

TEST

TURIN ENERGY STRATEGY

Introduction

Just a big industrial city. That is the label attached - both now and in the past - to Turin. A definition mistaken from the start and inappropriate today. Turin is no longer another Manchester thrown up at the turn of the century by and industrial revolution, or even a European version of Detroit in the Sixties, Seventies, a city of assembly lines and mass production workers. This is not to deny that Turin is the one of the capital towns in automotive geography, the Italian birthplace of this means of transport.

Yet it would be equally wrong to rest satisfied with the simple formula: Turin = cars. The city has other "firsts", all closely connected with science, in keeping with its rationalism and industriousness.

The city is peopled by small firms and workshops characterized by very professional skills.

Of course, like in every metropolitan area, also in Turin the population is shrinking year by year, and that is one of the reasons in order to which the local administration is oriented to provide itself with tools and instruments that can help to address the future city development to a sustainable model based on a higher environmental quality for the urban area.



1. Aim and method

Aim

TEST Project aim is to answer to the need for tools on energy planning at the urban level, in order to support the evaluation and monitoring of the effects of the city development from the energy and environmental point of view.

Specific objective of this work is the organization of an information system on energy for the City of Torino able to give a picture of the relationship between the energy flows entering in the urban system and the final demand of the different sectors (building, transportation and industry), and the related amount of pollutant emissions, evaluated in a simplified way.

Method

The three main sectors of the city energy system are separately considered:

- Building Sector
- Transportation Sector
- Industrial Sector

The general method of working, applied to each of the three sectors, can be summarized as follows:

1. Information about the sub-system structure and main features;
2. Development of an effective Data Base for the sector;
3. Information about the energy supply system;
4. Energy and environment indicators;
5. Development of a model for the sector.



2. Building sector: energy and environmental balance

The objective of the study is to provide the City of Turin with the necessary information to build up a system able to assist the energy management of the building stock and to evaluate the environmental effects. The analysis is limited to the City of and it is developed on three sub-categories:

- residential buildings;
- office and trade buildings;
- city property buildings.

Residential Buildings

The total energy consumption of the residential building sector of Torino area is 9.644.227 MWh/year. Thermal energy represents the 88% of the sectorial consumption and corresponds to 19 MWh/year per dwelling. The electricity consumption of the sector is estimated in 1.181.365 MWh/year, including lighting, appliances and part of the SHW. These data, have been calculated on the base of the energy consumption of a sample of more than 1000 buildings, over the city residential building stock, corresponding to 446.000 dwellings (1990).

Office and trade buildings

The tertiary sector was analysed through the information given by the Turin Chamber of Commerce. These data were associated to the unitary energy consumption (per employee) coming from a survey on energy consumptions in industry and office buildings. The results, updated 1990, show a total consumption of 2.047.642 MWh/year.

Public buildings

The specific energy consumption for heating in non-residential public buildings of the City of Turin is 883.570 MWh/year, and the unitary energy consumption is 68 kWh/m³ year.

The building stock analysis has been made according to the different typologies, and it shows the importance of schools that, with 6.247.977 m³, represent the 50% of the global stock, while office buildings correspond to 2.287.209 m³.

The annual energy consumption for public lighting in Turin (75387 lights), amounts to 69668 MWh/year, and the light intensity in the urban area is equal to 45.84 Lumen per m² of street.

TEST
(T)urin (E)nergy-environmental (S)trategy

INDAGINE CAMPIONE SUI CONSUMI ENERGETICI DI 1000 EDIFICI

<1919 1919-1945 1946-1960 1961-1971 1971-1991 >1991

Epoca 14 147 275 441 130 14

Contiguità contigua non contigua

300 56

N.° Abitazioni 15.355 N.° Es. Commerciali 769

Tipologia edilizia

In linea 921 a schiera 1
a torre 68 a ballatoio 1
a corte 25 mono/bilani 15
altro 4

Tecnologia edilizia

c. a. p. 81 c. a. 732
pietra-mattone 198 altro 3
non individuali 1

Situazione manutentiva

Chiusure opache

buona 73 normale 350
mediocre 443 accidentale 105
scotturite 6

Chiusure trasparenti

buona 43 normale 455
mediocre 478 accidentale 68
scotturite 7

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Commissione Comunità Europee DGXXII
Città di Torino
Ass. Ambiente e Sviluppo Sostenibile

SETTORE RESIDENZIALE

RISCALDAMENTO DOMESTICO

Consumo annuo (GJ)

Consumo medio abit. (GJ)

Consumo mensile edif. (GJ)

Gen. Lug.

Feb. Ago.

Mar. Set.

Apr. Ott.

Mag. Nov.

Giù. Dic.

Fonte: ITALGAS (1990)

Tipo emissioni	metano t/anno	gasolio t/anno	olio comb. t/anno	Totale t/anno
SOx(*)	6	766	455	1227
NOx	1032	488	52	1572
Particolato	206	133	5	344
CO	84	66	2	151
COV	32	66	10	108
CO2	1225544	581644	23056	1830244

Residential sector: pollutant emissions from thermal end uses.

