Mediterranean and National Strategies for Sustainable Development
Priority Field of Action 2: Energy and Climate Change

Energy Efficiency and Renewable Energy
Syria - National study

Eng. Ashraf Kraidy, National Energy Research Center

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Introduction

The Syrian Arab Republic lies on the eastern coast of the Mediterranean Sea, bounded by Turkey to the north, Iraq to the east, Palestine & Jordan from the south and by Lebanon & The Mediterranean Sea to the west.

The total area of SAR is 18517971 hectares of which 6 million hectares are cultivated land & the remained is desert and Rocky Mountains. The Syrian Desert is suitable for grass growing & is used as pastures during sufficient rainfall.

The climate of the Mediterranean Sea generally prevails in Syria, this climate may be characterized by rainy winter & a dry hot summer separated by two short transitional seasons. The coastal region is characterized by heavy rainfall in winter & moderate temperature & high relative humidity in summer .The interior is characterized by a rainy winter season and a hot dry season during summer, the area in the mountains with an altitude of 1000 meters or more characterized by rainy winter where rainfall may exceed 1000 mm & moderate climate in summer.

PART 1 – The country's energy situation: indicators & basic data

1.1. Share of the Energy Sector and Institutional Specificities

The sectors economic weight:

Energy share in the GDP (%)

The Syrian population was about 18.269 Million at mid 2005, of which 9.197 Million was considered as "urban." According to the population census, the average annual growth rate was 2.45 during nineteenth of 20th century. The GDP share illustrated in the following table:

Years	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
GDP (Billion SP)	903.9	950.24	1006.43	1017.6	1105.5	1155.3
Population (thousand)	16320	16720	17130	17550	17921	18269
GDP per capita (SP per year)	55389	56833	58753	57984	61692	63243
GDP distributed as follows:						
Agriculture (%)	25	25	26	25	23	24
Mining & Manufacturing	**30**	**29**	**26**	**24**	**27**	**24**
Building & construction (%)	3	3	3	4	3	3
Wholesale & retail trade (%)	15	16	17	16	18	16
Transport & communication (%)	13	13	13	14	11	13
Finance & insurance (%)	4	3	3	4	4	5
Social & Personal services (%)	2	2	3	3	2	3
Government services (%)	8	8	9	10	9	10
Private non- Profit services	0	0	0	0	0	0
Customs duties	0	0	0	0	2	2
Value of imputed monetary	0	0	0	0	-1	-1
Total (%)	**100**	**100**	**100**	**100**	**100**	**100**

As shown from the previous table, the energy share in the GDP (%) was as follows:

Years	2000	2001	2002	2003	2004	2005
Energy share in the GDP (%)	30	29	26	24	27	24

It decreased from 30% down to 24%, which reflects that Syrian economy become less dependent on energy sector as main producer for GDP.

Energy shares in export and import (absolute value and percentage of the total) per type of energy (oil, gas, coal, electricity, other)

Unit: Million US$ (note: see below US$ exchange rate (SP))

Years	1990		1991		1992		1993		1994	
Label	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
Oil & OP	1754	45	1687	29	1983	48	1934	149	703	23
% of total exports & imports in Syria	45.19%	0.20%	53.36%	1.15%	69.58%	1.48%	66.71%	3.91%	56.23%	1.18%
NG & LPG	0	20	0	30	0	31	0	16	0	8
% of total exports & imports in Syria	0.00%	0.09%	0.00%	1.19%	0.00%	0.96%	0.00%	0.42%	0.00%	0.43%
Electricity	0	0	0	0	0	0	0	0	0	0
% of total exports & imports in Syria	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total value of energy exports & imports	1754	66	1687	60	1983	78	1934	165	703	31
% of total exports & imports in Syria	45.19%	0.30%	53.36%	2.34%	69.58%	2.44%	66.71%	4.32%	56.23%	1.62%
Total value of exports & imports in Syria	3882	22115	3161	2551	2851	3217	2900	3815	1249	1926
US$ exchange rate (SP)	12.18		12.18		12.18		12.18		31.87	

Years	1995		1996		1997		1998		1999	
Label	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
Oil & OP	818	9	896	24	650	33	420	27	562	13
% of total exports & imports in Syria	62.53%	0.60%	68.42%	1.34%	63.58%	3.16%	43.48%	2.83%	67.16%	1.42%
NG & LPG	0	7	0	8	0	11	0	11	0	13
% of total exports & imports in Syria	0.00%	0.46%	0.00%	0.43%	0.00%	1.05%	0.00%	1.13%	0.00%	1.38%
Electricity	19	0	61	0	32	0	30	0	45	0
% of total exports & imports in Syria	1.43%	0.00%	4.63%	0.00%	3.09%	0.00%	3.06%	0.00%	5.43%	0.00%
Total value of energy exports & imports	837	16	956	31	681	44	449	38	607	26
% of total exports & imports in Syria	63.96%	1.06%	73.05%	1.77%	66.68%	4.21%	46.54%	3.96%	72.59%	2.80%
Total value of exports & imports in Syria	1308	1552	1309	1761	1022	1051	966	961	836	925
US$ exchange rate (SP)	34.06		34.29		43.01		45.51		46.5	

Years	2000		2001		2002		2003		2004		2005	
Label	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**
Oil & OP	3505	152	4003	188	4811	125	4066	185	3472	466	4363	2522
% of total exports & imports in Syria	75.39%	3.77%	76.56%	3.97%	70.82%	2.47%	71.35%	3.63%	67.62%	6.91%	49.87%	24.34%
NG & LPG	0	61	0	7	6	39	0	0	0	33	4	28
% of total exports & imports in Syria	0.00%	1.50%	0.00%	0.15%	0.09%	0.78%	0.00%	0.00%	0.00%	0.50%	0.04%	0.27%
Electricity	101	0	77	0	44	0	21	0	48	0	89	0
% of total exports & imports in Syria	2.17%	0.00%	1.47%	0.00%	0.65%	0.00%	0.37%	0.00%	0.93%	0.00%	1.02%	0.00%
Total value of energy exports & imports	3606	213	4080	195	4861	164	4087	185	3520	499	4456	2549
% of total exports & imports in Syria	77.56%	5.27%	78.03%	4.11%	71.56%	3.24%	71.71%	3.63%	68.55%	7.41%	50.93%	24.61%
Total value of exports & imports in Syria	4649	4033	5229	4747	6794	5070	5700	5092	5134	6743	8748	10358
US$ exchange rate (SP)	46.5		46.5		46.5		46.5		48.5		48.5	

As the previous tables, we can say that the share of energy value exported in 2004 & 2005 is decreasing due to the reduction of crude oil production from 600000 b/day, down to 425000 b/day.

The amount of some oil products imports such as (diesel oil & LPG) is increasing gradually due to insufficient of refineries capacities in Syria, (only two refineries exists in Syria,
The value of such imports becomes a heavy burden on Syrian economy and it shares about 25% of total imports value in 2005 while it didn't exceed 5% before 2000.

Number of jobs in the energy sector (absolute value, percentage of the total)

Years	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Ministry of petroleum(workers)	28430	29117	30050	30275	31172	31712	32902	28113	36623	36645
% of total	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	3.5%	4.4%	4.2%
Ministry of electricity	19901	20178	21388	21691	23985	24837	25878	26914	28676	29564
% of total	2.9%	2.9%	3.0%	3.0%	3.3%	3.3%	3.3%	3.3%	3.4%	3.4%
Total workers number of energy	48331	49295	51438	51966	55157	56549	58780	55027	65299	66209
Energy sector share of total man power in Syria	7.1%	7.0%	7.2%	7.1%	7.5%	7.4%	7.5%	6.8%	7.8%	7.7%
Total man power in Syria*	681393	700517	717387	728944	736792	760773	788388	804422	833981	863778

Years	2000	2003	2004	2005	2006
Ministry of petroleum	37528	38070	41635	43386	37528
% of total	4.3%	3.9%	4.2%	4.2%	4.3%
Ministry of	30022	35375	36713	40305	30022
% of total	3.5%	3.6%	3.7%	3.9%	3.5%
Total workers number of energy sector in Syria	67550	73445	78348	83691	67550
Energy sector share of total man power in Syria	7.8%	7.5%	7.9%	8.1%	7.8%
Total man power in Syria*	867394	983476	986467	1031688	867394

*** Note:** Total manpower in Syria only include public sector.

As shown from the previous, the share of total workers number of energy sector in Syria is almost around 8% of total Syrian workers all over the period 1990 – 2005. Which mean that energy sector in Syria affords wide job opportunities for Syrian citizens.

Relative importance of the energy sector within the State budget

Unit: Million SP (note: see below US$ exchange rate (SP))

Years	1990	1992	1993	1994	1995	1996	1997	1998	1999
Mining & quarrying	2525	2684	3197	3160.186	5099	5856	8471	8965	8635
% of total	4.1%	2.9%	2.6%	2.2%	3.1%	3.1%	4.0%	3.8%	3.4%
Electricity, gas & water	3166	4934.718	12671	15969	17814	24056	27004	25168	23539
% of total	5.1%	5.3%	10.3%	11.1%	11.0%	12.8%	12.8%	10.6%	9.2%
Total energy sector	5692	7618	15868	19129	22913	29912	35475	34133	32174
Energy sector share of the Syrian budget	9.2%	8.2%	12.9%	13.3%	14.1%	15.9%	16.8%	14.4%	12.6%
Syrian consolidated	61875	93042	123018	144162	162040	188050	211125	237300	255300
US$ exchange rate	12.18	12.18	12.18	31.87	34.06	34.29	43.01	45.51	46.50

Years	2000	2001	2002	2003	2004
Mining & quarrying	10277	11449	14606	16490	16416
% of total	3.7%	3.6%	4.1%	3.9%	3.7%
Electricity, gas & water	25685	30667	32421	32645	35395.46
% of total	9.3%	9.5%	9.1%	7.8%	7.9%
Energy sector share of the	35961	42116	47027	49134	51812
Syrian consolidated budget	275400	322000	356389	420000	449500
US$ exchange rate (SP)	46.50	46.50	46.50	46.50	48.50

As shown in the previous table, the share of investments in energy sector within the State budget is around 9%, the rate was higher about 16% during the period 1994-1999 due to significant investments which had invested in electrical sector to built new power plants and transmission & distribution lines.

Share of total investment in the country, and of total industrial investment

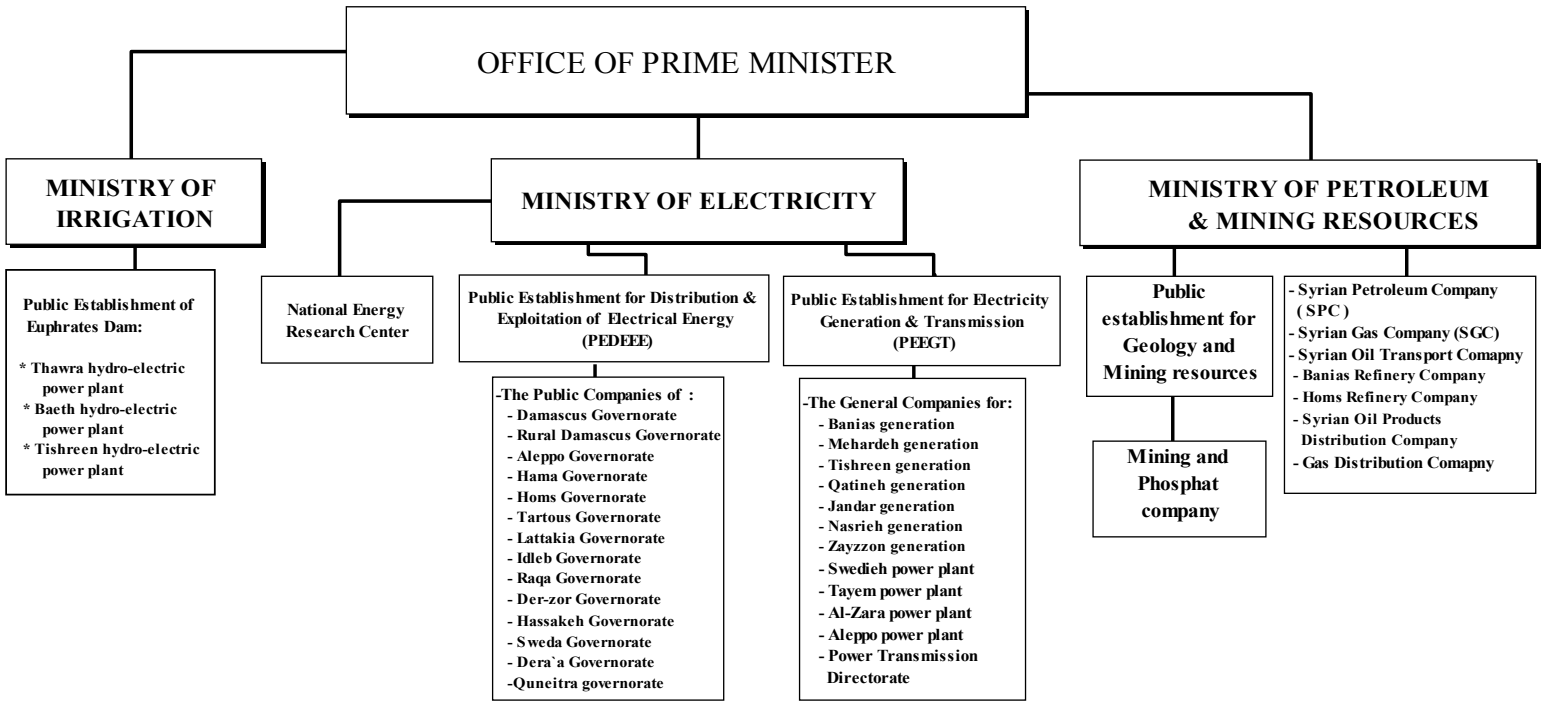
Unit: Million SP (note: see below US$ exchange rate (SP))

Years	1992	1993	1994	1995	1996	1997	1998	1999
Mining & quarrying & gas	4965	4567	5625	7060	8778	14479	17213	11664
% of total	13.7%	7.4%	8.3%	9.5%	9.6%	13.3%	14.4%	9.6%
Electricity	1296	3459	20598	16543	18493	18697	15207	11209
% of total	3.6%	5.6%	30.3%	22.3%	20.2	17.2%	12.7%	9.2%
Energy sector share of	17.3%	13%	38.6%	31.8%	29.8%	30.5%	27.1%	18.8%
Total investment in Syria	36250	61750	67964	74099	91473	108700	119600	121800
US$ exchange rate (SP)	12.18	12.18	31.87	34.06	34.29	43.01	45.51	46.50

Years	2000	2001	2002	2003	2004	2005
Mining & quarrying & gas	12012	9133	13292	10950	15153	14407
% of total	9.1%	5.7%	7.2%	5.2%	6.6%	5.8%
Electricity	14294	12251	15306	18261	26673	23972
% of total	10.8%	7.6%	8.3%	8.7%	11.6%	9.6
Energy sector share of investments	19.9%	13.3%	15.5%	13.9%	-	-
Total investment in Syria	132000	161000	184000	211000	230000	250000
US$ exchange rate (SP)	46.50	46.50	46.50	46.50	48.50	48.50

Infrastructures: number of refineries, power stations, length of the electricity network…

Organization structure of the Syrian energy sector



1. ***Electricity***:

Two main operating entities operate under the Ministry of Electricity: PEEGT (Public establishment for electricity generation and transmission) and PEDEEE (Public establishment for distribution and exploitation of electrical energy). The two entities have the autonomy on operational decisions. Regulation is carried out through the Ministry as the regulatory body in cooperation with the two entities. Within PEEGT and PEDEEE there are individual generating and distribution companies. These operating companies could in principle form the basis of industry, but transmission would need to be placed in a separate company from generation. There are still extensive subsidies to electricity prices for all classes of consumers, although recently the level of subsidy was much reduced.

