CEP-REC
Regional Energy Concepts

**3sCE417P3**
**Introduction of Regional Energy Concepts**

# 4.2 REPORT – ENERGY SUPPLY ANALYSIS IN THE PROVINCE OF TORINO

PROVINCIA DI TORINO

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# 1 Overview of the region

## 1.1 DESCRIPTION OF THE CONCEPT REGION

The concept region is located in the north-west part of the country and it is bordered to the west by France for 186 km (36% of the French-Italian border), to the north by Valle d'Aosta Region, to the east with the Province of Biella, Asti, Vercelli and Alessandria and to the south with the Province of Cuneo.
The Province of Turin covers an area of 6,830 km2 (equivalent to more than a quarter of the region and to 2.26% of the entire national territory) and it's the one with the greatest number of municipalities among the Italian provinces (316, year 2013).
Among Italia provinces, Turin is one of the wider and the one with the greatest number of municipalities (316 in total). The larger part of Municipalities are very small and 113 of them do not even reach the 1,000 inhabitants and grouping the 2.57% of the overall provincial population. The resident population (equal to half of the Piedmont's population, 52%, and about 4% of the whole National country) is focused mainly in a few larger towns located on the plain territory. The population density is very different within provincial borders, as in the main urban centers it is around 910 inhabitants/km$^2$, whereas in mountain areas is equal to 40 inhab./km$^2$. The average density value is about 328,60 inhab./km$^2$.
In the municipalities with more than 10,000 inhabitants (precisely 28, located mainly in the plain and at the foothills) lives approximately 75% of the overall population. The entire province is rich of water in terms of groundwater and river. Its economy is characterised by a highly skilled workforce, innovative companies and well-known universities. The productive structure of the Province is widely diversified, ranging from manufacturing to services activities. The manufacturing sector is mainly characterised by a concentration of automotive, engineering and aerospace industries. Although the industry sector is still strong, the majority of employees are occupied in the services sector.
Regarding the energy sector, the Province of Turin is one of most virtuous province in Italy for the high number of RES plants and with one of the largest remote heating district, and the city of Turin as a candidate to be one of the Smart Cities in the EU Initiative to foster the dissemination of the most efficient models and strategies.

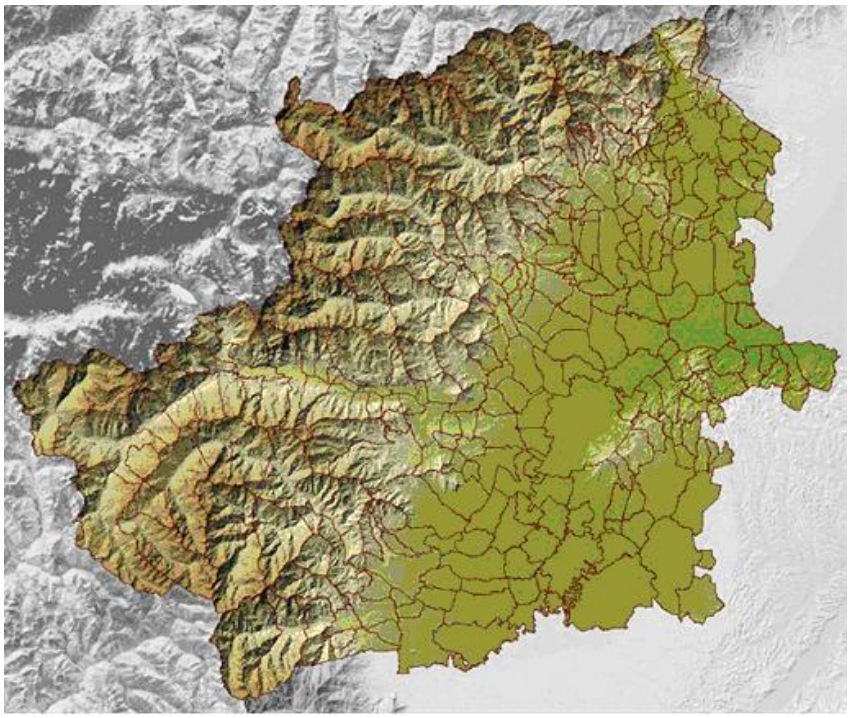



*Figure 1.1 – Morphological and political map of the concept region. (Source: PTC2)*

