CARBON STORED IN PRODUCTS**
SHEETS	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

	A	B	C	D	E	F	G	H
	Feedstock Use	Conversion Factor (TJ/Unit)	Feedstock Use (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)
FUEL TYPES			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)
Gas/Diesel Oil			0.00		0.00	0.00	0.5	0.00
LPG			0.00		0.00	0.00	0.8	0.00
Ethane			0.00		0.00	0.00	0.8	0.00
Naphtha			0.00		0.00	0.00	0.8	0.00
Lubricants	312285	0.0402	12,553.86	20	251,077.14	251.08	0.5	125.54
Natural Gas	3157367	0.0398	125,663.21	15.3	1,922,647.06	1,922.65	0.33	634.47
Coal Oils & Tars	275000	0.0402	11,055.00	25.8	285,219.00	285.22	0.75	213.91
Other Fuels (a)			0.00		0.00	0.00		0.00
			0.00		0.00	0.00		0.00
			0.00		0.00	0.00		0.00

(a) Please specify. Enter the results of this calculation in Worksheet 1-2 Step by Step Calculation, Sheet 4, in the cells marked with (b).

Documentation box:

1. Lubricants include all non-energy products of refineries and data is taken from Pakistan Energy Year Book 2012.
2. Coal Oils & Tars include coal used as coke in Pak-steel industries and data is take from Pakistan Energy Year Book 2012.
3. Natural Gas includes gas consumed in fertilizer sector as feedstock and data is taken from Pakistan energy Year Book 2012.
4. Fraction of carbon stored data is by default given in this sheet.

This spreadsheet contains sheet 5 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**5 OF 16 TRANSPORT**
COUNTRY	**Pakistan**
YEAR	**2012**

TRANSPORT	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Domestic Aviation [(a)]						
Gasoline			0.00		0.00	0.00
Jet Kerosene	656900	0.042	27,589.80	19.5	538,001.10	538.00
			0.00		0.00	0.00
		Subtotal	**27,589.80**			
Road Transport						
Natural Gas	2784591	0.0398	110,826.72	15.3	1,695,648.84	1,695.65
LPG	40096	0.042	1,684.03	17.2	28,965.35	28.97
Gasoline	2930230	0.042	123,069.66	18.9	2,326,016.57	2,326.02
Gas/Diesel Oil	6176986	0.042	259,433.42	20.2	5,240,555.08	5,240.56
			0.00		0.00	0.00
		Subtotal	**495,013.83**			
Rail Transport						
Gas/Diesel Oil	191041	0.042	8,023.71	20.2	162,079.02	162.08
Residual Fuel Oil	4638	0.042	194.80	21.1	4,110.20	4.11
Anthracite			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Kerosene	354	0.042	14.87	19.6	291.41	0.29
		Subtotal	**8,233.38**			
National Navigation [(a)]						
Gasoline			0.00		0.00	0.00
Gas/Diesel Oil			0.00		0.00	0.00
Residual Fuel Oil			0.00		0.00	0.00
Lubricants			0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00
			0.00		0.00	0.00
		Subtotal	**0.00**			
Pipeline Transport						
Natural Gas	194876	0.0398	7,756.06	15.3	118,667.79	118.67
			0.00		0.00	0.00
			0.00		0.00	0.00
		Subtotal	**7,756.06**			
		Total Transport [(a)]	**538,593.08**			
Memo items:						
Liquid Biomass			0.00		0.00	0.00
			0.00		0.00	0.00
		Total Biomass	**0.00**			

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
3. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 6 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**6 OF 16 TRANSPORT**
COUNTRY	**Pakistan**
YEAR	**2012**

TRANSPORT	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Domestic Aviation (a)						
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	538.00	0.99	532.62	1,952.94
		0.00	0.00		0.00	0.00
					Subtotal	**1,952.94**
Road Transport						
Natural Gas		0.00	1,695.65	0.995	1,687.17	6,186.29
LPG		0.00	28.97	0.995	28.82	105.68
Gasoline		0.00	2,326.02	0.99	2,302.76	8,443.44
Gas/Diesel Oil		0.00	5,240.56	0.99	5,188.15	19,023.21
		0.00	0.00		0.00	0.00
					Subtotal	**33,758.62**
Rail Transport						
Gas/Diesel Oil		0.00	162.08	0.99	160.46	588.35
Residual Fuel Oil		0.00	4.11	0.99	4.07	14.92
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Kerosene		0.00	0.29		0.00	0.00
					Subtotal	**603.27**
National Navigation (a)						
Gasoline		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
Lubricants	(b)	0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Subtotal	**0.00**
Pipeline Transport						
Natural Gas		0.00	118.67	0.995	118.07	432.94
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Subtotal	**432.94**
					Total Transport (a)	**36,747.77**
Memo items:						
Liquid Biomass		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

(a) Excluding international bunkers.
(b) Use a value of 0.5 for lubricants.

This spreadsheet contains sheet 7 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**7 OF 16 MEMO ITEMS: INTERNATIONAL BUNKERS**
COUNTRY	**Pakistan**
YEAR	**2012**

MEMO ITEMS: INTERNATIONAL BUNKERS	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Intl. Marine Bunkers						
Gasoline			0.00		0.00	0.00
Gas/Diesel Oil	9441	0.042	396.52	20.2	8,009.74	8.01
Residual Fuel Oil	88733	0.042	3,726.79	21.1	78,635.18	78.64
Lubricants			0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**4,123.31**			
Intl. Aviation Bunkers						
Gasoline			0.00		0.00	0.00
Jet Kerosene	206239	0.042	8,662.04	19.5	168,909.74	168.91
			0.00		0.00	0.00
		Total	**8,662.04**			

Note: Emissions of International Bunkers are excluded from national totals and are reported for informational purposes only.

Documentation box:

1. Fossil fuel data for international bunkers is taken from Pakistan Energy Year Book 2012.
2. Carbon emission Factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 8 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**8 OF 16 MEMO ITEMS: INTERNATIONAL BUNKERS**
COUNTRY	**Pakistan**
YEAR	**2012**

MEMO ITEMS: INTERNATIONAL BUNKERS	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions ($Gg\ CO_2$)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Intl. Marine Bunkers						
Gasoline		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	8.01	0.99	7.93	29.08
Residual Fuel Oil		0.00	78.64	0.99	77.85	285.45
Lubricants	(a)	0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**314.52**
Intl. Aviation Bunkers						
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	168.91	0.99	167.22	613.14
		0.00	0.00		0.00	0.00
					Total	**613.14**

(a) Use a value of 0.5 for lubricants.

Note: Emissions of International Bunkers are excluded from national totals and are reported for informational purposes only.

This spreadsheet contains sheet 9 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**9 OF 16 COMMERCIAL / INSTITUTIONAL SECTOR**
	PROCESS HEAT
COUNTRY	**Pakistan**
YEAR	**2012**

COMMERCIAL / INSTITUTIONAL SECTOR	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Gasoline			0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00
Other Kerosene	24384	0.042	1,024.13	19.6	20,072.91	20.07
Gas/Diesel Oil	103604	0.042	4,351.37	20.2	87,897.63	87.90
Residual Fuel Oil			0.00		0.00	0.00
LPG	189614	0.042	7,963.79	17.2	136,977.15	136.98
Anthracite			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Lignite			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Natural gas	927272	0.0398	36,905.43	15.3	564,653.01	564.65
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**50,244.71**			
Memo items:						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
3. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 10 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**10 OF 16 COMMERCIAL / INSTITUTIONAL SECTOR**
	PROCESS HEAT
COUNTRY	**Pakistan**
YEAR	**2012**

COMMERCIAL / INSTITUTIONAL SECTOR	G Fraction of Carbon Stored	H Carbon Stored (Gg C) H=(FxG)	I Net Carbon Emissions (Gg C) I=(F-H)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C) K=(IxJ)	L Actual CO_2 Emissions ($Gg\ CO_2$) L=(Kx[44/12])
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	20.07	0.99	19.87	72.86
Gas/Diesel Oil		0.00	87.90	0.99	87.02	319.07
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	136.98	0.995	136.29	499.74
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	564.65	0.995	561.83	2,060.04
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**2,951.71**
Memo items:						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

This spreadsheet contains sheet 11 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**11 OF 16 RESIDENTIAL SECTOR**
COUNTRY	**Pakistan**
YEAR	**2012**

RESIDENTIAL SECTOR	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Gasoline			0.00		0.00	0.00
Other Kerosene	81930	0.042	3,441.06	19.6	67,444.78	67.44
Gas/Diesel Oil			0.00		0.00	0.00
Residual Fuel Oil	27	0.042	1.13	21.1	23.93	0.02
LPG	251356	0.042	10,556.95	17.2	181,579.57	181.58
Anthracite			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00
Lignite	0		0.00		0.00	0.00
Peat			0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Natural gas	6128822	0.0398	243,927.12	15.3	3,732,084.87	3,732.08
			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**257,926.26**			
Memo items:						
Wood/Wood Waste	9460000	0.015	141,900.00	30.5	4,327,950.00	4,327.95
Charcoal/Crop Residue	1510000	0.03	45,300.00	30.5	1,381,650.00	1,381.65
Other Solid Biomass/*Dung*	2170000	0.012	26,040.00	27.3	710,892.00	710.89
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**213,240.00**			

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Data for non-commercial fuels (wood, charcoal and other biomass) is from Reference Energy Scenario generated by Pakistan Integrated Energy Model (Pak-IEM).
3. Conversion factors are calculated by reducing (5% for oil & coal, and 10% for natural gas) the Gross Calorific Values (GCV's) of oil, coal and natural gas as given in Pakistan Energy Year Book 2012 to Net Calorific Values (NCV's).
4. Conversion factors for non-commercial fuels are based on Revised 1996 IPCC Guidelines.
5. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 12 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**12 OF 16 RESIDENTIAL SECTOR**
COUNTRY	**Pakistan**
YEAR	**2012**

RESIDENTIAL SECTOR	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions ($Gg\ CO_2$)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Gasoline		0.00	0.00		0.00	0.00
Other Kerosene		0.00	67.44	0.99	66.77	244.82
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.02	0.99	0.02	0.09
LPG		0.00	181.58	0.995	180.67	662.46
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	3,732.08	0.995	3,713.42	13,615.89
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**14,523.26**
Memo items:						
Wood/Wood Waste		0.00	4,327.95	0.98	4,241.39	15,551.77
Charcoal/Crop Residue		0.00	1,381.65	0.98	1,354.02	4,964.73
Other Solid Biomass/*Dung*		0.00	710.89	0.98	696.67	2,554.47
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**23,070.97**

This spreadsheet contains sheets 13 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**13 OF 16 AGRICULTURE / FORESTRY / FISHING**
COUNTRY	**Pakistan**
YEAR	**2012**

AGRICULTURE / FORESTRY / FISHING	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Mobile						
Gasoline			0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00
Gas/Diesel Oil	2585000	0.042	108,570.00	20.2	2,193,114.00	2,193.11
Residual Fuel Oil			0.00		0.00	0.00
LPG			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total Mobile	**108,570.00**			
Stationary						
Gasoline			0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00
Gas/Diesel Oil	165000	0.042	6,930.00	20.2	139,986.00	139.99
Residual Fuel Oil			0.00		0.00	0.00
LPG			0.00		0.00	0.00
Anthracite			0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Lignite			0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Natural gas			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total Stationary	**6,930.00**			
Memo items:						
Mobile						
Liquid Biomass			0.00		0.00	0.00
Stationary						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

Documentation box:

1. Fossil fuel consumption data is taken from Pak-IEM Reference Energy Scenario (2011).
2. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 14 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**14 OF 16 AGRICULTURE / FORESTRY / FISHING**
COUNTRY	**Pakistan**
YEAR	**2012**

AGRICULTURE / FORESTRY / FISHING	G Fraction of Carbon Stored [(a)]	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions ($Gg\ CO_2$)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Mobile						
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	2,193.11	0.99	2,171.18	7,961.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total Mobile	**7,961.00**
Stationary						
Gasoline		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	139.99	0.99	138.59	508.15
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total Stationary	**508.15**
Memo items:						
Mobile						
Liquid Biomass		0.00	0.00		0.00	0.00
Stationary						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

(a) Use a value of 0.5 for lubricants.

