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The following approach has been used for validating the data.

- 1 Data with regard to gross generation, net generation, energy sold to various consumers has been obtained from the annual report.
- 2 Data with regard to gross electricity generation by central sector utilities have been obtained from their annual reports.
- 3 The gross electricity generation obtained from the central sector utilities annual report is 181212 Gwh as against the value of 176014 Gwh reported by CEA. Hence the data reported by CEA is in conformity with the value reported by the individual companies.
- 4 Based on the above, the gross and net generation of electricity reported by CEA is assumed to be practicable and reliable.

1 Validation of Country-wise total gross generation

Source 1:

(Source : CEA General review – 2002-03 Page 112;)

Description	Gross Generation (Gwh)	Auxiliaries consumption (Gwh)	Net generation (Gwh)	Energy sold to various consumers (Gwh)
Public utilities	532693	38256	* 502655	339598
Non-utilities	63850	7660	56190	50570
Total	596543	45916	559565	390168

* Includes purchase from captive plant of 6699 and 1519 Gwh from Nepal Non utilities ; Auxiliary consumption 12%; Transmission losses at 10% assumed

The electricity lost in transformation, transmission , distribution and unaccounted works out to 162882 Gwh i.e appox 32.54% of the total available electricity.

Source 2 :

Annual power generation compiled from respective annual reports for 2002 –03 for central power generating units.

The gross power generation from the central power plants have been compiled from the respective annual reports. It works out to a total of 181212 Gwh.

Company	Generation source	Gwh	Company web site
Damodar Valley Corporation	Thermal Hydel GT	9704 304 6.6 10014.6	http://www.dvcindia.org/commercial/Overview.htm
Nuclear Power corporation	Nuclear Cap Uti (90%)	2744	
National Hydroelectric Power Corporation	Hydel Cap Util (96%)	9862	http://nhpcindia.com/
NEEPCO	-	2762	http://www.neepco.com
National Thermal Power Corporation Limited	Thermal	140860	www.ntpc.co.in
Neyveli Lignite Corporation	Thermal	14970	http://www.nlcindia.co.in/company.htm
Total		181212	

As against the above values, the compiled value for hydro, thermal and nuclear power from the central sector (CEA Source) is 176014 Gwh. (a deficit of around 2.8%).

2 Industrial Power consumption

a Industrial Power Consumption

$$= 114958 + 50570 (90\%)$$

$$= 165528 \text{ Gwh (10\% towards Auxiliary Power)}$$

b Energy used for Electrolysis in chlor alkali plant

Caustic & Chlorine Production = 2.24 Million tonnes (Alkali Metal Corporation of India) & Company web sites

Manufacture by mercury process = 7.2 million tonnes (3300 kWh / MT)

Manufacture by Membrane process = 15.24 Million tonnes (2700 kWh / MT)

Total electricity consumption = $7.2 * 3300 + 2700 * 15.24 = 64908$ Million kWh

Auxiliary Consumption = $64908 * 0.08 = 5190$ Million kWh

Actual Electricity Consumption for electrolysis = 59710 Million kWh
= 59710 Gwh

i Energy used for electrolysis in Vanasapathi and other manufacture = $59710 * 0.03 = 1790$ Gwh

ii Total for electrolysis = 61500 Gwh

Induction Furnace & arc furnace

Production = 7.5 million tonne

Specific energy consumption = 750 kWh / Mt

Total energy consumption = 5625 million kWh

= 5625 Gwh

Energy consumption towards heat treatment = $5625 * 0.1 = 560$ Gwh

Total Furnace energy consumption = $5625 + 560 = 6185$ Gwh

APPENDIX 1

All India Energy Sales (UTILITIES ONLY + Non utilities) During 2002-03

Category	Energy used in 2002-03 (GWh)
Domestic	83355
Commercial	25437
Industrial Power	$114958(UTI) + 50570(Non-UTI) = 165528$
Public Lighting	3974
Railways & Tramways	8796
Agriculture	84485
Public Water works & Sewage pumping	7898
Miscellaneous	10690
Total	390168

Source : CEA Section – Page 162

Assessment of energy consumption of each of the gadgets in each of the above major user areas have been arrived at based on the energy consumption break up of sample reports available with the author. Details are given below.

1 Break up of Domestic Energy Consumption

Assessment of domestic energy consumption in refrigerators, Geysers, Ceiling and table fan, Lighting and appliances.. 70 % of 83355 i.e 58350 GWh by urban & 30% i.e 25000 GWh by Rural house holds.

TABLE 1

Equipment Ref	% consumption	Urban & Town GWh	Rural GWh	Total GWh
Refrigerator	30	17500	7500	25000
Geysers	30	17500	7500	25000
Ceiling & Table fan	15	8750	3750	12500
Lighting	5	8750	3750	3750
Appliances	8.5	4960	2375	7350
Air Conditioner	1.5	875	125	1000
Total		58350	25000	83350

Seasonal variations have been considered; Only domestic refrigerators

2 Break up of Commercial Energy Consumption

(Includes hotels, software parks, multi storeyed buildings, educational establishments, shops etc)

TABLE 2

Equipment Ref	%	Total (GWh)
Refrigerators (window & solt A/C)	5	1270
Centralized A/C	20	5087
Lighting	30	7630
Ceiling & Table fans	20	5090
Air conditioners	10	2543
Geysers	10	2540
Appliances	5	1270
Total		25430

Break up based on author's data base and experience

3 Break up of Public Water works & Sewrage pumping

TABLE 3

Equipment Ref	%	Total (GWh)
Pumping	99.2	7835
Ceiling fan	0.2	16
Lighting	0.5	39
Air Conditioners	0.1	8
Refrigerators	0.05	4
Total		7898

