Enabling Activities for Preparation of Syria's Initial National Communication to UNFCCC

# Green House Gases (GHG) Inventory in Syria

*Finale Report*

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Ministry of state for Environment Affairs (MSEA), in collaboration with United Nation Development Programm (UNDP) in Syria, and Global Environmental Facility (GEF).

Project Title: "Enabling Activities for Preparation of Syria's Initial National Communication to UNFCCC", *(Project Nr.00045323).*

**General Report**

**Of**

# Green House Gases (GHG) Inventory in Syria

(INC-SY_GHG_General Inventory-En)


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*This report has been approved unanimously by the technical committee, during the Technical Workshop which took place on 23.7.2009, in the Resort of Mount Hermon, Qunitra.*

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# First Chapter: Introduction

## 1.1. Climate Change and GHG inventory :

The second half of the twentieth century witnessed important changes in the global climate. Scientists registered a rise in the temperature, which resulted in melting of ice caps and rise in sea level. They attributed this to the Greenhouse Gas effect's phenomena which resulted from the increase in the concentration of green house gases GHG especially carbon dioxide $CO_2$. This increase is a result of human activities especially burning of fossil fuels, clearing of forests and others.(1) For this purpose, the World Climate Conference was held in 1979 by the World Meteorological Office WMO and came to the conclusion "The activities of human beings can cause local and global changes to the environment". We should notice here that until that time there was no clear signal about the effect on the global climate. The conference held in Austria in 1985 by WMO and United Nation Environment Program UNEP stated that "$CO_2$ and other gases influence the climate change", and the Intergovernmental Panel for Climate Change IPCC was established. IPCC presented its first report in 1990 which played an important role in establishing the United Nation Framework Convention for Climate Change UNFCCC" in The Earth Summit Conference which was held in Rio de Janiro in 1992. The second IPCC report titled "Climate Chang" led to signing the Koyoto Protocol in 1997. The third assessment report TAR by the title "Climate Change" was presented at the 7$^{th}$ conference of the UNFCCC in the year 2001. The report was recommended to be used by Conference of the Parties COP. The fourth report was presented in 2007.

Decision 17/COP8 of the 8$^{th}$ Conference of Parties which belongs to UNFCCC states that: "Countries are obliged to present National Communications every year about their emissions of GHG and its sinks". Countries from non-Annex 1 parties must deliver estimates of their emissions of CO2, $CH_4$ and $N_2O$ gases and its sinks. They are encouraged to present information about HFCs, PFCs and $SF_6$.

National Communications consist of the followings:

- National Circumstances.
- Inventory of GHG emissions and sinks.
- Policies for adaptation to climate change.
- Policies and measures for mitigation.
- Other measures for achieving these goals.
- Gaps, difficulties and the financial, technical and trained human personnel needed.

The Center for Scientific and Environmental Research which belongs to the Ministry of State for Environment in Syria carried out with the help of GTZ-Germany a study of GHG in Syria for the years 1990 and 1994. The study was presented in 2000. This report is the first concerned with GHG inventory in the First National Communication INC according to project number 00045323 with UNDP.

The First GHG inventory for Syria presents emissions of required GHG according to COP directions. It also gives an idea about emissions of non-direct GHG such as CO and NMVOC. It also gives emissions of $SO_x$ for the years studied. This inventory is essential for carrying out mitigation studies and policies and for their evaluations. The GHG inventory also gives information about the main sectors such as energy, agriculture, industry, transport and waste, which helps in dealing with other environmental issues.

It also provides data on the economic and social development which can help in planning and management.

The GHG inventory considered the year 1994 a base year for calculation as recommended by COP. The calculations were carried out for the years 1994 to 2005 to evaluate the trend of GHG emissions and sinks. This was explained in the context of the economic and social progress taking place in the country. They can provide a sound basis for evaluating mitigation policies and measures. They could also provide a useful tool for developing future scenarios.

### 1.2. Special Institutional Arrangements Concerning GHG Inventory:

A Team Leader was appointed by contract No 179 / 2008 by 20 July 2008, and was charged with composing Term of Reference TOR for GHG sectoral experts and presents it to Project Manager for announcement. A committee from the Focal Point, Project Leader, UNDP representative and Team Leader was established to interview applicants and choose candidates. The committee held two meetings, reviewed the CV's of applicants and intervied them decided to contract a group of four GHG experts in the fields of energy, agriculture, industry and wastes. Since there was no previous experience of GHG inventory compilation in Syria, it was essential to train people to carry out the work after completing the First National Communication. A group of personnel from the General Environmental Commission and the Center for Environmental Studies and other public establishments concerned with the project was established to accompany the work performed by GHG experts and to get training on the GHG inventory compilation according to Revised 1996 GHG Guidelines. The team was allocated to the four sectors (energy, agriculture, industry and wastes) according to specializations Table1).

The process of inventory compilation was done through self–learning since the team had no previous experience. The team was provided with the IPCC 1996 Revised Guidelines and Software. A workshop was supposed to be held with external experts to give an introductory course on the subject but the advance of the process by discussions in meetings and workshops given by team leader proved sufficient enough. Four workshops were held for trainees and they were engaged in collecting and preparing data as well as participating in some estimation.

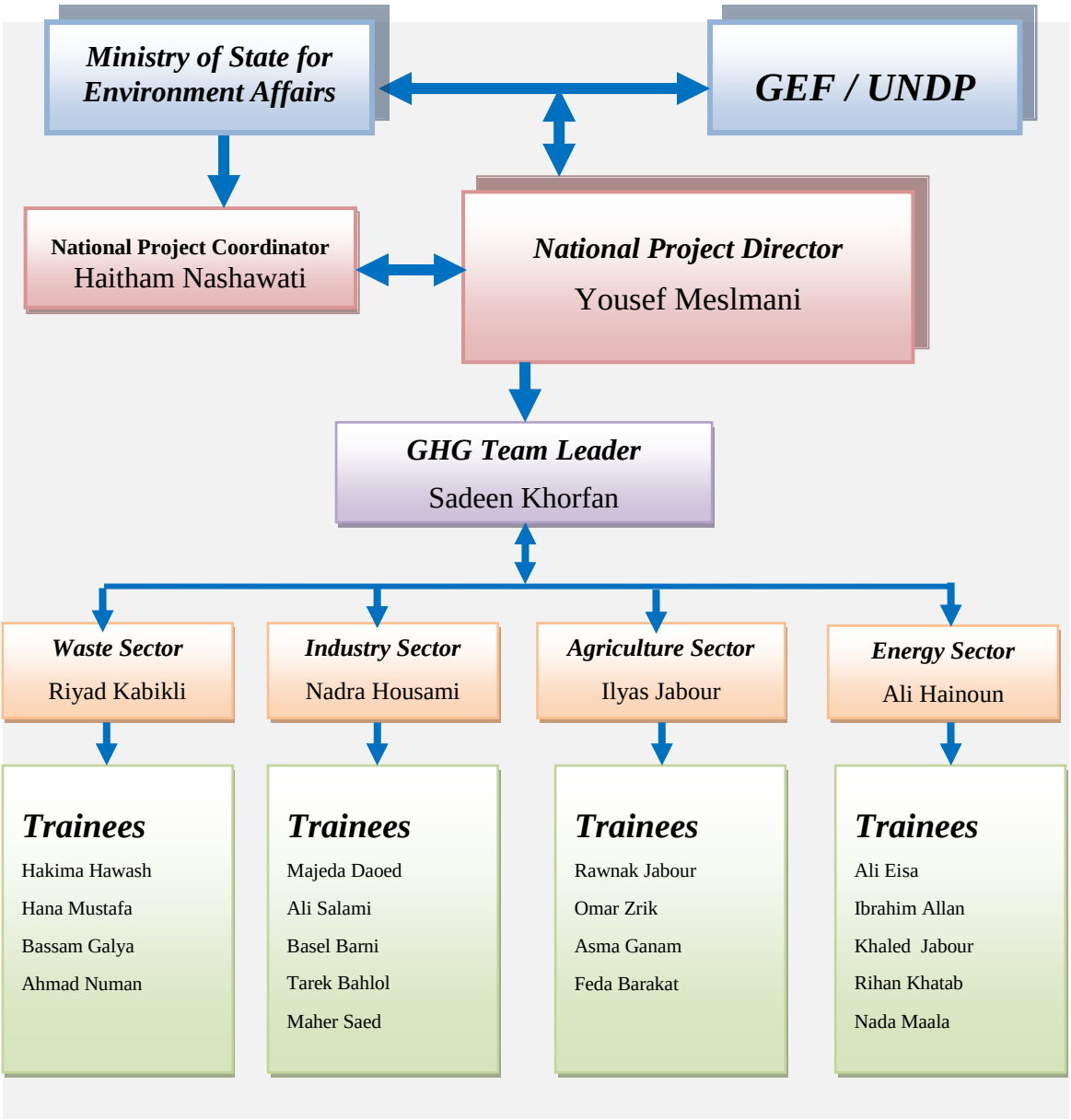



**Fig 1.** The Organization Chart of GHG Inventory Team Management

## 1.3. Preparation of GHG Inventory:

Data were obtained mainly from the Central Bureau of Statistics and data on each sector was obtained from the relevant ministries. Information on the energy sector came from the Ministry of Petroleum and Mineral Resources, Ministry of Electricity, Ministry of Industry, Ministry of Transport, Ministry of Agriculture and Agrarian Reform and Ministry of Local Administration. Data for agricultural sector was collected from the Ministry of Agriculture and Agrarian Reform. Data on wastes and municipal and industrial sewage was obtained from the Ministry of Housing, the Ministry of Industry and the Ministry of Local Administration. For the industrial sector information was obtained from the Ministry of Industry, the Ministry of Economics and the Ministry of Finance. Sectoral experts were provided with official letters from the Ministry of State for Environment to facilitate their missions.

However, great difficulties were encountered in obtaining data especially since climate change was new to officials working in these sectors. There was a lack of data in the energy sector since energy balances for the years 2000-2004 were not available. The same was true for data on HFCs, PFCs, $SF_6$ consumptions in the industrial sector. Data was converted to the form which can be used by IPCC Guidelines, and local conversion factors were used in some cases such as the calorific values of fuel products. In other cases, factors were chosen from the 1996 Guidelines for countries with similar circumstances. Detailed data are presented in tables in the sectoral reports.

### 1.4. Methodologies and Sources of Data:

According to decision 17 / COP8 "Non- Annex 1 countries should prepare the first national communication INC about climate change". This communication should include a GHG inventory. This inventory should adhere to the IPCC 1996 Revised Guidelines established by NGGIP [6]. These Guidelines were followed for all sectors. The GHG inventory included $CO_2$, $CH_4$, and $N_2O$ gases. The study used Tier 1 methodology although it was adjusted in certain cases to suit better local or national circumstances i.e. Tier 2. Default emission factors DEF from the Guidelines were used in most cases for similar circumstances. Activity data AD were taken from the Central Bureau of Statistics. [5] Other statistics and data were collected from the relevant sources in the ministries such as the Ministry of Industry, the Ministry of Agriculture and Agrarian Reform [7], the Ministry of Petroleum and Mineral Resources [8], the Ministry of Electricity [9, 10], the Ministry of Housing, the Ministry of Local Administration, the Ministry of State for Environment and the International World Energy IEA [11]. The computer program based on IPCC revised 1996 Guidelines and provided from NGGIP was used for calculations [12]. Moreover, the worksheets in the 1996 Guidelines were used. Finally, the relevant tables in the Guidelines were used for reporting.