This spreadsheet contains sheets 15 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**15 OF 16 OTHER (NOT ELSEWHERE SPECIFIED)**
	PROCESS HEAT
COUNTRY	**Pakistan**
YEAR	**2012**

OTHER (NOT ELSEWHERE SPECIFIED)	A Consumption (TOE)	B Conversion Factor (TJ/TOE)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil	(a)		0.00		0.00	0.00
Natural Gas Liquids			0.00		0.00	0.00
Gasoline			0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00
Gas/Diesel Oil			0.00		0.00	0.00
Residual Fuel Oil			0.00		0.00	0.00
LPG			0.00		0.00	0.00
Ethane			0.00		0.00	0.00
Naphtha			0.00		0.00	0.00
Lubricants			0.00		0.00	0.00
Petroleum Coke			0.00		0.00	0.00
Refinery Gas			0.00		0.00	0.00
Anthracite			0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00
Lignite			0.00		0.00	0.00
Peat			0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Blast Furnace Gas			0.00		0.00	0.00
Natural gas			0.00		0.00	0.00
Municipal Solid Waste			0.00		0.00	0.00
Industrial Waste			0.00		0.00	0.00
Oil Refining losses	131534	0.042	5,524.43	20	110,488.56	110.49
Gas T&D losses	583208.1	0.0398	23,211.68	15.3	355,138.74	355.14
			0.00		0.00	0.00
		Total	**28,736.11**			
Memo items:						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

(a) Include only consumption of crude that is burned, not crude oil which is refined into petroleum products.

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.
2. Gas T& D losses are in the form of natural gas leakage (assuming 10% of total) while refining losses are for crude oil in refineries.
3. Carbon emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 16 of Worksheet 1-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**16 OF 16 OTHER (NOT ELSEWHERE SPECIFIED)**
	PROCESS HEAT
COUNTRY	**Pakistan**
YEAR	**2012**

OTHER (NOT ELSEWHERE SPECIFIED)	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil		0.00	0.00		0.00	0.00
Natural Gas Liquids		0.00	0.00		0.00	0.00
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
Ethane		0.00	0.00		0.00	0.00
Naphtha		0.00	0.00		0.00	0.00
Lubricants	(a)	0.00	0.00		0.00	0.00
Petroleum Coke		0.00	0.00		0.00	0.00
Refinery Gas		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Blast Furnace Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
Municipal Solid Waste		0.00	0.00		0.00	0.00
Industrial Waste		0.00	0.00		0.00	0.00
Oil Refining losses		0.00	110.49	0.99	109.38	401.07
Gas T&D losses		0.00	355.14	0.995	353.36	1,295.66
		0.00	0.00		0.00	0.00
					Total	**1,696.74**
Memo items:						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

(a) Use a value of 0.5 for lubricants.

This spreadsheet contains sheet 1 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-2 OVERVIEW
SHEET	1 OF 8
COUNTRY	Pakistan
YEAR	2012

			A	B	C	D	E	F
			Crude Oil	Orimulsion	Natural Gas Liquids	Gasoline	Jet Kerosene	Other Kerosene
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00		0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00		0.00	1,629.68	0.00	2,103.74
Transport	Domestic Aviation [(a)]					0.00	27,589.80	
	Road					123,069.66		
	Railways							
	National Navigation [(a)]					0.00		
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00	0.00	1,024.13
	Residential					0.00		3,441.06
	Agriculture / Forestry / Fishing	Stationary				0.00		0.00
		Mobile				0.00	0.00	0.00
Other (not elsewhere specified)			0.00		0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**124,699.34**	**27,589.80**	**6,568.93**
Memo: International Marine Bunkers						0.00		
Memo: International Aviation Bunkers						0.00	8,662.04	
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00		0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00		0.00	111.81	0.00	149.68
Transport	Domestic Aviation [(a)]					0.00	1,952.94	
	Road					8,443.44		
	Railways							
	National Navigation [(a)]					0.00		
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00	0.00	72.86
	Residential					0.00		244.82
	Agriculture / Forestry / Fishing	Stationary				0.00		0.00
		Mobile				0.00	0.00	0.00
Other (not elsewhere specified)			0.00		0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**8,555.25**	**1,952.94**	**467.37**
Memo: International Marine Bunkers						0.00		
Memo: International Aviation Bunkers						0.00	613.14	

(a) Excludes International Bunkers.

This spreadsheet contains sheet 2 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-2 OVERVIEW
SHEET	2 OF 8
COUNTRY	Pakistan
YEAR	2012

			G	H	I	J	K	L
			Shale Oil	Gas / Diesel Oil	Residual Fuel Oil	LPG	Ethane	Naphtha
FUEL CONSUMPTION (TJ)								
Energy Industries				8,529.02	302,687.24	0.00	0.00	0.00
Manufacturing Industries and Construction				20,144.84	35,905.46	0.00	0.00	0.00
Transport	Domestic Aviation [a]							
	Road			259,433.42		1,684.03		
	Railways			8,023.71	194.80			
	National Navigation [a]			0.00	0.00			
	Pipeline Transport							
Other Sectors	Commercial/Institutional			4,351.37	0.00	7,963.79		
	Residential			0.00	1.13	10,556.95		
	Agriculture / Forestry / Fishing	Stationary		6,930.00	0.00	0.00		
		Mobile		108,570.00	0.00	0.00		
Other (not elsewhere specified)				0.00	0.00	0.00	0.00	0.00
Total [a]			**0.00**	**415,982.36**	**338,788.63**	**20,204.77**	**0.00**	**0.00**
Memo: International Marine Bunkers				396.52	3,726.79			
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries				625.40	23,293.60	0.00	0.00	0.00
Manufacturing Industries and Construction				1,477.14	2,750.11	0.00	0.00	0.00
Transport	Domestic Aviation [a]							
	Road			19,023.21		105.68		
	Railways			588.35	14.92			
	National Navigation [a]			0.00	0.00			
	Pipeline Transport							
Other Sectors	Commercial/Institutional			319.07	0.00	499.74		
	Residential			0.00	0.09	662.46		
	Agriculture / Forestry / Fishing	Stationary		508.15	0.00	0.00		
		Mobile		7,961.00	0.00	0.00		
Other (not elsewhere specified)				0.00	0.00	0.00	0.00	0.00
Total [a]			**0.00**	**30,502.32**	**26,058.71**	**1,267.88**	**0.00**	**0.00**
Memo: International Marine Bunkers				29.08	285.45			
Memo: International Aviation Bunkers								

(a) Excludes International Bunkers.

This spreadsheet contains sheet 3 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**3 OF 8**
COUNTRY	**Pakistan**
YEAR	**2012**

			M	N	O	P	Q	R
			Lubricants	Petroleum Coke	Refinery Gas	Anthracite	Coking Coal	Other Bituminous Coal
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	112,016.94
Transport	Domestic Aviation [(a)]							
	Road							
	Railways					0.00		0.00
	National Navigation [(a)]		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00		0.00
	Residential					0.00		0.00
	Agriculture / Forestry / Fishing	Stationary				0.00	0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**112,016.94**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	10,384.87
Transport	Domestic Aviation [(a)]							
	Road							
	Railways					0.00		0.00
	National Navigation [(a)]		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00		0.00
	Residential					0.00		0.00
	Agriculture / Forestry / Fishing	Stationary				0.00	0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10,384.87**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								

(a) Excludes International Bunkers.

This spreadsheet contains sheet 4 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**4 OF 8**
COUNTRY	**Pakistan**
YEAR	**2012**

			S	T	U	V	W	X
			Sub-Bituminous Coal	Lignite	Oil Shale	Peat	Patent Fuel	Brown Coal Briquettes
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	1,965.60		0.00	0.00	0.00
Manufacturing Industries and Construction			58,405.54	0.00		0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							
	Railways							
	National Navigation (a)		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00				0.00
	Residential		0.00	0.00		0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary		0.00			0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00
Total (a)			**58,405.54**	**1,965.60**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	194.94		0.00	0.00	0.00
Manufacturing Industries and Construction			5,498.61	0.00		0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							
	Railways							
	National Navigation (a)		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00				0.00
	Residential		0.00	0.00		0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary		0.00			0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00
Total (a)			**5,498.61**	**194.94**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								

(a) Excludes International Bunkers.

This spreadsheet contains sheet 5 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**5 OF 8**
COUNTRY	**Pakistan**
YEAR	**2012**

			Y	Z	AA	AB	AC	AD
			Coke Oven Coke	Gas Coke	Works Gas	Coke Oven Gas	Blast Furnace Gas	Natural Gas
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	267,968.46
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	309,545.02
Transport	Domestic Aviation [(a)]							
	Road							110,826.72
	Railways		0.00					
	National Navigation [(a)]							
	Pipeline Transport							7,756.06
Other Sectors	Commercial/Institutional		0.00		0.00	0.00		36,905.43
	Residential		0.00		0.00	0.00		243,927.12
	Agriculture / Forestry / Fishing	Stationary	0.00		0.00			0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**976,928.81**
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	14,957.87
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	17,278.65
Transport	Domestic Aviation [(a)]							
	Road							6,186.29
	Railways		0.00					
	National Navigation [(a)]							
	Pipeline Transport							432.94
Other Sectors	Commercial/Institutional		0.00		0.00	0.00		2,060.04
	Residential		0.00		0.00	0.00		13,615.89
	Agriculture / Forestry / Fishing	Stationary	0.00		0.00			0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**54,531.68**
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								

(a) Excludes International Bunkers.

This spreadsheet contains sheet 6 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**6 OF 8**
COUNTRY	**Pakistan**
YEAR	**2012**

			AE Municipal Solid Waste	AF Industrial Waste	AG (b) (additional fuels)	AH(b)	AI(b)	AJ(b)
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	146,533.53	0.00		
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00		
Transport	Domestic Aviation (a)				0.00			
	Road				0.00			
	Railways				14.87			
	National Navigation (a)				0.00			
	Pipeline Transport				0.00	0.00		
Other Sectors	Commercial/Institutional				0.00	0.00		
	Residential				0.00	0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary			0.00	0.00		
		Mobile			0.00	0.00		
Other (not elsewhere specified)			0.00	0.00	5,524.43	23,211.68	0.00	
Total (a)			**0.00**	**0.00**	**152,072.83**	**23,211.68**	**0.00**	**0.00**
Memo: International Marine Bunkers					0.00			
Memo: International Aviation Bunkers					0.00			
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	8,179.43	0.00		
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00		
Transport	Domestic Aviation (a)				0.00			
	Road				0.00			
	Railways				0.00			
	National Navigation (a)				0.00			
	Pipeline Transport				0.00	0.00		
Other Sectors	Commercial/Institutional				0.00	0.00		
	Residential				0.00	0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary			0.00	0.00		
		Mobile			0.00	0.00		
Other (not elsewhere specified)			0.00	0.00	401.07	1,295.66	0.00	
Total (a)			**0.00**	**0.00**	**8,580.50**	**1,295.66**	**0.00**	**0.00**
Memo: International Marine Bunkers					0.00			
Memo: International Aviation Bunkers					0.00			

(a) Excludes International Bunkers.

(b) Other Fuels should be linked to Step by Step Calculations where applicable.

This spreadsheet contains sheet 7 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-2 OVERVIEW
SHEET	7 OF 8
COUNTRY	Pakistan
YEAR	2012

			AK[b]	AL Total Liquid Fossil	AM Total Solid Fossil	AN Total Gaseous Fossil	AO Total Other Liquid Fuels[c]	AP Total Other Solid Fuels[c]	AQ Total Other Gaseous Fuels[c]	AR Total[d]
FUEL CONSUMPTION (TJ)										
Energy Industries				311,216.26	1,965.60	267,968.46				727,683.86
Manufacturing Industries and Construction				59,783.72	170,422.48	309,545.02				539,751.22
Transport	Domestic Aviation[a]			27,589.80	0.00					27,589.80
	Road			384,187.11	0.00	110,826.72				495,013.83
	Railways			8,218.51	0.00					8,233.38
	National Navigation[a]			0.00	0.00					0.00
	Pipeline Transport			0.00	0.00	7,756.06				7,756.06
Other Sectors	Commercial/Institutional			13,339.28	0.00	36,905.43				50,244.71
	Residential			13,999.15	0.00	243,927.12				257,926.26
	Agriculture / Forestry / Fishing	Stationary		6,930.00	0.00	0.00				6,930.00
		Mobile		108,570.00	0.00					108,570.00
Other (not elsewhere specified)				0.00	0.00	0.00				28,736.11
Total[a]			**0.00**	**933,833.84**	**172,388.08**	**976,928.81**	**0.00**	**0.00**	**0.00**	**2,258,435.23**
Memo: International Marine Bunkers				4,123.31	172,388.08					4,123.31
Memo: International Aviation Bunkers				8,662.04	0.00					8,662.04
CO_2 EMISSIONS (Gg)										
Energy Industries				23,919.00	194.94	14,957.87				47,251.23
Manufacturing Industries and Construction				4,488.73	15,883.48	17,278.65				37,650.86
Transport	Domestic Aviation[a]			1,952.94	0.00					1,952.94
	Road			27,572.33	0.00	6,186.29				33,758.62
	Railways			603.27	0.00					603.27
	National Navigation[a]			0.00	0.00					0.00
	Pipeline Transport			0.00	0.00	432.94				432.94
Other Sectors	Commercial/Institutional			891.67	0.00	2,060.04				2,951.71
	Residential			907.37	0.00	13,615.89				14,523.26
	Agriculture / Forestry / Fishing	Stationary		508.15	0.00	0.00				508.15
		Mobile		7,961.00	0.00					7,961.00
Other (not elsewhere specified)				0.00	0.00	0.00				1,696.74
Total[a]			**0.00**	**68,804.47**	**16,078.42**	**54,531.68**	**0.00**	**0.00**	**0.00**	**149,290.73**
Memo: International Marine Bunkers				314.52	0.00					314.52
Memo: International Aviation Bunkers				613.14	0.00					613.14

(a) Excludes International Bunkers.
(b) Other Fuels should be linked to Step by Step Calculations where applicable.
(c) Please include Fuels from columns AG to AK where applicable.
(d) Excluding Biomass.