Break up based on author's data base and experience

4 Break up of energy consumption in Railways / Tramways

TABLE 4

Equipment Ref	%	Total (GWh)
Traction	93.8	8250
Lighting	2	176
Ceiling & Table fans	2	176
Air Conditioners	1	88
Centralized A/C	1	88
Refrigerators	0.2	18
Total		8797

Break up based on author's data base and experience

5 Break up of miscellaneous energy consumption

TABLE 5

Equipment Reference	%	Total Consumption GWh
Lighting	5	930
Ceiling fans & Table fans	2	214
Geysers	2	214
Refrigerators	1	107
Air Conditioners	1	107
Total		1786

Balance energy consumption is considered as unaccounted = $(10690 - 1786 = 8900 \text{ GWh})$

6 Break up of energy consumption in Industrial power

The total industrial power consumption is $(114959 \text{ \{Utilities\}} + 50570 \text{ \{Non-Utilities\}}) = 165529 \text{ GWH}$ (Refer the text)

TABLE 6

Equipment Ref	%	Total (GWh)
Electrolysis	37	61500
Furnaces	3.7	6185
Lighting	9	14900
Distribution transformers	1.5	2482
Distribution losses	1.5	2482
Centralized A/C	3	4965
Air Conditioners (Windows & split A/C)	0.5	830
Ceiling Fans & table fans	1	1655
Geysers	0.05	83
Refrigerators	0.05	83
Total	51.2	95165

Note : Calculation details of electrolysis, furnaces are already given ; Distribution transformer losses are considered for receiving transformers at the industry only. ; Centralized A/C energy is calculated considering (20% of the total energy consumption going towards A/c consumption in Textile, Light Engineering, Engineering industry, Pharmaceutical industry etc and 15 % of the total energy consumed is for centralized A/C.)

Energy Consumed for Industrial Drives = $(165529 - 95165) + 4965 = 75495 = \text{GWh}$

VALIDATION OF ENERGY CONSUMPTION

1 Lighting

User Area	Total Lighting Consumption (GWH)	% energy for FTL	FTL + Ballast GWH
Industry(Table 6)	14900	55	8195
Domestic Lighting (Table1)	12500	70	8750
Commercial Lighting (Table 2)	7630	85	6485
Public Lighting	3974	60	2384
Miscellaneous (Table 5)	530	60	318
Railways & Tramways(Table 4)	176	30	53
Public Water Works & Sewrage	39	40	16
	39749		31230

Note : For details refer Appendix 1

Ballast Energy Consumption =

2 Ceiling and Table fans

User Area	Total Lighting Consumption (GWH)
Domestic (Table 1)	12500
Commercial (Table 2)	5090
Miscellaneous (Table 5)	214
Industries (Table 6)	1655
Railways & Tramways(Table 4)	16
Public Water Works & Sewrage(Table 3)	39
	19651

Note : For details refer Appendix 1

3 Refrigerators

User Area	Total Lighting Consumption (GWH)
Domestic (Table 1)	25000
Commercial (Table 2)	1270
Miscellaneous (Table 5)	107
Industries (Table 6)	83
Railways & Tramways(Table 4)	18
Public Water Works & Sewrage(Table 3)	4
	26482

Note : For details refer Appendix 1

4 Geysers

User Area	Total Lighting Consumption (GWH)
Domestic (Table 1)	25000
Commercial (Table 2)	2540
Miscellaneous (Table 5)	214
Industries (Table 6)	83
	27837

Note : For details refer Appendix 1

5 Air Conditioners

User Area	Total Lighting Consumption (GWH)
Domestic (Table 1)	1000
Commercial (Table 2)	2543
Miscellaneous (Table 5)	106
Industries (Table 6)	9105
Railways & Tramways(Table 4)	88
Public Water Works & Sewrage(Table 3)	8
	12850

Note : For details refer Appendix 1

CEA References

http://cea.nic.in/opm/0203/Sec11%20fin_lo.pdf

http://cea.nic.in/opm/0203/SEC10finn_lo.pdf

http://cea.nic.in/opm/0203/SEC2finn_lo.pdf

http://cea.nic.in/ge_re/2002-03/genrev101-128.pdf

http://cea.nic.in/ge_re/2002-03/genrev157-179.pdf

	1	2	3	4	5	6	7	8	9
Equipment	Annual Electricity Consumption of equipment Gwh	Annual sales of equipment in 2002-03 in millions	Annual Electricity consumption of new stock Gwh	Electricity consumption of new stock to total electricity (%)	Estimated improvement in efficiency of new stock(%)	Annual Electricity savings Gwh	Organized Sector (%)	Informal sector (%)	
Agricultural Pump sets		84485	0.8	6000					
Fluorescent tube lights		24984	190	16720					
Industrial Motors		75495	4103	24618					
Refrigerators		26482	3.4	2172					
Air Conditioners		12850	0.8	2100					
Ceiling & Table fans		19651	12.5	1313					
Industrial Pumps		49661	20%	3781					
Ballasts		6246	30	720					
Industrial fans		16000	15%	2725					
Distribution transformers		2482	16660	843					
Geysers(hot water)		27837	0.8	864					
CFL 60 W Incandescent		2141	1.75	158					
Replacements				1576					
Compressors		22750	12%	63590					
Total									

Note : Only Column No 2 I.e annual electricity consumption of equipment determined

Calculation details seperately attached in file **Ans - Issue 20**