### 1.5. Key Categories (KC):

The key categories were not analyzed quantitatively because the GHG inventory was done for the first time in Syria. Therefore, a qualitative analysis was performed to the key categories in the IPCC 1996 Guidelines as applied to Syria. In general most categories in the energy sector were key categories because of the significance of burning fossil fuel and the rapid increase in energy demand. This also includes fugitives from the oil industry since Syria is oil and gas producing and exporting country. As for agriculture enteric fermentation, fermentation of animal manure and fertilization of land are key categories. Forests and trees are important $CO_2$ sinks in the Land Use, Land Use Change and Forest sector LULUCEF sector. In the waste sector, solid waste disposal is a key category because of the increase in waste volume caused by a large population growth and the lack of suitable waste disposal methods for recovery of methane. Emissions from domestic waste water increased in importance because of building of waste water treatment units in big cities in Syria over the recent years. Emissions from industrial waste water stations were not significant because of the small scale of industry in Syria compared with industrialized countries and the lack of waste water treatment facilities in industry or their stoppage for technical reasons. But emissions from waste are in general small compared with the energy and even the agriculture sector. As for industry of cement manufacturing plants and lime production are significant categories for $CO_2$ emissions followed by the chemical and the metal industries.

# Second Chapter: Trend of GHG Emissions

*This chapter describes the results of GHG inventory compilation for the years 1994-2005.*

## 2.1. Total Emissions:

Total GHG emissions from Syria excluding LULUCF sector increased from 52.66 T g $CO_2$ eq in 1994 to 79.07 T g in the year 2005 as shown in Fig (2). Total emissions increased steadily from 1994 to 2005 due to population growth which averaged 2.5% yearly, the steady rise in the standard of living, the growth of economic development which averaged 4 -7 % yearly and the emigration from the countryside to the cities. But emissions from energy increased more rapidly from 38 T g in 1994 to 58 T g in 2005. This increase was due to a big growth in electricity demand and transport which increased rapidly due to liberation of the economy and reduction of custom duties in 2003-2005. But emissions per a unit of energy dropped due to increase in the efficiency of industry and its automation, the import of more efficient modern cars and the transfer from fuel oil to natural gas for electricity generation.

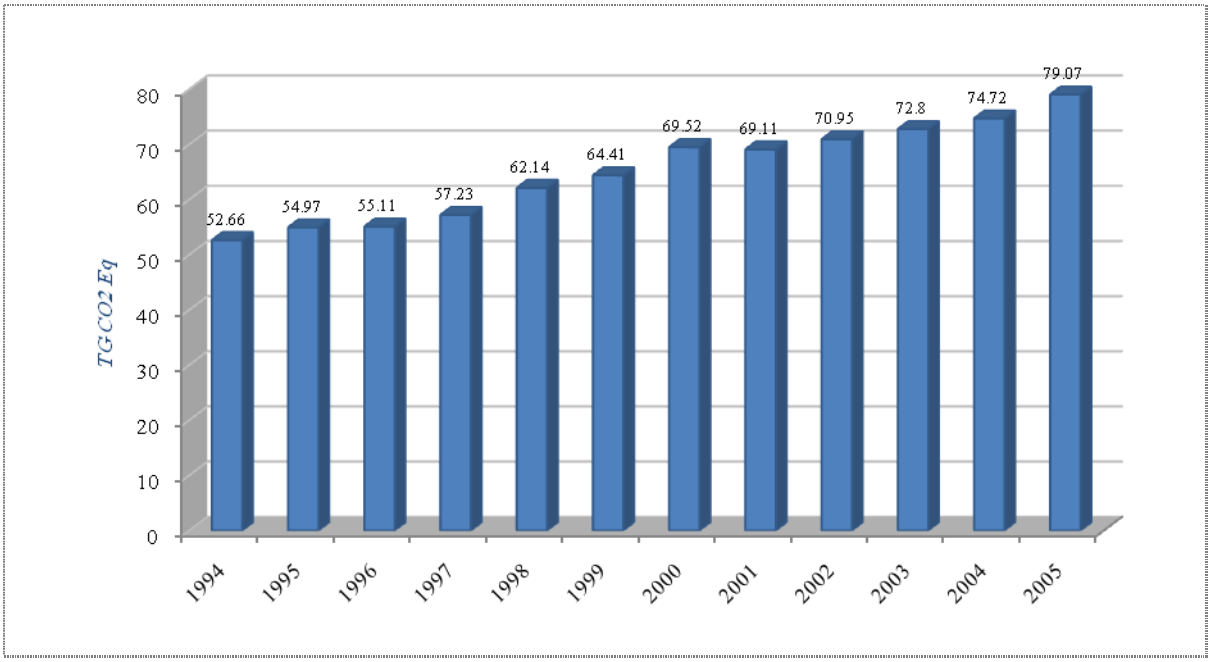



**Fig 2.** Total Emissions of GHG from 1994 to 2005

## 2.2. Total Emissions According to Gas:

Fig (3) shows the share of each GHG gas from total emissions. It is clear that the share of $CO_2$ is the highest and increased from 68% in 1994 to 74% in 2005 due to the increase in use of oil and gas for energy since most $CO_2$ comes from burning fossil fuels in the energy sector. The share of $CH_4$ decreased from 18% in 1994 to 13% in 2005 while the share of $N_2O$ decreased from 14% in to 13% during the same period.

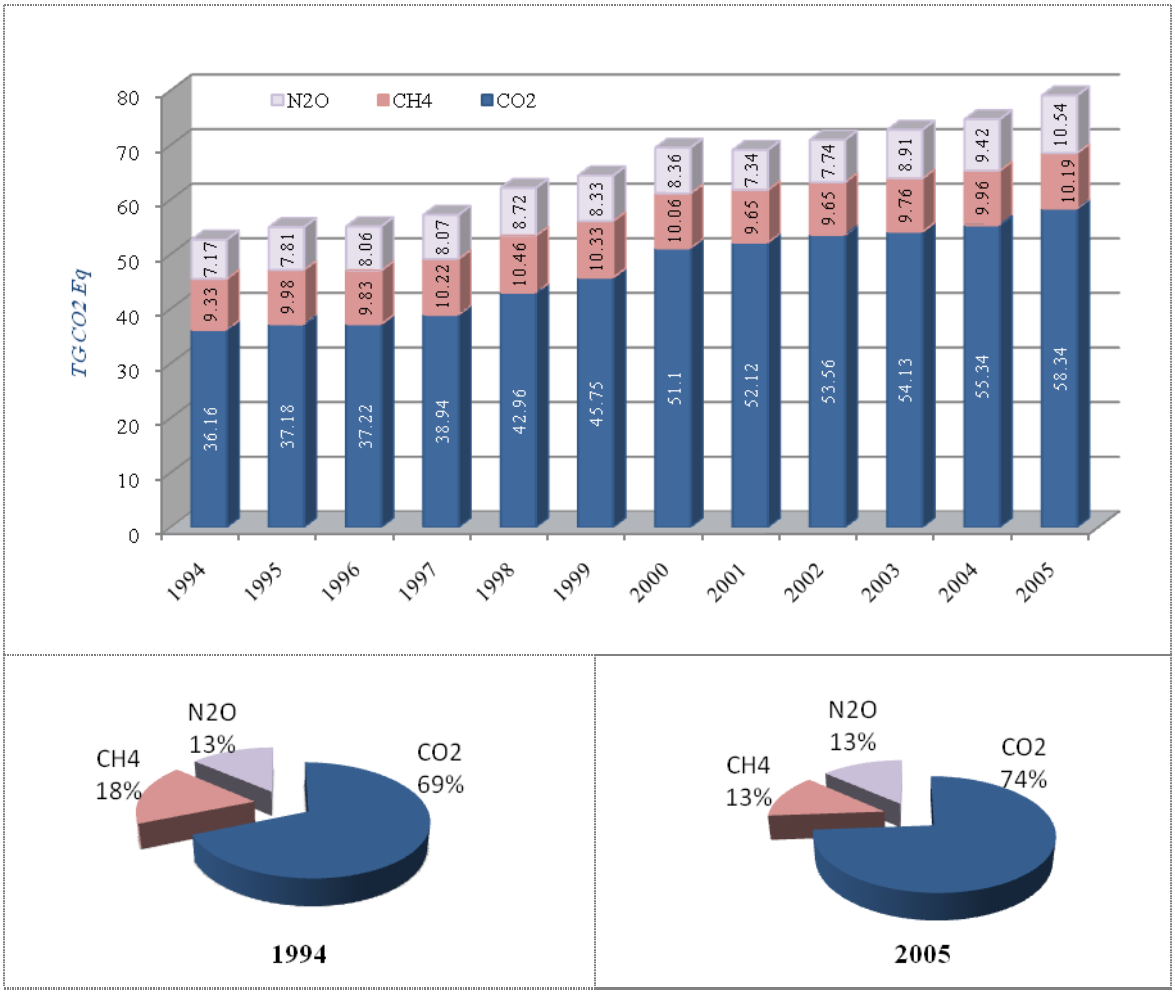



**Fig 3.** Share of Each GHG gas from Total Emissions from 1994 to 2005

## 2.3. Total Emissions According to Sector:

The share of the key sectors energy, agriculture (except LULUCEF), industry and wastes of GHG emissions were presented in Fig (4). This shows that the energy sector is the largest with 72% in 1994 and increased to reach 73% in 2005. The share of agriculture remained constant at 18% and that of waste at 5% while the share of industry dropped slightly from 5% in 1994 to 4% in 2005. This means that the energy sector grew fastest followed by agriculture and to a less extent waste, while the growth of industry was less.

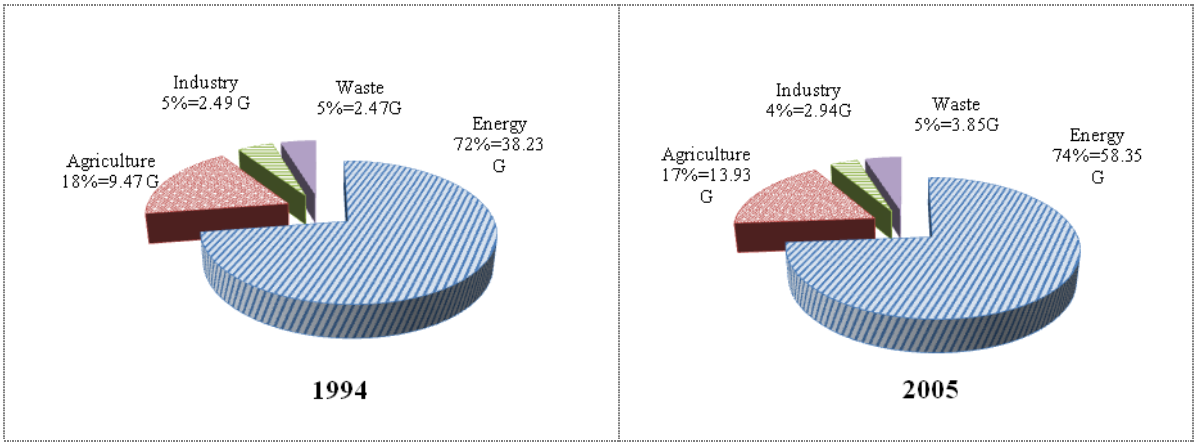



**Fig 4.** GHG Emissions by Sector in $CO_2$ eq for the years 1994 and 2005

Fig (5) also shows emissions of GHG for the years 1994-2005 according to sector. It is clear that emissions from the energy sector rise steadily and fast while the share of agriculture remained constant, and so the waste sector, with the share of industry dropping a little.