This spreadsheet contains sheet 8 of Worksheet 1-2 Overview, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**8 OF 8**
COUNTRY	**Pakistan**
YEAR	**2012**

			AS	AT	AU	AV	AW	AX
			Wood / Wood Waste	Charcoal	Other Solid Biomass	Liquid Biomass	Gaseous Biomass	Total Biomass
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	0.00
Transport	Domestic Aviation [a]							0.00
	Road					(b) 0.00		0.00
	Railways							0.00
	National Navigation [a]							0.00
	Pipeline Transport							
Other Sectors	Commercial/Institutional		0.00	0.00	0.00	0.00	0.00	0.00
	Residential		141,900.00	45,300.00	26,040.00	0.00	0.00	213,240.00
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile				0.00		0.00
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [a]			**141,900.00**	**45,300.00**	**26,040.00**	**0.00**	**0.00**	**213,240.00**
Memo: International Marine Bunkers								0.00
Memo: International Aviation Bunkers								0.00
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	0.00
Transport	Domestic Aviation [a]							0.00
	Road					(b) 0.00		0.00
	Railways							0.00
	National Navigation [a]							0.00
	Pipeline Transport							
Other Sectors	Commercial/Institutional		0.00	0.00	0.00	0.00	0.00	0.00
	Residential		15,551.77	4,964.73	2,554.47	0.00	0.00	23,070.97
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile				0.00		0.00
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total [a]			**15,551.77**	**4,964.73**	**2,554.47**	**0.00**	**0.00**	**23,070.97**
Memo: International Marine Bunkers								0.00
Memo: International Aviation Bunkers								0.00

(a) Excludes International Bunkers.

(b) Provisionally linked to Road Transport. Change if not applicable.

This spreadsheet contains sheet 1 of Worksheet 1-3, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**1 OF 3**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			A Fuel Consumption (TJ)					
			A1	A2	A3		A4	A5	A6
			Coal	Natural Gas	Oil		Wood / Wood Waste	Charcoal	Other Biomass and Wastes
Energy Industries			1,965.60	267,968.46		311,216.26	0.00	0.00	0.00
Manufacturing Industries and Construction			170,422.48	309,545.02		59,783.72	0.00	0.00	0.00
Transport	Domestic Aviation[(a)]					27,589.80			
	Road			112,510.75	Gasoline 123,069.66	Diesel 259,433.42			
	Railways		0.00			8,218.51			
	National Navigation[(a)]		0.00			0.00			
Other Sectors	Commercial/Institutional		0.00	36,905.43		13,339.28	0.00	0.00	0.00
	Residential		0.00	243,927.12		13,999.15	141,900.00	45,300.00	26,040.00
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		6,930.00	0.00	0.00	0.00
		Mobile		0.00		108,570.00			
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00	0.00
Total [(a)]			**172,388.08**	**970,856.78**		**1,055,219.47**	**141,900.00**	**45,300.00**	**26,040.00**
Memo: International Marine Bunkers			172,388.08			4,123.31			
Memo: International Aviation Bunkers						8,662.04			

(a) Excludes international bunkers.

Documentation box:

1. Fossil fuel consumption data is taken from Pakistan Energy Yearbook 2012.

This spreadsheet contains sheets 2 of Worksheet 1-3 (CH_4), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**2 OF 3 CH_4**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			**B** Emission Factors (kg/TJ)					
			B1 Coal	B2 Natural Gas	B3 Oil	B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries			1	1	3			
Manufacturing Industries and Construction			10	5	2			
Transport	Domestic Aviation[(a)]				0.5			
	Road			50	Gasoline 20 / Diesel 5			
	Railways		10		5			
	National Navigation[(a)]		10		5			
Other Sectors	Commercial/Institutional		10	5	10	300	200	300
	Residential		300	5	10	300	200	300
	Agriculture / Forestry / Fishing	Stationary	300	5	10	300	200	300
		Mobile		5	5			
Other (not elsewhere specified)								
Total [(a)]								
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								

(a) Excludes international bunkers.

Documentation box:

1. Emission Factors for CH_4 are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 3 of Worksheet 1-3 (CH_4), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**3 OF 3 CH_4**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			C Emissions by Fuel (kg)						D Total Emissions (Gg)
			C=(AxB)						
			C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D= sum (C1..C6) / 1 000 000
Energy Industries			1,965.60	267,968.46	933,648.79		0.00	0.00	0.00	1.20
Manufacturing Industries and Construction			1,704,224.76	1,547,725.09		119,567.45	0.00	0.00	0.00	3.37
Transport	Domestic Aviation[a]					13,794.90				0.01
					Gasoline	Diesel				
	Road			5,625,537.69	2,461,393.20	1,297,167.10				9.38
	Railways		0.00			41,092.55				0.04
	National Navigation[a]		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	184,527.13		133,392.84	0.00	0.00	0.00	0.32
	Residential		0.00	1,219,635.58		139,991.46	42,570,000.00	9,060,000.00	7,812,000.00	60.80
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		69,300.00	0.00	0.00	0.00	0.07
		Mobile		0.00		542,850.00				0.54
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total[a]			**1,706,190.36**	**8,845,393.95**		**5,752,198.28**	**42,570,000.00**	**9,060,000.00**	**7,812,000.00**	**75.75**
Memo: International Marine Bunkers			0.00			0.00				0.00
Memo: International Aviation Bunkers						0.00				0.00

(a) Excludes international bunkers.

This spreadsheet contains sheets 2 of Worksheet 1-3 (N_2O), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**2 OF 3 N_2O**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			B Emission Factors (kg/TJ)					
			B1 Coal	B2 Natural Gas	B3 Oil		B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries			1.4	0.1	0.6		4	4	4
Manufacturing Industries and Construction			1.4	0.1		0.6	4	4	4
Transport	Domestic Aviation[(a)]					2			
	Road			0.1	Gasoline 0.6	Diesel 0.6			
	Railways		1.4		0.6				
	National Navigation[(a)]		1.4		0.6				
Other Sectors	Commercial/Institutional		1.4	0.1	0.6		4	1	4
	Residential		1.4	0.1	0.6		4	1	4
	Agriculture / Forestry / Fishing	Stationary	1.4	0.1	0.6		4	1	4
		Mobile		0.1	0.6				
Other (not elsewhere specified)									
Total [(a)]									
Memo: International Marine Bunkers									
Memo: International Aviation Bunkers									

(a) Excludes international bunkers.

Documentation box:

1. Emission Factors for N_2O are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 3 of Worksheet 1-3 (N_2O), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**3 OF 3 N_2O**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			C Emissions by Fuel (kg) C=(AxB) C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D Total Emissions (Gg) D= sum (C1..C6) / 1 000 000
Energy Industries			2,751.84	26,796.85		186,729.76	0.00	0.00	0.00	0.22
Manufacturing Industries and Construction			238,591.47	30,954.50		35,870.23	0.00	0.00	0.00	0.31
Transport	Domestic Aviation[(a)]					55,179.60				0.06
					Gasoline	Diesel				
	Road			11,251.08	73,841.80	155,660.05				0.24
	Railways		0.00			4,931.11				0.00
	National Navigation[(a)]		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	3,690.54		8,003.57	0.00	0.00	0.00	0.01
	Residential		0.00	24,392.71		8,399.49	567,600.00	45,300.00	104,160.00	0.75
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		4,158.00	0.00	0.00	0.00	0.00
		Mobile		0.00		65,142.00				0.07
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total [(a)]			**241,343.31**	**97,085.68**		**597,915.60**	**567,600.00**	**45,300.00**	**104,160.00**	**1.65**
Memo: International Marine Bunkers			0.00			0.00				0.00
Memo: International Aviation Bunkers						0.00				0.00

(a) Excludes international bunkers.

This spreadsheet contains sheets 2 of Worksheet 1-3 (NO_X), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**2 OF 3 NO_X**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			**B**					
			Emission Factors (kg/TJ)					
			B1	B2	B3	B4	B5	B6
			Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes
Energy Industries			300	150	200	100	100	100
Manufacturing Industries and Construction			300	150	200	100	100	100
Transport	Domestic Aviation[(a)]				300			
	Road			600	Gasoline 600 / Diesel 800			
	Railways		300		1200			
	National Navigation[(a)]		300		1500			
Other Sectors	Commercial/Institutional		100	50	100	100	100	100
	Residential		100	50	100	100	100	100
	Agriculture / Forestry / Fishing	Stationary	100	50	100	100	100	100
		Mobile		1000	1200			
Other (not elsewhere specified)								
Total [(a)]								
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								

(a) Excludes international bunkers.

Documentation box:

1. Emission Factors for NO_x are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 3 of Worksheet 1-3 (NO_X), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3
SHEETS	3 OF 3 NO_X
COUNTRY	Pakistan
YEAR	2012

ACTIVITY			C Emissions by Fuel (kg)						D Total Emissions (Gg)
			C=(AxB)						
			C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D= sum (C1..C6) / 1 000 000
Energy Industries			589,680.00	40,195,269.72	62,243,252.40		0.00	0.00	0.00	103.03
Manufacturing Industries and Construction			51,126,742.80	46,431,752.61		11,956,744.80	0.00	0.00	0.00	109.52
Transport	Domestic Aviation[(a)]					8,276,940.00				8.28
					Gasoline	Diesel				
	Road			67,506,452.28	73,841,796.00	207,546,735.98				348.89
	Railways		0.00			9,862,212.02				9.86
	National Navigation[(a)]		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	1,845,271.28		1,333,928.40	0.00	0.00	0.00	3.18
	Residential		0.00	12,196,355.78		1,399,914.60	14,190,000.00	4,530,000.00	2,604,000.00	34.92
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		693,000.00	0.00	0.00	0.00	0.69
		Mobile		0.00		130,284,000.00				130.28
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total [(a)]			**51,716,422.80**	**168,175,101.67**		**507,438,524.21**	**14,190,000.00**	**4,530,000.00**	**2,604,000.00**	**748.65**
Memo: International Marine Bunkers			0.00			0.00				0.00
Memo: International Aviation Bunkers						0.00				0.00

(a) Excludes international bunkers.

This spreadsheet contains sheets 2 of Worksheet 1-3 (CO), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3
SHEETS	2 OF 3 CO
COUNTRY	Pakistan
YEAR	2012

ACTIVITY			B Emission Factors (kg/TJ)					
			B1 Coal	B2 Natural Gas	B3 Oil		B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries			20	20	15		1000	1000	1000
Manufacturing Industries and Construction			150	30		10	2000	4000	4000
Transport	Domestic Aviation[(a)]					100			
					Gasoline	Diesel			
	Road			400	8000	1000			
	Railways		150		1000				
	National Navigation[(a)]		150		1000				
Other Sectors	Commercial/Institutional		2000	50	20		5000	7000	5000
	Residential		2000	50	20		5000	7000	5000
	Agriculture / Forestry / Fishing	Stationary	2000	50	20		5000	7000	5000
		Mobile		400	1000				
Other (not elsewhere specified)									
Total [(a)]									
Memo: International Marine Bunkers									
Memo: International Aviation Bunkers									

(a) Excludes international bunkers.