The following table indicates Nominal & Actual capacity of power plants in Syrian power system by turbine type & subsidiary at the end of 2006

Power plants by turbine type & subsidiary	Nom. Capacityof generating units	Total (MW) Nominal	Total (MW) Actual (available)	Fuel type	Commissioning date
1 - Steam turbine		**3547**	**2995**		
A- PEEGT		3435	2955		
- Mehardeh	2*150+2*165	630	490	HFO - NG	1979 - 1988
- Banias	4*170	680	340	HFO	1982 - 1987
- Thermal tishreen	2*200	400	400	HFO - NG	1993 - 1994
- Aleppo	5*213	1065	1065	HFO - NG	1997
- Alzara	3*220	660	660	HFO - NG	2000
B- Other public sector		112	40		
- Homs refinary	2*32	64	40	HFO - NG	1984
- Banias refinary	4*12	48		HFO	1988
2 – Gas turbine		**1322**	**1172**		
2-1- DO Gas turbine		**90**	**0**		
A- PEEGT		90	0		
- Mehardeh	1*30	30		DO	1988
- Banias	1*30	30		DO	1988
- Aleppo	1*30	30		DO	1997
2-2- NG Gas turbine		**1232**	**1172**		
A- PEEGT		1112	1112		
- Alswediah	5*30	150	150	NG	1988 - 1989
- Altayem	3*34	102	102	NG	1991
- Tishreen extension	2*100	200	200	HFO - NG	1995
- Alnasryeh	3*110	330	330	HFO - NG	1995
- Zayzun	3*110	330	330	HFO - NG	1996
B- Other public sector		120	60		
- Syrian petroluem company	6*20	120	60	NG	1975 - 1987
3 – Combined cycle		**640**	**640**		
- Jandar	2*100+4*110	640	640	NG	1984 - 1995
4 – Hydro turbine		**1528**	**1201**		
A- PEEGT		23	0		
- Barada, Shezar & Alrastan	1*7+2*8	23			1956 - 1972
B- Public establishment for Euphrates dam		1505	1201		
- Althawra	8*100	800	700		1974 - 1978
- Albaath	3*25	75	51		1987 - 1988
- Tishreen dam	6*105	630	450		1999 - 2002
Total installed capacity		**7037**	**6008**		

Total Under Construction (Power plants up gradations) 1100 MW
Combined Cycle 800 MW
Converting GT to Combined Cycle 300MW

2. ***Renewable energy & rational use of energy:***

National Energy Research Center in Syria was created (mid of 2003) in order to supervise the energy efficiency improvements studies & facilitate the renewable energies usage in Syria.

3. Natural gas:

There has been some loosening of the vertical integration, but the sector remains firmly in state hands. The Syrian Petroleum Company (SPC) owns the natural gas reserves on behalf of the Ministry of Petroleum and Mineral Resources. Until recently it was also the owner and operator of all pipelines.

In February 2003 the Syrian Gas Company was created by Presidential Decree under the Ministry, and charged to plan for the exploitation and marketing of gas and to contract gas from domestic and foreign sources to meet the national needs. A second company, the Syrian Gas Distribution Company, was established in April 2003 with the duty to develop, operate and maintain the networks for distributing gas to residential consumers. It is intended to supply initially the cities of Damascus, Homs, Hama, Lattakya and Aleppo. These steps are welcome, but much more remains to be done before such a market would be consistent with competitive wholesale supply.

4. Upstream hydrocarbons:

The regime of regulation for upstream hydrocarbons lacks many of the features desirable in a liberal system. The Ministry of Petroleum and Mineral Resources licenses all acreage to the Syrian Petroleum Company (SPC), which then sub-contracts by negotiation to international oil companies through a PSC for the exploration and production activities. The SPC forms a joint operating company with the IOC's for the execution of the PSC and manages the relationship with the contractors. The Ministry of Petroleum and Mineral Resources, or an independent body, should be assigned these licensing and regulatory functions. The fiscal regime for hydrocarbons also has some undesirable features. It is based upon a PSC with a negotiable royalty and features other non-transparent negotiable terms for profit sharing and non cost-recoverable bonuses. A review of the whole fiscal structure including the role and rights of the foreign investor and the distribution of income between the parties is required to determine the changes required to encourage investment.

5. Refineries & oil transportation:

Both existing refineries are state owned and the Syria Company controls pipelines for Oil Transport. Distribution is the responsibility of the Syrian Company for the Storage and Distribution of Petroleum Products. Provision needs to be made for the entry of competing firms and access to strategic assets. Petroleum products are lower than in the EU and the refineries in their present configuration are not capable of meeting EU specifications. Petroleum product prices are heavily subsidized and controlled by government and there are no published ex-refinery prices. The pricing system needs to be made more transparent and needs to allow profitable operation by private companies. The refineries produce relatively low yields of light products.

The following table shows the main key figures of Syrian Power System:

Lable		Unit	1992	1993	1994	1995	1996	1997	1998	1999
Total installed capacity	Installed	MW	3198	3398	3998	4698	4998	6028	6028	6133
	available		2886	3024	3624	4234	4534	5564	5534	5569
Steam tubine	Installed	MW	1500	1750	2031	1976	1976	2976	2976	2976
	available		1291	1225	1473	1586	1715	2685	2660	2635
Gas turbine	Installed	MW	0	0	570	860	1160	1160	1160	1160
	available		219	240	232	604	740	1140	1140	1140
Hydro turbine	Installed	MW	820	898	898	898	898	898	898	1213
	available		477	453	475	718	500	752	752	857
Combined cycle	Installed	MW	0	0	200	600	600	600	600	600
	available		0	0	200	600	600	600	600	600
Diesel oil	Installed	MW	340	340	340	364	364	394	394	394
	available		126	116	124	10	55	90	90	90
Substations 400/230 kV		No. / MVA	0/0	0/0	2/1000	3/1500	4/1800	4/1800	4/1800	4/1800
Substations 230/66/20 kV		No. / MVA	29/3580	29/3580	30/3980	30/3980	34/4290	36/4920	38/5510	41/5940
Substations 66/20 kV		No. / MVA	122/3911	126/4061	132/4286	138/4436	142/4586	151/5036	158/5998	165/6322
Substations 20/0.4 kV		No.	23861	24638	25466	26313	27641	29060	29989	32291
Length of transmisson lines 400 kV		km	167	167	167	170	322	322	322	478
Length of transmisson lines 230 kV		km	3602	3654	3776	3781	3885	4045	4176	4333
Length of transmisson lines 66 kV		km	4413	4603	4795	4883	5077	5154	5348	5466
Length of transmisson lines 20 kV		km	37715	38335	39128	40294	41800	34060	44892	46292
Length of transmisson lines 0.4 kV		km	54365	55411	56528	58097	58891	61714	63953	68391
Number of consumers		Consumers	2314000	2391000	2523000	2523379	2655915	2793452	2944641	3080877
Number of electrified villages		No.			7765	7988	8227	8443	8736	10169
Percentage of pepole with access to grid %						411600%	387700%	366100%	336900%	306000%
Number of employees at electricity sector No.			0.94	0.94	0.95	0.96	0.96	0.96	0.96	0.96
Total electricity gross generation by Fuel Type:			21216	21691	23874	24748	25838	26870	28666	29705
Hydro		Gwh				1946	2008	2153	2318	2372
Gas		Gwh	12392.3	12510.3	14700.3	16631	18342	19513	21161	22820
Fuel oil		Gwh	1512	1538	2459	2800	3549	3535	3481	2103
Diesel		Gwh	2051	2123	2272	7356	9432	10437	11023	10718
Wind turbine		Gwh	8177	8301	9760	6455	5352	5535	6652	9988
Total electricity gross generation by sources:			585	503	209	20	9	6	5	11
Ministry of electricity		Gwh	0	0	0	0	0	0	0	0
Ministry of Petroleum		Gwh	67	45	0	0	0	0	0	0
Ministry of irrigation		Gwh	10186	10226	11570	12789	13747	14791	16421	19517
Annual peak demand		MW	699	755	709	1076	1064	1205	1279	1203
Date of annual peak			1440	1484	2421	2766	3531	3517	3461	2100
Annual load factor		%	226700%	222500%	247400%	284700%	294400%	327100%	358000%	389100%

Lable		Unit	2000	2001	2002	2003	2004	2005
Total installed capacity	Installed	MW	6699	6804	7014	7014	7014	7057
	available		6145	6250	6450	6450	6450	6008
Steam tubine	Installed	MW	3636	3636	3701	3701	3701	3547
	available		3050	3355	3355	3355	3355	2995
Gas turbine	Installed	MW	1160	1160	1160	1250	1250	1342
	available		1140	1140	1140	1140	1140	1172
Hydro turbine	Installed	MW	1213	1318	1528	1528	1528	1528
	available		962	1170	1380	1380	1380	1201
Combined cycle	Installed	MW	600	600	600	600	600	640
	available		600	600	600	600	600	640
Diesel oil	Installed	MW	394	394	394	394	394	394
	available		90	90	90	90	90	0
Substations 400/230 kV		No. / MVA	6/2700	6/2700	6/3000	7/3600	7/3600	8/3600
Substations 230/66/20 kV		No. / MVA	43/6430	44/6880	47/7935	49/8765	49/9030	53/10510
Substations 66/20 kV		No. / MVA	169/6482	170/6662	173/7136	203/8616	218/9156	229/9606
Substations 20/0.4 kV		No.	33946	35384	38343	40808	43597	45109
Length of transmisson lines 400 kV		km	678	678	738	738	738	760
Length of transmisson lines 230 kV		km	4421	4518	4756	4985	5000	5046
Length of transmisson lines 66 kV		km	5496	5599	5881	6047	6502	6773
Length of transmisson lines 20 kV		km	48089	50821	52725	55046	57547	59963
Length of transmisson lines 0.4 kV		km	70989	71542	74968	79263	82243	85910
Number of consumers		Consumers	3198000	3327000	3494000	3680000	3902000	4133000
Number of electrified villages		No.	10434	10774	11042	11901	12326	12871
Percentage of pepole with access to grid		%	97%	98%	98%	99%	99%	99%
Number of employees at electricity sector		No.	31791	32667	33822	35390	36755	37827
Total electricity gross generation by Fuel Type:			25227	26715	28014	29533	32077	34935
Hydro		Gwh	2503	2119	2501	2804	4247	3445
Gas		Gwh	11224	11915	15015	15579	14062	13642
Fuel oil		Gwh	11489	12677	10396	11148	13766	17846
Diesel		Gwh	7.8	1.9	102	1.4	1.8	1.3
Wind turbine		Gwh	3.09	1.71	0.16	0.29	0.20	0.3
Total electricity gross generation by sources:			25227	26715	28014	29533	32077	34935
Ministry of electricity		Gwh	21493	23428	24450	25548	26770	30455
Ministry of Petroleum		Gwh	1233	1171	1067	1224	1083	1035
Ministry of irrigation		Gwh	2501	2116	2497	2761	4224	3445
Annual peak demand		MW	4128	4565	4791	5081	5770	6008
Date of annual peak			23 Dec.	24 Dec.	16 Dec.	24 Dec.	20 Dec.	27 Dec.
Annual load factor		%	70%	67%	67%	66%	63%	66%

National energy resources and potential saving

- Fossil energy resources:
  The main indicators for oil and gas sector in 2005 are illustrated in the following table:

Indicator	Oil	Unit	Gas*	Unit
Geological assured reserve	23.9	Milliard barrel	680	Milliard m^3
Producible reserve	6.8	Milliard barrel	396	Milliard m^3
Cumulative production	3.8	Milliard barrel	101	Milliard m^3
Residual and producible reserve	3	Milliard barrel	295	Milliard m^3
Domestic production level	425	Thousand barrel /day	22	Million m^3/day
Domestic internal consumption level	235	Thousand barrel /day	22	Million m^3/day

***) the current consumption of gas concludes the gas re-injected into oil wells to increase their efficiency.**

- Potentials of renewable energies:

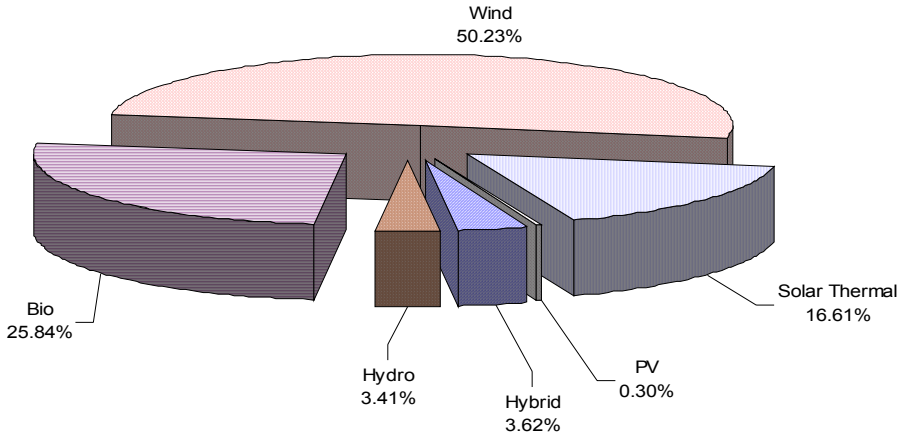
The hydro energy is a significant factor in the electricity generation system. There are three large hydroelectric power stations in operation on the Euphrates River. In 2003 the installed capacity of hydro plants was 1528 MW. The installed capacity of hydro plants is going to increase by 0,88 GW in the decade 2010-20.

Ministry of electricity in cooperation with UN DESA in the year 2002 has lunched a master plan for development of the usage of RES.

RES Master Plan presented, delineates sub-plans to be carried out for giving a major thrust to renewable energy development in Syria. Recommended program initiatives are outlined including specific plans to be taken up for mainstreaming renewable energy in the national energy balance. Research, Development and Demonstration projects for technology development, Pilot projects for technology demonstration as well as investment-worthy projects covering different forms of renewable energy on the basis of existing data have also been identified based on national level consultations and the extensive analytical work

The National Renewable Energy Master Plan (REMP) consists of a set of actionable recommendations and proposals for renewable energy systems development along with the accompanying measures to facilitate this energy development. The master plan proposals have been formulated assuming that,

- The implementation period of the master plan will extend over a period of 10 years, from 2002 to 2011;
- The development of energy systems contributes to meeting the primary energy demand in the country. By progressively increasing the contribution of renewable energy in the total energy mix trough planned efforts, the country would be able to reduce the burden of dependence on hydrocarbon sources such as gas based electricity, gasoline generators, diesel heaters and butane lamps;
- The accompanying measures such as the establishment of institutions, conducting studies and surveys and training and capacity building efforts would be put in place in order to facilitate implementation of the proposed plan.
- Government commitment to the master plan will result in adequate resource allocation and establishment of Institutional Framework.
- In 2011 the final year of the master plan the contribution by renewable energy technologies is estimated at 1012 kTOE, which will represent 4.31% of the primary energy demand. The share of different renewable energy technologies is shown in the following figure:



Note: the Hydro share indicated in the previous figure didn't include the big hydro electrical power plants.

Institutional specificities and energy policies

We can summarize the main points in energy policies as follows:

- Giving long term loans to purchase efficient appliances.
- Giving non interest loans to purchase efficient appliances.
- Reducing taxes and the charge dues.
- Repaying rate of costs.
- Sealing energy efficient appliances by soft installment plan.

- Securing suitable financing & funds, for private individual engineering offices (ESCOs core) to purchase energy audits equipments (power analyzers, flue gas analyzers, non-contact stroboscopic tachometer, light meter…..).

1.2. Energy Supply, Demand and Production: evolution and structure

Electricity Access

ENE_C10: SHARE OF THE POPULATION WITH NO ACCESS TO ELECTRIFICATION

The share of the population with access to electrification for the whole country equals 99,7% of the total population; the population with no access to electrification equals 0,3%, all of them are small villages and individual farms.

The main problem facing the electricity sector is the average population annual growth rate which equals 2.45%, which mean an annual increment of electricity demand, besides the electricity low prices due to the government subsidies.

Evolution and structure of the energy demand and production

Security of Energy Supply:

Syrian energy policy takes into consideration the following matters:

- To expand the gas usage.
- To sustain the oil production.
- To develop the country's power capacity.
- To promote the energy efficiency and the use of renewable energy resources.

Energy Balance in Syria (million TOE):

Years	1990	1991	1992	1993
Oil products	7.73	8.20	9.24	9.35
Natural gas	0.77	0.86	1.12	1.27
Hydro-electricity	0.33	0.33	0.38	0.39
Total Energy Demand	8.83	9.39	10.74	11.01
Annual growth rate %		6.35%	14.37%	2.53%
Average annual growth rate %	7.64%			

Years	1994	1995	1996	1997	1998	1999
Oil products	8.76	8.88	8.64	9.25	9.68	10.16
Natural gas	1.84	2.52	2.99	3.51	3.84	3.94
Hydro-electricity	0.61	0.70	0.88	0.88	0.86	0.53
Total Energy Demand	11.21	12.10	12.51	13.64	14.38	14.63
Annual growth rate %	1.83%	7.91%	3.43%	8.98%	5.46%	1.70%
Average annual growth rate %	5.46%					

Years	2000	2001	2002	2003	2004	2005
Oil products	11.13	11.30	11.73	12.31	13.89	14.73
Natural gas	3.83	4.11	4.88	4.88	4.66	4.76
Hydro-electricity	0.63	0.53	0.55	0.62	0.93	0.76
Total Energy Demand	15.59	15.94	17.16	17.81	19.48	20.25
Annual growth rate %	6.56	2.25	7.65	3.78	9.37	3.95
Average annual growth rate %	5.36%					

Average annual growth rate % all over the period 1990 – 2005 is about 5.69 %.

Note: In addition to mentioned above energy resources consumption values, wood-fuel amount is estimated about 600-700 kTOE annually.