# 2 Mapping of present used energy sources

The total amount of energy supply in the Province of Torino in 2011 was 5 Mtoe.
The supply grew by 15% from 2000 to 2009 but after 2010 started to fall down. The increase was relevant between 2004 and 2005 when the amount of energy supplied overcame the 5,5 Mtoe and in the following year the peak value of nearly 5,7 Mtoe was reached. In 2009 a slow down was recorded but the total amount keeps on being far higher than the beginning of the decade. The energy supply depends mainly on natural gas, which was 54% in 2000 and 68% in 2011. This dependency is thus increasing since natural gas is being used more and more for feeding CHP plants. As it will be said later on, several CHP plants entered into force or were rewamped in the second half of the decade where local production of electricity overcame the local consumptions, turning the Province of Torino from and importing Region to an exporting one. As natural gas increased a lot its contribution to energy supply (from 2.4 Mtoe in 2000 to 3.3 Mtoe in 2011), on the other hand oil products decreased their supply in a very relevant way. Their share turned to be in 2011 24% against the 38% recorded in 2000. Petrol and Oil are the two energy carriers having decreased more.

## 2.1 PRIMARY ENERGY

### *2.1.1 Fossil sources*

In the concept region, there aren't any direct fossil sources or productions on its territory. As a consequence, the Province of Torino is strongly dependent from foreign supplies (about 93%), in particular natural gas, accounting for 68% in 2011. This percentage is almost equal to the average of the last five years and are not observed the important processes of transition to other energy sources. Because of the lack of fossil energy reserves, the only way to limit the external supply and consumption of fossil sources is to resort to a more consistent use of renewable energy and increase efficiency in the final use of energy.

#### *2.1.1.A Coal and peat*

There is no use and production of this type of sources in the Province of Turin.

#### *2.1.1.B Natural gas*

The energy system supply of the Province depends mainly on natural gas, which was 54% in 2000 and 68% in 2011 of total energy supply. This dependency is thus increasing since this source is being used more and more for feeding CHP plants for electricity production. All natural gas used in the concept region is imported from foreign regions by the national transport grid. Main suppliers are foreign countries, such as Russia and North African countries.
From the data published by the Ministry of Economic Development, the Province of Turin consumes more than half of all gas transported in Piedmont (in 2011 the share was 52.2%) and holds 5.2% of the national share of consumption.
In the concept region, its nearly 8000 km of local grid network is operated by 15 gas distributors. The main one is Italgas and manages 139 municipalities, more than half of the 264 achieved by the network. 51 Municipalities are devoid of the network and in them resides about 1% of the population.
The distributors manage the local network, but the total amount of natural gas that passes in the province is transported by SNAM Rete Gas, which supplies the carrier, in addition to local distribution networks, also directly to end users, such as power plants or industrial plants or plant refueling for auto-vehicles. Overall, the natural gas transported in the province in 2011 was slightly more than 4 billion cubic meters.
In 2011, natural gas consumption was divided in 3 groups of use: 47% in thermal power generation, 36% in the residential sector (30% domestic sector and 6% tertiary) and 17% in industry. Other uses (transport and agriculture) showed marginal units (totaling 0.5%), although the issue of transportation has doubled since 2005.

| Surface | 5.503,13 sq-Km |
|---|---|
| Population | 2.285.475 inhabitants (2010) |
| Length of the grid | 7899 sq-Km |
| Customers | 1.006.181 |

*Table 2.1.1.B – Local gas grid main data (province of Turin)*

#### *2.1.1.C Crude oil*

There is no production and direct use of this type of source in the Province of Turin.

### *2.1.2 Renewable sources*

Renewable energy sources increased a little bit their share (from 8% in 2000 to 10,4% in 2011) even though in terms of absolute values they had a growth by nearly 50%. Biomass and hydropower are the most relevant renewable source (more than 95% of total supply in 2011) even though it is very probable that solar energy will start giving an important contribution in next years.

a - Renewable sources consumed in the Province of Turin are hydropower, geothermal energy of low enthalpy, solar energy (thermal and photovoltaic), wind power energy and biomass in its various possible forms: wood, biogas and biofuels. Their production and consumption is increasing a lot during last 5-6 years. In 2011 there were registered consumption from renewable sources by about 520 ktoe, by which 370 ktoe from domestic production and about 150 ktoe imported from other regions. The situation is close to the peak supplied in 2009, which recorded a very high production of hydroelectric power. The average annual rate of growth of renewables is about 4.5%. Renewable sources of energy allocated directly to end-users constitute 86% of total consumption, the remainder is the energy loss due to energy transformations. Considering only the portion destined to end-uses, it is important to note that 48% is represented by thermal energy, while 52% by electricity. Renewable energy sources provide 10,5% of total energy supplied in 2011.