Documentation box:

1. Emission Factors for CO are from Revised 1996 IPCC Guidelines.

This spreadshee This spreadsheet contains sheets 3 of Worksheet 1-3 (CO), in accordance with the
Revised 1996 II Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY	ENERGY
SUBMODULE	NON-CO_2 FI	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3	1-3
SHEETS	2 OF 3 CO	3 OF 3 CO
COUNTRY	Pakistan	Pakistan
YEAR	2012	2012

ACTIVITY			B	C						D
			Emission Factors (k	Emissions by Fuel (kg)						Total Emissions (Gg)
				C=(AxB)						
			B1	C1	C2	C3	C4	C5	C6	D= sum
			Coal	Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	(C1..C6) / 1 000 000
Energy Industries			20	39,312.00	5,359,369.30	4,668,243.93	0.00	0.00	0.00	10.07
Manufacturing Industries and Construction			150	25,563,371.40	9,286,350.52	597,837.24	0.00	0.00	0.00	35.45
Transport	Domestic Aviation[(a)]					2,758,980.00				2.76
						Gasoline / Diesel				
	Road				45,004,301.52	984,557,280.00 / 259,433,419.98				1,289.00
	Railways		150	0.00		8,218,510.02				8.22
	National Navigation[(a)]		150	0.00		0.00				0.00
Other Sectors	Commercial/Institutional		2000	0.00	1,845,271.28	266,785.68	0.00	0.00	0.00	2.11
	Residential		2000	0.00	12,196,355.78	279,982.92	709,500,000.00	317,100,000.00	130,200,000.00	1,169.28
	Agriculture / Forestry / Fishing	Stationary	2000	0.00	0.00	138,600.00	0.00	0.00	0.00	0.14
		Mobile			0.00	108,570,000.00				108.57
Other (not elsewhere specified)				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]				**25,602,683.40**	**73,691,648.40**	**1,369,489,639.77**	**709,500,000.00**	**317,100,000.00**	**130,200,000.00**	**2,625.58**
Memo: International Marine Bunkers				0.00		0.00				0.00
Memo: International Aviation Bunkers						0.00				0.00

(a) Excludes in (a) Excludes international bunkers.

This spreadsheet contains sheets 2 of Worksheet 1-3 (NMVOC), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**2 OF 3 NMVOC**
COUNTRY	**Pakistan**
YEAR	**2012**

ACTIVITY			B Emission Factors (kg/TJ)					
			B1 Coal	B2 Natural Gas	B3 Oil	B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries			5	5	5	50	100	50
Manufacturing Industries and Construction			20	5	5	50	100	50
Transport	Domestic Aviation[(a)]				50			
	Road			5	Gasoline 1500 / Diesel 200			
	Railways		20		200			
	National Navigation[(a)]		20		200			
Other Sectors	Commercial/Institutional		200	5	5	600	100	600
	Residential		200	5	5	600	100	600
	Agriculture / Forestry / Fishing	Stationary	200	5	5	600	100	600
		Mobile		5	200			
Other (not elsewhere specified)								
Total [(a)]								
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								

(a) Excludes international bunkers.

Documentation box:

1. Emission Factors for NMVOC are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheets 3 of Worksheet 1-3 (NMVOC), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3
SHEETS	3 OF 3 NMVOC
COUNTRY	Pakistan
YEAR	2012

ACTIVITY			C Emissions by Fuel (kg) C=(AxB)						D Total Emissions (Gg)
			C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D= sum (C1..C6) / 1 000 000
Energy Industries			9,828.00	1,339,842.32		1,556,081.31	0.00	0.00	0.00	2.91
Manufacturing Industries and Construction			3,408,449.52	1,547,725.09		298,918.62	0.00	0.00	0.00	5.26
Transport	Domestic Aviation[a]					1,379,490.00				1.38
					Gasoline	Diesel				
	Road			562,553.77	184,604,490.00	51,886,684.00				237.05
	Railways		0.00			1,643,702.00				1.64
	National Navigation[a]		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	184,527.13		66,696.42	0.00	0.00	0.00	0.25
	Residential		0.00	1,219,635.58		69,995.73	85,140,000.00	4,530,000.00	15,624,000.00	106.58
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		34,650.00	0.00	0.00	0.00	0.03
		Mobile		0.00		21,714,000.00	0.00			21.71
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total [a]			**3,418,277.52**	**4,854,283.89**		**263,254,708.08**	**85,140,000.00**	**4,530,000.00**	**15,624,000.00**	**376.82**
Memo: International Marine Bunkers			0.00			0.00				0.00
Memo: International Aviation Bunkers						0.00				0.00

(a) Excludes international bunkers.

This spreadsheet contains Worksheet 1-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**SO_2 EMISSIONS FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-4**
SHEETS	**1 OF 5: ENERGY INDUSTRIES**
COUNTRY	**Pakistan**
YEAR	**2012**

		A	B	C	D	E	F	G
		Fuel Consumption (TJ)	Sulphur content of fuel [(a)] (%)	Sulphur retention in ash (%)	Abatement efficiency (%)	Net Calorific Value [(a)] (TJ/kt)	SO_2 Emission Factor [(a)] (kg/TJ)	Emissions (Gg)
FUEL TYPE							F=2 x (B/100) x (1/E) x 1000 000 x ((100-C)/100) x ((100-D)/100)	G=(AxF)/1000000
Coal	low						0.00	0.00
	medium						0.00	0.00
	high	556.92	3	30	0	11.9	3,529.41	1.97
Heavy Fuel Oil	low						0.00	0.00
	medium						0.00	0.00
	high	294759.72	4	0	0	40.4	1,980.20	583.68
Light Fuel Oil / Diesel	low	8975.78	0.3	0	0	43	139.53	1.25
	high						0.00	0.00
Diesel (road)							0.00	0.00
Gasoline (road)							0.00	0.00
Jet Kerosene							0.00	0.00
Oil Shale							0.00	0.00
Other Oil							0.00	0.00
Natural Gas [(a)]		267968.46	0	0	0	48	0.00	0.00
Municipal Waste							0.00	0.00
Industrial Waste							0.00	0.00
Black Liquor							0.00	0.00
Fuelwood							0.00	0.00
Other Biomass							0.00	0.00
Total		**572260.88**						586.90

(a) The sulphur content of natural gas is expressed in gram per cubic meter and the net calorific value should be expressed in kilo Joules per cubic meter. The sulphur content for natural gas (in column B) will not be divided by 100 when calculating the emission factor in column F.

Documentation box:

1. Values for sulphur content of fuel and sulphur retention in ash are taken from Revised 1996 IPCC Guidelines.
2. Emission factors for SO_2 are estimated by formula and primarily depend on sulphur contents in the fuels.

This spreadsheet contains Worksheet 1-4, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**SO_2 EMISSIONS FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-4**
SHEETS	**2 OF 5: MANUFACTURING INDUSTRIES AND CONSTRUCTION**
COUNTRY	**Pakistan**
YEAR	**2012**

		A	B	C	D	E	F	G
		Fuel Consumption (TJ)	Sulphur content of fuel [(a)] (%)	Sulphur retention in ash (%)	Abatement efficiency (%)	Net Calorific Value [(a)] (TJ/kt)	SO_2 Emission Factor [(a)] (kg/TJ)	Emissions (Gg)
FUEL TYPE							F=2 x (B/100) x (1/E) x 1000 000 x ((100-C)/100) x ((100-D)/100)	G=(AxF)/1000000
Coal	low	68810.41	0.5	5		25.8	368.22	25.34
	medium						0.00	0.00
	high	26143.43	3	30		18.8	2,234.04	58.41
Heavy Fuel Oil	low						0.00	0.00
	medium						0.00	0.00
	high	34965.08	4	0		40.4	1,980.20	69.24
Light Fuel Oil / Diesel	low	21200.04	0.3	0		43	139.53	2.96
	high						0.00	0.00
Diesel (road)							0.00	0.00
Gasoline (road)							0.00	0.00
Jet Kerosene							0.00	0.00
Oil Shale							0.00	0.00
Other Oil							0.00	0.00
Natural Gas [(a)]		309545.02	0	0		48	0.00	0.00
Municipal Waste							0.00	0.00
Industrial Waste							0.00	0.00
Black Liquor							0.00	0.00
Fuelwood							0.00	0.00
Other Biomass							0.00	0.00
Total		**460663.98**						155.94

(a) The sulphur content of natural gas is expressed in gram per cubic meter and the net calorific value should be expressed in kilo Joules per cubic meter. The sulphur content for natural gas (in column B) will not be divided by 100 when calculating the emission factor in column F.

Documentation box:

1. Values for sulphur content of fuel and sulphur retention in ash are taken from Revised 1996 IPCC Guidelines.
2. Emission factors for SO_2 are estimated by formula and primarily depend on sulphur contents in the fuels.

This spreadsheet contains Worksheet 1-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**SO_2 EMISSIONS FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-4**
SHEETS	**3 OF 5: TRANSPORT**
COUNTRY	**Pakistan**
YEAR	**2012**

		A	B	C	D	E	F	G
		Fuel Consumption (TJ)	Sulphur content of fuel [(a)] (%)	Sulphur retention in ash (%)	Abatement efficiency (%)	Net Calorific Value [(a)] (TJ/kt)	SO_2 Emission Factor [(a)] (kg/TJ)	Emissions (Gg)
FUEL TYPE							F=2 x (B/100) x (1/E) x 1000 000 x ((100-C)/100) x ((100-D)/100)	G=(AxF)/1000000
Coal	low						0.00	0.00
	medium						0.00	0.00
	high						0.00	0.00
Heavy Fuel Oil	low						0.00	0.00
	medium						0.00	0.00
	high	189.69	4			40.4	1,980.20	0.38
Light Fuel Oil / Diesel	low						0.00	0.00
	high						0.00	0.00
Diesel (road)		281466.79	0.3			43	139.53	39.27
Gasoline (road)		131274.3	0.1			44.3	45.15	5.93
Jet Kerosene		28443.77	0.05			44.1	22.68	0.64
Oil Shale							0.00	0.00
Other Oil							0.00	0.00
Natural Gas [(a)]		110826.72	0			48	0.00	0.00
Municipal Waste							0.00	0.00
Industrial Waste							0.00	0.00
Black Liquor							0.00	0.00
Fuelwood							0.00	0.00
Other Biomass							0.00	0.00
Total		**552201.27**						46.22
Memo: Fuels for International Marine Bunkers							0.00	0.00
Memo: Fuels for International Aviation Bunkers							0.00	0.00

(a) The sulphur content of natural gas is expressed in gram per cubic meter and the net calorific value should be expressed in kilo Joules per cubic meter. The sulphur content for natural gas (in column B) will not be divided by 100 when calculating the emission factor in column F.

Documentation box:

1. Values for sulphur content of fuel and sulphur retention in ash are taken from Revised 1996 IPCC Guidelines.
2. Emission factors for SO_2 are estimated by formula and primarily depend on sulphur contents in the fuels.

This spreadsheet contains Worksheet 1-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**SO_2 EMISSIONS FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-4**
SHEETS	**4 OF 5: OTHER SECTORS (COMMERCIAL/INSTITUTIONAL, RESIDENTIAL, AGRICULTURE/ FORESTRY/FISHING)**
COUNTRY	**Pakistan**
YEAR	**2012**

		A	B	C	D	E	F	G
		Fuel Consumption (TJ)	Sulphur content of fuel [(a)] (%)	Sulphur retention in ash (%)	Abatement efficiency (%)	Net Calorific Value [(a)] (TJ/kt)	SO_2 Emission Factor [(a)] (kg/TJ)	Emissions (Gg)
FUEL TYPE							F=2 x (B/100) x (1/E) x 1000 000 x ((100-C)/100) x ((100-D)/100)	G=(AxF)/1000000
Coal	low						0.00	0.00
	medium						0.00	0.00
	high						0.00	0.00
Heavy Fuel Oil	low						0.00	0.00
	medium						0.00	0.00
	high	1.1	4			40.4	1,980.20	0.00
Light Fuel Oil / Diesel	low	126129.3	0.3			43	139.53	17.60
	high						0.00	0.00
Diesel (road)							0.00	0.00
Gasoline (road)							0.00	0.00
Jet Kerosene							0.00	0.00
Oil Shale							0.00	0.00
Other Oil							0.00	0.00
Natural Gas [(a)]		243927.12	0			48	0.00	0.00
Municipal Waste							0.00	0.00
Industrial Waste							0.00	0.00
Black Liquor							0.00	0.00
Fuelwood							0.00	0.00
Other Biomass							0.00	0.00
Total		**370057.52**						17.60

(a) The sulphur content of natural gas is expressed in gram per cubic meter and the net calorific value should be expressed in kilo Joules per cubic meter. The sulphur content for natural gas (in column B) will not be divided by 100 when calculating the emission factor in column F.

Documentation box:

1. Values for sulphur content of fuel and sulphur retention in ash are taken from Revised 1996 IPCC Guidelines.
2. Emission factors for SO_2 are estimated by formula and primarily depend on sulphur contents in the fuels.