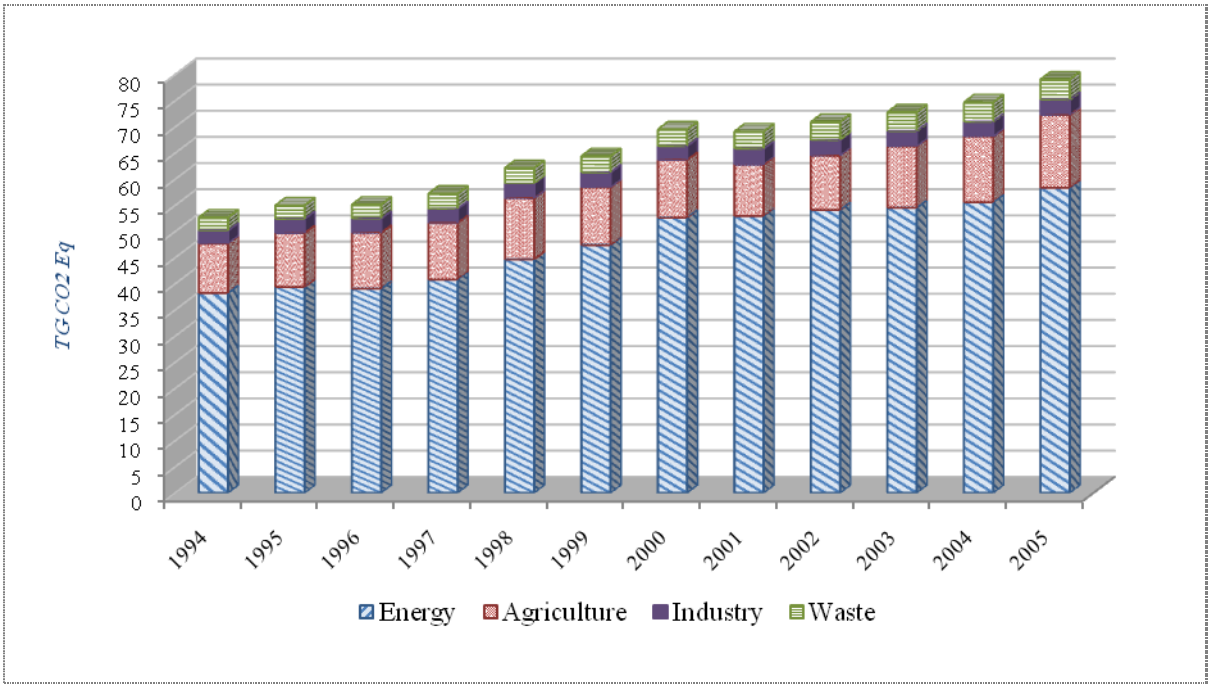



**Fig 5.** Emissions of GHG According to Sector from 1994 to 2005

Table (1) shows a comparison of emissions from different countries. Per capita emission of equivalent $CO_2$ is around 4.0 ton in Syria for the year 2005 (without taking LULUCF into account). It is obvious that emission per capita in Syria is much less than that of the European Union, 15 or 25 and less than the world average and slightly less than Turkey.[13].

**Table 1.** Indicators of GHG Emissions in Syria and World [13]

| Countries | Ton $CO_2$/ acpita Without LUCF | Tg $Co_2$ eq Without LUCF | Ton $CO_2$/ capita | Tg $Co_2$ eq |
|---|---|---|---|---|
| **EU-15** | 10.9 | 4.180 | 9.0 | 3.447 |
| **EU-25** | 11.0 | 4.925 | 9.0 | 4.064 |
| **OECD** | NA | NA | 11.1 | 12.780 |
| **Annex 1** | 14.7 | 17.288 | 12.2 | 14.289 |
| **Non Annex 1** | 16.0 | 13.855 | 13.4 | 11.633 |
| **The world** | NA | NA | 4.0 | 24.983 |
| **Turkey** | 4.1 | 286.3 | 3.3 | 231.0 |
| **Syria**(*) | 3.95 | 79.0 | 2.85 | 57.00 |

(*)In suppose the population of Syria is 20 million.

# Third Chapter: Overview of Emissions

## 3.1. Total Emissions:

In the year 2005 the share of $CO_2$ was the largest of GHG emissions in Syria. It reached 74% while share of $CH_4$ was 13% and $N_2O$ 13% $CO_2$ eq. Table (2) gives the total emissions for 1994 according to GHG gas. Table (3) shows total emissions of GHG in TG $CO_2$ eq in the four sectors.

**Table 2.** Total Emissions of GHG According to Gas for 1994

| Gas | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 36.16 | 37.18 | 37.22 | 38.94 | 42.96 | 45.75 | 51.10 | 52.12 | 53.56 | 54.13 | 55.34 | 58.34 |
| $CH_4$ | 9.33 | 9.98 | 9.83 | 10.22 | 10.46 | 10.33 | 10.06 | 9.65 | 9.65 | 9.76 | 9.96 | 10.19 |
| $N_2O$ | 7.17 | 7.81 | 8.06 | 8.07 | 8.72 | 8.33 | 8.36 | 7.34 | 7.74 | 8.91 | 9.42 | 10.54 |

**Table 3.** Total Emissions of GHG according to Sector for 1994

| Sector | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy | 38.23 | 39.40 | 39.06 | 40.82 | 44.65 | 47.40 | 52.66 | 52.96 | 54.13 | 54.54 | 55.60 | 58.35 |
| Agriculture | 9.47 | 10.32 | 10.70 | 10.78 | 11.72 | 11.04 | 11.04 | 9.85 | 10.38 | 11.74 | 12.56 | 13.93 |
| Industry | 2.49 | 2.71 | 2.74 | 2.74 | 2.81 | 2.88 | 2.65 | 3.04 | 2.99 | 2.95 | 2.86 | 2.94 |
| Waste | 2.47 | 2.54 | 2.61 | 2.88 | 2.95 | 3.07 | 3.16 | 3.25 | 3.45 | 3.57 | 3.670 | 3.85 |

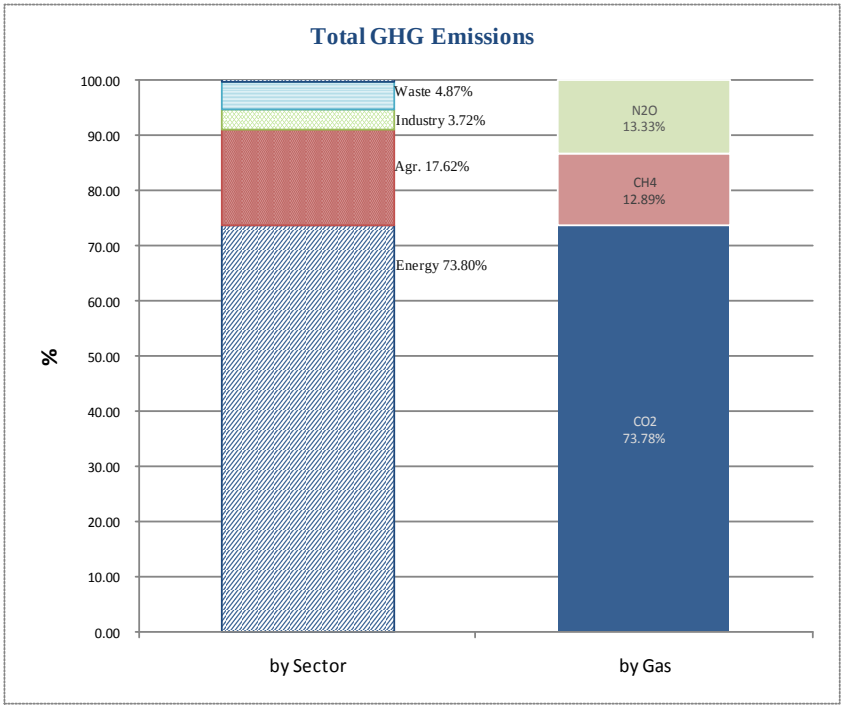



**Fig 6.** Overview of Total Emissions in 2005 according to Gas and Sector

In Syria the majority of GHG gases emitted are $CO_2$ and from the energy sector. This sector emitted 95.137% of all $CO_2$ gases in 2005. Electricity generation is responsible for 39% while transport represented 22% in 2005.

## 3.2. Energy Sector

### 3.2.1. Trend of GHG emissions

Emissions from the energy sector grew steadily from 1994 to 2005 as shown in Fig (7) . Since energy balance for the years 2000-2004 was not available, emissions were calculated for these years by the Reference method only. A comparison was made between the Reference and Sectoral methods for GHG emissions from the energy sector for the year 2005. It was found that total emissions from the energy sector was 58.35 T g by the sectoral method and 58.366 T g by the Reference method ( after taking emissions of $CH_4$ and $N_2O$ in the reference method into account). The difference between both methods is 0.03%.

Total emissions of GHG in 1994 were around 38.24 M ton $CO_2$ eq with $CO_2$ representing 89%. GHG emissions nearly doubled to reach 58.35 M ton $CO_2$ eq in 2005 with $CO_2$ constituting 95%. So it achieved an annual growth of 3.9% on average. This growth is less than the growth of demand on primary energy which increased from 11.7 M ton oil equivalent to 19.39 M ton during the same period. Therefore, emission per capita from the energy sector only decreased from 3.30 ton $CO_2$ eq /ton equivalent oil to 2.98 during this period.

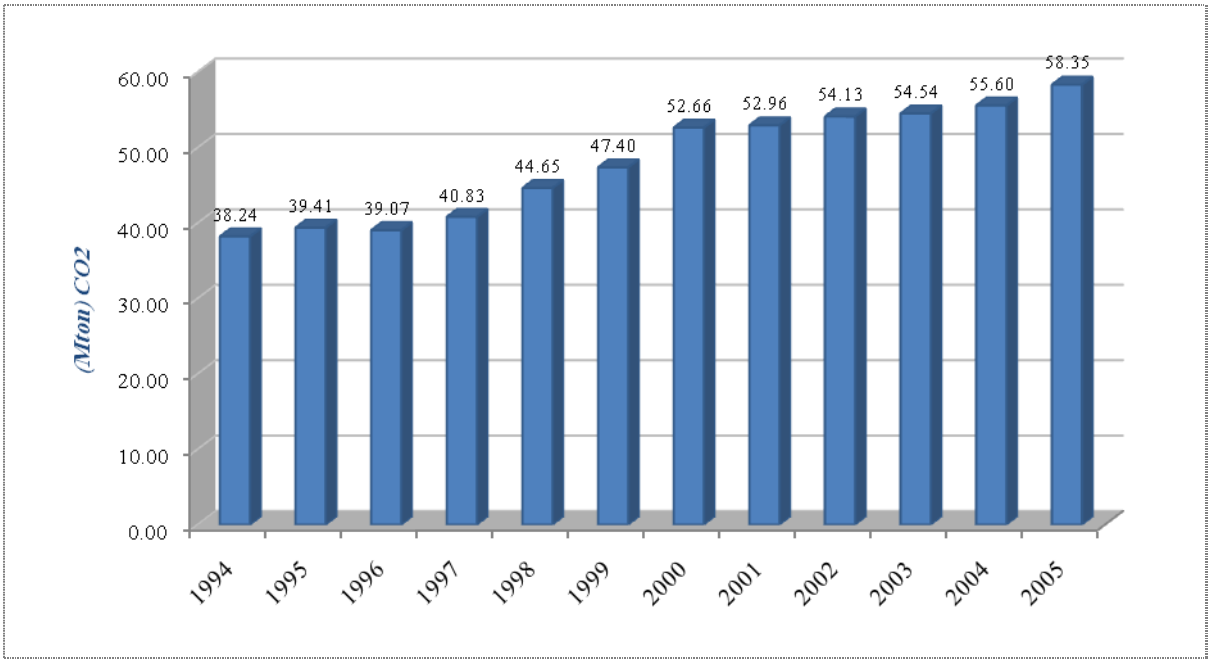



**Fig 7.** Trend of Total GHG Emissions from the Energy Sector from 1994 to 2005

### 3.2.2. Emissions of the Energy Sector by Gas

Fig (8) shows emissions of GHG according to gas from the energy sector. It is quite clear that the share of $CO_2$ is the largest by far reaching 89% in 1994 and that $CH_4$ comes second with 11% while that of $N_2O$ is negligible. This situation developed due to the increase in consumption of oil and gas in electricity generation and transport and to get energy so share of $CO_2$ reached 95% of GHG emissions in 2005 while that of $CH_4$ 4% and $N_2O$ 1%.