Primary energy future demand (Million toe)

Years	2007	2010	2015	2020
Oil products	18.70	20.66	25.36	32.43
Natural gas	3.22	5.18	8.60	12.15
Hydro-electricity	0.625	0.625	0.625	0.625
Total Energy Demand	22.54	26.47	34.59	45.21

General Electricity Profile:

The production of electricity reached 34.9 TWh in 2005 whiles the installed capacity almost 7 GW. With Syrian electric power demand growing rapidly, adding electricity supply capacity is an important national priority.

1- Distribution of gross electricity generation in Syrian power system by fuel sources & turbine:

Label	2000	2001	2002	2003	2004	2005
1- Total gross generation	25212	26713	28014	29533	32077	34935
1-1- Hydro electricity production (GWh)	2503	2119	2501	2803	4247	3445
1-2- Thermal electricity production (GWh) of it:	22709	24594	25513	26730	27830	31490
** Steam turbine (GWh)*	*12770*	*14492*	*14769*	*15869*	*16468*	*18985*
** Gas turbine (GWh)*	*5720*	*5623*	*5776*	*5776*	*6410*	*7323*
** Combined cycle (GWh)*	*4219*	*4479*	*4968*	*5085*	*4952*	*5182*
2- Electricity generation by fuel sources:						
2-1- Electricity generation by HFO	12770	14492	14769	15869	16468	18985
2-2- Electricity generation by NG	9939	10102	10744	10861	11362	12505

2- Peak load demand & minimum load in Syrian power system:

Label	2000	2001	2002	2003	2004	2005
1- Peak load demand (MW)	4128	4565	4791	5081	5770	6008
1-1- Peak load for internal demand (MW)	3878	4315	4731	5018	5620	6008
1-2- Exported capacity (MW)	250	250	60	63	150	0
2- Minimum load demand (MW)	1760	1768	1924	2121	2253	2552

3- Distribution of electricity generation by Facilities:

	2000	2001	2002	2003	2004	2005
1- Ministry of electricity (% of total)	85.2%	87.7%	87.3%	86.5%	83.5%	87.2%
1-1- Public establishment for electrical energy generation & transmission (PEEGT)	21471	23421	24445	25506	26746	30454
1-2- Public establishment for distribution & exploitation of electrical energy (PEDEEE)	7	5	5	43	25	22
2- Ministry of Irrigation (% of total)	9.9%	7.9%	8.9%	9.3%	13.2%	9.8%
Public establishment for Euphrates dam (Hydroelectric).	2501	2116	2496	2761	4223	3425
3- Ministry of petroleum & mineral resources						
(% of total)	4.9%	4.4%	3.8%	4.1%	3.4%	3.0%
3-1- Syrian petroleum company (SPC)	689	655	550	702	557	561
3-2- General company of Homs refinery	371	356	326	354	339	292
3-3- General company of Banias refinery	173	160	192	168	187	182
Grand total	25212	26713	28014	29533	32077	34935

4- Electricity future demand & needed fuel for electricity sector by fuel type:

Year	Gross electricity demand	HFO demand for power plants			Natural gas minimum demand for power plants		
	GWh	ton/day	ton/year	toe/year	thousands m^3/day	thousands m^3/year	toe/year
2007	40753	13390	4887350	4691856	9788	3572778	3215500
2010	51337	15033	5487045	5267563	15768	5755278	5179750
2015	72000	15033	5487045	5267563	26189	9559011	8603110
2020	96356	15033	5487045	5267563	36995	13503278	12152950

5- Electricity Tariff over Years

The next table shows the electricity tariff effective since 1988-2005 (S.Piaster/kWh)

Note: 1 S.Pound = 100 S.Piaster = 0.02 US$

Item	Consumption Voltage Level	From 1988 to 1990	From 1991 to 31 /5 /2002	From 1 /6 /2002
1 -	230 KV	34	75	170
2 -	66 KV	36	80	180
3 -	20 KV	42	90	200
4 -	20 /0 .4 KV			
4 - 1 -	Industrial	43	120	240
4 - 2 -	Commercial	43	125	240
4 - 3 -	Agriculture (all crops)	25	80	180
5 -	0 .4 KV			
5 - 1 -	Residential			
	1 - 50 kWh /month	19	25	25
	51 - 100 kWh /month	24	35	35
	101 - 200 kWh /month	35	50	50
	201 - 300 kWh /month	35	75	75
	301 - 400 kWh /month	55	150	250
	400 and above kWh /month	75	150	250
5 - 2 -	Commercial	75	150	250
5 - 3 -	Small Scale Artisan	75	140	250
5 - 4 -	Street Lighting	15	75	150
5 - 5 -	Government Offices			
	1 - 50 kWh /month	19	75	200
	51 - 100 kWh /month	24	75	200
	101 and above kWh /month	35	75	200
5 - 6 -	Religious Buildings	Free of Charge		

Taxes collected for other Ministries				
* Note 1 : / 10% / of 0.4 kV sales for Ministry of Local Administration & Environment.				
** Note 2 : / 12.5% / of Total Electricity Sales for Ministry of Finance				
*** Note 3 : / 50 SP / . Electric Meter Charge per cycle per Single Phase Meter.				
**** Note 4 : / 150 SP / . Electric Meter Charge per cycle per Three Phase Meter.				
***** Cycle = two months. Peak starts from sunset for 4 hours				
Night starts from end of peak for 8 hours, the rest is day time				
Power Factor correction (Penalty & Bonus) :				
(0.9-0.93) = (0.9/Costomer PF)-1 (penalty tariff)				
More than 0.93 = (Customer PF/0.93)-1 (bonus tariff)				

6- Electricity Consumption & losses:

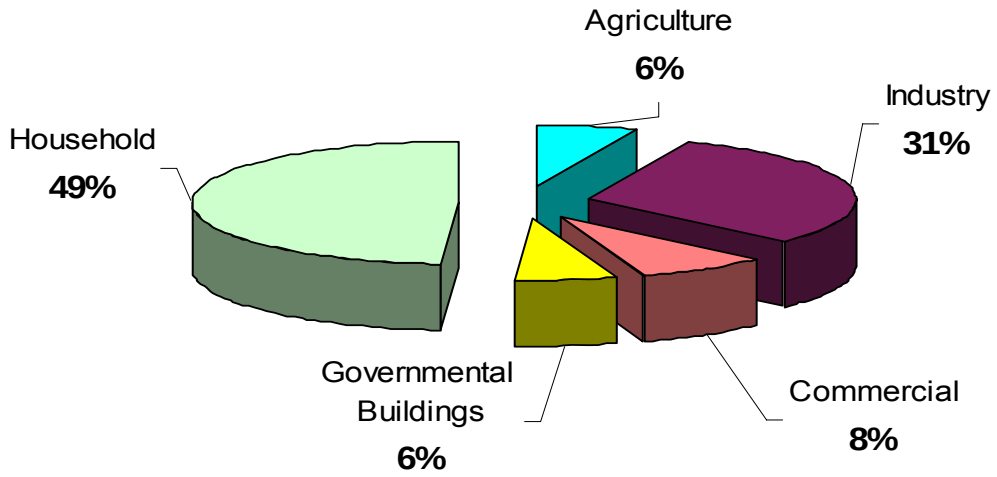
Distribution of electricity consumption by voltage level & consumption categories (GWh)

Label		2000	2001	2002	2003	2004	2005
Electricity gross generation		**25217**	**26712**	**28014**	**29533**	**32077**	**34935**
Auxiliary consumption		1065	1163	1162	1233	1268	1437
Special consumption in other public sector facilities		754	790	827	816	860	872
Net generation		**23398**	**24759**	**26025**	**27484**	**29949**	**32626**
Export		1418	1271	692	249	548	843
Technical losses of 230 & 400 kV		**665**	**793**	**845**	**966**	**921**	**944**
Sales of 230 kV customers		327	298	325	307	342	380
Total electricity flow at 66 kV		**20988**	**22397**	**24163**	**25962**	**28138**	**30460**
Motive power consumption	**66 kV**	1605	1802	1898	1900	1926	2073
	20 kV	1214	1271	1285	1417	1648	1743
	20/0.4 kV	2838	3092	3195	3575	3904	4293
	0.4 kV	313	306	349	314	329	341
	Total motive power consumption	**5970**	**6471**	**6727**	**7206**	**7807**	**8450**
Lighting consumption	**Residential**	7244	7604	8139	8885	9940	10993
	Commercial	1289	1308	1460	1464	1617	1699
	Government directorates	227	234	297	379	362	404
	Street lighting	364	440	490	530	700	666
	Religious building	354	342	371	296	337	386
	MOE subsidiary directorates	92	104	106	98	138	98
	Total lighting consumption	**9570**	**10032**	**10863**	**11652**	**13094**	**14246**
Total consumption on 66 kV & down		**15540**	**16503**	**17590**	**18858**	**20901**	**22696**
Total Losses on 66 kV & down		**5448**	**5894**	**6573**	**7104**	**7237**	**7764**
Total losses in Syrian power system		**6113**	**6687**	**7418**	**8070**	**8158**	**8708**
Total losses rate		**26%**	**27%**	**29%**	**29%**	**27%**	**27%**

7- Distribution of Primary Energy Demand in Syria By Fuel & Sector for year 2005:

By Fuel	20247	kTOE	By Sector	100%
Oil Products	14732	=	Industry	10%
Natural Gas	4757	=	Residential	16%
Hydro-Electricity	758	=	Electricity Generation	35%
Wood-Fuel	700	=	Oil & Gas Facilities	8%
			Agriculture	5%
			Transport	20%
			Building & Construction & Commercial	6%

The following figure shows electricity demand by sector in 2005:



8- Future aspects of electric sector in Syria concentrate on the following:

- Rehabilitation of old generating units.
- Convert existing single gas turbine to combined cycle.Expansion dependency on natural gas.Decrease total electrical losses in Syrian power system.Improve billing & electric meter reading system in distribution networks.Decrease specific consumption of HFO & NG down to 174 goe/kWh in 2020, throw economic operation of existing PP.Improve technical qualification of working manpower in ministry of electricity.Improve power system's load factor by applying DSM procedures.Construct pumping storage hydro-electric power plant on Euphrates river.Provide all existing power plants with EMS & MMS.
- Expansion dependency on renewable energies (solar, wind, biomass)
- Improve & enhance power systems interconnections with Arabic countries & Turkey.

1.3. Impacts and risks of the observed and forecast evolutions

Energy dependence and Energy bill, reduction in export capacities

ENE_C01: External Energy Dependency

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Domestic supply (MTOE)	34.67	34.89	34.85	35.11	35.07	33.57	35.45	38.70	37.47	29.46	28.26
Domestic demand (MTOE)	12.34	12.57	13.75	14.27	14.92	15.75	16.02	16.61	16.59	18.55	21.07
Energy dependency rate %	**-181**	**-178**	**-154**	**-146**	**-135**	**-113**	**-121**	**-133**	**-126**	**-59**	**-34**

ENE_PO3: Greenhouse gas effect emission ; CO_2 emitted from energy production and use.

Years	1990	1991	1992	1993	1994	1995	1996	1997
CO2 emission by oil products (mton CO2 equivalent)	23.18	24.58	27.71	28.07	26.27	26.63	25.90	27.74
CO2 emission by natural gas (mton CO2 equivalent)	1.79	2.00	2.62	2.96	4.29	5.88	6.97	8.17
Total (mton CO2 equivalent)	24.97	26.59	30.33	31.03	30.56	32.51	32.88	35.91

1998	1999	2000	2001	2002	2003	2004	2005
29.02	30.48	33.38	33.90	35.20	33.28	39.25	45.61
8.94	9.18	8.92	9.57	11.36	11.07	10.85	11.08
37.97	39.66	42.29	43.47	46.56	44.35	50.11	56.69

Review about the National Environmental Policy:

The total CO2 emissions are 42.29 m ton (the energy sector are approximately 18.528 million tones) in year 2000. The application of RES is modest, mainly due to the low (subsidized) energy and electricity prices. Syria's potential to utilize solar energy is very large. Despite, the high solar energy potential, solar heaters and photovoltaic systems are not extensively used. Wind is another source of high potential in Syria although it is not sufficiently exploited.

CO2 equivalent emissions per capita are approximately 2.6 tones / capita.

Hot spots of environmental impact / environmental problems are air-borne emissions caused by transportation intercity, by space and water heating using DO in residential sector, refineries, textile, chemical and cement factories. Emissions to water and soil, not mentioned.

1. Environment in the ninth five years plan in Syria (Strategic goals)
    - Realization sustainable development and natural resources & environmental balance conservation.
    - Limit environmental decline, & define existing environmental problems.
    - Incorporate environmental activities in development plans.
    - Development of human beings capabilities & improve skills in environmental field.
    - Develop & construct national environmental protectorate.
    - Promote environmental awareness in the Syrian society.
2. Environment policy & measures:
    - Issue of environment protection law (2002).
    - Establish permanent pollution monitoring stations in various regions in the country.
    - Obtainment of developed laboratories for pollution measurements, and continuing equipping the Syrian environmental & scientific research center.
    - Conduct environmental & scientific conferences & training workshops on environment protection aspects.
    - Continuing creation of environmental departments in Syrian governorates.
    - Construct central & sub branches environmental laboratories.
    - Cooperation with local & international environmental agencies.
    - Creation in the Syrian central bank account of " Fund for support & environment protection".
3. Direct & indirect instruments (Some of punishments):
    - Punished by penalty from 100000 to 2000000 Sp (2000-40000 $) any industrial, commercial, services facility to get rid of any (sold, liquid wastes, gas emissions) cased any damage for environment. And in case of repetition to be imprisoned for one month at least in addition to mentioned penalty.
    - Punished by penalty from 10000 to 1000000 Sp (200-20000 $) any industrial, commercial, services facility to be breached the Syrian environment's low And in case of repetition to be

double and in case of third repetition imprisoned for two months to two years in addition to mentioned doubled penalty.

- Remove of the breach directly or closing the facility, and in case of delay in removing the breach it will pay (5000 – 10000 SP) per each day.
- Obligate all the facilities which pollute the environment by effluence, to install suitable metering systems.

4. Overview about National Ambient Air Quality Standards:

a) Sulfur dioxide (SO_2)

Margin of tolerance	Number of exceedances	Limit value		Averaging Period
		ppm	µg/m^3	
none	none	0.188	500	10 minutes
150 µg/m^3(43 % of limit value)	24 times a year	0.132	350	1 hour
none	3 times a year	0.047	125	24 hours
none	none	0.019	50	1 year

to be measured in sequence through three hours 500 µg/m^3 is the threshold of SO_2

b) Nitrogen dioxide NO_2

Margin of tolerance	Number of exceedances	Limit value		Averaging Period
		ppm	µg/m^3	
100 µg/m^3 (50 % of limit value)	18 times a year	0.105	200	1 hour
20 µg/m^3 (50 % of limit value)	none	0.021	40	1 year

to be measured in sequence through three hours 400 µg/m^3 is the threshold of NO_2

c) Ozone O3

Limit value		Averaging Period
ppm	µg/m^3	
0.08	160	1 hour
0.06	120	8 hours

d) Carbon monoxide CO

Limit value		Averaging Period
ppm	mg/m^3	
51.5	60	30 minutes
25.8	30	1 hour
8.6	10	8 hours

e) Lead Pb

Limit value	Averaging Period
1	Annual average

f) Total Suspended Particulate TSP:

Limit value µg/m^3	Averaging period
240	Average 24 hours

150	Annual average

g) M_{-10} Respirable Suspended Particulate:

Limit value	Averaging period
100	Average 24 hours
50	Annual average

h) Benzene, C_6H_6:

Limit value μg/m^3	Averaging period
20	Annual average

i) Maximum permitted limits for air pollutants near effluence sources

	Max limit	Unit	Polluter
1	250-500	mg/m^3	CO
2	300-3000	mg/m^3	NO_x
3	1000-3000	mg/m^3	SO_2
4	50-150	mg/m^3	SO3
5	50-250	mg/m^3	TSP
6	2-20	mg/m^3	Pb
7	1-10	mg/m^3	Sb
8	1-10	mg/m^3	As
9	1-5	mg/m^3	Cd
10	5-20	mg/m^3	Cu
11	0.5-5	mg/m^3	Hg
12	1-5	mg/m^3	Ni
13	5-20	mg/m^3	Total value for heavy metals**
14	5-10	mg/m^3	H_2S
15	5-20	mg/m^3	CL_2
16	10-100	mg/m^3	HCL
17	1-20	mg/m^3	F
18	2-20	mg/m^3	CH_2O
19	50-250	mg/m^3	C
20	10	mg/m^3	SiF_4

* The small number indicates the minimum limit of the emission and the big number indicates the maximum limit of the emission

** The heavy metals include: Pb ,Sb ,As, Cd ,Cu , Hg, Ni.

k) The limitation of the noise in production areas

The maximum limit of noise	The production activity
90	Places of 8 hours shift and the purpose is to reduce the noise bad effects

80	Places where it is necessary to hear voice signals and oral instructions
65	Operation control and measurements places
70	Computer and typing rooms .
60	Places where concentrating is required

l) The maximum limit of noise admissible

The max limits			Area
night	afternoon	day	
55-45	60-50	55-65	The center of the city and the commercial ,administration
50-40	55-45	60-50	The residential areas with some workshops or next to a main
45-35	50-40	55-45	Residential areas in the city
35-25	40-30	45-35	Country side, Hospitals and gardens
60-50	65-55	70-60	Industrial areas.