This spreadsheet contains Worksheet 1-6, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	ENERGY
SUBMODULE	METHANE EMISSIONS FROM COAL MINING AND HANDLING
WORKSHEET	1-6
SHEETS	1 OF 1
COUNTRY	Pakistan
YEAR	2012

		STEP 1						
		A	B	C	D	E	F	G
		Amount of Coal Produced	Emission Factor	Methane Generated	Methane recovered or flared	Methane Emissions	Conversion Factors	Methane Emissions
		(millions t)	(m^3 CH_4 / t)	(millions m^3)	(millions m^3)	(millions m^3)	(0.67 Gg CH_4 /million m^3)	(Gg CH_4)
				C=(AxB)		E=C-D		G=(ExF)
Underground Mines	Mining	3.612803	18	65.03		65.03	0.67	43.57
	Post-Mining	3.612803	2.5	9.03		9.03	0.67	6.05
Surface Mines	Mining			0.00		0.00	0.67	0.00
	Post-Mining			0.00		0.00	0.67	0.00
							Total	**49.62**

Documentation box:

1. Data for coal production is taken for Pakistan Energy Year Book 2012.
2. Emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains Worksheet 1-7, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

PLEASE ONLY FILL EITHER SHEET 1-7s1 OR SHEET 1-7s2

MODULE	**ENERGY**
SUBMODULE	**METHANE EMISSIONS FROM OIL AND GAS ACTIVITIES (TIER 1)**
WORKSHEET	**1-7**
SHEETS	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

Category	A	B	C	D
	Activity	Emission Factor	CH_4 Emissions	Emissions CH_4
			($kg\ CH_4$)	($Gg\ CH_4$)
			C = (A x B)	D = (C / 1 000 000)
OIL				
Exploration *(Optional if data is locally available)* (a)	*number of wells drilled*	$kg\ CH_4$ */ well drilled*		
			0.00	0.00
Production (b)	*PJ oil produced*	$kg\ CH_4$ */ PJ*		
	138.46	2750	380,764.35	0.38
Transport	*PJ oil loaded in tankers*	$kg\ CH_4$ */ PJ*		
	841.71	745	627,074.41	0.63
Refining	*PJ oil refined*	$kg\ CH_4$ */ PJ refined*		
	401.62	240	96,388.39	0.10
Storage	*PJ oil refined*	$kg\ CH_4$ */ PJ refined*		
			0.00	0.00
			TOTAL CH_4 FROM OIL	**1.10**
GAS				
Production (b) / Processing	*PJ gas consumed*	$kg\ CH_4$ */ PJ*		
	1416.15	*298000*	422,011,781.15	422.01
Transmission and Distribution	*PJ gas consumed*	$kg\ CH_4$ */ PJ*		
	1215.87	128000	155,631,761.46	155.63
Other Leakage	*PJ gas consumed*			
	- non-residential gas consumed	$kg\ CH_4$ */ PJ*		
			0.00	0.00
	- Residential gas consumed	$kg\ CH_4$ */ PJ*		
			0.00	0.00
			TOTAL CH_4 FROM GAS	**577.64**
VENTING AND FLARING FROM OIL/GAS PRODUCTION (c)	*PJ oil and gas produced*			
	- Oil	$kg\ CH_4$ */ PJ*		
			0.00	0.00
	- Gas	$kg\ CH_4$ */ PJ*		
			0.00	0.00
	- Combined	$kg\ CH_4$ */ PJ*		
			0.00	0.00
			TOTAL CH_4 FROM VENTING AND FLARING	**0.00**

(a) Emission Factors are not provided.
(b) If using default emission factors these categories will include emissions from production other than venting and flaring.
(c) If using default emission factors, emissions from venting and flaring from all oil and production should be acconted for here.

Documentation box:

1. Oil and Gas data is taken from Pakistan Energy Yearbook 2012.
2. Emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 1 of Worksheet 1-8, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**OZONE PRECURSORS AND SO_2 FROM OIL REFINING**
WORKSHEET	**1-8 OZONE PRECURSORS AND SO_2 FROM REFINING**
SHEETS	**1 of 4**
COUNTRY	**Pakistan**
YEAR	**2012**

A	B	C	D	E
Crude Oil Throughput	Pollutant	Emission factor [(a)]	Emissions	Emissions
(kt)		(kg/t)	(t)	(Gg)
			D=(AxC)	E=D/1000
9190.662	CO	0.09	827.16	0.83
	NO_x	0.06	551.44	0.55
	NMVOC	0.62	5,698.21	5.70
	SO_2	0.93	8,547.32	8.55

(a) Default values. Use local values where possible, particularly for NMVOCs for which emission factors vary widely.
The default values shown above have been derived from the values given in the IPCC Reference Manual using an average crude oil density of 860 kg/cubic meter (33 degrees API).

Documentation box:

1. Crude oil data is taken from Pakistan Energy Yearbook 2012.
2. Emission factors are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 3 of Worksheet 1-8, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**OZONE PRECURSORS AND SO_2 FROM OIL REFINING**
WORKSHEET	**1-8 SO_2 FROM SULPHUR RECOVERY PLANTS**
SHEETS	**3 OF 4**
COUNTRY	**Pakistan**
YEAR	**2012**

A	B	C	D
Quantity of Sulphur Recovered (t)	Emission Factor (kg/t)	Emissions (kg)	Emissions (Gg)
		C=AxB	D=(C/1 000 000)
27571.986	139	3,832,506.05	3.83

Documentation box:

1. Data for quantity of sulphur recovered is assumed in the same ration as was in 1994 inventory i.e. about 20000 tonnes of sulphur from 6.5 million tonnes of crude oil.

This spreadsheet contains sheet 4 of Worksheet 1-8, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**ENERGY**
SUBMODULE	**OZONE PRECURSORS AND SO_2 FROM OIL REFINING**
WORKSHEET	**1-8 NMVOC EMISSIONS FROM STORAGE AND HANDLING**
SHEETS	**4 OF 4**
COUNTRY	**Pakistan**
YEAR	**2012**

A	B	C	D	E
Crude Oil Throughput (kt)	Storage Type	Emission factor (kg/t)	Emissions (t)	Emissions (Gg)
			D=(AxC)	E=D/1000
	Secondary Seals	0.2	0.00	0.00
9190.662	Primary Seals	0.7	6,433.46	6.43
	Fixed Roof	4.9	0.00	0.00

Documentation box:

1. Crude oil data is taken from Pakistan Energy Yearbook 2012.
2. Emission factors are from Revised 1996 IPCC Guidelines.

Annexure 6:

Industrial Processes: Worksheets of emission estimates for the year 2012

This spreadsheet contains sheet 1 of Worksheet 2-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

PLEASE ONLY FILL EITHER SHEET 2-1s1A OR SHEET 2-1s1B

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**CEMENT PRODUCTION**
WORKSHEET	**2-1A**
SHEET	**1 OF 2 CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1

A	B	C	D
Quantity of Cement Produced (t)	Emission Factor ($t\ CO_2$/ t cement produced)	CO_2 Emitted (t)	CO_2 Emitted (Gg)
		C = (A x B)	D = C/1000
29557000	0.4985	14,734,164.50	14,734.16

Documentation box:

1. Data for cement production is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 2 of Worksheet 2-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**CEMENT PRODUCTION**
WORKSHEET	**2-1**
SHEET	**2 OF 2 SO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A	B	C	D
Quantity of Cement Produced (t)	Emission Factor ($kg\ SO_2$ /t cement produced)	SO_2 Emitted (kg)	SO_2 Emitted (Gg)
		C = (A x B)	D = C/1 000 000
29557000	0.3	8,867,100.00	8.87

Documentation box:

1. Data for cement production is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.

This spreadsheet contains Worksheet 2-3, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**LIMESTONE AND DOLOMITE USE**
WORKSHEET	**2-3**
SHEET	**1 OF 1 CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

Material Type	A Quantity of Limestone or Dolomite Used (t)	B Emission Factor (kg CO_2/t limestone or dolomite used)	C CO_2 Emitted (kg) C = (A x B)	D CO_2 Emitted (Gg) D = C/ 1000 000
Limestone	1280840	440	563,569,600.00	563.57
Dolomite	175281	477	83,609,037.00	83.61
			Total (Gg):	647.18

Documentation box:

1. Due to the unavailability of data for Limestone and Dolomite usage in Pakistan steel, the data/share from Pakistan Economic Survey 2013-14 has been kept same as was in 1993-94 initial national communication because of the fact that capacity of Pakistan Steel has not increased since 1994.
2. Emission factors used are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 2 of Worksheet 2-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**SODA ASH PRODUCTION AND USE**
WORKSHEET	**2-4**
SHEET	**2 OF 2 SODA ASH USE - CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A	B	C	D
Quantity of Soda Ash Used (t)	Emission Factor ($kg\ CO_2$/t soda ash used)	CO_2 Emitted (kg)	CO_2 Emitted (Gg)
		C = (A x B)	D = C/1 000 000
370700	415	153,840,500.00	153.84

Documentation box:

1. Data for Soda Ash production is taken from Pakistan Economic Survey 2013-14.
2. Emission factors used are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 3 of Worksheet 2-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**PRODUCTION AND USE OF MISCELLANEOUS MINERAL PRODUCTS**
WORKSHEET	**2-5**
SHEET	**3 OF 5 ROAD PAVING WITH ASPHALT- NMVOC EMISSIONS**
COUNTRY	**0**
YEAR	**0**

STEP 3

Emission Source	A Quantity of Road Paving Material Used (t)	B Emission Factor (kg NMVOC/t road paving material used)	C NMVOC Emitted (kg)	D NMVOC Emitted (Gg)
			C = (A x B)	D = C/1 000 000
Asphalt Plant	169737	0.023	3,903.95	0.00
Road Surface	169737	320	54,315,840.00	54.32
			Total (Gg):	54.32

Documentation box:

1. Data for Asphalt production is taken from Pakistan Energy Yearbook 2011-12.
2. Emission factors used for both emission sources are from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 1 of Worksheet 2-6, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**AMMONIA PRODUCTION**
WORKSHEET	**2-6**
SHEET	**1 OF 3 TIER 1a - CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1

A	B	C	D	E
Amount of Gas Consumed (m^3)	Carbon Content of Gas (kg/m^3)	Conversion Ratio	CO_2 Emitted (kg)	CO_2 Emitted (Gg)
		44/12	D = (A x B x C)	E = D/1 000 000
4470100000	0.2	44/12	3,278,073,333.33	3,278.07

Documentation box:

1. Instead of amount of gas consumed, data for urea fertilizer is available in kilograms.
2. Data for Urea production is taken from Pakistan Economic Survey 2013-14.

This spreadsheet contains sheet 2 of Worksheet 2-6, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**AMMONIA PRODUCTION**
WORKSHEET	**2-6**
SHEET	**2 OF 3 TIER 1b - CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A	B	C	D
Amount of Urea Produced (t)	Emission Factor (t CO_2/t urea produced)	CO_2 Emitted (t)	CO_2 Emitted (Gg)
		C = (A x B)	D = C/1000
4470100	1.5	6,705,150.00	6,705.15

Documentation box:

1. Data for Urea production is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 1 of Worksheet 2-11, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**METAL PRODUCTION**
WORKSHEET	**2-11**
SHEET	**1 OF 11 TIER 1a - CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1

	A Mass of Reducing Agent (t)	B Emission Factor (t CO_2/t reducing agent)	C (Carbon content of ore minus carbon content of metal) x 3.67 (t CO_2)	D CO_2 Emitted (t)	E CO_2 Emitted (Gg)
				D = (A x B) + C	E = D/1000
Iron and steel production	192900	3.1		597,990.00	597.99
Ferroalloys production				0.00	0.00
Aluminium production				0.00	0.00
Other				0.00	0.00

Documentation box:

1. Data for coke production is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 2 of Worksheet 2-11, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**METAL PRODUCTION**
WORKSHEET	**2-11**
SHEET	**2 OF 11 IRON AND STEEL - TIER 1b - CO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A	B	C	D
Amount of Iron or Steel Produced (t)	Emission Factor ($t\ CO_2$/t of iron or steel produced)	CO_2 Emitted (t)	CO_2 Emitted (Gg)
		C = (A x B)	D = C/1000
249100	1.6	398,560.00	398.56

Documentation box:

1. Data for steel production (pig iron) is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.

This spreadsheet contains sheet 2 of Worksheet 2-12, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