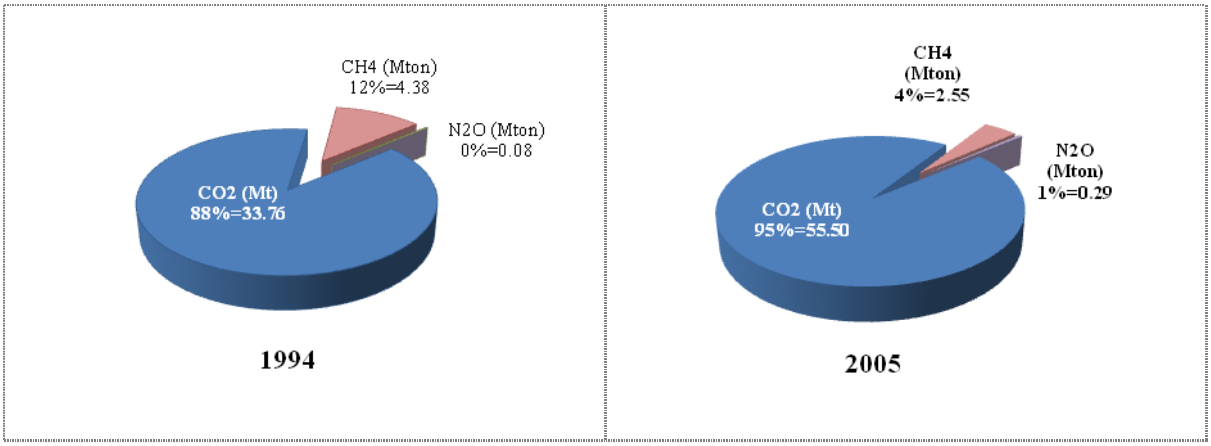
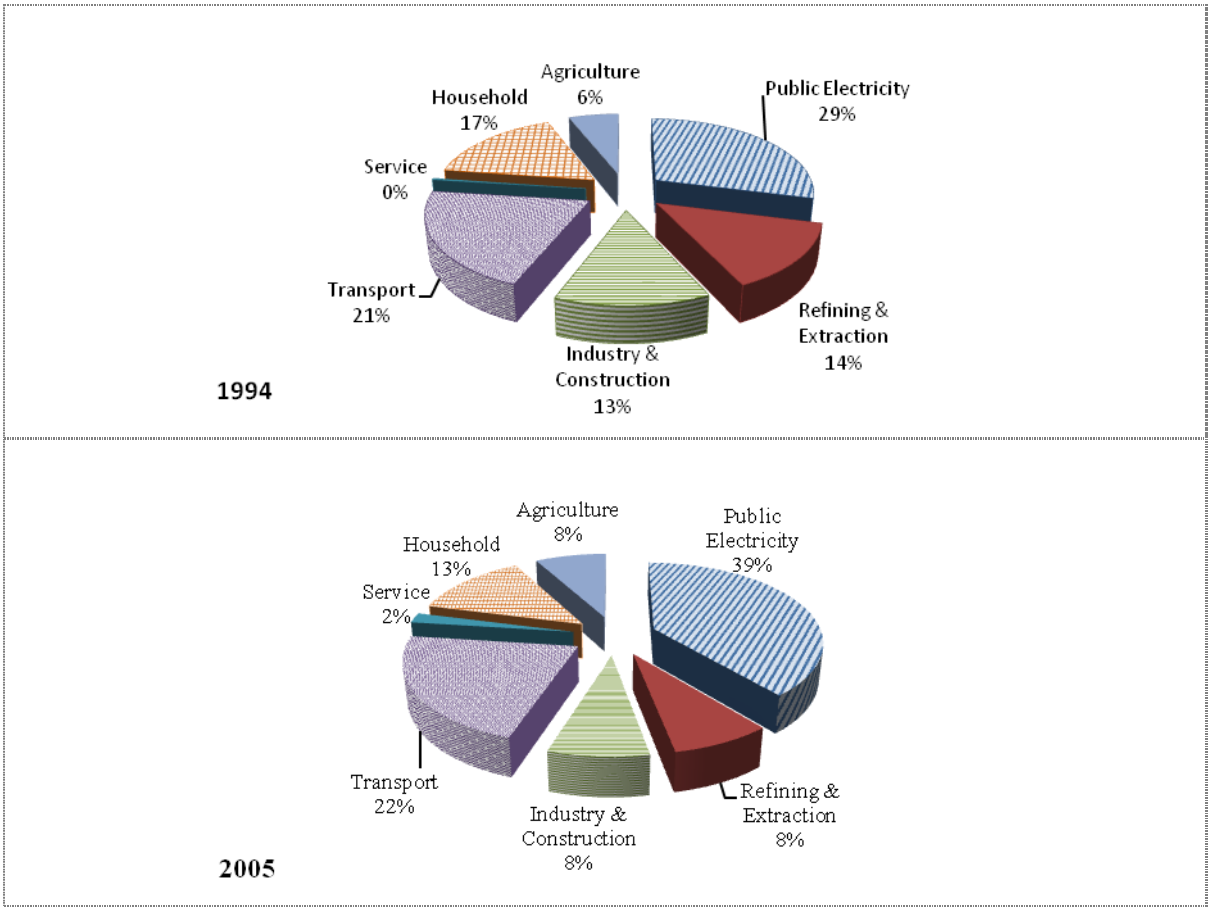



**Fig 8.** Emissions of GHG by Gas from Energy Sector for the year 1994 and 2005

### 3.2.3. Emissions of Energy Sector by Sectors:

Fig (9) shows the emissions of GHG in the energy sector for the relevant categories for the years 1994-2005, It is clear that electricity generation occupies the dominant position in emissions of GHG with its share increasing from 29% in 1994 to 39% in 2005. This was followed by the transport sector which increased its share from 21% to 22% over the same period. Third comes the housing sector with its share decreasing from 17% in 1994 to 14% in 2005. The share of industry and construction retreated from 13% to 8% and the share of oil extraction and industry from 14% to 8% during the same period. The share of electricity generation, transport and oil industry combined, increased from 64% to 77% during the same period.



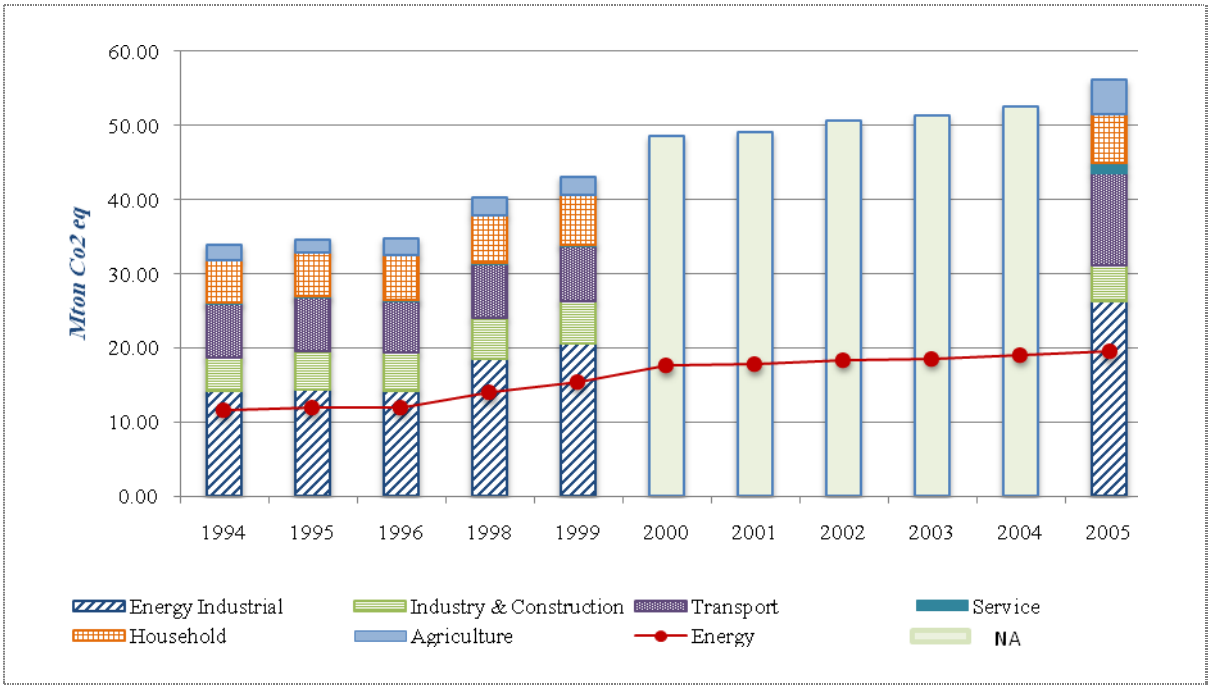



**Fig 9.** Emissions of GHG in Energy Sector according to Sectors in 1994-2005

## 3.3. Industrial Sector:

### 3.3.1. Trend of Total GHG Emissions from Industry:

Fig (10) shows total emissions of GHG in $CO_2$ eq from the industrial sector for the years 1994-2005. The curve shows a slight increase in emissions from 1994 to 1999 which reached a peak in 2001 then dropped slightly till 2005. This is explained by fluctuations in production especially in the cement industry which is responsible for most of the emissions from the industrial emissions.

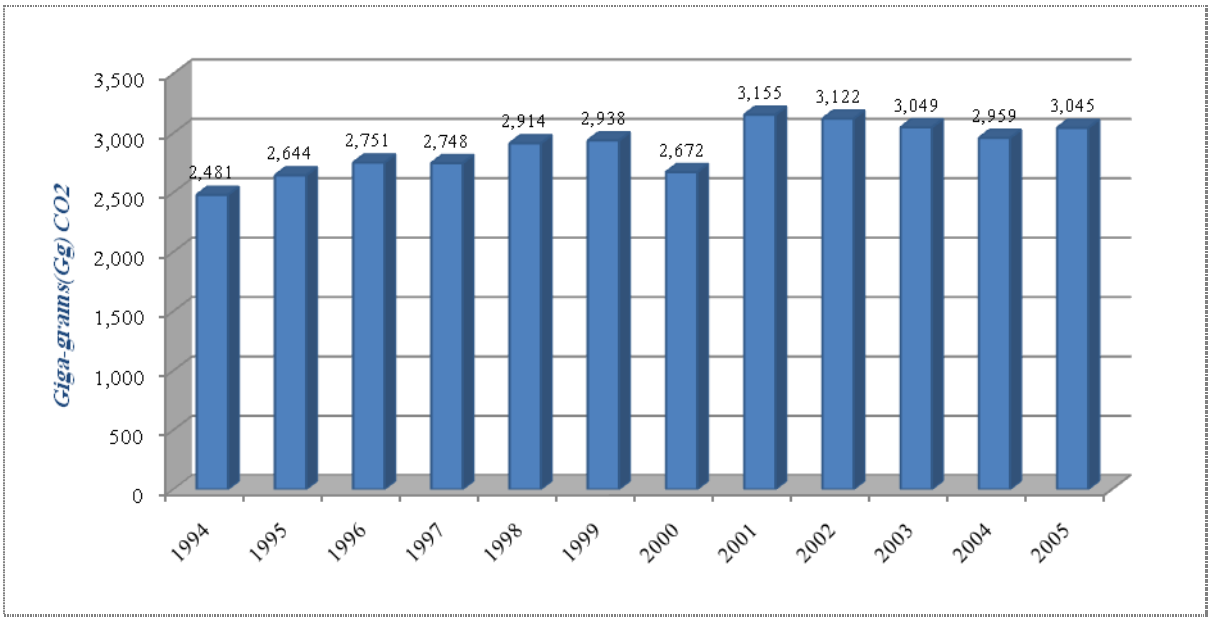



**Fig 10.** General Trend of GHG Emissions from Industry for 1994-2005

### 3.3.2. Emissions from Industry by GHG Gas

Emissions of the three main GHG gases $CO_2$, $CH_4$ and $N_2O$ from industry were presented on Fig (11) . It shows that the highest emission from industry is in the form of $CO_2$ while emission of $CH_4$ from the petroleum coke industry is negligible and so $N_2O$ from fertilizer's industry.