ENE_C04: Number of energy infrastructures in coastal areas

There are two energy infrastructure in the caostal area:

1. Bnias power plant
2. Banias refinery

Statistical Survey for Non Electrified Communities in Three Syrian Governorates,

(Homs, Hamah, Al-hassakeh):

During 2003-2004 Ministry of Electricity in cooperation with central bureau of statistics and UNDP office in Damascus. implemented a survey about energy consumption in the non electrified communities in three Governorates, Homs, Hama, Al-hassakeh as an essential approach in order to launch overall survey in all Syrian remote areas.

Results analysis:

Since it was discovered, Electricity has been considered a key factor for development in all fields of life, so the electric system has to be expand in order to meet the demand.

International researches show that it is not economically feasible to connect remote area to the main grid , especially in the case of scattered small villages.

The development of renewable energy especially solar, wind, and biomass energy, gives the economic solution to electrify remote area .

In Syria renewable energy has been used in different fields, such as wind mill in the past Al-Qalamon region), and hydroelectric and biomass residents in present.

No doubt that renewable energy which is formed basically of wind, solar and biomass energy, could be essentially contribute in the national energy balance; and the Master Plan of renewable energy in Syria which has been prepared and published by Ministry of Electricity financed by UNDP, has enhanced our understanding of the current situation and future possibility for the renewable energy in S.A.R .

As a continuation of the Master plan and for the purpose of rural area developing, a survey was executed in cooperation with Central Bureau of Statistics and financed by UNDP. The survey discover the energy use in remote non electrified area in three Governorates, Homs, Hama, & Al-Hassakeh as an essential approach in order to lunch overall survey in the whole country . and hereunder a brief summary of survey's result.

General data about communities:

- The results show some unoccupied communities though it is mentioned in the administration division and in the schedules of electricity distribution company for non electrified communities, The number of the unoccupied communities is 14 while the total number of communities is 510 in the three Governorates.

- 28% of studied communities are less than 1000 meters far from nearest electrified communities, so they are candidates for detailed study to connect them to the main grid, while 72% of the

communities are more than 1000 meters far away, and this mean trying to find other way for energy than main grid.

- Usually these communities obtain drink water by two ways, even from nearby wells, as wells not far than 1 km counted 196, or by containers from faraway area. Total number of wells are 245, of which 64 of it owned by the state and the rest by residents of communities. with noting that deep of water in 83 wells reaches no more than 100 meters, which gives a good possibility to use pumps operates by PV cells .

- Total number of families in the studied communities 5036 families. 210 families live seasonally in the communities. The population in the communities was 43181 persons, Average size of family is 8.6 person per family.

- Total number of houses is 5759 including tents. 1781 houses are build by blocks and cement, the rest are build by stone and wood and mud. Occupied houses are 4752 and 98.76% of which are heated.

Data about energy resources and uses within communities:

- The results shows considerable quantities of consumed oil products for purpose of lighting, cooking, water and space heating; which indicates to inefficient use of these sources. Besides number of small and medium size batteries used annually reaches 1031203, analyzing these data will help within feasibility studies for energy substitution studies. As well as people of communities used 4770 of chemical batteries (car batteries) to operate TVs.

- Total annual amount of consumed DO within the communities is 5719 thousand liters per year. Average amount for each family is 1135 liters per family per year, knowing that average amount for rural family according to previous survey is 771 liters per family per year. 60.87% of the total amount is used for space heating, 23.38% is used for lighting, 0.45% is used for water heating and 15.3% is used to operate cars or tractors. Average price of DO is (7.5) S.P per liter.

- Total annual amount of consumed LPG 134030 Bottiles, which equal to 1608 ton, and the average is 26.6 Bottiles per family per year, - knowing that the average in the previous survey for electrified rural area was 17.9 Bottiles per family per year - 18.32% of total amount used for lighting, 81.62% is used for cooking and water heating, 0.06% is used for space heating Cost of cylinder is 175 S.P.

- Total amount of kerosene consumed annually within the communities is 601 thousand liters, the average is 119.6 liter per family per year - knowing that the average in the previous mentioned survey was 40 liter per family per year - 55.88% of total amount is used for lighting, 44.4% is used for cooking and water heating, 0.08% is used for space heating. The cost of kerosene is 21 S.P per liter.

- Total annual amount of animal residue is 2011 tons, 2.84% of the total amount is used for space heating, 97.16% is used for cooking and water heating. Knowing that a lot of animal residue don't collected and left in the ground, there is a possibility to use this amount of residues to produce biogas as an alternative of LPG.

- Total annual amount of agricultural residues is 8641 tons, including 3544 tons of purchased wood which cost between 1000 and 3000 S.P. per ton, 8.74% of total amount is used for space heating and the rest for cooking and water heating. When asking people about the way of how they get red off the plant residue the answer was 50.98% answered they use it to feed animals, 18.96% answered they just leave it on the ground or burn it, so this indicate that there is a possibility to obtain biogas from those residue.

Data about facilities exist within the communities:

The results show that there is about 34 schools within the communities and 3 veterinary clinic located in Homs desert, besides 6 small commercial shops. The annual number of small and medium consumed batteries was 929 batteries, and the annual amount of consumed light oil was 44.6 thousand liters, 83.74% of it was used for space heating, and the rest for lighting. Total annual amount of consumed LPG was 221 Bottiles which equal to 2.6 tons, 34.39% of it is used for lighting, 57,47% is used for cooking and water heating, the rest is used for space heating.

While total annual amount of kerosene consumed was 380 liters, 73.68% of its was used for lighting, the rest for cooking and water heating, there was no notice for any use of biomass residue within the facilities.

***Conclusion*:**

1. Total amount of fossil fuel (DO, kerosene and LPG) consumed is about 2200 tons, the average is 436 tons per family, and this costs every family about 5000 S.P according to the local prices and 150$

according to the international prices, in addition the total number of consumed small and medium batteries was more than one million batteries, this means that the average is 200 batteries for each family, as well as every family use at least one chemical batteries, and this increase the lighting cost about 2000 S.P. So it is very feasible to find alternative source of energy for those poor families which pay too much according to their ability to get low level of lighting.

2. Total annual amount of fossil fuel (kerosene and LPG) which is used for cooking is about 1200 tons, lead to average of 240 kg per family, with cost 3000 S.P per family per year, besides the cost of wood used for cooking. This means that encouraging the use of solar cooker will help to raise the standard of living for those families who substitute to such device.
3. In order to achieve the goals of this study, we suggest to choose some of mentioned above studied communities according to certain criteria to prepare a feasibility study for using renewable energy.

2. PART II - Rational Energy Use (RUE) - Renewable Energies (RE):

(policies, tools, progress, resulting effects, case studies)

2.1 RUE and RE Policies

2.1.1. Rational energy use (RUE) policies

Working in RUE started since 1998 through Supply Side and Energy Efficiency Conservation and Planning Project (SSEECP) financed by UNDP, GEF, OPEC Fund . The primary objective of the "Syrian Energy Conservation and Planning Project" was to improve demand-side energy through the creation of a multi-purpose Syrian Energy Services Centre (SECS) and a National Energy Efficiency Program (NEEP). The activities of the project focused on the greatest opportunities for improving electrical energy efficiency and reducing growth rate of electric power demand while slowing the growth of greenhouse gases emission from industrial and other use. The work included also the strengthening of institutional capacity of the

Ministry of Electricity to implement and sustain long-term, sound energy measures that have a measurable, documented impact on the economic, environmental and social well being of the Syrian people. In a fast-changing economy, there are new measures through which these types of activities can be profitable and therefore lead to job creation while assuring improved efficiency and affordable energy resources to the people of Syria.

The main activities of the SSEECP project were:

- Conduct preliminary (walk throw) energy audit studies for 200 industrial, commercial, & services facilities in Syria.
- Conduct 50 detailed energy audit studies from the above-mentioned facilities.
- Conduct 20 feasibility studies from the above-mentioned facilities, in order to find financing to implement recommendations & improvements of energy audits in 10 industrial, commercial, & services facilities in Syria.
- A full demand side management assessment of energy/electricity use in Syria, designee DSM pilot project
- Launch & designee energy efficiency and standards program and their adoption initiated, for residential electric appliances (refrigerators, washing machines, air conditions).
- Launch & initiation of The National Energy Efficiency Program, designee and analyze energy policy initiatives.
- Launch a cross sectoral information dissemination and promotion program for energy efficiency (issue brochures, TV & newspapers advertisements, Hotline…)

the SSEECP project launched in 1998 and continued till 2006.

One of the main objectives of the SSEECP project was establishing the national energy research centre (NERC) which was created in 2003 to carry out the energy efficiency and renewable energy R&D in Syria.

The accredit document which concern the strategies in all sectors is the five years plan which put by the Syrian State Planning Commission.
The five years plan 2000-2005 mentioned the energy efficiency issues in a very simple, limited term, concentrated on encouraging adopting energy efficiency applications to decrease energy demand.
The five years plan 2006-2010 which has been put in 2006 included in the long term view specific procedures for decreasing energy demand through adopting energy efficiency as the following:

- Improve energy efficiency in production side and reduce the grid losses.
- Increase the reliability in production and distribution systems.
- Implementing demand side management strategies through concentrating on the benchmarked indicators.
- Implementing integrated resource planning strategies targeted to enlarge the electrical system to achieve the sustainable development.
- Create new policies for energy pricing aiming to improve energy efficiency and demand management in residential, industrial, commercial sectors.
- Issuance encouragements procedures to adopt building thermal insulation.

Regarding the strategies in the five years plan 2006-2010 mentioned above, (NERC) shouldered implementing them through preparing “Energy Conservation Law” which determined the regulating mechanism for RUE in the national level through:

1. Legalizing all action and activities related to energy conservations issues.
2. Exchanging the unsustainable patterns used in energy production and consumption.
3. Executing energy efficiency procedures in all sectors.
4. Increase the availability of the national existing fossil fuel resources and reservation.
5. Greenhouse gases reduction.
6. Activating the public participation in the national socio-economic support.
7. Developing the national abilities and raise the general awareness about RUE for the sustainable development objectives and environment protection.

As a result of the mentioned points, NERC steps forward in determining definite procedures regarding RUE as follows:

- ***In the residential sector:***
  1. Working on improving energy efficiency for home appliances through execute Standards and Labels programme, starting with refrigeration systems since 2003, and expanding it to include cooling systems in 2007, and washing machines, lighting sets till the end of 2010.
  2. Preparing the first version of "Building Thermal Insulation Code" in 2006 which aimed to improve thermal behaviour in buildings to reduce traditional energy used for cooling and heating systems, the code planned to be set as an obligatory document in 2007.
  3. Demand side projects:

     The first project years were dedicated mainly on integrated resource planning. IRP plan has been developed with the support of international consultant.

     DSM assessment was initiated only in 2001 and the study was completed in 2003. The electricity demand forecast study showed that residential sector and industry electricity consumption are with contributing most to the overall growth in the country electricity demand. Based on the data collected during the household survey as well as the information gathered during the demand forecast, some 18 end-use electricity saving measures have been identified. From these three pilot programs were chosen for further development of pre-feasibility studies - time of use metering, industrial motors and motor systems and building envelope improvement

- ***In the industrial sector:***
  1. Energy audits – the SSEECP project team developed by NERC, and the governorate distribution companies energy efficiency units with cooperation of the Ministry of Industry and University of Damascus have performed 250 walk through audits in different industrial sites, more than 100 detailed audits covering boilers, steam systems and electrical systems for 50 plants. Detailed design and feasibility studies have been developed with the support of Greek international consultants for 20 investment projects.
  2. NERC will execute the saving opportunities declared in the detailed audits performed (in 2007 NERC started implementing energy efficiency project to improve power factor in many industrial establishments).

- ***In Electrical Generation Side:***

  Rehabilitation of Banias Thermal Power Station – The Syrian government and SSEECP project performed a rehabilitation of Banias thermal power station, the rehabilitation conclude the following:

  - Rehabilitation of units 1 and 2 of installed capacity of 170 MVA for each.
  - Conversion these two units to work on natural gas instead of heavy fuel oil.
  - Installation a Condition Monitoring System (CMS) works in online term for the four units in the station, this system to be applied in all power plants.
  - Using Maintenance Management System (MMS) to appropriate the targets of reliability selected, and to achieve fully functional MMS installed.

- ***In Electrical Distribution Side:***

  The Public Establishment for Distribution and Exploitation of Electrical Energy (PEDEEE) adopted power factor correction project for distribution substations since 2004 and the installed capacity equals 1400 MVAR till now and the project still in progress.

Regarding the institutional structure the "Energy Conservation Law" directed to create energy conservation unites in all governmental associations which will be NERC's representative in their associations to collect data regarding energy consumption and determine the saving opportunities to be implemented in cooperation with NERC in all sectors.

2.1.2. Renewable Energy (RE) policies

The objective of the Syrian Renewable Energy strategies is to ensure an increasing contribution of RE applications to meet Syria's Primary Energy Demand. This is expected to result in a decreasing dependence on hydrocarbon energy sources and an environmentally sound and sustainable development.

There have already been efforts by the Syrian Government, and the industrial sector to utilise renewable energy sources in the past. These initiatives have not had any significant impact on the energy scenario partly because of a non-coordinated approach and lack of planning. The Government of Syria recognised that for renewable energy resources to play a greater role, a planned and co-ordinated approach is required. This recognition was reflected in the European Union -Syria Energy Policy Dialogue during 1998[1] - In the UNDP/UN-DESA project - The need of Sustainable Energy in the Arab States and emerged as the key recommendation[2]. Thereafter joint efforts by the Syrian Government, UN-DESA and UNDP led to Syria Renewable Energy Master Plan[3] project. The project under UNDP funding was implemented by UN-DESA and co-ordinated by the Ministry of Electricity. The National Renewable Energy Master Plan for Syria performed in 2004.

After that the National Energy Research Centre carried out renewable energy actions in Syria through many practical projects regarding solar, wind, and biomass energies.

Strategies for RE has been illustrated (at national level) in the five year plan 2006-2010 as the following:

- Get the maximum advantage of RE sources in Syria as the hydropower and wind energy, besides solar thermal energy applications, and any RE sources available.
- Contribute photovoltaic and wind energy in electricity produced into the grid, to reduce the oil and gas used for that purpose.
- Divide RE needs according to areas requirements, for example using wind energy in electricity supply for regions that has a suitable average of wind speed, or using biomass energy for thermal purposes in the rural areas.
- Government Incentives for using RE applications as solar thermal in residential sector, and manufacturing wind turbines, photovoltaic cells, solar thermal sets.

Government Institutions and Co-ordinating Authorities

The State Planning Commission acts as the co-ordinator for planning in all sectors of the Syrian economy. In the energy sector, several entities / government ministries are involved with energy - planning based on the resources at their disposal. Resource and energy planning in Syria are organised by the Higher Planning Council (HPC) and by the Supreme Energy Committee (SEC). In addition to managing the present energy resources, the HPC and SEC also examines the potential of renewable energy (RE) as an alternative to fossil fuels.

Since 1998, some of activities in the field of renewable energy were attached to the Atomic Energy Commission (AEC). This succeeded an earlier arrangement where a Renewable Energy Office was attached to the Prime Minister's Office. This change was seen as the first step towards establishing an autonomous Renewable Energy Authority. Recommendations for an institutional framework for renewable energy, proposed in a EU financed study[4] in December 1998, proposed the establishment of a Renewable Energy Authority, under the authority of the Ministry of Electricity[5] .

Renewable energy activities and projects have been carried out by several Government of Syria entities, such as the Scientific Studies and Research Centre, Atomic Energy Commission, Universities, the Ministry of Electricity, Ministry of Environment, Ministry of Irrigation, Ministry of Agriculture and Agrarian Reform, Ministry of Industry, Ministry of Petroleum and Mining Resources. These activities have been carried out with little co-ordination among the implementing ministries. Some examples of such instances are:

1. Ministry of Agriculture and Agrarian Reforms have been implementing renewable energy programmes involving water pumping using wind electric generators, use of biogas digesters and biomass burners for tobacco drying. There have also been efforts to involve the Food and Agriculture Organisation in a project dealing with renewable energy for the Bedouins in the Badia;
2. Ministry of Industry established a Solar Hot Water Systems manufacturing facility in 1982 and the General Company for Batteries and Liquid Gases in Aleppo has been involved in renewable energy storage systems;
3. The Ministry of Environment under its greenhouse gas abatement strategy is planning renewable energy projects involving biogas, solar hot water systems for domestic and industrial purposes, PV electricity generation and wind energy;
4. There are villages and farms that have not been electrified in Homs region (Palmyra):, such as Alkoum, Alfasdeh, Alfourglos and Job-Aljarrah. The Public Establishment for

[1] A workshop on Syrian Institutional Framework for Renewable Energy was organised in Damascus under the EU-Syria dialogue co-ordinated by the DG XVII of EC in Nov1998.