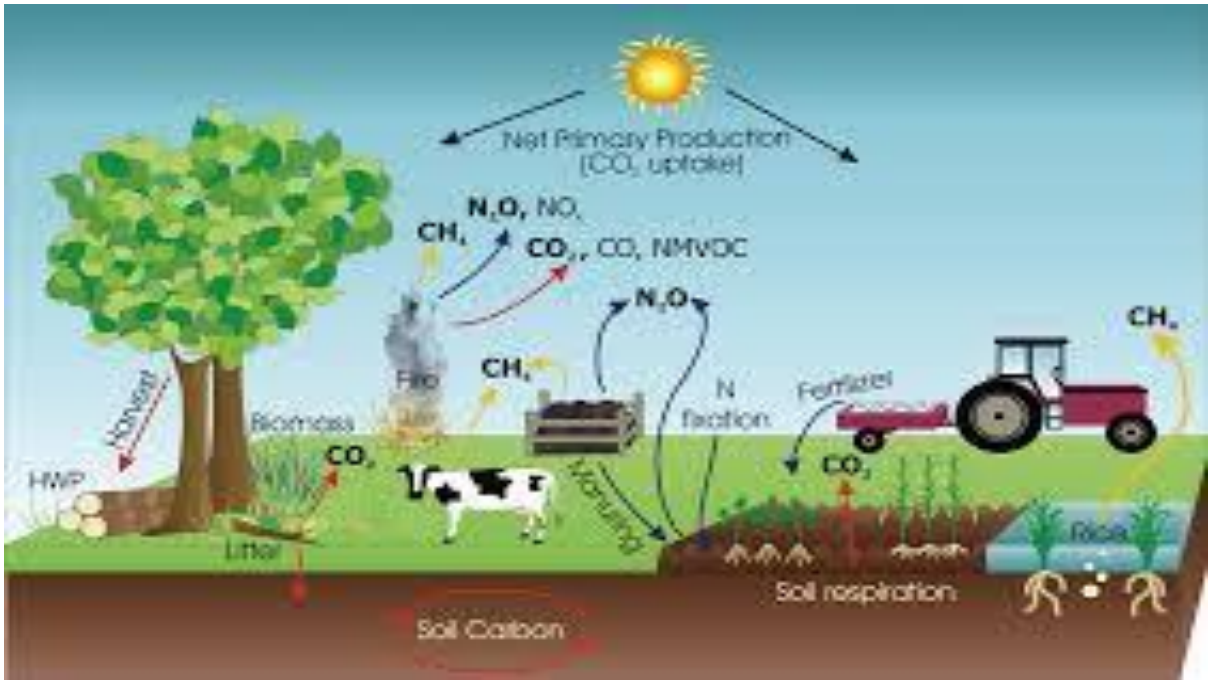
MODULE	**INDUSTRIAL PROCESSES**
SUBMODULE	**PULP AND PAPER INDUSTRIES**
WORKSHEET	**2-12**
SHEET	**2 OF 2 SO_2 EMISSIONS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

	A	B	C	D
Pulp Process Type	Quantity of Air Dried Pulp Produced (t)	Emission Factor (kg SO_2/t air dried pulp produced)	SO_2 Emitted (kg)	SO_2 Emitted (Gg)
			C = (A x B)	D = C/1 000 000
Kraft			0.00	0.00
Acid Sulphite	529300	30	15,879,000.00	15.88
			0.00	0.00
			0.00	0.00
			Total (Gg):	15.88

Documentation box:

1. Data for paper and board production is taken from Pakistan Economic Survey 2013-14.
2. Emission factor used is from Revised 1996 IPCC Guidelines.



Annexure 7:

Agriculture Sector: Worksheets of emission estimates for the year 2012

This spreadsheet contains sheet 1 of Worksheet 4-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1**
SHEET	**1 OF 2 METHANE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
COUNTRY	**Pakistan**
YEAR	**2012**

	STEP 1			**STEP 2**		**STEP 3**
Livestock Type	A Number of Animals	B Emissions Factor for Enteric Fermentation (kg/head/yr)	C Emissions from Enteric Fermentation (t/yr)	D Emissions Factor for Manure Management (kg/head/yr)	E Emissions from Manure Management (t/yr)	F Total Annual Emissions from Domestic Livestock (Gg)
			C = (A x B)/1000		E = (A x D)/1000	F =(C + E)/1000
Dairy Cattle	10888000	46	500,848.00	6	65,328.00	566.18
Non-dairy Cattle	26012000	25	650,300.00	2	52,024.00	702.32
Buffalo	32700000	55	1,798,500.00	5	163,500.00	1,962.00
Sheep	28418000	5	142,090.00	0.21	5,967.78	148.06
Goats	63147000	5	315,735.00	0.22	13,892.34	329.63
Camels	1000000	46	46,000.00	2.56	2,560.00	48.56
Horses	400000	18	7,200.00	2.18	872.00	8.07
Mules & Asses	5029000	10	50,290.00	1.19	5,984.51	56.27
Swine			0.00		0.00	0.00
Poultry	721000000		0.00	0.023	16,583.00	16.58
Totals			3,510,963.00		326,711.63	3,837.67

Documentation box:

1. Livestock population is from Pakistan Economic Survey &Agricultural Statistics of Pakistan 2011-2012
2. Methane emission factors are from IPCC 1996 Revised Guidelines, Vol. 2, Chapter 4.

This spreadsheet contains Worksheet 4-1 (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 (SUPPLEMENTAL)**
SPECIFY AWMS	**SOLID STORAGE AND DRYLOT**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Pakistan**
YEAR	**2012**

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	26012000	40	0.14	145,667,200.00
Dairy Cattle	10888000	60	0	0.00
Poultry				0.00
Sheep				0.00
Buffalo	32700000	40	0.14	183,120,000.00
Others				0.00
			TOTAL	328,787,200.00

Documentation box:

1. Nitrogen Excretion rate, animal mass, fraction of N retention are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-6, Table 4-7, TableA-1

This spreadsheet contains Worksheet 4-1 (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 SUPPLEMENTAL)**
SPECIFY AWMS	**DAILY SPREAD**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Pakistan**
YEAR	**2012**

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	26012000	40	0.16	166,476,800.00
Dairy Cattle	10888000	60	0.21	137,188,800.00
Poultry			0	0.00
Sheep	28418000	12	0	0.00
Buffalo	32700000	40	0.16	209,280,000.00
Others				0.00
			TOTAL	512,945,600.00

Documentation box:

1. Nitrogen Excretion rate, animal mass, fraction of N retention are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-6, Table 4-7, TableA-1

This spreadsheet contains Worksheet 4-1 (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 (SUPPLEMENTAL)**
SPECIFY AWMS	**PASTURE RANGE AND PADDOCK**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Pakistan**
YEAR	**2012**

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	26012000	40	0.29	301,739,200.00
Dairy Cattle	10888000	60	0.24	156,787,200.00
Poultry				0.00
Sheep	28418000	12	0.83	283,043,280.00
Buffalo	32700000	40	0.29	379,320,000.00
Others (goats, horses, camels, mules & asses)	69576000	40	0.95	2,643,888,000.00
			TOTAL	3,764,777,680.00

Documentation box:

1. Nitrogen Excretion rate, animal mass, fraction of N retention are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-6, Table 4-7, TableA-1

This spreadsheet contains Worksheet 4-1 (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 (SUPPLEMENTAL)**
SPECIFY AWMS	**OTHER**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Pakistan**
YEAR	**2012**

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle				0.00
Dairy Cattle				0.00
Poultry	721000000	0.6	0.52	224,952,000.00
Sheep				0.00
Buffalo				0.00
Others (goats, horses,camels, mules & asses)				0.00
			TOTAL	224,952,000.00

Documentation box:

1. Nitrogen Excretion rate, animal mass, fraction of N retention are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-6, Table 4-7, TableA-1

This spreadsheet contains sheet 2 of Worksheet 4-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1**
SHEET	**2 OF 2 NITROUS OXIDE EMISSIONS FROM ANIMAL PRODUCTION EMISSIONS FROM ANIMAL WASTE MANAGEMENT SYSTEMS (AWMS)**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 4

Animal Waste Management System (AWMS)	A Nitrogen Excretion $Nex_{(AWMS)}$ (kg N/yr)	B Emission Factor For AWMS EF_3 (kg N_2O–N/kg N)	C Total Annual Emissions of N_2O (Gg)
			C=(AxB)[44/28] / 1 000 000
Anaerobic lagoons	0.00		0.00
Liquid systems	0.00		0.00
Daily spread	512,945,600.00		
Solid storage & drylot	328,787,200.00	0.02	10.33
Pasture range and paddock	3,764,777,680.00		
Other (Poultry)	224,952,000.00	0.005	1.77
Total	4,831,462,480.00	**Total**	12.10

Documentation box:

1. Emission factors (fraction of N emitted as N2O) are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-8.

This spreadsheet contains Worksheet 4-2, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE EMISSIONS FROM FLOODED RICE FIELDS**
WORKSHEET	**4-2**
SHEET	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

Water Management Regime			A Harvested Area (1000 ha)	B Scaling Factor for Methane Emissions	C Correction Factor for Organic Amendment	D Seasonally Integrated Emission Factor for Continuously Flooded Rice without Organic Amendment (g/m^2)	E CH_4 Emissions (Gg)
							E = (A x B x C x D)/100
Irrigated	Continuously Flooded						0.00
	Intermittently Flooded	Single Aeration	2571.2	0.5	1	10	128.56
		Multiple Aeration					0.00
Rained	Flood Prone						0.00
	Drought Prone						0.00
Deep Water	Water Depth 50-100 cm						0.00
	Water Depth > 100 cm						0.00
Totals			**2,571.20**				**128.56**

Documentation box:

1. Area under rice cultivation from Agricultural Statistics of Pakistan 2011-2012
2. Scaling factors for methane emissions are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-10.
3. Methane emission factors are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-11.

This spreadsheet contains sheet 1 of Worksheet 4-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**FIELD BURNING OF AGRICULTURAL RESIDUES**
WORKSHEET	**4-4**
SHEET	**1 OF 3**
COUNTRY	**Pakistan**
YEAR	**2012**

	STEP 1			STEP 2		STEP 3		
Crops (specify locally important crops)	A Annual Production	B Residue to Crop Ratio	C Quantity of Residue	D Dry Matter Fraction	E Quantity of Dry Residue	F Fraction Burned in Fields	G Fraction Oxidised	H Total Biomass Burned
	(Gg crop)		(Gg biomass)		(Gg dm)			(Gg dm)
			C = (A x B)		E = (C x D)			H = (E x F xG)
Sugarcane	58396.4	0.1	5,839.64	0.9	5,255.68	0.4	0.9	1,892.04
Rice (Paddy)	6160.3	1.4	8,624.42	0.83	7,158.27	0.58	0.9	3,736.62
Wheat	23473.4	1.3	30,515.42	0.83	25,327.80	0.1	0.9	2,279.50
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
.			0.00		0.00			0.00
Total:								7,908.16

Documentation box:

1. Annual crop production is from Agricultural Statistics of Pakistan 2011-2012
2. Residue to Crop Ratio, Dry matter fraction and fraction oxidized are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-15
3. Fraction burned in fields for rice is based on SANDEE Working Paper (No. 76-13), 'Why do farmers burn rice residue?' Examining farmer's choices in Pakistan (ISBN: 978-9937-596-05-3)
4. Fraction burned in the fields for wheat is based on FAO-STAT database for GHG inventory of Pakistan.