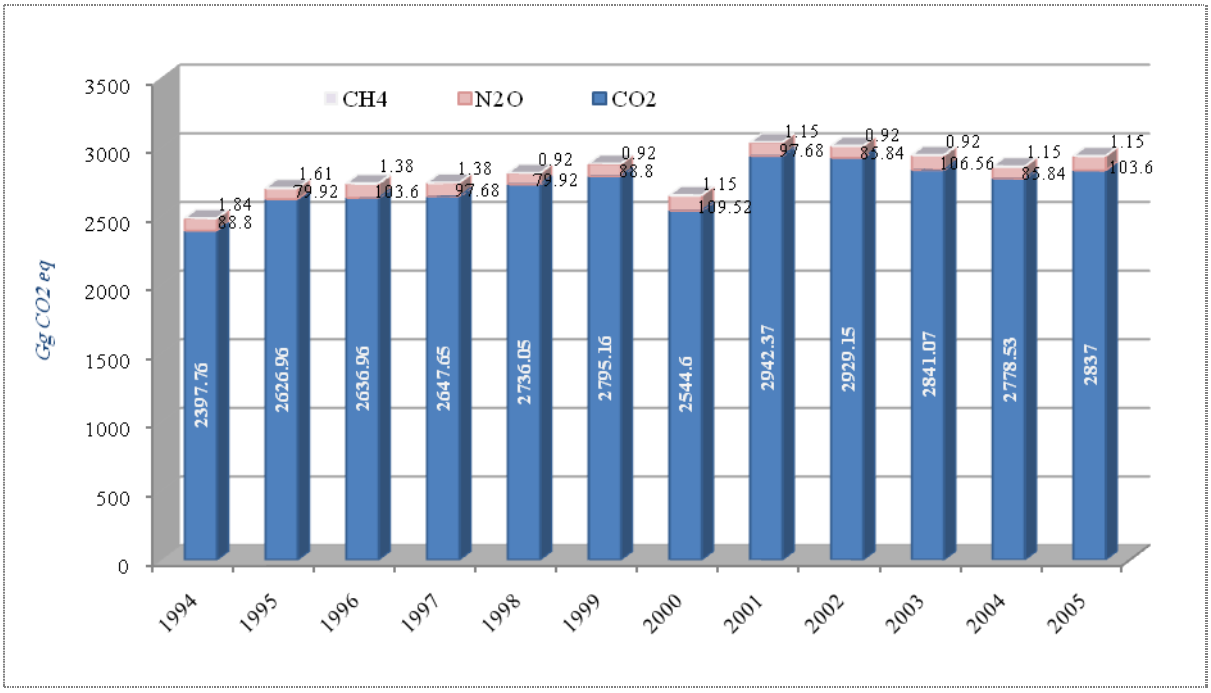
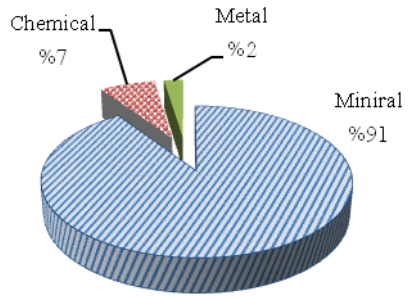


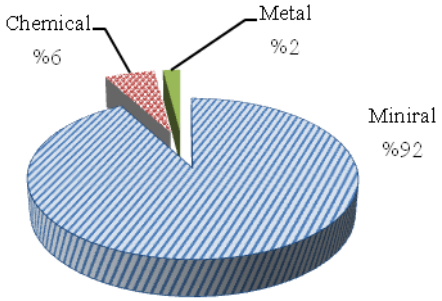

**Fig 11.** Emissions of GHG from Industry according to Gas from 1994-2005

### 3.3.3. Emissions of GHG from Industry by Sector:

Fig (12) shows emissions from industry of $CO_2$ gas by sector. It is obvious that the biggest share (89 % - 91% for the years 1994-2005) comes from the cement industry alone. The second contribution (7%) comes from fertilizer's industry and a small (2%) comes from metal and iron industry.




$CO_2$ Emissions, 1994




$CO_2$ Emissions, 2005

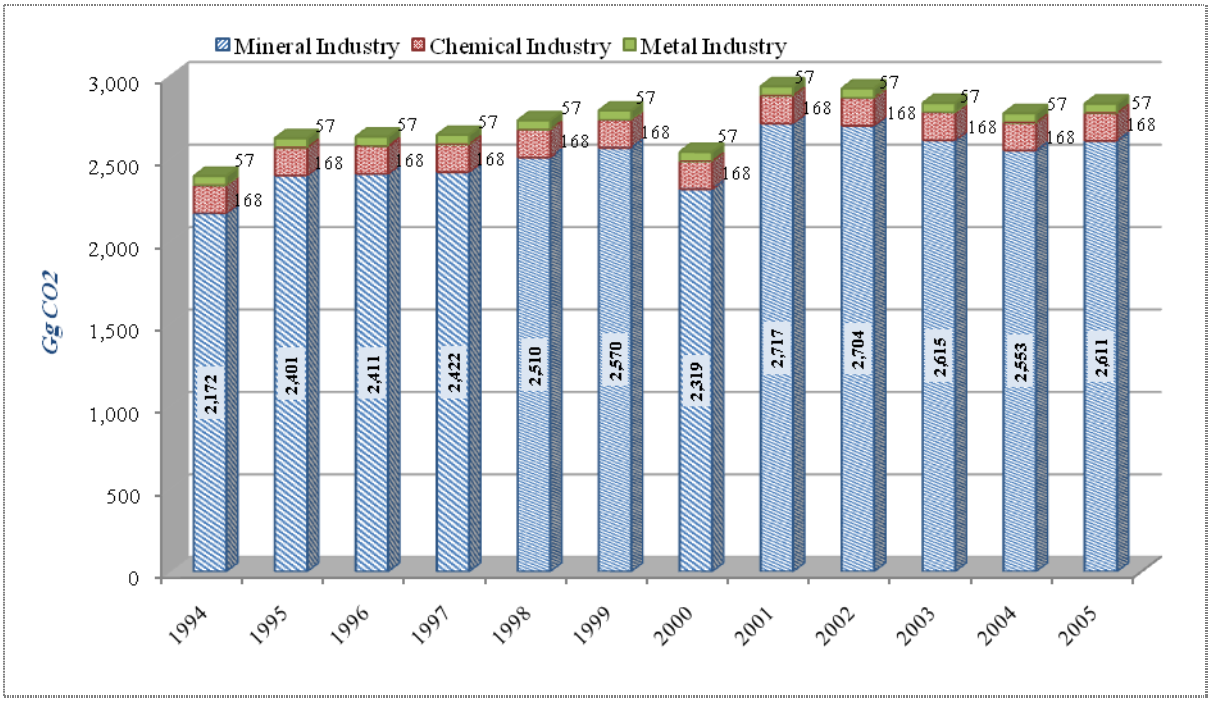



**Fig 12.** Emissions of GHG from Industry according to Sector

## 3.4. Waste Sectors:

### 3.4.1. Trend of total GHG Emissions from the Waste Sector

Fig (13) shows that total GHG emissions from the waste sector in $CO_2$ eq increased steadily for the years 1994-2005. The increase averaged 5% a year during this period. This high growth reflects the rapid increase in populations which averaged 2.5% for the specified period, the rise in the standard of living, the expansion in cities and urban population due to migration from the countryside and the lack of solid waste treatment to recover $CH_4$.

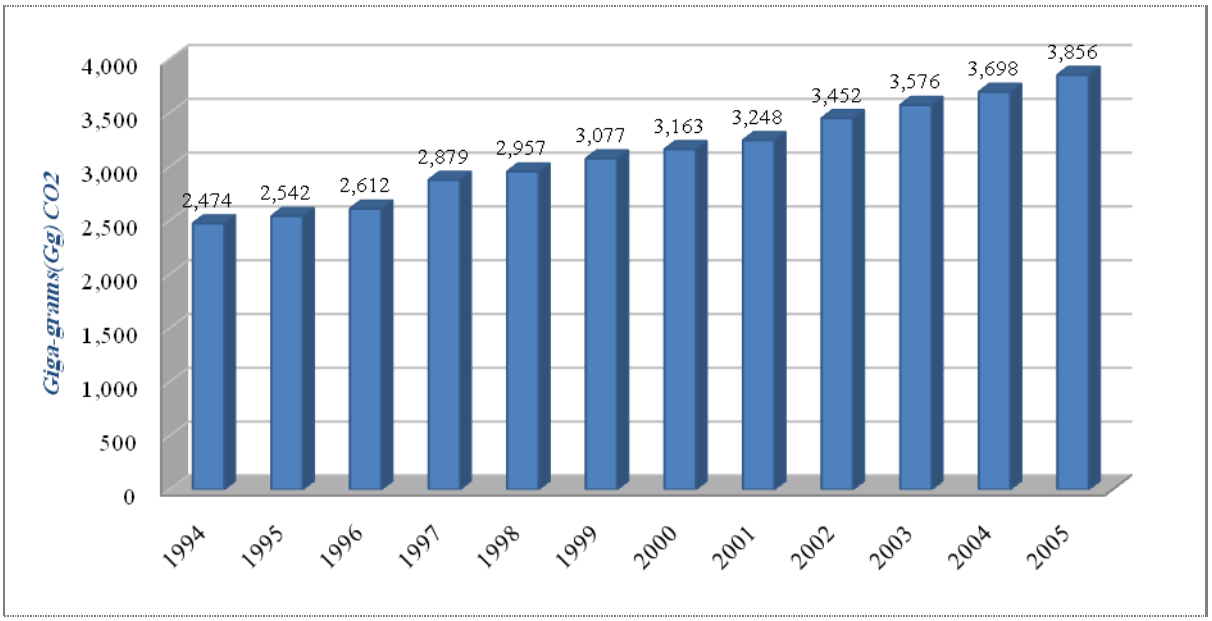



**Fig 13.** Total Emissions of GHG from Waste Sector in CO2 eq for 1994-2005

## 3.4.2. Emissions of Waste Sector by GHG gas:

Fig (14) shows emissions from the waste sector according to the GHG gas. It is clear that the main GHG is $CH_4$ from fermentation of organic wastes followed by $N_2O$ since most municipal waste water stations were not in operation in 1994.