[2] As an outcome of the Renewable Energy Entrepreneur Development Workshop held in Damascus in 2000

[3] SYR/99/001/08

[4] Carried out by Hagler Bailly Consulting Ltd and Partex CE

[5] Source Reference: Institutional framework for Renewable energy, December 1998

Electricity Distribution (PEDEE) of the Ministry of Electricity is considering some of these villages and farms as candidates for renewable energy based micro-grids.

The lack of a coordinating establishment, with the specific objective of facilitating the accelerated development of renewable energy resources is considered a major barrier.

Renewable Energy Sector Policies

Syrian energy policy has three main priorities: to expand the gas market; to sustain oil production; and to develop the country's power capacity. As Syria hasn't enough natural gas to meet domestic consumption and making oil available for export, the dependency focused on the Arab gas line. The current policy aims to increase the use of natural gas in thermal power stations, replacing HFO and thus prolonging the availability of reserves. In addition, the policy encourages investment in oil exploration and the greater use of modern technology for the purpose. The refining policy objective is to align with the world regulations on quality of petroleum products. The private sector is being brought in to engage in the distribution of oil products. The government aims to reduce the state monopoly over the power sector. There are many ongoing efforts to reinforce the transmission and distribution of networks, and to improve the quality of customer services[6].

Within this global policy, energy from renewable resources is not a priority. A national target has been proposed to replace approximately 5 % of energy produced from fossil fuels by that produced from renewable resources by 2010[7], which consider a very optimistic scenario. This inconsistency between the current global policy and the national strategy is also illustrated by an Integrated Resource Plan, prepared by Stockholm Environmental and Tellus Institutes in 1999 in association with the Ministry of Electricity, which projects that 5 % levels of penetration from solar and wind resources may not be realistically achieved before 2020, with most growth after 2010 [8].

There are presently very few specific policies, which specifically cover renewable energy. Policy for projects revolves recently for the most part around Investment Promotion Law No 8 of 2007. This law governs capital investments in development projects by all parties, whether resident, non-resident, Syrian or foreign, and applies to approved economic and social development projects in Energy, Industry, Transport or any other sector which the Supreme Investment Council deems within the scope of the Investment law. Key criteria for approval of projects under this Law comprise:

1) Compliance with State development plan,
2) Focus upon locally available resources,
3) Increased employment opportunities,
4) State of the art technology transfer.

The low is a development of the old investment low No.10 issued in 1991 and presents many facilities to the investors, for example the permission to own the required land for the project by the investor, and to transfer all foreign currency out of Syria, ..Etc.

1. Solar Thermal Energy:

Solar thermal applications are the most common in Syria for many reasons:

1. There are many manufacturers of water heating solar systems.
2. Prices of water heating solar systems is nearly reasonable comparing with other RE applications.
3. The average solar radiation is about 5 kWh/m^2/day which present high output of these systems.
4. Solar water heating systems are easy to install and enough experience is available.
5. Savings appear directly especially in the governmental side because the government buys the diesel oil and electricity (energy carriers used in water heating) in international prices and sell them to the end consumer in subsidy prices.

Therefore the national strategies focused on solar thermal application especially for residential and commercial sectors, through identify a national target of installing 200000 m^2 annually that will encourage the national solar thermal systems manufacturing in quality and quantity by expanding its markets.

NERC Actions:

- The national project for residential solar thermal water heating sets by the cooperation with the industrial bank, Agency for Combating Unemployment, and local manufacturers. The project based In the payment in instalment solar thermal sets to all governmental employees, the project

[6] Extract from the International Energy Data Report:1998.
[7] Information source: Renewable Energy Country Profile. Sept 2000
[8] Initial Application of Integrated Resource Planning: 1998/99 UN DESA IRP Training project. Volume I.

aimed to increase the installed areas of solar collectors, but it didn't succeed as expected because the low income of the employees and the energy low prices. The project result to install just 2800 m^2 of solar collectors, which equal about 7% of the expected area installed.

- As a result of the mentioned project NERC suggested a new policy for solar thermal applications in residential sector, this policy concentrated on the government subsidy to expand solar applications through paying a percentage of 50% of the total price of the solar collectors and the rest to be paid from the user as a 5 years loan without any interests. This suggestion approved by the governmental highest economic committee and it is now in progress.
- NERC started execution many pilot projects in this field by the cooperation with the Ministry of Electricity in all generation and substations where hot water is needed besides employees dormitories which belong to the ministry, and Ministry of Health to install solar thermal collectors in all governmental hospitals. The pilot project started in November 2006 by one hospital, and performed successfully. NERC is planning to implement 28 hospitals and all electrical substations in 2007 the project is expected to be achieved in 2008.

Besides "Energy Conservation Law" obligate all engineering offices which design and construct new building or establishment to install solar water heating systems with identified incentives.

Solar thermal applications in Syria are limited in water heating projects currently, the applications regarding heating and cooling purposes will be taken into consideration in R&D issues in NERC and other related associations, in addition to NERC partnership in SOLATERM project financed by EU and coordinated by GTZ, this project launched in November 2006 and will go on till the end of 2008.
SOLATERM project objectives are:

1. Widespread application of a new generation of solar systems for hot water, heating and cooling in the Mediterranean partner countries (MPC).
2. To transfer technological know-how on solar thermal and cooling systems to the MPC and adapt new technologies to the specific needs of MPC
3. To broaden the spectrum of solar thermal and cooling applications in the MPC through the promotion of cost-effective solutions.
4. To support the R&D and application of solar thermal and cooling systems in the MPC with political measures.

2. Photovoltaic Systems:

The five years plan 2006-2010 put in the main national objectives aspects using solar energy to produce electricity especially for no electrified areas.
The photovoltaic industry in Syria consists of a module assembly unit in the PV Lab, run by the Scientific Studies and Research Centre (SSRC). This is an R&D cum module production facility with an annual production capacity of 250 kWp and was established in 1998. The facility produced 15 kWp of modules in 1999 - representing a capacity utilization of only 6 % and approximately 0.01 % of world production in that year.
The facility was set up under technology transferred from Central Electronics Limited (CEL) in India and apart from module assembly has the capability to manufacture balance-of-systems components such as charge regulators, inverters and electronic ballasts. SSRC also co-operates with a public factory producing SLI[9] batteries to produce solar batteries. There are other private sector distributors that are involved in supplying professional PV systems to the industrial and commercial sector.
About 90 kWp of solar PV systems are installed in the entire country, and most of this has been financed through bi-lateral and multi-lateral aid programs. Approximately 10 kWp have been installed in a commercial context, mostly for telecommunications and beacon lighting. Japanese International Co-operation Agency (JICA) has committed 10 million US$ to solar electrification, pumping and desalination. The project was executed jointly by JICA study team and PV Lab. team/SSRC to electrify approximately 100 households. The project installed approximately 65 kWp of PV systems on a non-commercial basis.
Several commercial sources for PV products are available such as Alia Company in Damascus and Hamatis and Soukkar companies in Aleppo.

Till now there is no specific policy for photovoltaic applications for many reasons:

- No specific incentives from the government.
- The available systems are only off grid systems.
- High prices of photovoltaic cells and its accessories.
- Lack in experience in photovoltaic applications.

In spite of all above mentioned barriers, there are R&D associations still focusing in this kind of RE illustrated in the following table:

[9] Staring, Lighting and Ignition batteries, these are also known as car batteries.

Association	Structure	Activities
Photovoltaic transmission laboratory (SSRC)	-PV cells manufacturing. -Testing photovoltaic instruments and accessories.	250 kW of PV cells annually, besides electronic accessories since 1990.
Atomic Energy Commission (AECS)	Laboratory equipments to develop PV cells.	Specify and preparation PV cells.
NERC	Renewable energy applications R&D and pilot project execution.	Researches in widespread PV systems.
Damascus University	laboratories	PV specification and testing.
Aleppo university	PV energy research laboratories	Electronic researches in PV control
Albaath University	laboratories	PV layers and films deposition.
General Commission for Environmental Affairs	-----	International cooperation for sustainable development and CO2 trade.

Overall, achieve the national objective in increasing the contribution of PV will focus on two main items the first is lighting the no electrified areas and the second is water pumping, which mean using PV in areas far of the electrical grid to avoid electrical transmission and transforming equipment costs, that's will approximately make using PV is a semi feasible application.

3. Wind Energy:

Mechanical windpumps had been popular in Syria and there was an active wind-pumping industry that installed over 4,000 windpumps in Syria. The market for windpumps has been severely affected by the precipitation levels and increasing depth of the water table stretching the limits of the technology.

The Company Systèms d'Avant-Garde (SAG) is an indigenous private company that started operations in 1990 and manufactures small wind electric generators in the range of 750 W to 50 kW and a frost defender with a rated capacity of 10 HP. The company has so far supplied systems totaling 650 kW, since its inception. SAG has also exported samples of their equipment to Japan, Jordan, Lebanon, Macedonia and Spain.

The largest wind turbine in Syria is a 150 kW Nordex machine installed at Qunaitera as a UNDP demonstration in 1994. This is the only grid-connected machine in the country, contributing 300 MWh/year.

There are estimated to be 1000 multi-bladed windmills currently operating out of the 4000 installed over a forty-year period. Sizes range from 3-5 meter rotor diameters and from 10-15 meter hub heights. Current costs range between 75 000 Syrian Pounds and 140 000 Syrian Pounds per unit (1500 USD – 3000 USD). Current domestic annual production does not exceed 20 machines per year. In this sector, commercialization is competing against the growing availability of electrical pumps, the availability of grid electricity and decreasing levels of water tables.

Approximately 650 kW of locally manufactured wind turbines have been used for power generation, frost prevention and battery charging. Production capacity at the above-mentioned manufacturing facility is approximately 600 kW/year. On account of low capacity utilization and slow commercialization, SAG is finding the business prospects unattractive. The Ministry of Agriculture is currently evaluating the performance of the installed wind turbines. The study should provide good indicators for further commercialization. In addition to the domestic consumption, a few frost protection turbines have been exported to several countries, mainly Lebanon. The export market could also contribute to better capacity factors.

In addition to domestic manufacture mentioned above, the Ministry of Electricity has received proposals from foreign developers to install and operate wind farms to tap the available wind resources. A proposal from several investors for a 100-500 MW farm is currently under consideration by the Ministry of Electricity.

Several of the potential sites which have been identified by the Ministry of Electricity under a wind resource assessment program[10] are located where infrastructure to transport and erect wind turbines and the infrastructure to evacuate the electricity produced by the wind farms exist.

In the end of 2002 the Wind Resource Assessment Project has been started in cooperation with decon (Deutsche Energie-Consult), the project is aiming at identifying and promoting an appropriate contribution of wind energy use to the power generation mix in Syria.

By means of the project activities the basis for a cost effective and environmentally sustainable wind power generation in Syria shall be created in terms of:

- Improved information on the spatial distribution of the wind energy resources.
- Pre-visibility level evaluations of potential win park sites.
- Recommendations for the further wind park development program in Syria.
- On the job training of local staff.

[10] Assessment carried out by the Meteorology Department and Risø National labs in Denmark.

The project obtained the permits from the local authorities for the erection of the 20 measurement stations. So far, for ten potential win park sites a one-year measurement cycle has been completed and the data evaluated.
The so called Wind Atlas model as developed by RIS (Danish National Research laboratories) was applied for analyzes of the wind conditions, that allows to determine the detailed wind conditions in the wider surroundings of the measurements mast and thus to select the optimal micro-sites and to develop a detailed lay-out of a wind park.
Five of the investigated sites proposals for which the calculated dynamic generation cost range between 4,5 and 5,5 €cent per kWh are considered worth for further investigation and project realization.
If we assume that areas for wind farms are totally available we could install about 140 MW wind energy capacity till 2010.

Nowadays, NERC is executing the first wind farm in Sindianah after the required measurements had been taken and evaluated, the project is financed by the Spanish government, and with total capacity of 6 MW, the announcement for the invitation for tenders or bids will be at the end of February 2007.

4. Biomass Energy:

Agriculture is the primary sector having the highest percentage of contribution (33%) to GDP in Syria during 1998. The popular crops raised include wheat and barley, cotton, olives, sugar beet, tobacco and fruit.

Approximately 49% of the Syrian populations live in rural areas and a considerable number of these people continue to use biomass in the form of animal and agricultural wastes for their energy needs such as lighting, heating, hot water production and cooking. The quantity of biomass used in the domestic sector has decreased over the last twenty years with the spread of oil and gas stoves and electrification. In 1996, wood consumption in Syria was estimated to be 500 thousand toe[11].

Other combustion of biomass for energy includes heat generated from burning olive leaves which is used for heating greenhouses and poultry farms, or drying tobacco

In addition to direct combustion of biomass there is the following use of biomass in Syria[12]:

Two biogas plants (20m^3 and 100 m^3)[13] owned by the Ministry of Agriculture for cow waste at Gotta, near Damascus;

Two biogas plants (12 m^3 and 35 m^3) in Ezraa village, Daraa. The daily output of the larger unit is 8 m^3;

Two biogas plants of 12 m^3 in Der Alfradese, Hama;

Two family biogas plants of 12 m^3 and 14 m^3 are planned to provide gas to 13 families;

Four biogas digesters were transferred from India and tested in Damascus. There are plans to construct four plants in the south of Syria under the supervision of the Ministry of Agriculture.

Under the Mediterranean Environment Technical Assistance Programme (METAP), the City of Aleppo commissioned a feasibility study with grant assistance from the European Investment Bank (EIB) for a solid waste management project. The study[14] had three elements:

Assessment of the current municipal waste handling and disposal arrangements, and the institutional framework;

Preparation of a solid waste management plan with a 15 year horizon plus separate provision for inert and construction waste;

Definition of similar surveys and waste management plans in locations with industrial and hazardous waste.

The study completed in 2001, is expected to result in Syria's first urban waste-to-energy power plant.

Some of the lessons that are relevant to Syria from the global developments in bio-energy technologies are:

Biomass could be an important source for providing heat and power to the Syrian energy sector and potential of this sector needs to be explored further. More demonstration and pilot projects need to be promoted using biomass technologies;

Although there has been some experience with biological conversion of biomass to energy through the biogas route in Syria. The thermo-chemical route has not been pursued so far in Syria. There is scope for more incineration and pyrolysis projects in Syria;

Syria may proceed and set up a urban waste based power plant in one of the major cities and could start with Aleppo where the process has already begun.

[11] National consultant responses
[12] ibid
[13] Digester volume
[14] undertaken by Cowiconsult

NERC is now responsible to widespread using biomass energy through special directory specialized in Biomass energy developments needs, tools, projects, and researches. The aim now is to find a financing organization to support R&D and executive projects regarding CDM in rural areas.

5. Urban Waste Resources

Over 50 % of the Syrian populations live in urban areas and approximately 47 % of the populations live in Aleppo and Damascus. Since there is a concentration of a large percentage of population in the major cities, there appears to be opportunity to use the municipal waste for energy purposes.

The solid waste generated in the cities at Damascus and Aleppo are over 1000 tones per day[15]. Currently the urban waste in Damascus is collected and transported to a treatment plan at Najha where it is converted to fertilizer. The next table shows the production of domestic waste from the main cities of Syria. 7797 tones of waste is produced per day.

Production of Domestic Waste in Syrian Cities (1998)

City	Population in Thousand	Production of Solid Waste Tons/day
Damascus	1513	766
Suburb of Damascus	1934	967
Aleppo	3385	1692.2
Homs	1373	686
Hama	1232	616.1
Lattakia	827	413.3
Deir-ezzor	827	413.3
Edlib	1029	514.7
Al-Hasakeh	1169	577
Al-Raqua	624	311.9
Al-Sweida	296	148.2
Deraa	702	350.9
Tartous	639	319.7
Al-Qunaitera	62	31.2
Total	**15 5997**	**7 797**

The liquid waste from the main cities equals 1,154,000 m^3 per day with 85 % of the contribution from five cities, Damascus, Aleppo, Homs, Hama and Lattakia[16]. The Damascus city waste water is collected in a water treatment plant linked to a co-generation plant of 2 MW.

There was a feasibility study carried out by COWI Consulting Engineers for the City of Aleppo financed by the European Investment Bank. The study was carried out during the period 1998 to 2000. The study found that the quantities of wastes generated in Aleppo in 1999 were over half a million tones annually which was projected to grow to about a million in 2015. It is envisaged that this project will be implemented soon.

The summary of the urban wastes and assessments in Syria are:

The cities of Aleppo, Damascus[17], Homs and Hama present good prospects for waste-to-energy plants in Syria;

The COWI consult study has also found that the annual growth rates in wastes are almost 5% for domestic waste and about 4% for commercial, public facility, health care and demolition wastes. Such annual growth rates presents a problem for waste handling as well as an opportunity for waste to energy generation.