This spreadsheet contains sheet 2A of Worksheet 4-4, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

	MODULE	AGRICULTURE		
	SUBMODULE	FIELD BURNING OF AGRICULTURAL RESIDUES		
	WORKSHEET	4-4		
	SHEET	2 OF 3		
	COUNTRY	Pakistan		
	YEAR	2012		
	STEP 4		STEP 5	
Crops	I Carbon Fraction of Residue	J Total Carbon Released (Gg C)	K Nitrogen-Carbon Ratio	L Total Nitrogen Released (Gg N)
		J = (H x I)		L = (J x K)
Sugarcane	0.5	946.02	0.02	18.92
Rice (Paddy)	0.41	1,532.01	0.014	21.45
Wheat	0.48	1,094.16	0.012	13.13
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
.		0.00		0.00
Total:		3,572.20		53.50

Documentation box:
1. Carbon fraction of residue and Nitrogen Carbon ratio are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-15

This spreadsheet contains sheet 3 of Worksheet 4-4, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**FIELD BURNING OF AGRICULTURAL RESIDUES**
WORKSHEET	**4-4**
SHEET	**3 OF 3**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 6

	M	N	O	P
	Emission Ratio	Emissions	Conversion Ratio	Emissions from Field Burning of Agricultural Residues
		(Gg C **or** Gg N)		(Gg)
		N = (J x M)		P = (N x O)
CH_4	0.005	17.86	16/12	23.81
CO	0.06	214.33	28/12	500.11
		N = (L x M)		P = (N x O)
N_2O	0.007	0.37	44/28	0.59
NO_x	0.121	6.47	46/14	21.27

Documentation box:

1. Emission ratios are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-16

This spreadsheet contains sheet 1 of Worksheet 4-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**1 OF 5 DIRECT NITROUS OXIDE EMISSIONS FROM AGRICULTURAL FIELDS, EXCLUDING CULTIVATION OF HISTOSOLS**
COUNTRY	**Pakistan**
YEAR	**2012**

	STEP 1	**STEP 2**	
Type of N input to soil	A Amount of N Input (kg N/yr)	B Factor for Direct Emissions EF_1 (kg N_2O–N/kg N)	C Direct Soil Emissions (Gg N_2O-N/yr)
			C = (A x B)/1 000 000
Synthetic fertiliser (F_{SN})	2,886,300,000.00	0.01	28.86
Animal waste (F_{AW})	2,270,787,365.60	0.01	22.71
N-fixing crops (F_{BN})			0.00
Crop residue (F_{CR})	40,812,750.00	0.01	0.41
		Total	51.98

This spreadsheet contains Worksheet 4-5A (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5A (SUPPLEMENTAL)**
SHEET	**1 OF 1 MANURE NITROGEN USED**
COUNTRY	**Pakistan**
YEAR	**2012**

A	B	C	D	E	F
Total Nitrogen Excretion (kg N/yr)	Fraction of Nitrogen Burned for Fuel (fraction)	Fraction of Nitrogen Excreted During Grazing (fraction)	Fraction of Nitrogen Excreted Emitted as NO_X and NH_3 (fraction)	Sum (fraction)	Manure Nitrogen Used (corrected for NO_X and NH_3 emissions), F_{AW} (kg N/yr)
				F = 1 - (B + C + D)	F = (A x E)
4,831,462,480.00	0	0.33	0.2	0.47	2,270,787,365.60

Documentation box:

1. Fraction of nitrogen burned for fuel is based on IPPC Revised guidelines 1996, Vol. 2, Chapter 4, Table 4-17, ,
2. Fraction of nitrogen excreted during graining are calculated by assuming that one-third nitrogen of animals is excreted during grazing
3. Fraction of nitrogen emitted as NOx and NH3 are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-17,

This spreadsheet contains Worksheet 4-5B (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5B (SUPPLEMENTAL)**
SHEET	**1 OF 1 NITROGEN INPUT FROM CROP RESIDUES**
COUNTRY	**Pakistan**
YEAR	**2012**

A	B	C	D	E	F	G
Production of non - N - Fixing Crops	Fraction of Nitrogen of non - N - Fixing Crops,	Production of Pulses and Soybeans	Fraction of Nitrogen in N-Fixing Crops,	One minus the Fraction of Crop Residue Removed From Field,	One minus the Fraction of Crop Residue Burned	Nitrogen Input from Crop Residues, F_{CR}
(kg dry biomass/yr)	(kg N/kg dry biomass)	(kg dry biomass/yr)	(kg N/kg dry biomass)	(fraction)	(fraction)	(kg N/yr)
						G = 2 x (A x B + C x D) x E x F
50951000000	0.015	1733000000	0.03	0.05	0.5	40,812,750.00

Documentation box:

1. Dry biomass of crops has been estimated using method given in 2006 IPCC guidelines, Chapter 11, Table 11.2, (as used by ASAD in 2008 GHG inventory).
2. Fraction of nitrogen of non- N-fixing and N-fixing crops are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-17,.
3. Factor for direct emission is based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-18.
4. It is assumed that in Pakistan about 95% of the crop residues are removed from the fields and 50% of the residues left in fields are burned (as assumed by ASAD in 2008 GHG inventory).

This spreadsheet contains sheet 2 of Worksheet 4-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**			
SUBMODULE	**AGRICULTURAL SOILS**			
WORKSHEET	**4-5**			
SHEET	**2 OF 5 DIRECT NITROUS OXIDE EMISSIONS FROM CULTIVATION OF HISTOSOLS**			
COUNTRY	**Pakistan**			
YEAR	**2012**			
	STEP 3			**STEP 4**
	D Area of Cultivated Organic Soils F_{OS} (ha)	E Emission Factor for Direct Soil Emissions EF_2 (kg N_2O–N/ha/yr)	F Direct Emissions from Histosols (Gg N_2O–N/yr)	G Total Direct Emissions of N_2O (Gg)
			F=(D x E)/1 000 000	G = (C+F)[44/28]
Subtotal			0.00	81.68

This spreadsheet contains sheet 3 of Worksheet 4-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**3 OF 5 NITROUS OXIDE SOIL EMISSIONS FROM GRAZING ANIMALS - PASTURE RANGE AND PADDOCK**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 5			
	A	B	C
Animal Waste Management System (AWMS)	Nitrogen Excretion $Nex_{(AWMS)}$ (kg N/yr)	Emission Factor for AWMS EF_3 (kg N_2O–N/kg N)	Emissions Of N_2O from Grazing Animals (Gg)
			C = (A x B)[44/28]/1 000 000
Pasture range & paddock	3,764,777,680.00	0.02	118.32

Documentation box:
1. Emission factors for AWMS are based on Revised IPCC 1996 Guidelines, Vol. 2, Chapter 4, Table 4-8,.

This spreadsheet contains sheet 4 of Worksheet 4-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**4 OF 5 INDIRECT NITROUS OXIDE EMISSIONS FROM ATMOSPHERIC DEPOSITION OF NH_3 AND NO_X**
COUNTRY	**Pakistan**
YEAR	**2012**

	STEP 6							
	A	B	C	D	E	F	G	H
Type of Deposition	Synthetic Fertilizer N Applied to Soil, N_{FERT} (kg N/yr)	Fraction of Synthetic Fertilizer N Applied that Volatilizes $Frac_{GASFS}$ (kg N/kg N)	Amount of Synthetic N Applied to Soil that Volatilizes (kg N/kg N)	Total N Excretion by Livestock N_{EX} (kg N/yr)	Fraction of Total Manure N Excreted that Volatilizes $Frac_{GASM}$ (kg N/kg N)	Total N Excretion by Livestock that Volatilizes (kg N/kg N)	Emission Factor EF_4 (kg N_2O–N/kg N)	Nitrous Oxide Emissions (Gg N_2O–N/yr)
			C = (A x B)			F = (D x E)		H = (C + F) x G /1 000 000
Total	3207000000	0.1	320,700,000.00	4,831,462,480.00	0.2	966,292,496.00	0.01	12.87

Documentation box:

1. Nitrogen from Synthetic fertilizer applied is from Agricultural Statistics of Pakistan 2011-2012,
2. Fraction of synthetic fertilizer applied and fraction of total manure N excreted are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, , Table 4-17,
3. Emission factors are based on Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-18,

This spreadsheet contains sheet 5 of Worksheet 4-5, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**5 OF 5 INDIRECT NITROUS OXIDE EMISSIONS FROM LEACHING**
COUNTRY	**Pakistan**
YEAR	**2012**

	STEP 7					STEP 8	STEP 9
	I Synthetic fertilizer Use N_{FERT} (kg N/yr)	J Livestock N Excretion N_{EX} (kg N/yr)	K Fraction of N That Leaches $Frac_{LEACH}$ (kg N/kg N)	L Emission Factor EF_5	M Nitrous Oxide Emissions From Leaching (Gg N_2O–N/yr)	N Total Indirect Nitrous Oxide Emissions (Gg N_2O/yr)	O Total Nitrous Oxide Emissions (Gg)
					M = (I + J) x K x L/1 000 000	N = (H + M)[44/28]	O = (G + C + N) (G from Worksheet 4-5, sheet 2, Step 4; C from Worksheet 4-5, sheet 3, Step 5; N from Worksheet 4-5, sheet 5, Step 8).
Total	3,207,000,000.00	4,831,462,480.00	0.06	0.025	12.06	39.17	239.17

Documentation box:

1. From the total livestock N Excretion, it is assumed that about 20% is in leaching region so Fraction of N that leached, Frac_LEACH (0.3 from IPCC revised 1996 guidelines table 4.17 *0.2 leaching region) would be 6%, 2. Emission factors are based Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-18,
2. Emission factors are based Revised 1996 Guidelines, Vol. 2, Chapter 4, Table 4-18,

Annexure 8:

Land Use Change and Forestry Sector: Worksheets of emission estimates for the year 2012

This spreadsheet contains sheet 1 of Worksheet 5-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**LAND USE CHANGE AND FORESTRY**						
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**						
WORKSHEET	**5-1**						
SHEET	**1 OF 3**						
COUNTRY	**Pakistan**						
YEAR	**2012**						
STEP 1							
			A Area of Forest/Biomass Stocks (kha)	B Annual Growth Rate (t dm/ha)	C Annual Biomass Increment (kt dm)	D Carbon Fraction of Dry Matter	E Total Carbon Uptake Increment (kt C)
					C=(A x B)		E=(C x D)
		Conifers	1946	0.02	38.92	0.5	19.46
		Riverian	273	3.65	996.45	0.5	498.23
		Scrub	1584	0.99	1,568.16	0.5	784.08
		Irrigated Plantation	254	4.01	1,018.54	0.5	509.27
		Mangroves	362	0.99	358.38	0.5	179.19
		Irrigated including farmland trees	19270	1	19,270.00	0.5	9,635.00
		Non-Irrigated including farmland trees	1900	0.32	608.00	0.5	304.00
		Linear (Urban/roadside) plantation	21	4.01	84.21	0.5	42.11
		Inland water bodies	2522	0	0.00	0.5	0.00
		others	79610	0	0.00	0.5	0.00
					0.00		0.00
					0.00		0.00
Non-Forest Trees (specify type)			A Number of Trees (1000s of trees)	B Annual Growth Rate (kt dm/1000 trees)			
					0.00		0.00
					0.00		0.00
						Total	11,971.33

Documentation box:

1. Area of forest/biomass stock: i). Area of forest/biomass stock: Latest available data of Conifers, Riverian, Scrub, Irrigated Plantation and mangroves is taken from Agricultural Statistics of Pakistan 2011-12. ii). Non-irrigated area is calculated by subtracting irrigated area from total cultivated area from Table 2.2 of Pakistan Economic Survey 2008-09. iii). Inland water bodies from FAO, Pakistan Country Report, FRA2005/198, Rome, 2005.
2. Annual growth rates are same as assumed in Pakistan's Initial National Communication.
3. Default Carbon fraction of dry matter (0.5) is used from IPPC revised guidelines of 1996.

This spreadsheet contains sheet 2 of Worksheet 5-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**LAND USE CHANGE AND FORESTRY**
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**
WORKSHEET	**5-1**
SHEET	**2 OF 3**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

Harvest Categories (specify)	F Commercial Harvest (if applicable) (1000 m^3 roundwood)	G Biomass Conversion/ Expansion Ratio (if applicable) (t dm/m^3)	H Total Biomass Removed in Commercial Harvest (kt dm)	I Total Traditional Fuelwood Consumed (kt dm)	J Total Other Wood Use (kt dm)	K Total Biomass Consumption (kt dm)	L Wood Removed From Forest Clearing (kt dm)	M Total Biomass Consumption From Stocks (kt dm)
			H = (F x G)	FAO data		K = (H + I + J)	(From column M, Worksheet 5-2, sheet 3)	M = K - L
All categories	34561	0.5	17,280.50	11937	0	29,217.50		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
Totals	34561.00		17,280.50	11,937.00	0.00	29,217.50	0.00	29,217.50

Documentation box:

1. Category wise commercial harvest data is not available, therefore total commercial harvest is calculated on the basis of annual harvest rate from 1994-2012.
2. Biomass Conversion/ Expansion Ratio is default (0.5) based on IPCC Revised guidelines 1996.