#### *2.1.2.A Wind power*

About this type of source, it's important to note that since 2010 there was a production of wind energy in the province, although the values are still negligible.
The reason is mainly the average wind speed of the Province, that is insufficient to allow the diffusion of this technology. Only close to mountains the wind speed is greater than 4 m/s (10m above the ground) but landscape protection rules limit the installation of such plants. So the principal barriers to the wind power diffusion are: the little statistical significance of the events of wind with a speed greater than 5 m/s and the frequency less than 10%.
There are only two wind power plants on the provincial territory: one located near the Valle d'Aosta region in the north, in Quincinetto; and another in Susa valley in the west part, in Oulx. They are very small and less powerful.
Due to this situation it's not possible to provide further data about wind power.
Below two maps are reported: they come from a study conducted by ARPA Piemonte and the Province of Torino and indicate the average annual wind speed at 10 and 50 meters.

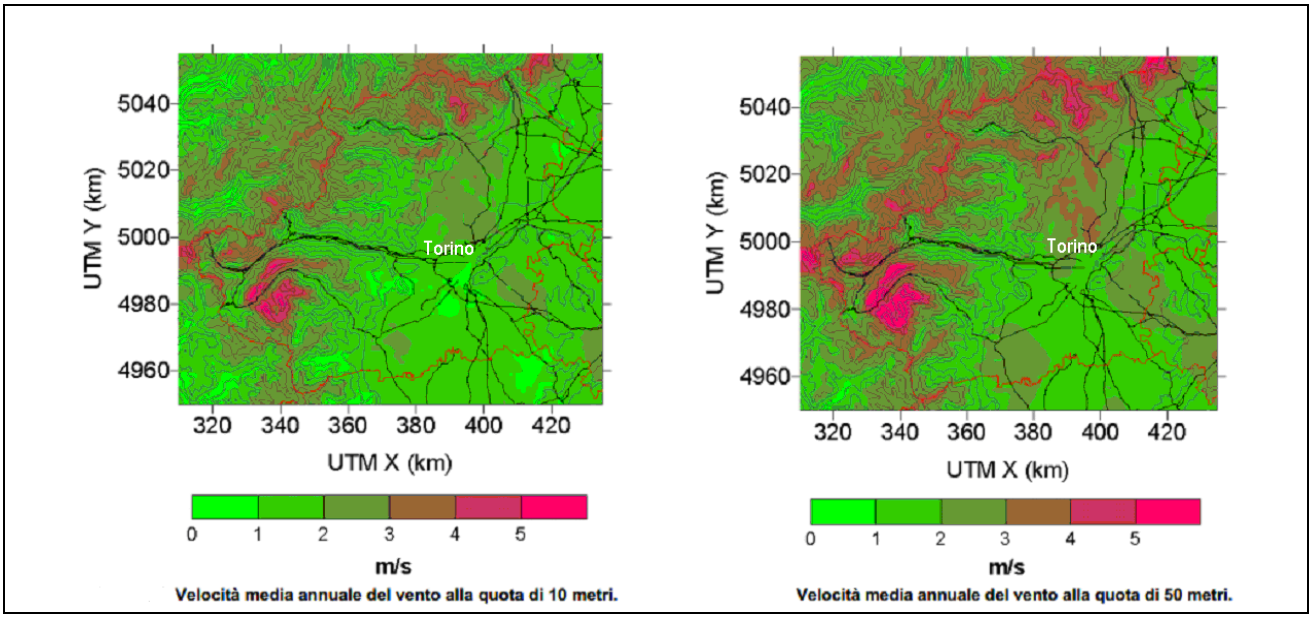



*Figure 2.1.2.Am - Average annual wind speed at 10 meters and 50 meters above the ground*
*(source: "Costruzione di una base dati meteorologici sulla Provincia di Torino con l'ausilio di modellistica numerica, Provincia di Torino e Arpa Piemonte, 2003)*