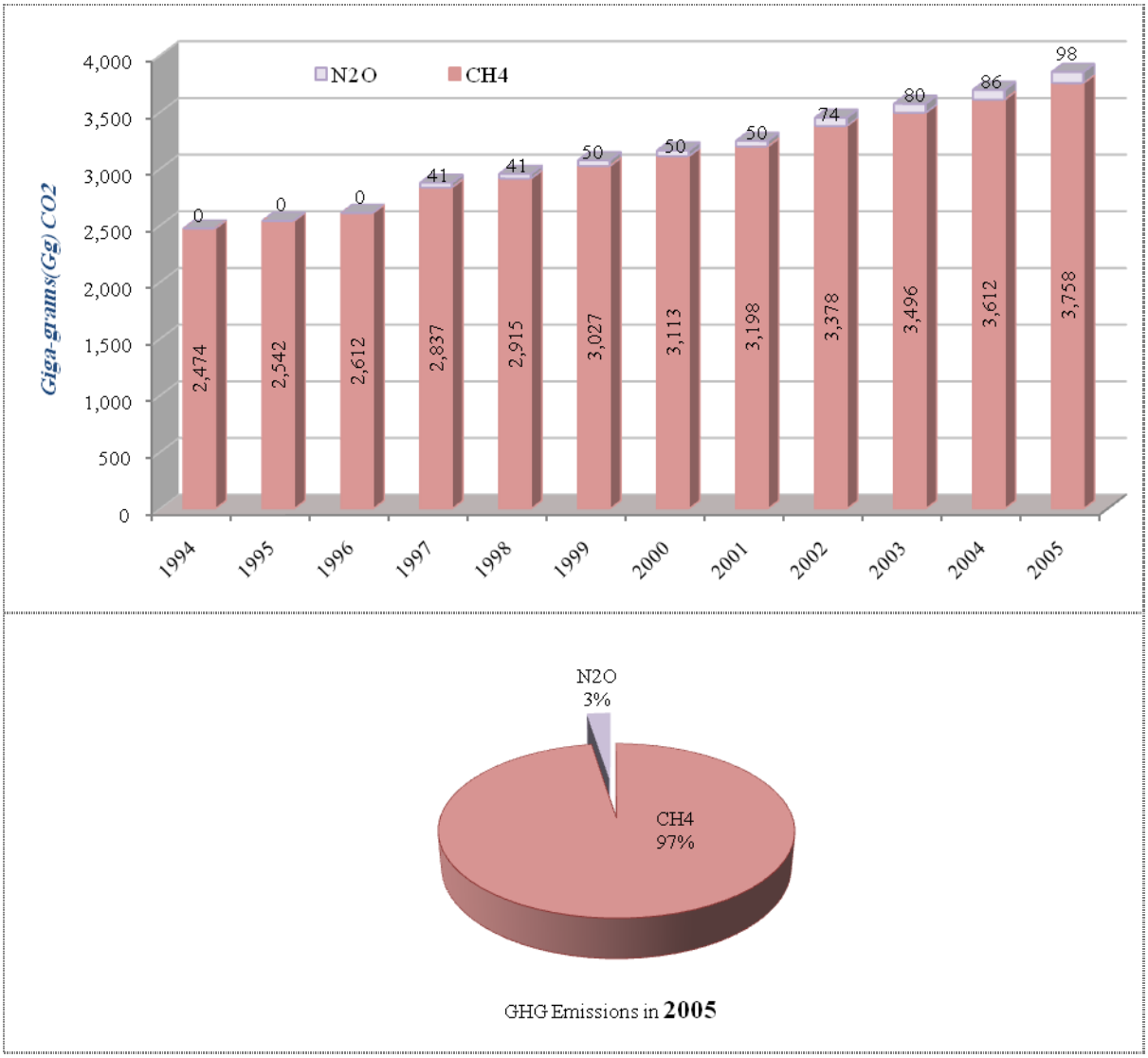



**Fig 14.** GHG Emissions from the Waste Sector in $CO_2$ eq by gas

## 3.4.3. Emission of the Waste Sector by Sectors:

Fig (15) shows emission of the waste sector from methane for the years 1994 – 2005 according to sector. It is clear that the main sector is solid waste followed by municipal waste water and finally industrial waste water. The figure shows also distribution of methane emissions in the waste sector for the years 1994 and 2005. It is clear that emissions from solid waste accounted for 88% in 2005 followed by 11% from municipal waste water and 1% only from industrial waste water. The reason for this is the delay in building municipal and waste water stations and the lack of waste water stations in industry or its stoppage due to technical reasons.

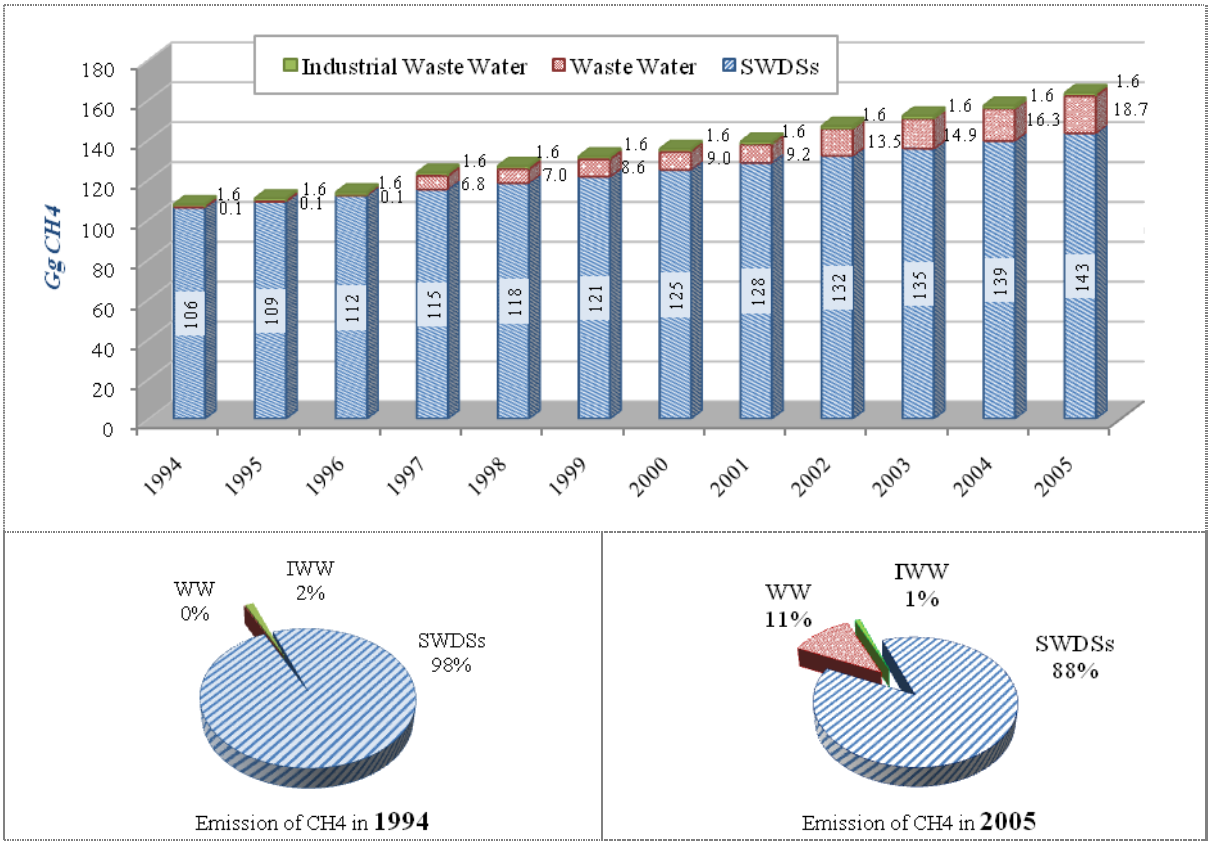



**Fig 15.** Emission of $CH_4$ from the Waste Sector by Sector for 1994 and 2005

## 3.5. Agriculture Sector:

### 3.5.1. Trend of Total Emissions in Agriculture:

Fig (16) shows the total emissions from agriculture in $CO_2$ eq for the years 1994 to 2005. It is clear that emissions increased from 1994 to 1998 and then decreased till 2001 to increase again from 2002 and reach its peak at 14 T g / year in 2005. This could be explained by fluctuation of agriculture production.

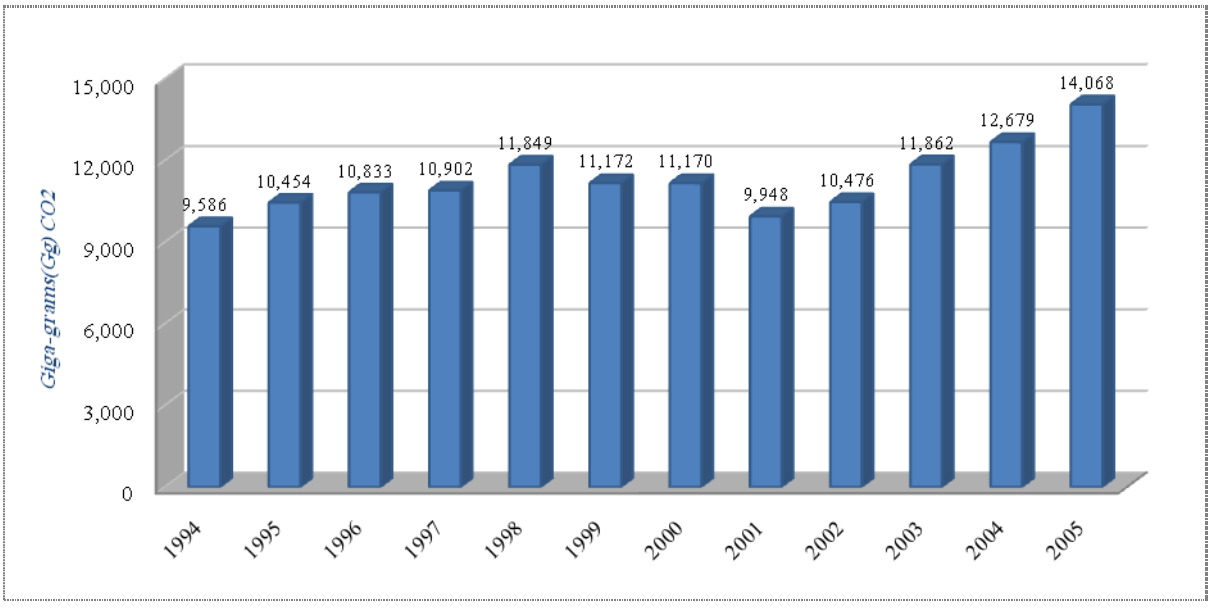



**Fig 16.** Total GHG Emissions from Agriculture for the years 1994-2005

### 3.5.2. Emissions of Agriculture by gas

Fig (17) shows emissions of GHG from agriculture sector for the year 1994 and 2005 for $CH_4$ and $N_2O$ only. It is clear that share of $N_2O$ in $CO_2$ eq is higher with 72% to 74%. The major part comes from fertilizing the soil followed by animal waste.