This spreadsheet contains sheet 3 of Worksheet 5-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**LAND USE AND FORESTRY**
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**
WORKSHEET	**5-1**
SHEET	**3 OF 3**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 3		**STEP 4**	
N	O	P	Q
Carbon Fraction	Annual Carbon Release (kt C)	Net Annual Carbon Uptake (+) or Release (-) (kt C)	Convert to CO_2 Annual Emission (-) or Removal (+) ($Gg\ CO_2$)
	O = (M x N)	P = (E - O)	Q = (P x [44/12])
0.5	14,608.75	-2,637.42	-9,670.54

Documentation box:

1. Default Carbon fraction of dry matter (0.5) is used from IPPC revised guidelines of 1996.

Annexure 9:

Waste Sector: Worksheets of emission estimates for the year 2012

This spreadsheet contains Worksheet 6-1, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES**
WORKSHEET	**6-1**
SHEET	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1	**STEP 2**	**STEP 3**						**STEP 4**				
A Total Annual MSW Disposed to SWDSs (Gg MSW)	B Methane Correction Factor (MCF)	C Fraction of DOC in MSW	D Fraction of DOC which Actually Degrades	E Fraction of Carbon Released as Methane	F Conversion Ratio	G Potential Methane Generation Rate per Unit of Waste (Gg CH_4/Gg MSW)	H Realised (Country-specific) Methane Generation Rate per Unit of Waste (Gg CH_4/ Gg MSW)	J Gross Annual Methane Generation (Gg CH_4)	K Recovered Methane per Year (Gg CH_4)	L Net Annual Methane Generation (Gg CH_4)	M One Minus Methane Oxidation Correction Factor	N Net Annual Methane Emissions (Gg CH_4)
						G= (C x D x E x F)	H= (B x G)	J= (H x A)		L= (J - K)		N= (L x M)
6627.47	0.6	0.18	0.77	0.5	16/12	0.09	0.06	367.43	0	367.43	1	367.43
					16/12	0.00	0.00	0.00		0.00		0.00
					16/12	0.00	0.00	0.00		0.00		0.00

Documentation box:

1. Urban Population is based on Pakistan Economic Survey 2011-12, Table 12.1.
2. MSW Generation Rate is based on GoP, Data collection for preparation of National Study of privatization of solid waste management in eight cities of Pakistan (1996).
3. Default Fraction of MSW disposed to SWDSs is based on IPCC Revised guidelines 1996, Table 6-1.
4. MCF default value 0.6 is based on IPCC Revised Guidelines 1996, Vol. 2, Chapter 6. Table 6-2.
5. Default Fraction of DOC of MSW, (0.18) is based on IPCC Revised guidelines 1996, Table 6-1.
6. Default Fraction of DOC which actually degrades (0.77) is based on IPCC Revised guidelines 1996, Vol. 2, Chapter 6.
7. Default Fraction of Carbon releases as Methane (0.5) is based on IPCC Revised guidelines 1996, Vol. 2, Chapter 6.
8. Default methane oxidation factor (1-0=1) is based on IPCC Revised guidelines 1996, Vol. 2, Chapter 6.

This spreadsheet contains Worksheet 6-1A (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**QUANTITY OF MSW DISPOSED OF IN SOLID WASTE DISPOSAL SITES USING COUNTRY DATA**
WORKSHEET	**6-1A (SUPPLEMENTAL)**
SHEET	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

A Population whose Waste goes to SWDSs (Urban or Total) (persons)	B MSW Generation Rate (kg/capita/day)	C Annual Amount of MSW Generated (Gg MSW)	D Fraction of MSW Disposed to SWDSs (Urban or Total)	E Total Annual MSW Disposed to SWDSs (Gg MSW)
		C = (A x B x 365)/1 000 000		E = (C x D)
67550000	0.448	11,045.78	0.6	6,627.47

Documentation box:

1. Urban Population is based on Pakistan Economic Survey 2011-12, Table 12.1.
2. MSW Generation Rate is based on GoP, Data collection for preparation of National Study of privatization of solid waste management in eight cities of Pakistan, average of 0.283 and 0.613, (1996).
3. Default Fraction of MSW disposed to SWDSs is based on IPCC Revised guidelines 1996, Table 6-1.

This spreadsheet contains Worksheet 6-1C (supplemental), in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE CORRECTION FACTOR**
WORKSHEET	**6-1C (SUPPLEMENTAL)**
SHEET	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

Type of Site	W Proportion of Waste (by weight) for Each Type of SWDSs	X Methane Correction Factor (MCF)	Y Weighted Average MCF for Each Type of SWDS
			Y = W x X
Managed		1.0	0.00
Unmanaged - deep (>=5m waste)		0.8	0.00
Unmanaged - shallow (< 5m waste)		0.4	0.00
Total (Unmanaged)	1	0.6	0.60

Documentation box:

1. Default value of 1 as proportion of waste (by weight) for unmanaged wastes is based on IPCC Revised Guidelines 1996, Vol. 2, Chapter 6.
2. MCF default value 0.6 is based on IPCC Revised Guidelines 1996, Vol. 2, Chapter 6. Table 6-2.

This spreadsheet contains sheet 1 of Worksheet 6-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM DOMESTIC AND COMMERCIAL WASTEWATER AND SLUDGE TREATMENT**
WORKSHEET	**6-2**
SHEET	**1 OF 4 ESTIMATION OF ORGANIC WASTEWATER AND SLUDGE**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1

A Region or City	B Population (1,000 persons)	C Degradable Organic Component (kg BOD/1000 persons/yr)	D Fraction of Degradable Organic Component Removed as Sludge	E Total Domestic/Commercial Organic Wastewater (kg BOD/yr)	F Total Domestic/Commercial Organic Sludge (kg BOD/yr)
				E = [B x C x (1-D)]	F = (B x C x D)
Population (Urban+Rural)	180710	14600	0	2,638,366,000.00	0.00
				0.00	0.00
				0.00	0.00
				0.00	0.00
			Total:	2,638,366,000.00	0.00

Documentation box:

1. Urban and Rural Population is based on Pakistan Economic Survey 2011-12, Table 12.1.
2. Default value of Degradable Organic Component is based on IPCC Revised Guidelines 1996, Vol. 2 Chapter 6, Table 6-5
3. Fraction of Degradable Organic Component removed as Sludge is (0) based on IPCC Revised Guidelines 1996.

This spreadsheet contains sheet 2 of Worksheet 6-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM DOMESTIC AND COMMERCIAL WASTEWATER TREATMENT**
WORKSHEET	**6-2**
SHEET	**2 OF 4 ESTIMATION OF EMISSION FACTOR FOR WASTEWATER HANDLING SYSTEMS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A Wastewater Handling System	B Fraction of Wastewater Treated by the Handling System	C Methane Conversion Factor for the Handling System	D Product	E Maximum Methane Producing Capacity (kg CH_4/kg BOD)	F Emission Factor for Domestic/Commercial Wastewater (kg CH_4/kg BOD)
			D = (B x C)		F = (D x E)
Urban	0.05	0.75	0.04		
			0.00		
			0.00		
			0.00		
		Aggregate MCF:	0.04	0.25	0.01

Documentation box:

1. Fraction of waste water treated by the handling system is based on IPCC Revised guidelines 1996, Vol. II, Chapter 6, Table 6-7
2. Methane conversion factors is based on IPCC Revised guidelines 1996, Vol. II, Chapter 6, Table 6-7
3. Maximum Methane Producing Capacity for the wastewater (default 0.25) is based on IPCC Revised guidelines 1996, Vol. II, Chapter 6

This spreadsheet contains sheet 4 of Worksheet 6-2, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM DOMESTIC AND COMMERCIAL WASTEWATER AND SLUDGE TREATMENT**
WORKSHEET	**6-2**
SHEET	**4 OF 4 ESTIMATION OF METHANE EMISSIONS FROM DOMESTIC/COMMERCIAL WASTEWATER AND SLUDGE**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 4

	A Total Organic Product (kg BOD/yr)	B Emission Factor (kg CH_4/kg BOD)	C Methane Emissions Without Recovery/Flaring	D Methane Recovered and/or Flared (kg CH_4)	E Net Methane Emissions (Gg CH_4)
	from Worksheet 6-2, Sheet 1	from Worksheet 6-2, Sheets 2 and 3	C = (A x B)		E = (C - D)/1 000 000
Wastewater	2,638,366,000.00	0.01	24,734,681.25	0	24.73
Sludge	0.00	0.00	0.00	0	0.00
				Total:	24.73

Documentation box:

1. Methane recovered/flared (default 0.0) is based on IPCC Revised guidelines 1996, Vol. II, Chapter 6

This spreadsheet contains sheet 1 of Worksheet 6-3, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER AND SLUDGE HANDLING**
WORKSHEET	**6-3**
SHEET	**1 OF 4 TOTAL ORGANIC WASTEWATER AND SLUDGE**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 1

		A	B	C	D	E	F
		Total Industrial Output (t/yr)	Degradable Organic Component (kg COD/m^3 wastewater)	Wastewater Produced (m^3/tonne product)	Fraction of Degradable Organic Component Removed as Sludge	Total Organic Wastewater from Industrial Source (kg COD/yr)	Total Organic Sludge from Industrial Source (kg COD/yr)
						E = [A x B x C x(1-D)]	F = (A x B x C x D)
Iron and Steel						0.00	0.00
Non-ferrous metals						0.00	0.00
Fertiliser		5755900	1.1	2		12,662,980.00	0.00
Food & Beverage	Canneries					0.00	0.00
	Beer					0.00	0.00
	Wine					0.00	0.00
	Meatpacking					0.00	0.00
	Dairy products					0.00	0.00
	Sugar	4733000	4.8	10		227,184,000.00	0.00
	Fish processing					0.00	0.00
	Oil & grease					0.00	0.00
	Coffee					0.00	0.00
	Soft drinks					0.00	0.00
	Other (ghee)	1131000	3.1	0.7		2,454,270.00	0.00
Paper & Pulp	Paper	649700	150	7		682,185,000.00	0.00
	Pulp					0.00	0.00
	Other (textile)	3288200	5.9	3		58,201,140.00	0.00
Petroleum refining/Petrochemicals						0.00	0.00
	Bleaching					0.00	0.00
	Dying					0.00	0.00
	Other					0.00	0.00
Rubber						0.00	0.00
Other						0.00	0.00
					Total	982,687,390.00	0.00

Documentation box:

1. Degradable Organic Component (Kg COD/m3) and wastewater produce (m3/tonne product) is same as used in 1994 GHG Inventory.

This spreadsheet contains sheet 2 of Worksheet 6-3, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER TREATMENT**
SOURCE	
WORKSHEET	**6-3**
SHEET	**2 OF 4 ESTIMATION OF EMISSION FACTOR FOR WASTEWATER HANDLING SYSTEMS**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 2

A Wastewater Handling System	B Fraction of Wastewater Treated by the Handling System	C Methane Conversion Factor (MCF)	D Product	E Maximum Methane Producing Capacity (kg CH_4/kg DC)	F Emission Factor for Industrial Wastewater Source (kg CH_4/kg COD)
			D = (B x C)		F = (D x E)
Untreated	0.95	0.095	0.09		
Treated	0.05	0.01	0.00		
			0.00		
			0.00		
		Aggregate MCF:	0.09	0.25	0.02

Footnote: B_o is expressed in units of kg CH_4/kg DC, where DC is the indicator of degradable component of the waste (either COD or BOD). By definition, BOD is less than or equal to COD; the maximum BOD possible is, in fact, the COD. Therefore, when estimating the maximum CH_4 producing potential from BOD or COD, the maximum potential CH_4 produced per unit of BOD is equivalent to the maximum potential CH_4 produced per unit of COD. This value is 0.25. kg CH_4/kg COD.

Documentation box:

1. Fraction of waste water treated by the handling system is based on IPCC Revised guidelines 1996, Vol. II, Chapter 6, Table 6-7 which is 5%.
2. Methane Conversion Factors for Untreated Handling System are based of ASAD Inventory for 2008.

This spreadsheet contains sheet 4 of Worksheet 6-3, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER AND SLUDGE TREATMENT**
WORKSHEET	**6-3**
SHEET	**4 OF 4 ESTIMATION OF METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER AND SLUDGE**
COUNTRY	**Pakistan**
YEAR	**2012**

STEP 4

	A	B	C	D	E
	Total Organic Product (kg COD/yr)	Emission Factor (kg CH_4/kg COD)	Methane Emissions without Recovery/Flaring	Methane Recovered and/or Flared (kg CH_4)	Net Methane Emissions (Gg CH_4)
	Worksheet 6-3, Sheet 1	Worksheets 6-3, Sheets 2 and 3	C = (A x B)		E = (C - D) / 1 000 000
Wastewater	982,687,390.00	0.02	22,294,720.16		22.29
Sludge	0.00	0.00	0.00		0.00
				Total:	22.29

This spreadsheet contains Worksheet 6-4, in accordance with the
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

MODULE	**WASTE**
SUBMODULE	**INDIRECT NITROUS OXIDE EMISSIONS FROM HUMAN SEWAGE**
WORKSHEET	**6-4**
SHEET	**1 OF 1**
COUNTRY	**Pakistan**
YEAR	**2012**

	A Per Capita Protein Consumption (Protein in kg/person/yr)	B Population (number)	C Fraction of Nitrogen in Protein $Frac_{NPR}$ (kg N/kg protein)	D Amount of sewage N produced (kg N/yr)	E Amount of sewage N applied to soils as sewage sludge (kg N/yr)	F Net amount of sewage N produced (kg N/yr)	G Emission factor EF_6 (kg N_2O-N/kg sewage-N produced)	H Total Annual N_2O Emissions (Gg N_2O/yr)
				D = A x B x C		F = D - E		H = (F x G) x (44/28) / 1 000 000
Total	25.55	94743000	0.16	387309384	0	387309384	0.01	6.09

Documentation box:

1. It is assumed that 90 % of urban population and 30% of rural population whose effluents go with waste water.
2. Protein available in Pakistan is 70 gm/capita/day as reported in Pakistan Economic Survey 2011-12.