[15] Present status and policy on the development of renewable energy sources in the Syrian Arab Republic, draft, Abed-el-hadi Zein.

[16] National experts consultation – May 2001

[17] including it's suburbs

2.2 Instruments and measures to be taken in favour of RUE and RE:

2.2.1 Tools and measures in favour of rational energy use (RUE):

Incentive methods:

"Energy Conservation Law" includes a list of governmental incentives for RUE projects and actions to encourage people, organizations and manufacturers to adopt RUE aspects, these incentives are illustrated as follows:

- Exemption the imported raw and manufactured materials used in building insulation from all taxes.
- Exemption imported materials (raw, semi manufactured, manufactured) regarding saving energy tools, instruments, and high efficiency appliances and equipments.
- Put low fees for testing and elaborating energy efficiency instruments and equipments which consume energy for the purpose of improving its efficiency.
- Grant all researchers and inventions regarding RUE special remunerations.
- Grant all the associations, organizations, building, and establishments which carry out "Energy Efficiency Law" special remunerations.

Carbon and energy audits:

- As mentioned in paragraph Rational energy use (RUE) policies in the industrial sector the SSEECP project performed more than 100 detailed audits covering boilers, steam systems and electrical systems for 50 plants.
  These audits illustrated that the savings in CO2 are about 100000 ton/year distributed in many regions in Syria.
- Rehabilitation of Banias thermal power station contributed to reduce about 300000 ton CO2 per year.
- The initial studies regarding home appliances energy efficiency labels and standards for refrigerators illustrated that the average energy consumption of the refrigerator in Syria is about 850 kWh/year, about 100000 new refrigerators sold annually, if the program as expected and calculated will due to reduce the average energy consumption to 650 kWh/year that's mean the annual savings in CO2 will be in the next year after the program launched 15000 ton CO2 per year, after ten years as a cumulative calculation the CO2 savings will reach 825000 ton, and if the program will include air-conditioning residential system, washing machines, and lighting systems as mentioned above the expected CO2 saving could reach in 2017 about 2,5 Million ton.
- The PEDEEE power factor correction project which results till now to install 1400 MVAR contribute in CO2 savings about 30000 ton/year, whereas the project in continued and the expected MVAR installed will reach 5000 MVAR till 2010, so the CO2 savings expected will be about 220000 ton CO2.
- Apply "Building Thermal Insulation Code" on the new buildings regarding that 130000 new buildings established yearly in Syria will result a CO2 savings about 200000 ton CO2 per year, after 10 years the cumulative calculations of CO2 savings will be 2.9 million ton of CO2, whereas the residential sector is the highest energy consumer and its percentage of the total consumption is about 48%.

Evolution of R&D and training programmes:

In SSEECP project many of training programmes and seminars and workshops performed, the local training programmes included more than 800 participants from Ministry of Electricity, Ministry of Industry, Ministry of Health, Engineers syndicate, and universities. The training axes focused on about 12 different fields in energy efficiency regarding thermal and electrical systems efficiency in buildings and factories.
The training program aimed to create certificated energy auditors in all sectors.
The trainers were many of international and national experts.
The global training vary in its fields and trained associations and institute and also focused on the implementation of energy efficiency and energy savings opportunities execution, and it was in Egypt, Germany, Jordan, Greece, Spain, Finland, Armenia, China, Japan, India.

NERC nowadays is concentrating on creating cooperation phases with global and local organizations for development R&D investments regarding RUE in Syria.
Till now no R&D real work has been performed, but it is in progress with high levels of efforts done and still to achieve the required sustainable development regarding RUE.

Awareness-raising campaigns:

After searching for local associations interested in RUE awareness campaigns, I found that the only who did that was SSEECP project because it was part of the TOR put by the funded sides.
SSEECP project had a cooperation agreement with Ministry of Education for RUE awareness campaign in schools curriculum in different grades and stages, besides many of brochures about special applications

for saving energy in homes like how to use home appliances in efficient ways, and a lot of seminars and conferences gathered the industrial associations to direct them to adopt efficient procedures in the productions lines especially boilers, steam and air networks, motors, electrical systems, and lighting.

SSEECP project participated in many exhibitions regarding power and energy presenting samples of green buildings and distributing many kinds of brochures.

2.2.2 Tools and measures in favour of rational energy use (RE):

Incentive methods:

"Energy Conservation Law" includes a list of governmental incentives for RE projects and actions to encourage people, organizations and manufacturers to adopt RE aspects, these incentives are illustrated as follows:

- Exemption the imported raw and manufactured materials used in RE applications from all taxes.
- Exemption RE projects from all usual projects taxes and grant the required encouragements to invest in RE to produce electricity, the encouragements are that the Ministry of Electricity is ready to buy all produced electricity and connect it to the grid, besides the facilities presented by the government for all investors cleared in Decree number /8/ issued by the Syrian president in 2007.
- Government subsidy to expand solar water heating applications through paying a percentage of 50% of the total price of the solar collectors and the rest to be paid from the user as a 5 years loan without any interests.
- In general the government through Ministry of Electricity and NERC are ready to support any RE investment in Syria as an essential orientation.

Carbon reductions

- Wind farm of 6 MW in Sindianah after being put in service at the end of 2007 will contribute to reduce about 20000 ton CO2 per year.
- We expect to install about 500 MW of wind turbines in the near future, that will lead to reduce about 1.6 Million ton CO2 per year.
- NERC is planning to install about 200000 m^2 of solar collectors yearly that will lead to reduce about 25000 ton CO2 per year, after 10 years the cumulative calculations of CO2 savings will be 1,4 million ton of CO2.

Evolution of R&D and training programmes:

Research, Development and Demonstration (RD&D) has been conducted by several institutes and dates back more than 20 years to the mid-1980s. RD&D efforts have focused upon the techno-economic evaluation and potential of solar and wind resources and technologies.

Expenditure on RD & D has been modest to date in the four Syrian universities: Damascus, Aleppo. Al-Baath and Tishreen. The universities, as well as the Higher Institute of Applied Science and Technology (HIAST), Ministry of Electricity, the Atomic Energy Commission and the SSRC have research and development capacity from technician level to PhD. The SSRC is considered the best-equipped centre in Syria, with technical capacity and equipment that the four Syrian universities do not possess. RD&D output from the four Universities in Syria is limited, mostly because facilities are not adequately equipped and institutes have little or no budgetary provision.

More specific to the renewable energy research, there is an absence of a concerted and targeted RD&D action program, with the exception of the activities conducted through SSRC. The situation is aggravated by the lack of budgetary provision from the Government of Syria[18] for RD&D work. Given the low levels of experience and activity in a demonstration context, substantial governmental support is required to trigger applied RD&D. Research and Development activities in renewable energy undertaken and in progress are summarized below:

1) In the mid 1980s, SSRC/HIAST erected an outdoor liquid flat plate collector test facility and several years later a similar facility for air collectors. A number of test stations were established with the objective of introducing quality control of industrially produced equipment;

2) PV Lab./SSRC activities include monitoring and performance analysis of PV systems installed through JICA project. Development of a charge regulator for a PV system, such as PWM in use in Kalif village[19]. It extended this activity to include development of an inverter and other balance of systems (BOS) components for PV systems;

3) Some research on photovoltaic cells has been conducted by the Atomic Energy Commission;

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[18] Source Ref: Present Status and Policy on the development of RE sources in the Syrian Arab Republic, P8.

[19] Source Ref: Study for introduction of integrated PV systems into Syrian Arab Republic, Section 12.5

4) The PV Lab./SSRC is currently adapting[20] battery technology for solar applications. With initial guidance from Chloride Technical Training, UK, it is associated with the General Company for Batteries and Liquid Gases in Aleppo in this endeavour;

5) Performance testing of PV and solar thermal systems has been conducted by SSRC and deemed to have reached a state of maturity. In testing solar thermal systems, these include collectors, water heating systems, drying and desalination plants;

6) Research on frost protection wind machines by the only private sector manufacturer of this technology in Syria[21].

Demonstration activities undertaken and in progress are summarized below:

1) Equipping some households with PV power in 2 villages near Damascus in 1994 and setting up performance monitoring facilities (6 kWp total);

2) Setting up PV stand-alone and central PV power plants in 4 villages, plus fresh water pumping and brackish water desalination units at one location, (67 kWp total);

3) Technology transfer of a 250 kWp single crystalline R&D and limited production facility, complete with indoor simulator. 15 kWp of cells/modules were produced in 1999;

4) The Ministry of Electricity set up a 150 kW wind turbine demonstration project in 1994. Since installation the site has been regularly monitored and maintained by the Ministry;

5) The Ministry of Agriculture and Agrarian Reform (MAAR) installed 4 solar home systems in Bedouin settlements in 1998. PV module of one unit was damaged with the first four months of installation. Users of the remaining systems have expressed satisfaction and have evinced interest in purchasing additional SHS. Lanterns were also demonstrated and market value assessed. Subsequently 4 solar lanterns and 2 solar refrigerator/lighting systems were procured, installed and feedback obtained. Their successful deployment triggered procurement of 2 further systems and 24 more lanterns. The systems work well and no problems were faced during the three years of operation. No new systems were added[22];

6) The largest demonstration project in the PV sector, initiated in 1995 was jointly executed by JICA and SSRC. The programme worth 10 million USD brings electricity to four pilot villages (Zarzita, Fedre, Katoura and Rasem Al Shikh Kalif) near Aleppo, good quality drinking water through water pumping and desalination and develops local cottage industries. The project also includes socio-environmental studies and an analysis of behavioural patterns in pilot villages. Three of the four pilot villages were equipped in 1997 with stand alone solar home systems, whilst the fourth (Zarzita) is equipped with a 35 kWp centralised PV micro-grid system. The electricity provides power for lighting, radios, TV and refrigerators and washing machines in Zarzita where the central plant is installed. Later the JICA study team investigated the degree of satisfaction of the residents of the four villages with the overall performance of the systems. The results were as follows: irrespective of generation, a little over 60 % indicated satisfaction. About 25 % were fairly satisfied and less than 9 % were dissatisfied. The Ministry of Electricity with support from PV Lab. is responsible for establishment and operation of a private institutional, management and financial system in the pilot villages. This includes billing end users and ensuring electricity services are available. From this pilot investment the Government of Syria is expected to finance the extension of supply and services to other villages.

Other activities include a proposal of co-operation with the member States of ESCWA including provision for a training component on the testing of RE components and systems in various applications. This activity is currently in the planning phase.

The draft proposal for establishing a National Renewable Energy Centre includes a strong focus on RD&D, which would extend substantially beyond technology development. The general mandate of RD&D proposed would include: 1) Policy and strategic research, 2) economic of technology research, 3) demonstration projects in field environment, 4) supply and demand side energy efficiency research, and 5) collaborative research.

Also there are some separated activities as follows:

- In SSEECP project many of training programmes and seminars and workshops performed.
- NERC nowadays is concentrating on creating cooperation phases with global and local organizations for development R&D investments regarding RE in Syria, find a financing organization to support R&D and executive CDM projects.

Awareness-raising campaigns:

[20] With support from UNDP experts
[21] SAG company
[22] National consultant responses

There have been no visible efforts from the government to generically promote renewable energy systems or specific technologies. However the government has been engaged in other promotion, such as of agriculture, through print and electronic media.

Efforts to build awareness about the prospects of renewable energy sources have been limited to activities undertaken by the state owned and private sector manufacturers and suppliers. The manufacturers of wind energy equipment, SHWS and PV systems use attractive product and corporate brochures to promote the products. There have also been advertisements by the renewable energy equipment manufacturers in the newspapers to promote their products.

One major avenue for renewable energy systems promotion is via the Trade Fairs and Exhibitions, which are held in different parts of the country. The Damascus International Fair held annually in August is one such event that could be used as a vehicle to promote renewable energy technology. There was also an Energy Equipment Exhibition in Damascus during October 2000 where SHWS and wind energy equipment were exhibited.

Also SSEECP project participated in many exhibitions regarding power and energy presenting samples of green buildings and distributing many kinds of brochures.

Indicators:

ENE_C08: Expenditures in RE and RUE: RE and RUE programmes share in energy investments and R&D expenses:

The Expenditures in RE and RUE ratio of the total expenditure in the energy sector between 2000-2005 was about 1.5%.

The RE & RUE investments ratio of the total energy sector investments in energy sector between 2006-2010 will be about 4%.

ENE_C05: Final consumer energy price per fuel and per sector:

The prices of energy carrier are illustrated in below:

Type of energy carrier	Previous prices	Recent Prices	Ratio of subsidization for Recent Prices (%)
Heavy fuel (industry sector)	26 ($/ton) (till 2004)	120 ($/ton)	100
Light fuel (household sector)	146 ($/ton) (till 2001)	175 ($/ton)	340
Automotive diesel oil (transport sector)	150 ($/ton) (till 2001)	175 ($/ton)	340
Unleaded premium (transport sector)	485 ($/ton) (till 2005)	727 ($/ton)	0
natural gas (industry sector)	0.1 ($/$m^3$)		200
LPG (household sector)	167 ($/ton) (till 2002)	250 ($/ton)	120

Electricity Tariff Effective Since 1/6/2002 (US$/KWh)

Item	Consumption Voltage Level	Peak	Day	Night	Average
1-	230 KV	0.043	0.034	0.030	0.034
2-	66 KV	0.045	0.036	0.032	0.036
3-	20 KV	0.047	0.040	0.034	0.040
4-	20/0.4 KV				
4-1-	Industrial	0.065	0.048	0.04	0.048
4-2-	Commercial	0.065	0.048	0.04	0.048

4-3-	Agriculture (all crops)	0.045	0.036	0.032	0.036
5-	0.4 KV				
5-1-	Residential				
	1-50 kWh/month	0.005			
	51-100 kWh/month	0.007			
	101-200 kWh/month	0.01			
	201-300 kWh/month	0.015			
	301 and above kWh/month	0.05			
5-2-	Commercial & Small Workshops	0.05			
5-3-	Government Offices	0.04			
5-4-	Street Lighting	0.03			
5-5-	Religious Building	Free of Charge			

The average subsidization of electricity prices is about 120%.

ENE_C11: Share of fuel and electricity expenditures in household budgets

As mentioned in the indicators profile the calculation done for two levels of the income as follows:

- The general level which consist about 60% of the Syrian society:

  The share of fuel and electricity expenditures in household budgets for this level is between 7.5 - 6%.

- The poor level which consist about 20% of the Syrian society:

  The share of fuel and electricity expenditures in household budgets for this level is between 8%.

This indicator is about the same in this two levels because when the income decreases the energy usage decreases.

ENE_C06: Existing incentive measures and policies for RE and RUE development at national level

Till now there aren't any documented incentives, but the "Energy Conservation Law" is the main policy result which contains definite incentives, the law arranged to be issuance in 2007.

ENE_C07: Cities/regions/provinces with an existing energy audit and/or a carbon audit and/or with objectives in terms of RE and RUE:

All energy audits and CO_2 emissions savings didn't related to regions and cities as mentioned before in the study, but we can make some assumptions regarding the electricity thermal power plants distributed in whole Syria and have the opportunity to be rehabilitated to reduce CO_2 emissions.

As we mentioned above the rehabilitation, development, and conversion of two units In Banias thermal power station to work on natural gas instead of heavy fuel oil, will lead to reduce about one Million of CO_2 per year in Banias city.

There are five thermal power plants had been prepared to work on natural gas, but they currently don't because of the lack of the produced natural gas, Nowadays there are several projects to increase gas production, which will lead to supply these stations with enough natural gas instead of HFO for full production capacity.

In case of all of that, the estimated CO_2 reduction illustrated in the following table with clarify how those stations are distributed in several regions of Syria.

Power plants	Region-city	Capacity of generations (MW)	Produced power (MWh)	Reduction of CO_2 (Ton CO_2 / year)	Fuel type
Mehardeh	Hama	630	3150000	826875	HFO - NG
Banias	Banias	680	3400000	892500	HFO - NG
Tishreen	Rural Damascus	400	2400000	630000	HFO - NG
Aleppo	Aleppo	1065	6390000	1677000	HFO - NG

Alzara	Rural Homs	660	3960000	1039500	HFO - NG
total		3435	19300000	**5065875**	

RE Tradable Green Certificates

The creation of "Tradable Economic Instruments". In practical terms this means that the environmental parameters, which policy makers try to control, are represented as tradable commodities. With the commodity defined, government can then establish demand drivers for trading and competition, which will drive an economic agenda. The present situation in Syria lends itself well to the creation of similar tradable instruments as a mechanism for separating and addressing issues of energy cost and competition with alternative energy sources of generation and the environmental benefit in the form of a tradable commodity. One example of such a tradable economic instrument in Europe is called the "Tradable Green Certificate" (TGC) system. The functions are as follows: An issuing body, which could be the Apex body, authorizes a registrar, typically a financial institute or broker, to issue TGC's to an organization producing a certain quantity of electricity from renewable resources. The organization producing electricity from renewable energy can then sell the certificates to a new owner. The new owner would typically be an electricity producer or supplier that is required to meet a minimum mandatory quota of electricity supply from clean energy resources, such quotas being stipulated through government regulatory policies. The new owner would then redeem the TGC with a registrar as evidence of contribution, either through production or trading of its required quota of electrical energy from clean sources. TGC's can be traded between owners, not unlike stocks. TGC's are uniquely identified by serial numbers and can only be redeemed once through a registrar, thus avoiding double counting of green energy production. Registrar's fees are levied by imposing a financial spread between the issuing value and redeeming value of the TGC's.