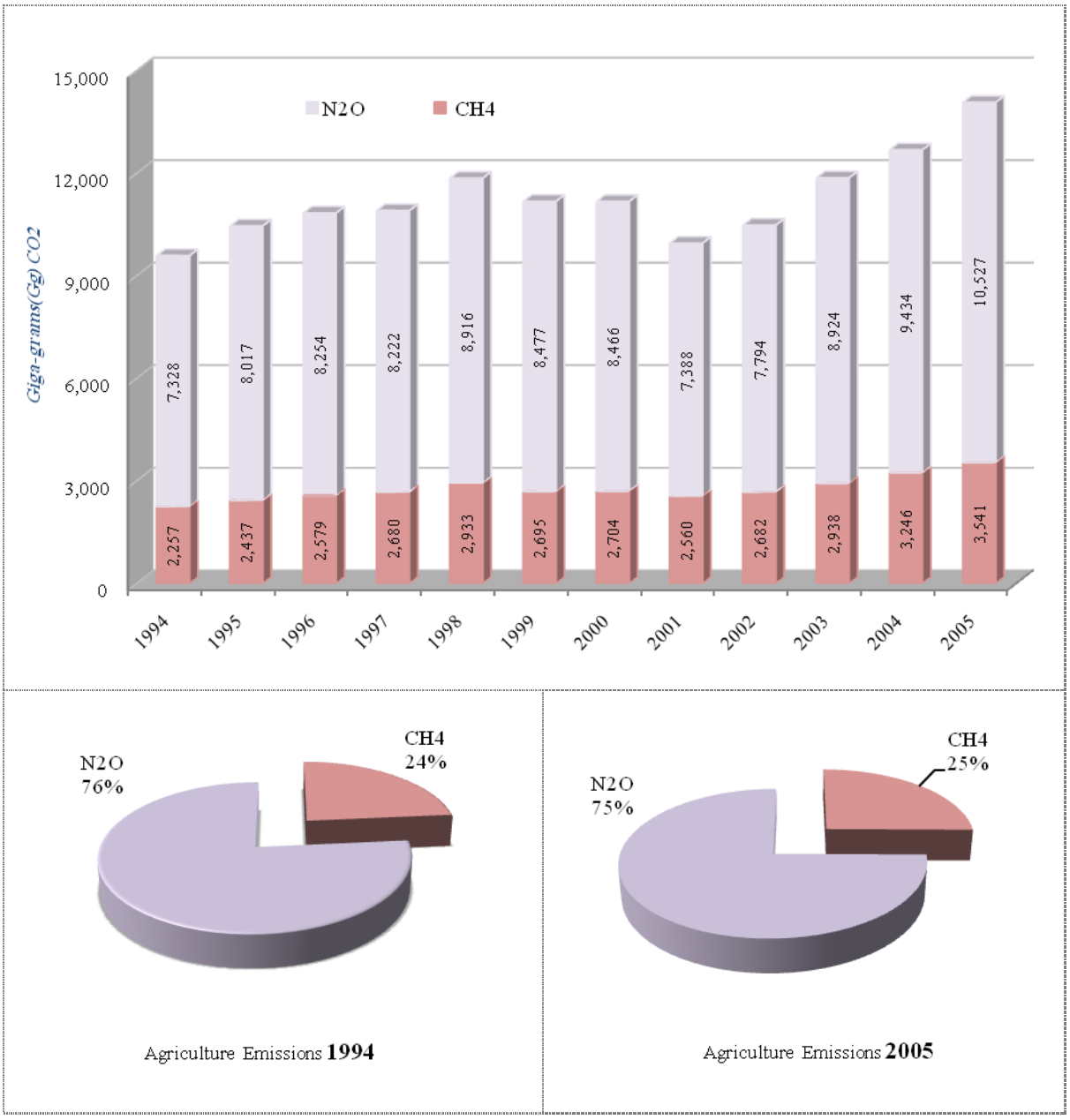



**Fig 17.** Total Emissions of GHG from Agriculture by Gas

### 3.5.3. Emissions of Agriculture by Sector

Fig (18) shows emissions from agriculture in $CO_2$ eq according to sectors. It is clear that the key category in this sector is $N_2O$ from fertilization in agriculture with 72 -74%. It is followed by $CH_4$ from enteric fermentation of animals with 22-24%. The share of emissions from burning agriculture crop wastes accounts for a mere 3%, animal waste share is 1% while emissions from burning savanna is negligible.

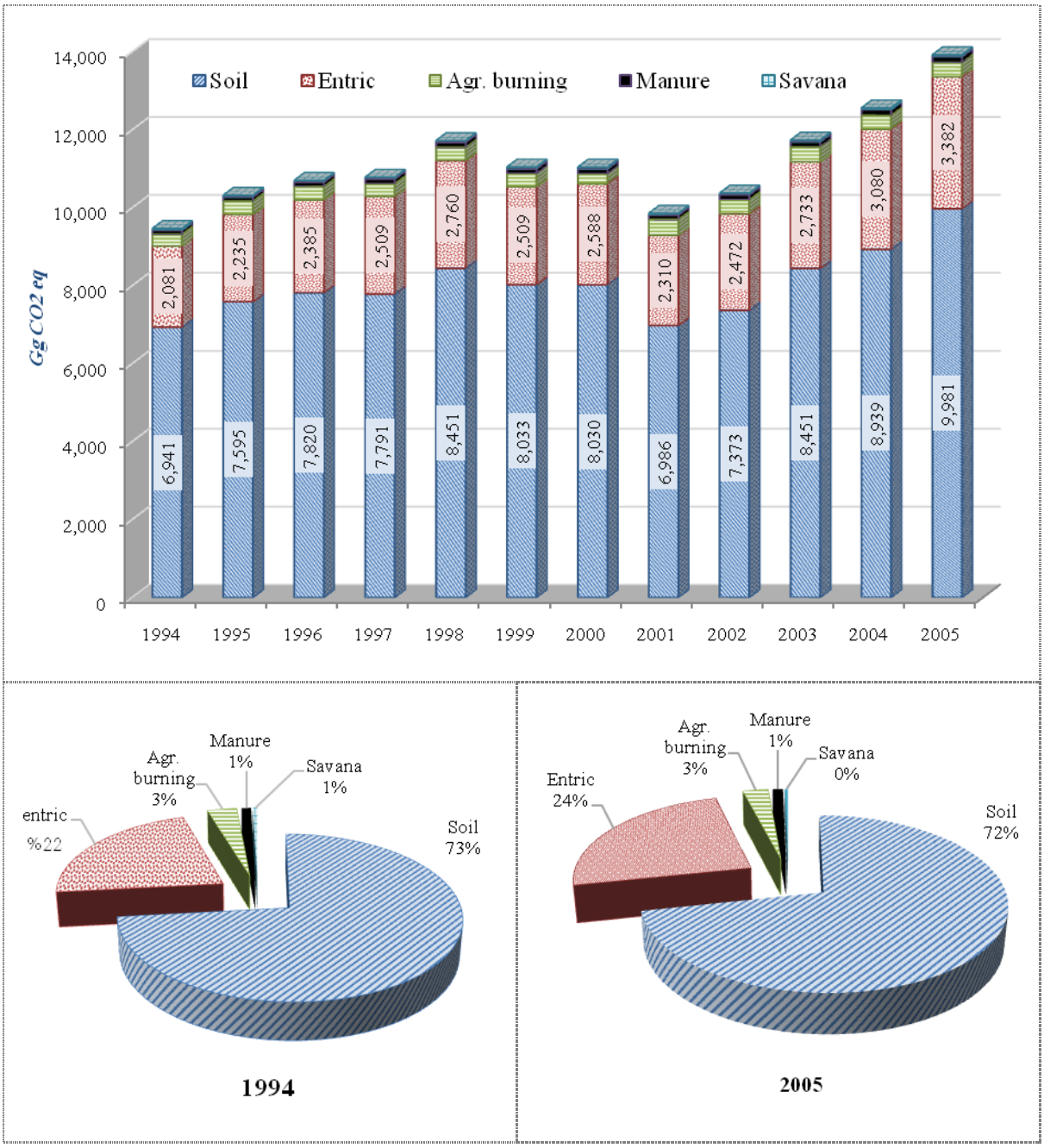



**Fig 18.** Emissions of GHG from Agriculture by Sector

## 3.6. Emissions of GHG from Land Use and Forestry

### 3.6.1. Emissions of GHG by Gas

Fig (19) shows emissions of GHG from land use and forestry sector LUCEF according to gas. It is obvious that emissions of $CO_2$ are the highest by far while those of CH4 and N2O are negligible.

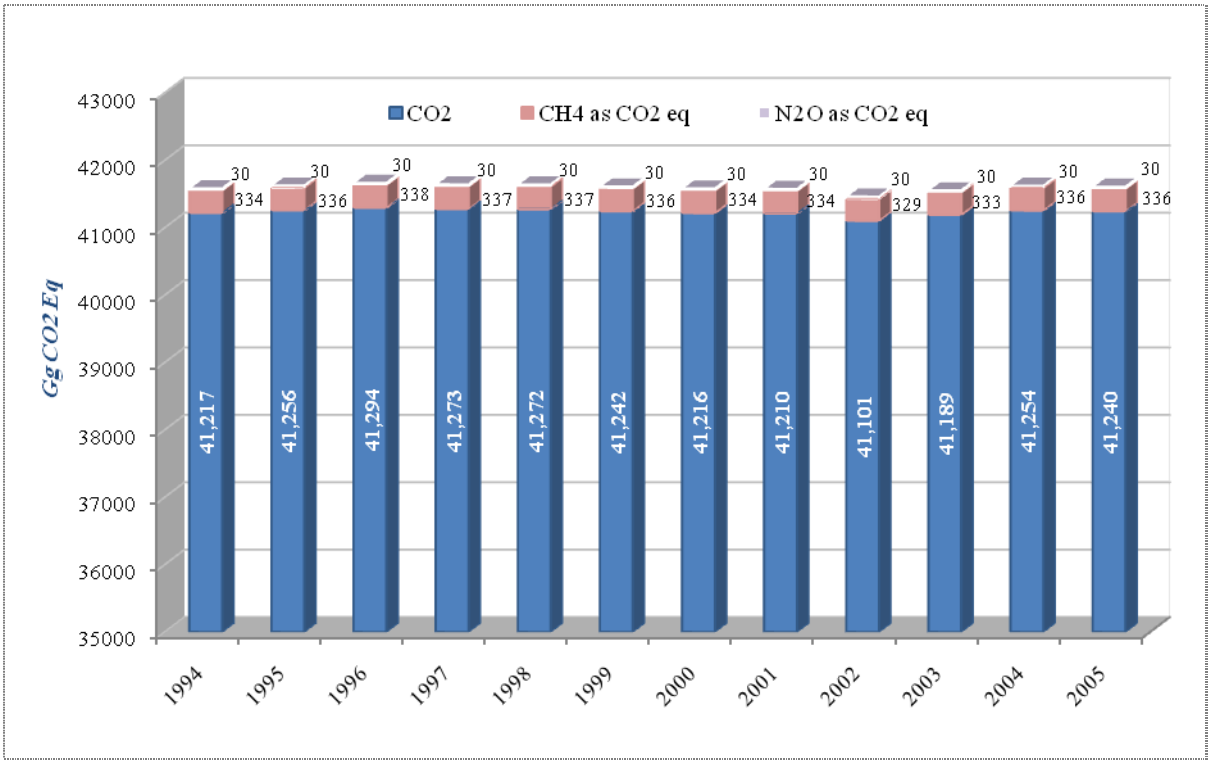



**Fig 19.** Emissions of GHG from LUCEF by Gas

## 3.6.2.Emissions of GHG and sinks by sector

Fig (20) shows emissions of GHG and its sinks in the LUCEF sector according to sector for the year 1994. It is clear that emissions are less than sinks. The main sink comes from forests and trees followed to a much less extent by deserted land. Emissions were highest from fires in forests and ranges followed by emissions from mineral soils and finally emissions from in- field burning.