3. Transport sector: energy and environment balance

The energy consumption related to private transportation in the metropolitan area were estimated by:

- dividing the means of transport by nominal horsepower clusters;
- evaluating the average energy consumption of each cluster;
- estimating the vehicles stock of the metropolitan area by nominal horsepower clusters;
- recovering the number of public transport means in use within the metropolitan area, by class of means;
- estimating, for the public transport means in use, the number of passengers and the total driven kilometers.

Private transport

Within the Torino metropolitan area are registered 1.050.924 private vehicles, 906.562 of them are cars.

The total energy consumption during 1990 was 6.210.044 MWh, corresponding to 665.955.000 litres of gasoline equivalent fuel.

Public urban transport

The number of vehicles and the energy consumption of the public transport network for the years 1990-1994 were assessed using the statistical data given by ATM, Azienda Tramvie Municipali (public transport utility). The total energy consumption figure corresponds to 326.172 MWh/year, the 89% being diesel for buses and the 11% electric power for trams.

The network is used by 191.281.947 passengers per year, with a consumption of 1.7 kWh/passenger year. During rush hours, there are 1017 public vehicles on the road, 794 buses and 232 trams



TEST (Turin Energy-environmental Strategy) VEICOLI CIRCULANTI CARBURANTE EROGATO (1990)	
Area Metropolitana di TORINO	
Autoveicoli	906.562
Autobus	2.439
Autocarri merci	70.108
Autocarri speciali	8.306
Tiratori	2.049
Motocicli	57.690
Motocari	3.810
Totale	1.050.924

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SETTORE TRASPORTI



CARBURANTE EROGATO NELL'AREA METROP.		
Benzina super	437.206.000	65,85 %
Benzina normale	2.156.000	0,32 %
Benzina senza Pb	10.211.000	1,53 %
Gasolio	180.356.000	27,08 %
GPL	33.159.000	4,98 %
Metano	2.867.000	0,43 %
Totale	665.955.000	(litri/anno)
	22.356.341	GJ/anno
	6.210.095	Mwh/anno

Fonti: Regione Piemonte / ACI Roma

Type of emission	Natural Gas toe/year	LPG toe/year	fuel toe/year	diesel toe/year	Total toe/year
SOx(*)	0	0	182	633	815
NOx	72	591	14162	5537	20361
Particulate	0	1	607	2482	3090
CO	49	412	127117	6747	134324
COV	40	340	10790	2947	14117
CO2			1348719	649282	1998001

Transport sector: pollutant emissions from fuel consumption



4. The Industrial Sector: the energy and environmental balance

The data concerning the structure (size, number of workers per production sector) and the main features of the Turin industrial system, coming from different sources, have been collected and sorted: ISTAT census 1981, survey of the Turin Industrial Union, lists of industries from the local Chamber of Commerce.

A data base has been set up, categorizing the Turin industries according to the ISTAT code and containing the information related to the number of workers and to the unitary energy consumptions per energy source.

To evaluate the energy consumptions of the industrial sector in the metropolitan area, two specific actions have been promoted:

- a detailed information on energy consumptions in the period 1987-1990, for the industries with more than 50 employers, to set up a data base on the monthly consumptions, per energy sources, of more than 400 industries of this size located in the area;
- a survey on the energy uses and the industrial processes, addressed to a limited sample of industries, without any limitation in the number of employers.

TEST
(Turin) Energy-environmental (ST)ategy
CONSUMI ENERGETICI NEL SETTORE INDUSTRIALE
Consumi Totali(GJ)
Codice ISTAT **141**

Mese	Elettrico (Mwh)	Termico (GJ)	Totale (Mwh)
GEN	51.511	2.143.356	652.083
FEB	50.136	1.668.598	517.744
MAR	51.603	1.342.435	427.888
APR	46.732	676.429	292.507
MAG	51.345	450.117	177.887
GIU	52.166	368.140	155.662
LUG	48.192	329.821	141.935
AGO	28.842	207.268	86.806
SET	47.394	308.988	142.102
OTT	48.174	677.182	238.171
NOV	51.107	1.321.660	421.580
DIC	46.832	1.748.106	536.693
Tot.	574.635	11.470.062	3.798.849

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In the Turin metropolitan area the energy consumption of the industrial sector corresponds to 23.241.612 MWh/year, with the following distribution (according to the source):

- 19.0 % electric
- 4.9 % fuel oil
- 1.4 % gas oil
- 74.6 % natural gas

The average energy consumption per employer is: 110 MWh/year.

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SETTORE INDUSTRIA

CONSUMI ENERGETICI TOTALI ANNO 1990

AREA METROPOLITANA

Consumi elettrici	5.097.973 (Mwh)
Consumi termici	18.036.908 (Mwh)
Consumi totali	23.175.669 (Mwh)

Fonti: Ispet. lavoro (1993) / Un. Ind. (1990)

Type of emission	Natural Gas toe/year	fuel toe/year	diesel toe/year	c.oil toe/year	petrol toe/year	Total toe/year
SOx(*)	17	4	107	5735	1	5872
NOx	3829	349	68	657	1	4909
Particulate	85	15	9	124	0	234
CO	957	3130	19	60	0	4168
COV	157	266	9	16	0	448
CO2	3333104	33212	81922	291709	826	3707654

Industrial sector: pollutant emissions from thermal end uses