ENE_P04: total sum of investments made within the Kyoto Protocol's Flexibility Mechanism

Recognizing the importance of Kyoto Protocol in GHG Reduction, Syria certified the protocol in the mid of 2005.
The Sustainable Development Criteria for CDM projects in Syria include the following:

A-Conformity to political and legal dispositions

B-Contribution to:

1- Technology Autonomy.
2- Sustainable use of Natural Resources
3- Social Criteria (Improve Quality of Life and Equity, Alleviate Poverty).
4- Economic criteria (Provide Financial returns to Local Entities, Transfer of New Technology).
5- Environmental Criteria (Mitigation of Global Climate Change, Reduce GHG, Conserve Local Resources).

The Syrian institutional and regulatory framework for the implementation of the CDM:

- In accordance with Decision 17/CP.7, Para 29, Syria has designated General Commission for Environmental Affairs (GCEA) as the national authority for the CDM-Designated National Authority (DNA).
- The DNA main tasks are to provide written approval to the project participants and in case of a host party, confirm, through written approval, that the CDM project activity assists it in achieving sustainable development.
- Official establishment of the DNA at GCEA by the Minister of state for Environmental Affairs on March 15, 2003.
- GCEA through the National Climate Change Committee is the official focal point for climate change activities in Syria, including CDM projects.

Promotion of Syrian CDM Projects among the International Investment Community is one of the priorities of the Syrian CDM-DNA.

The process of Project Evaluation until delivering the Final Approval Letter to the project promoter by the DNA in Syria is under development in all sectors:

- Energy and Industrial Processes (Fuel Switching, Energy efficiency, Cogeneration, Fertilizer factories, Cement factories ...).
- Electricity (Wind Farms, Solar Energy…).
- Transportation (Fuel Switching).
- Wastes (Landfills, wastewater Treatment Stations).
- Agriculture (A forestation, Methane recovery from agricultural wastes …etc).

Taking into account the complex legal, financial and technical issues related to the implementation of CDM:

- Developing countries with limited institutional capacity will face significant challenges.

- Syria now is required to establish an operational and efficient setup through which the national CDM process can function properly.

2.3 Energy Efficiency Evolution

ENE_P01: Total energy intensity and by sector

	Energy Intensity					
Sectors \ Year	2000	2001	2002	2003	2004	2005
total(KgOE/1000$)	896	867	882	905	808	902
Residental(KgOE/m^2)	20.9	20.2	21	21.4	21.8	23.3

The illustrated table refers to the energy intensity as a total value according to the national GDP and by sector, it is clear the increasing of this indicator each year which explain the necessity of EE&RE applications in Syria.
In spite of the energy share per capita is low the energy intensity is high which clarify that the energy used in a non efficient ways in all sectors especially in residential sector.

ENE_C03: Efficiency of Energy conversion and distribution

The main indicator for the efficiency of the energy conversion and distribution is the grid loss which is the difference between the net electrical power sent from the output of the power plants and the registered electrical energy consumed, with taking in account the necessary self consumption of power plants equipments.

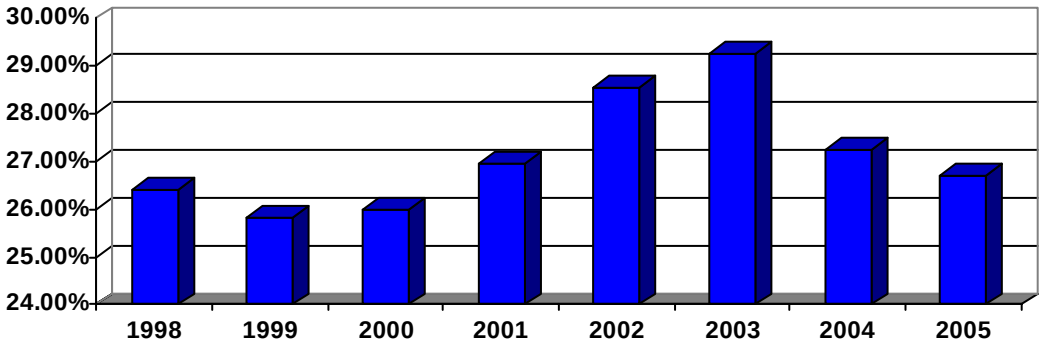
The loss in the electrical grid in Syria is:
Technical loss
Commercial loss

Technical Loss:
It's the electrical power consumed by the grid equipments (lines, transformers, protection devices, control panels), this kind of loss is unavoidable but, it could be reduced through improving the efficiency of the system.

Commercial Loss:
It's the deference between the total loss and the technical loss, the commercial loss caused by the following reasons:

- Inaccurate and broken meters.
- Fault readings of the meters.
- illegal consumption.

The following chart illustrates the loss value from 1998-2005:



It is obvious that the total loss increased extremely in 2002-2003, because of in 2002 the tariff structure changed and the electricity prices became higher, this cause the increasing of commercial loss especially the illegal consumption in poor areas, this force the Ministry of Electricity through the electricity companies to find the appropriate solutions to decrease the loss as in 2004-2005, aiming to reach the optimal case at least for the commercial loss.
The main reasons of the grid loss:

- Energy demand extremely growth (more than 8% annual).
- Electrifying the very far villages and towns.
- Not enough generation facilities in some areas.

- Increment of illegal residential areas, leaded to illegal electricity consumption.
- Random widespread of some residential areas.
- Inaccurate meters readings.

Whereas the loss ratio defers from one city to another between less than 20% to higher than 30 %.
Case 1: The following table shows the electricity main parameters till 2020 if nothing done regarding the grid loss.

Energy demand till 2020 at the same grid loss growth ratio

Fuel needed	Installed capacity	Sells	Loss	Loss ratio	Gross production	Total Demand	Year
TOE	MW	Million KWh	Million KWh	%	Million KWh	Million KWh	
5787735	7018	19440	8048	29.28	27488	29534	2003
6864106	7018	23916	8707	26.69	32623	34939	2005
9700414	11060	35253	12835	26.69	48088	51337	2010
13050643	15528	49709	18097	26.69	67806	72003	2015
16561247	20793	66522	24219	26.69	90740	96356	2020

Case 2: In case serious measures will be implemented to reduce the loss for 10% the values in the last table will be as follows:

Energy demand till 2020 where the grid loss will be 10%

Fuel needed	Total Demand	Installed capacity	Gross production	Loss		Sells	Growth rate	year
TOE	Million KWh	MW	Million KWh	Million KWh	%	Million KWh	%	
5787735	29534	7018	27488	8048	0.293	19440		2003
6864106	34939	7018	32623	8707	0.267	23916	9.75	2005
9431255	50004	9979	46854	11714	0.250	35141	8.00	2010
11838772	65624	12083	61818	9891	0.160	51927	7.00	2015
14442708	84454	15550	79555	7956	0.100	71600	6.00	2020

Conclusion:

Fuel Needed	Total Demand	Gross consumption	
182011079	990326	757651	Case 2
195668931	1064049	731569	Case 1
13657852	73723	26082	Energy savings
300 $	0.02 $	0.05 $	Capital Cost
4097 $	1,474 $	1,304 $	Financial Savings Values
6876 million $			Total

Whereas the investments value needed to achieve loss value 10% is about 1350 million $ and the gross cumulative savings is about 5496 million $ and the NPV is about 1866 million $.

2.4 Renewable Energy evolution

ENE_P02: Renewable energy share in the total energy

The only renewable energies that affect the energy share in Syria are just the Hydropower and biomass, the following table illustrates the share of renewable energy in the total energy produced in Syria:

Energy (million TOE)	2000	2001	2002	2003	2004	2005
Total	16.19	16.54	17.76	18.41	20.08	20.85

Hydro	0.63	0.53	0.55	0.62	0.93	0.76
Biomass	0.6	0.6	0.6	0.6	0.6	0.6
Ratio of RE %	7.6	6.8	6.5	6.6	7.6	6.5

The planned is to raise the percentage of RE of the total energy production to 7.5% in 2020 through activating solar and wind energies in all sectors.

ENE_C02: RE capacity installed per inhabitant: wind, photovoltaic and thermal solar

As mentioned before, till now there are no energy produced by wind, photovoltaic, solar thermal applications that could affect the energy balance in Syria, what we could say that about 160000 m^2 of solar water heating collectors are installed in the past period, the energy produced of them are negligible regarding the total energy demand in Syria.

Assessment of Barriers to EE & RE in Syria

Barriers, which have been largely responsible for the relatively limited development and acceptance of EE&RE programs, in particular pilot and commercial applications, in Syria may be grouped into:

- Absence of an effective organisation which acts as a driving force with clear responsibility to develop policy, legislation and regulatory evolution within the Government of Syria;
- A heavily subsidised conventional energy carriers, with no special incentives in place to promote EE&RE investment, resulting in a non-level playing field;
- A predominant public sector EE&RE industry, with no particular incentives to respond to market driven demand on one hand and a nascent emerging private sector industry, being heavily constrained by regulatory restrictions;
- Lack of favourable import duties for EE&RE products and components and well as conducive policies to promote EE&RE developments;
- Unavailability of financial mechanisms and instruments encouraging EE&RE manufacture or use either through Government banks or private lending organisations to provide credit to consumers, especially rural applications, or even start-up manufacturing ventures;
- Limited activities to create awareness of EE&RE potential or opportunities;
- Limited scope for RD&D institutions to interface with international bodies and to share expertise already existing within the sector;
- Syria does have a limited fully skilled and experienced human resource base to support the integration, service and operation of such technologies and does not have a ready made training infrastructure to rapidly develop this resource.

This is however a changing and evolving situation. A great deal of work and effort is required to bring about the adjustment of a framework such that EE&RE investments are viewed with optimism and represent strong business opportunities. The process of liberalization is clearly assisting this change, but needs support internally through policy and regulatory measures to stimulate market opportunities and needs support externally to introduce innovative methodologies, attractive schemes, investment capital, flexible financial mechanisms and expertise. Syria has relatively few immediate technological or energy resource barriers. For the most part, technology solutions for a multitude of applications are readily available within other developing country programs, specifically solutions for rural electrification, water heating, agricultural processing, wind power generation, micro hydro for motive and electrical power etc.
The energy resource barriers are likewise not acute for the most part. Levels of solar radiation exceed 5.4 kWh/m^2/day on a horizontal plane in much of the country throughout much of the year, wind resources are favorable for both small scale and wind farm developments in some locations, hydro resources for micro applications are for the most part unexplored but likely to be available in the mountainous regions with good precipitation. Whilst bio-energy reserves are scarce throughout much of the arid and semi arid regions of the country, urban waste is abundant and offers good opportunity for processing.

Establishing an effective apex body with an appropriate mandate and financial/promotional institutional bodies are both essential and integral components of this process. Today, a multitude of learning and operational experience is available both in developing and industrialized nations. Such experience needs to be rigorously examined by the Apex body through its working groups of experts, to ascertain which of these experiences can be effectively adopted in Syria and what adaptations are necessary to apply the selected experiences. This exercise is an important starting point in the process of further evolving policy and regulatory mechanisms.

2.5 Existing or expected effects and benefits of RE and RUE

Costs and benefits

A. Costs

For the energy development plan, cost trends for each of the technologies were projected over the period covered by the study. The projections were made based on existing global trends in the respective technologies. The following table gives details about the costs trends, which have been assumed:

Technology	Cost in 2005	Cost in 2011	Trend
PV lighting, professional systems	7 $/Wp	5$/Wp	Linear
Hybrid Systems	5$/Wp	3$/Wp	Linear
PV Pumping	6$/Wp	4$/Wp	Linear
Wind Electric	1000$/kW	800$/kW	• 1000 to 900 in first five years • 900 to 800 in second five years
Defrosting wind machines	500$/kW	350$/kW	Linear
Solar Thermal Systems	200$/$m^2$	180$/$m^2$	Linear
Solar Hot Water Systems	5$/lpd capacity	3$/lpd	Linear
Small and Micro Hydro	800$/kW	700$/kW	Linear
Biogas Digester	1500$/$m^3$	1800$/$m^3$	Constant for first 3, then linear increase
Solid Waste to energy	800$/kW	500$/kW	Linear
Efficient lighting	0.35$/W	0.25$/W	Linear
Residential high efficiency refrigerators	30$/$ft^3$	35$/ ft^3	Linear
Building insulation	7$/$m^2$	5$/$m^2$	Linear
Efficient widows	100$/$m^2$	80$/$m^2$	Linear

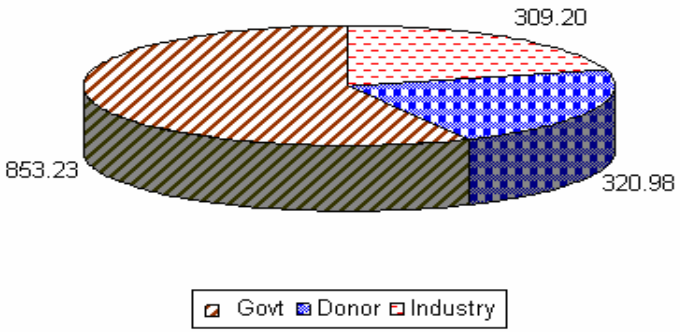
For the accompanying measures, costing has been carried out based on the levels of effort involved in carrying out the assignments/studies, estimates of infrastructure costs (where physical infrastructure needs to be established or upgraded), salaries, and overheads based on the current levels in Syria for the operating expenses.

It is assumed that about 88% of the costs of accompanying measures are spent on institutional development. In the energy developments, RUE accounts for the major share of 40% followed by wind energy, bio energy, solar thermal developments and hybrid systems with 30, 12, 8 and 6% respectively.

B. Means

Based on the current trends in development finance to EE&RE, and the past trends of government, donor and private sector investments in Syrian EE&RE sector, estimates were made with respect to the financing/contribution possible for the accompanying measures. In addition to donor trends and past Syrian experience, the current trend in private sector investments in EE&RE was considered and estimates made on the possible contributions to the energy developments. Experiences of successful EE&RE developments in Egypt, Morocco, Tunisia, India and Philippines were studied to model the donor and private sector participation trends.

In line with these trends, it can be seen from next figure that the majority of the resources of 57% for the study will be leveraged from the government, private sector industry and the remaining portion contributed by donor assistance.



C. Socio-economics

1. Employment Generation

As a result of the demand for the technical manpower to design, manufacture, integrate, supply, install, commission, operate and service the EE&RE systems there will be large scale employment opportunities generated for technicians and engineers. About 6000 technicians and over 2200 engineers will be required.

These employment opportunities are expected to be generated in existing and future governmental and private sector enterprises and there will also be a demand to manage these enterprises. This will require financial professionals involved in financing the developments, marketing personnel who will be involved in marketing and advertisements and well as managers for manufacturing and assembly units. So in addition to the technical manpower there will also be a direct need for about 730 managers.

Such large requirements of professionals will place major demands on the Syrian higher education system for EE&RE engineering and management, for which provision has been made under the institutional development component of the accompanying measures. There will be several new courses started and will provide direct employment to about 590 teachers. Apart from the direct requirements for technicians, engineers, managers and teachers there will also be employment created by the institutional development components, which will be equal to 168**.** Therefore, the total number of direct jobs created is 9688. It may be noted that several indirect jobs will also be created in providing support services to these new institutions and enterprises, which is not quantified here.

2. Economic Analysis

Detailed economic analysis was carried out for each of the energy technologies, which are being considered under the study. Since a large number of technologies were being used to provide heat and power for a variety of applications, no single baseline was found suitable to cover all developments. Therefore five different baselines were used to analyze all energy system components:

Diesel water heaters were considered as the baseline for technologies involving supply of hot water such as the domestic and non-domestic solar water heating systems;

Electricity was considered as a baseline for solar thermal technologies for heating and cooling as well as for industrial process heat;

Butane gas lamps were considered as the baseline for lighting in rural and decentralised areas, this baseline was used in PV Solar Home Systems for the Bedouins;

Gas based electricity generation and grid extension was used as the baseline in the analysis of technologies such as wind electric generation, hydro electric, hybrid electric, solar thermal electric and waste-to energy power plants;

Gasoline generators were used as the baseline for off-grid professional applications of PV, PV pumping, health and education systems etc.