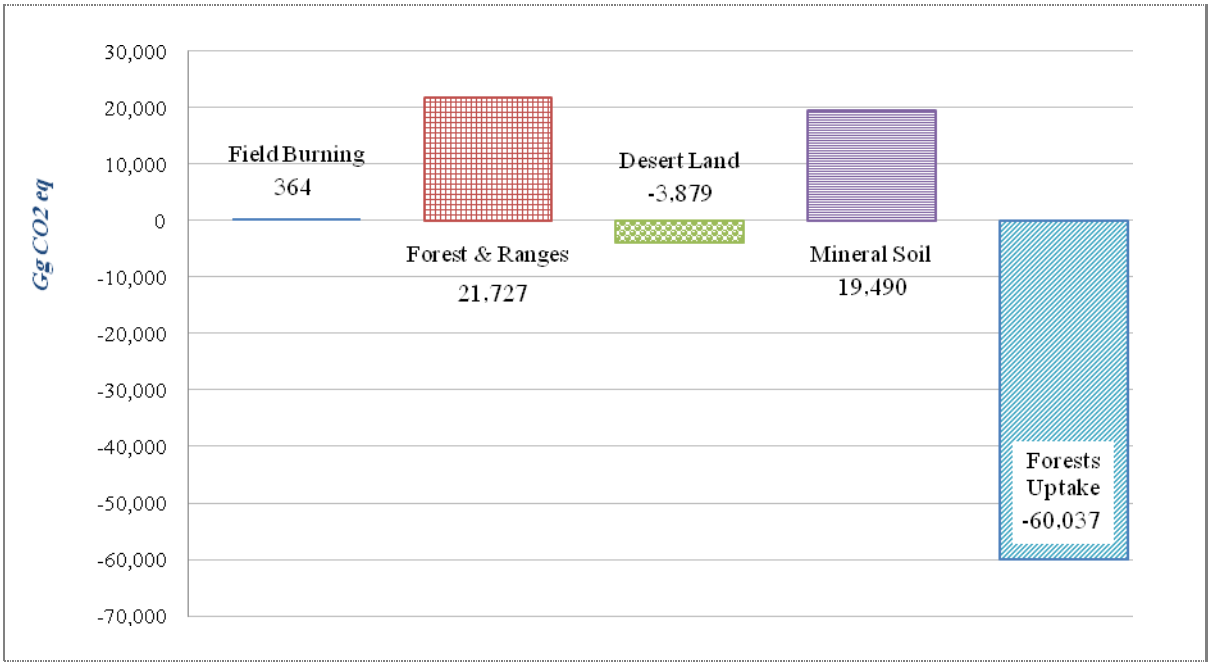



**Fig 20.** Emissions & Sinks of GHG from LUCEF for 1994

Fig (21) shows results of GHG emissions and sinks in LUCEF from 1994-2005.


**Fig 21.** Emissions and Sinks of GHG from LUCEF for 1994-2005

## 3.5. Trend of Emissions of GHG Precursors and $SO_2$

Emissions of NMVOC, CO, $SO_2$ and NOx from the industry sector were calculated according to IPCC 1996 Revised Guidelines. Fig (22) shows the total emissions of these gases. Most emissions are in the form of NMVOC which come from the food and drinks industry, followed by asphalt used on roads and to cover roofs. Next come Sox which comes mainly from the cement industry. It is worth mentioning that SOx is not a GHG gas or a precursor, but it is a pollutant.

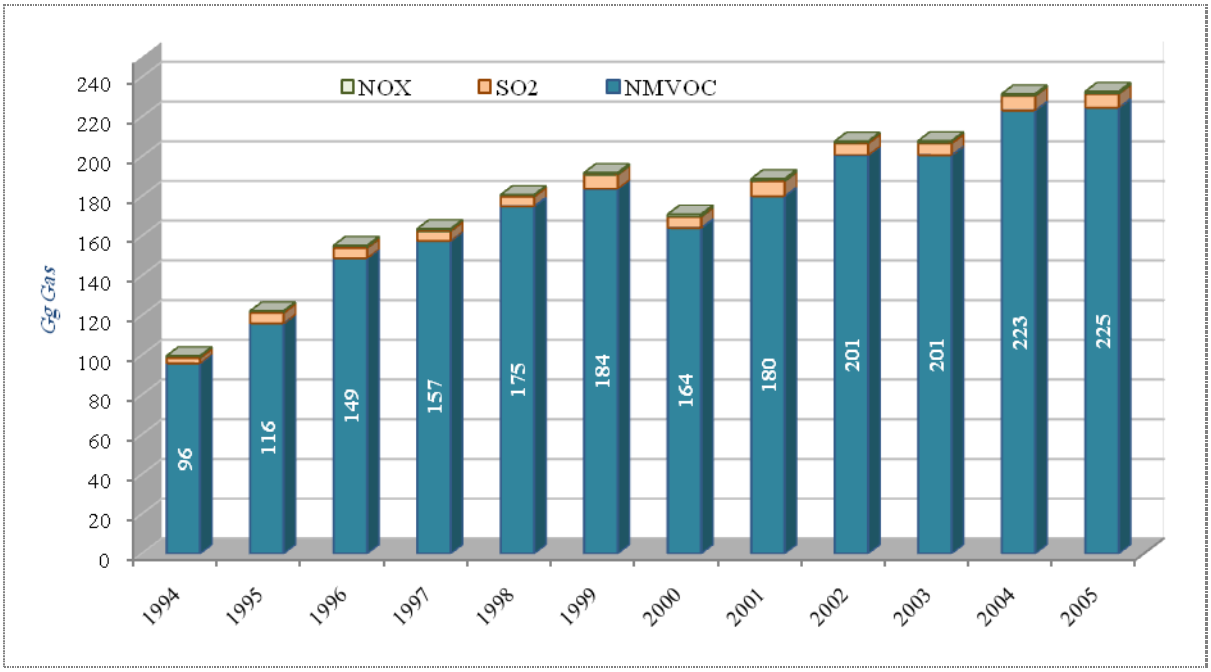



**Fig 22.** Emissions of NMVOC, SOx and NOx from Industry

Emissions of CO from LUCEF sector is presented in Fig (23). CO is a precursor to $CO_2$. The share from forests is nearly constant while that from agriculture is increasing slightly through the years.

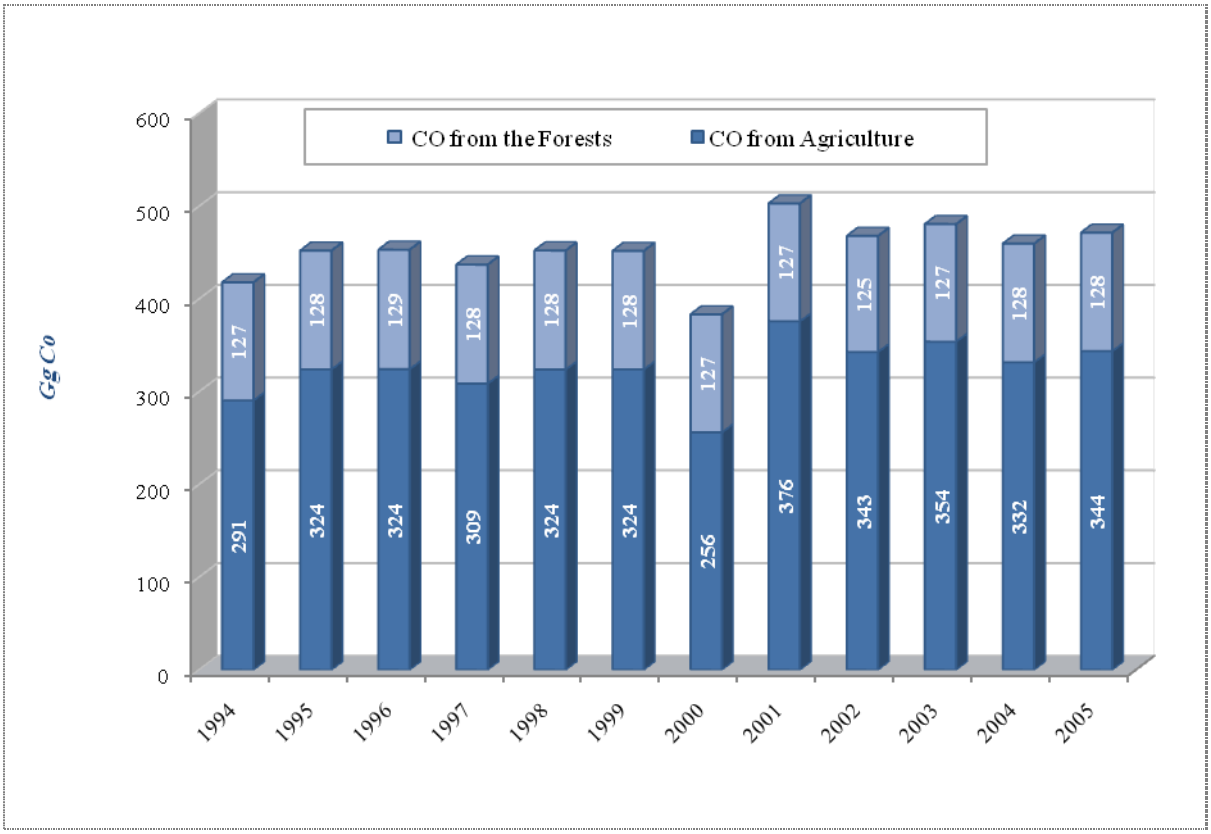



**Fig 23.** Emissions of CO from LUCEF

# Fourth Chapter: General Issues and Scope for Development

## 4.1. Quality Control:

Since this report is the first national communication for Syria following the methodologies and instructions of the IPCC, and due to the absence of institutions dealing with GHG inventory, there was in general a lack of data or a lack in the quality of data. This was found in the energy sector with the lack of energy balance for the years 2000- 2004. This made it necessary to calculate GHG emissions from the energy sector for these years by the Reference method only. There was a lack of data in the industrial sector concerning other GHG gases such as $SF_6$, HFCs and PFCs. Another problem in industry is concerned with lack of data especially from the private sector such as the absence of data on lime production. In the waste sector there was also a lack of quality data on municipal waste water stations and especially on industrial waste water stations.

## 4.2. Uncertainty:

Uncertainty is inevitable in GHG inventory compilation for many reasons. Data were obtained from the Central Bureau of Statistics and the concerned ministries. There is uncertainty in these data due to inaccuracies and its availability from more than one source. There were many cases of lack of data, conversion factors and emission factors. This made it necessary to use default emission factors DEF from IPCC Guidelines and many of these default factors were not local and so there is uncertainty connected with it. In several cases, local conversion factors when available were used for better estimation such as the calorific values of oil products used in Syria. Also Tier 1 was used which added another source of uncertainty.

## 4.3. Use of higher methodologies:

Tier 1 in the IPCC Revised 1996 Guidelines was used. This was recommended by COP for non-annex 1 countries and for the first national communication INC. In this work the gaps were recognized. It will be possible in the second national communication to avoid these gaps and to use a mixture of Tier 1 and Tier2 which depends on a more accurate data and local emission factors.

## 4.4. Training of GHG inventory group:

During the process of GHG inventory compilation connected with the first national communication a group of trainee from the Ministry of State for Environment were assembled and trained. In the training workshops other trainees from the concerned ministries joined in. These trained personnel could form the basis of a permanent unit entrusted with preparing inventories for the following years and for the second national communication. Further training could be needed both locally and externally.

# Symbols and Nomenclature

| | |
|---|---|
| AD | Activity Data |
| $CO_2$ | Carbon Dioxide |
| CO | Carbon Monoxide |
| COP | Conference of Parties |
| $CH_4$ | Methane |
| DEF | Default Emission Factor |
| EF | Emission Factor |
| GEF | Global Energy Forum |
| Gg | Giga gram equal $10^9$ gram |
| GHG | Green House Gases |
| Guidelines 1996 | IPCC Guidelines for GHG calculation 1996 |
| GTZ | German association for technical cooperation |
| GWP | Global Warming Potential |
| HFC's | Hydro flouro Carbons |
| IEA | International Energy Agency |
| IPCC | Inter-Governmental Panel for Climate Change |
| KC | Key Categories |
| LULUCEF | Land Use, Land-Use Change and Forestry |
| NC | National Communication |
| NGGIP | National Green House Gases Inventory Program |
| NMVOC | Non Methane Volatile Organic Compounds |
| $N_2O$ | Nitrous Oxide |
| Non-Annex 1 | Countries not included in Annex 1 of Koyoto Ptotocol |
| PFC's | Per Flouro Carbons |
| $SF_6$ | Sulfur Hexa Flouride |
| $SO_2$ | Sulfur Dioxide |
| Tg | Tera gram equal $10^{12}$ gram |
| TOR | Term of Reference |
| Tier 1 | Methodology 1: lower level for GHG calculation |
| UNDP | United Nation Development Program |
| UNEP | United Nation Environment Program |
| UNFCCC | United Nation Framework Convention for Climate Change |
| WMO | World Meteorological Organization |

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