PART III - Examples of good practice, case studies

Case Study 1:
Install Hot Water Solar System for IbnAlwaleed Hospital In Homs City

Overview:

Following the National Strategies aiming to widespread renewable energy applications, especially solar hot water systems, the decision had been taken in NERC in cooperation with Ministry of Health to execute a project to install solar hot water systems in all public hospitals starting from IbnAlwaleed Hospital in Homs.

A technical committee created to identify the hospital needs of hot water, and the technical specifications of the system required to cover that need.

The technical committee issuance a Term Of Reference to be announced as a local tender, this results three offers tow of a private solar systems manufacturers and one of a governmental manufacturer.

All offers studied technically and financially according the TOR and the decision taken to choose the governmental manufacturer (Mechanical and Metal Structure Company) for these reasons:

1. According to test reports asked from the whole offers, the optical efficiency of the collector of the Mechanical and Metal Structure Company was the best and equals 76%.
2. The company had a good experience to implement central solar water heating projects.
3. The absorber of the collector used from the company is imported from Greece and painted with selective coating.
4. The financial offer seems reasonable according to other offers.

NERC instructed the company to start installing works in the hospital.

Project Description:
The hospital consumption of hot water estimated as 6500 L/day, so the collector area collected equal to 120 m^2 divided into three groups, each group has a 2200 letter tank provided with double jacket heat exchanger, and the circuit between collectors and tanks works with a pump working regarding a deferential controller.

Projects Indicators:

- Technical Indicators:
  Renewable energy delivered (MWh/year): 58.28
  Net average GHG reduction (tCO_2/year): 31.37
  Solar fraction: 93%
  System efficiency: 28%
  Specific yield: 462 kWh/m^2 yearly
- Financial indicators:
  The Project total costs: 32000$
  NERC paid for the project 20000$ and the Ministry of Health 12000$.
  Project cumulative cash flows according to international energy prices:
  Year-to-positive cash flow: 4 years
  Internal Recovery Ratio of the project (IRR): 26.7%
  Cumulative cash flow: 234000 $
  Net present value (NPV): 62000$
  Annual life cycle savings: 6400$

The project is in use since the first of 2007.

Case Study 2:
Banias power plant rehabilitation:

Overview:
Banias Power Plant Company is located in Banias city at the Mediterranean coast; it consists of four steam turbines (4 x 170 MW) and one gas turbine (35 MW).
The company established into two stages the first was in 1982 and the second in 1989.
Banias power plant rehabilitation project implemented under the framework of SSEECP financed by the Syrian government, GEF, UNDP and OPEC.
Main Contractor of the project was ABB Utilities GmbH Mannheim, Germany.

Project Description:
The Project contained the following:

- Rehabilitation of units 1 and 2.
- Conversion these two units to work on natural gas in addition to heavy fuel oil.
- Installation online Condition Monitoring System (CMS) for the four units.
  (CMS) is an online system used as a tool in the hand of operators to optimize the power plant economical operation and to keep high reliability of equipment.
  The main features of the (CMS) system are:
  - Technical calculations for main parameters and process parts, main process components and emissions.
  - Boiler condition oriented advisory for operating the soot blowers.
  - Advisory system for operating important process conditions.
- Installation Maintenance Management System (MMS).
  (MMS) contains several functions such as:
  - Plant Register includes a tree of the power plant (units-systems-equipment- equipment components).
  - Preventive Maintenance Activities (all manufacturer maintenance instructions).
  - Administrate store items (all spare parts registered).

- Spare Parts purchase.
- Follow-up maintenance cost.
- Available spare parts.
- Equipment documentation.

Throw combination between (CMS) and (MMS) and transferring data from (CMS) to (MMS) we can provide the basis of Predictive Maintenance which is higher level than Preventive Maintenance.
The Main Goals of installation of such systems are: Technical, Economical and Environmental.

Projects Indicators:

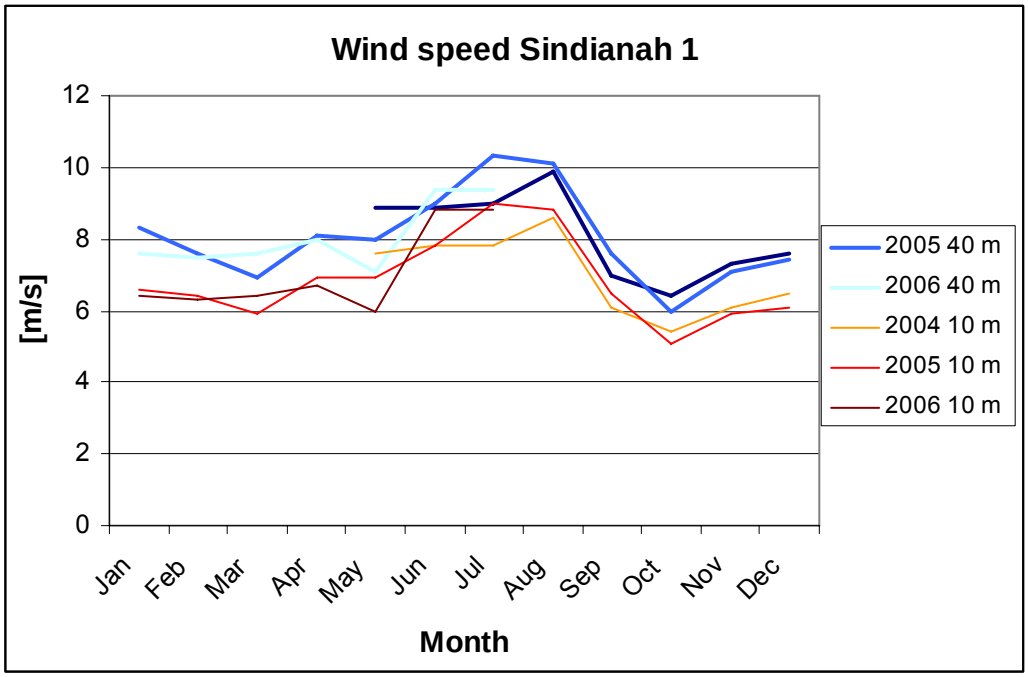
- Technical Indicators:
  Saving energy (toe/ year): 100000
  GHG reduction (tCO_2/year): 300000
- Financial indicators:
  The Project total costs: 66.6 Million $, the Syrian government paid 65 million $ for the rehabilitation and the conversion and GEF, UNDP and OPEC 1.8 million $ for (CMS) and (MMS) systems.
  Year-to-positive cash flow: 2.5 year

Case Study 3:
Sindianah wind farm:

Overview:
In 2003 the Spanish government granted the Syrian government a loan of 7 million euro to built a wind farm in one of the suitable sites in Syria.
In the end of 2002 the Wind Resource Assessment Project has been started in cooperation with decon (Deutsche Energie-Consult), the project is aiming at identifying and promoting an appropriate contribution of wind energy use to the power generation mix in Syria.
The team work chose Sindianah area to built the wind farm.

Site description

The Sindianah site is located some 20 km west of Homs. The surrounding landscape is characterised by smooth hills of heights up to 700 m height with some villages as well as scattered farm buildings. The area seems to be mainly used as farmland, no trees or larger bushes are observed. The surface consists of bare soil or low plants, however, this might depend on seasons and the agricultural cycles. It is possible that the surface roughness of the surrounding changes with the seasons.
The selected measurement site is free from all directions without any obstacle to be considered as having a significant influence on the measurement. There is only one building about 150 m north to north west of the site, but with a height of about 4 m it is not expected to influence the measurement. With regards to the wind atlas modelling, the site should be characterised as slightly complex.
The site is owned by the Homs electricity company, but the exact limitation of the area is not known.
The position of the Sindianah measurement mast is:
E 265,673 N3844,438 (UTM)
E 36°26.4730' N34°42.9101' (geographic system)
E 377,781 N3844,250 (undefined local Mercator based coordinate system)
Altitude 545 m a.s.l. the monthly average wind speed measured in the site indicated in the following curve:



Technical Indicators:

Total installed capacity 6 MW.
Estimated energy production: 18 million kWh/year.
GHG reduction: 15000 tco2/year

Grid connection

A 66 kV line is passing at the south of the project site. The next substation is located at As Sweri at about 2 km southeast of the Sindianah measurement mast. In this newly constructed substation cells are already reserved at 20 kV as well as at the 66 kV level. The grid connection the base case of 6 MW should not pose any problem; however, a more detailed project study needs to develop the most economic solution.
At the first estimation the grid connection can be efficiently realised as follows:

- Each turbine will be equipped with an appropriate LV/20kV transformer station, either as a turbine integrated or as separated compact station.
- All transformers shall be connected to a wind park internal 20 kV feeder, which shall be underground cable. (In case of the alternative scenario it would 2 main feeders would be necessary)
- Outside the wind park area (at sufficient distance to the turbines) the connection to the substation is possible via a 20kV overhead line (about 2000 m).
- The connection at the station shall be made at the 20 kV level.

The Expected commissioning date: end of 2007

4. PART IV – Proposals for more sustainable energy development

4.1 Summary of under exploited RE and RUE

The main actions to improve situation of RE&RUE to be exploited in the next decade could be illustrated as follows:

1. Issuance energy control laws starting from “Energy Conservation Law”, “Energy Efficiency Home Appliances Labels and Standards Law” and “Building Thermal Insulation Code”, and create the suitable mechanisms to apply this laws and their impact on the General Energy Balance and Primary energy Demand.
2. Establish “National Energy Data Base” directed by specialists in “Demand Side Managements” and “Integrated Resource Planning” to monitor the energy demand and find the optimal solution to face it, using RUE&RE technologies.
3. Execute projects to reduce the electrical grid losses to achieve the international levels and standards till 2020.
4. widespread energy saving audits in all sectors by nominate an energy managements team works in all residential, commercial, industrial and governmental establishments.
5. Develop the institutional framework regarding RUE&RE through making NERC plenipotentiary in energy evaluation (resources, production, demand) in Syria, with supervision by the Supreme Energy Committee, and NERC to be responsible to issuance the “Annual National Energy Report” which indicates the RUE&RE contribution development in “National Energy Balance” as planned in the five year plan.
6. Obligations of large energy users towards efficient use of energy and tapping the available Renewable Energy.
7. Obligations of major energy equipment manufacturers and distributors towards equipment efficiency.
8. Obligations of building designers, developers and operators towards the adoption of Energy Efficiency and Renewable Energy in new and retrofitted buildings.
9. Obligations of large energy users and power suppliers towards energy conversion and use of Renewable Energy including Combined Heat & Power generation.
10. Role of local Energy Service Companies (ESCOs).
11. Government incentives for stimulating the Energy Efficiency and Renewable Energy market in the country.
12. Creation and operation of a Green Fund Account.
13. Procedures for the EE & RE Regulation enforcement.

In case of executing the mentioned actions, the national experts estimate that the ratio of RUE&RE contribution in energy demand reduction will be in 2020 as the following table:

Activity	Ratio
Energy Efficient Building	2,5%
Efficient Home Appliances	2%
Electrical Grid Efficiency Improvement	2%
Renewable Energy (including hydro)	7,5%
Energy Auditing	2%
Total	16 %

This scenario is a mid scenario, because it didn’t take into account the gas contribution in operating power plants.

This ratio of reduction will cause:

1. Reduction about 18 million TCO2 in 2020.
2. Create about 10000 job opportunities in many fields.
3. Reduction in energy investments by executing RUE applications (Each 1% reduction in energy demand by RUE costs ¼ of energy generating investments costs).
4. Improve the socio-economic situation.
5. Decrease the extremely high energy intensity to be closer to the global levels.

The estimated energy demand in 2020 is about 45 Million TOE so 16% of the total demand equals 7.2 Million TOE which main a financial savings about 2,6 Billion $ in current energy prices.

4.2 Proposal for a sustainable energy development

Objectives:

The energy statistical calculations in Syria shows that energy situation could face difficulties regarding decreasing oil reserve and production expected in the next decade, this main issue directed the recent strategies to avoid these conditions and to achieve the following objectives:

- Energy demand reduction and increase the availability of the existing resources as much as possible.
- Generalize energy efficiency and renewable energy concepts in all sectors.
- Increase public awareness regarding energy efficiency and renewable energy applications.
- Greenhouse gases emissions reduction and environment protection.
- Achieve sustainable development requirements.

Details on the main sectors for which specific targets would be defined, in terms of RE&RUE

No	Energy System/Technology	2003	2004	2005	2007	2008	2010	2015	2020
1	Solar Thermal Space Heating and cooling Systems (Collector area in m^2)						5,000	15,000	35,000
3	Solar Hot Water Systems (Collector area in m^2)			160000	180000	280000	480,000	1,500,000	3,000,000
4	Solar dryers for agriculture (Collector area in m^2)					1000	3000	8000	13000
5	Industrial Process Heat through Solar Thermal (Collector area in m^2)					25,000	75,000	325,000	550,000
6	PV Village electrification systems (kWp)					120	200	1000	2500
7	Solar Electrification for Bedouins (kWp)		8	12	24	48	68	80	150
8	PV Pumping Systems (kWp)					105	210	392	410
11	Wind electric generation (MW)				6		140	500	1000
12	Wind pumps (no of systems)				15	20	25	35	55
14	Hydro power (MW)	1526	1526					2500	2500
15	Hybrid Systems (kW)							30000	30000
17	Biogas systems (m^3 of digester volume)					12000	20000	37000	52000
19	Urban waste to energy plants (MW)							10	25
20	Thermal insulation (buildings)					50,000	150,000	400,000	650,000
21	Energy efficiency refrigerators (set)					25,000	100,000	500,000	1,000,000
22	Energy efficiency air-conditioner (set)						10,000	50,000	100,000
23	energy efficiency washing machine(set)						25,000	200,000	600,000
24	Energy auditing(TOE)				31,000	100,000	500,000	1,500,000	2,500,000
25	Power factor correction (MVAR)				1400			5000	

Main tools

Most of the main tools which would need to be implemented to overcome identified obstacles, in order to attain the proposed objectives, are as follow:

1. Regarding prices policies: the government is going to raise energy prices for the end users by reducing the subsidies especially for diesel fuel and electricity, this step needed to be studied carefully with talking into account the per capita income which till now couldn't take the new prices suggested in State Planning Commission, the decision have been taken since the first of 2006 to be executed gradually, but it has been not executed yet because of economical considerations, to overcome this barrier, procedures should be implemented to increase the citizens ability to face the new energy prices.

2. Regarding raising public awareness: Energy associations and organizations should shoulder implementing awareness campaigns through TV, radio, newspapers, street media and brochures. Each of these organizations should reserve in their financial plan a special budget for awareness campaigns, with talking into account that RE&RUE public applications couldn't succeed without this procedure.

   Advertisement and Publicity Campaigns will involve development of sector specific advertisement and publicity campaigns through the print and electronic media[23]. The activity will involve design of media campaigns by a local media agency based on the feedback from the market studies. These campaigns will then be implemented through the appropriate media.

3. Regarding training programmes: Include training programme on RE&RUE planning for the Ministry of Electricity and NERC planners including exposure to developing country policy experience through visits. Entrepreneurship Training Programmes to be conducted for prospective entrepreneurs and private sector in small business management. Also required are training programmes for NGOs and grass-roots level organisations on renewable energy technologies and service delivery mechanisms.

4. Regarding green certificates, white certificates:
   As we mentioned before, Syria through DNA could achieve CDM projects and inter the green certificates and white certificates markets in the next few years through implementing RE&RUE measures.

Costs and Benefits

The total cost of implementing the study components would amount to $3 billion. About 98% of the resources are required for the energy development plan and the rest for accompanying measures plan. Institutional developments account.

Based on the international trends in donor assistance and private sector developments and considering the past and the recent involvement by Syrian government and private sector in RUE&RE,

There will be a total of about 10000 jobs created for technicians, engineers, and teachers apart from 168 jobs created in institutions established/upgraded under the accompanying measures plan. For every government job created 10 jobs will be created in the private sector. There will also be reduction of 2,604,200 tones/year of CO_2, 32,400 tones/year of SO_x, 17,200 tones/year of NO_x and 26,300 tones/year of CO in the year 2015. The avoided societal costs of these emissions annually, are quantified at over $351.33 million in the year 2015.

Detailed economic analysis was carried out for each of the energy systems, which are being considered under energy development plan with an appropriate conventional baseline. The conventional baselines considered were gas based electricity generation, diesel heaters, gasoline generators, and butane gas lamps.

Proposed Indicators

1. Share of private sectors in RE&RUE investments (%)
2. Energy demand reduction caused by applies EE&RE measures (TOE).
3. The period that the national oil reserve could cover the energy demand (years).
4. Grid losses reduction (MWH).
5. energy carriers demand in sectors by each type(TOE)
6. Identify the national benchmark for each sector comparing with the international one (TOE/unit).
7. Number of employee and workers involved in RUE&RE fields (employee).
8. Number of efficient appliances sold annually (set/year).
9. Energy production investments saved by implementing RUE&RE applications (million $).
10. Share of the income of white and green certificates on GDP (%).

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