### *2.1.2.B Solar power*

Regarding the solar power, it's important to underline that the annual average daily irradiation is about 3.660 Wh/sqm/day on horizontal plane and 4.280 Wh/sqm/day on optimally inclined plane (37° as average value for the Province). So the annual horizontal irradiation is about 1.200 kWh/smq/y.
The total amount of energy produced by PV plants in 2012 in the province is about 329,7 MW with a production of about 362.000 MWh.
Regarding residential buildings (systems with capacity under 20 MW), the existing capacity of PV plants installed is about 62,1 MW (2012) with a number of plants of 10.536. The production of energy derived from this capacity is about 68.310 MWh. Some years ago, in 2006, the installed capacity was about 300 kW so this source faced a very impressive increase in a short period. Such growth pushed in the last 5 years by a very favorable feed-in incentives system seems to slow down as the incentives are getting lower. About the solar thermal installations the capacity is almost 90 MW (2011) with an equivalent covered area of about 133.000 square meters. From 2001 and 2011 the solar thermal covered area has increased tenfold.
In 2020, the expected trend will bring an increase in the solar thermal final uses of about 300% in relation to 2011 (524.000 square meters of ST plants installed). According to the burding sharing target fixed at a regional level, in the province of Torino a solar thermal covered area of about 1.730.000 square meters should be achieved.
From a recent research conducted on about 50 municipalities of the metropolitan area of the city of Turin, the theoretical capacity of solar thermal energy (reaching the maximum objective allowed from the law: that is the 60% of the needs of hot water for half of the inhabitants) is about 470 MW; if we could install solar PV panels on the rest of the free buildings' roof of these municipalities, it's possible to reach a capacity of 512 MW for electricity. It's worth noting that these data derive from a study conducted on the most populated part of the province, so that the results should be increased by 30% to be consisted with the whole territory.
About the industrial level, the existing capacity of PV plants is about 267,6 MW (2012) with a number of plants of 1.490. Few of such plants were installed on the ground, but for the future installations are no more eligible for public founding due to land use protection. Other installations are on brownfield, such as exhausted waste landfill or mines, and on the roof of industrial buildings. The principal barriers hindering the use of solar energy are the uncertainty of the regulatory framework and, for bigger plants, the huge documentation (with lengthy procedures) that has to be produced whenever an environmental impact assessment is required. A recent national law extended the tax reduction system for people willing to install solar panels (Thermal and PV) giving additional impulse to solar energy sector.

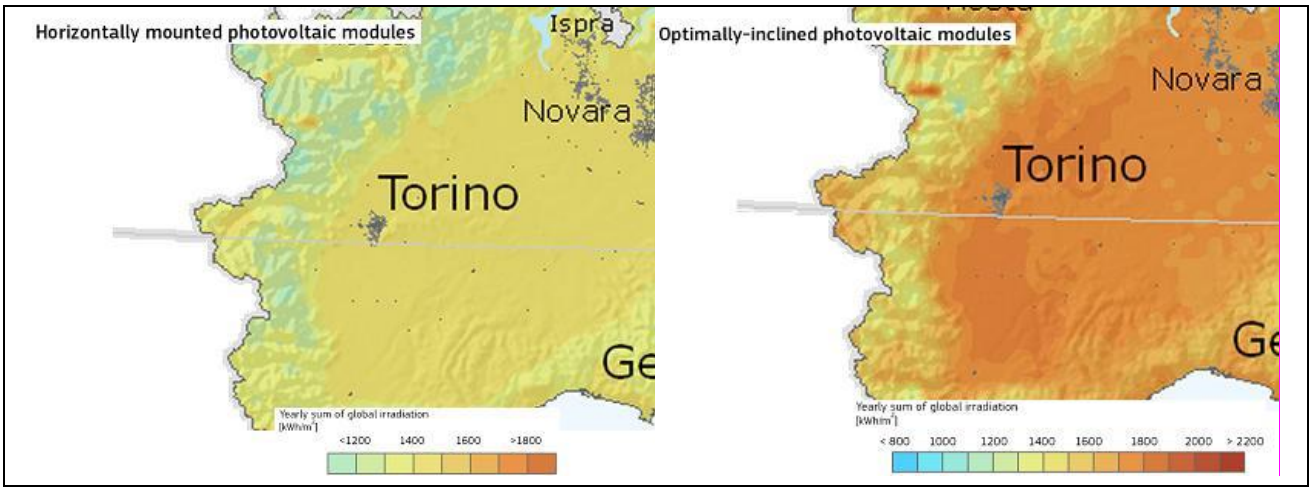



*Figure 2.1.2.Bm – Solar irradiation per year in Turin Province (horizontal and optimal-inclined modules) (source: PVGis, Institute for Energy and Transport (JRC))*

From Atlasole website (the official GSE portal - National Energy Management Authority) it's possible to obtain the data about the photovoltaic production of the province on municipal level. Below it's reported one of these maps: it represents the residential PV production in 2012 (systems under 20 kW).

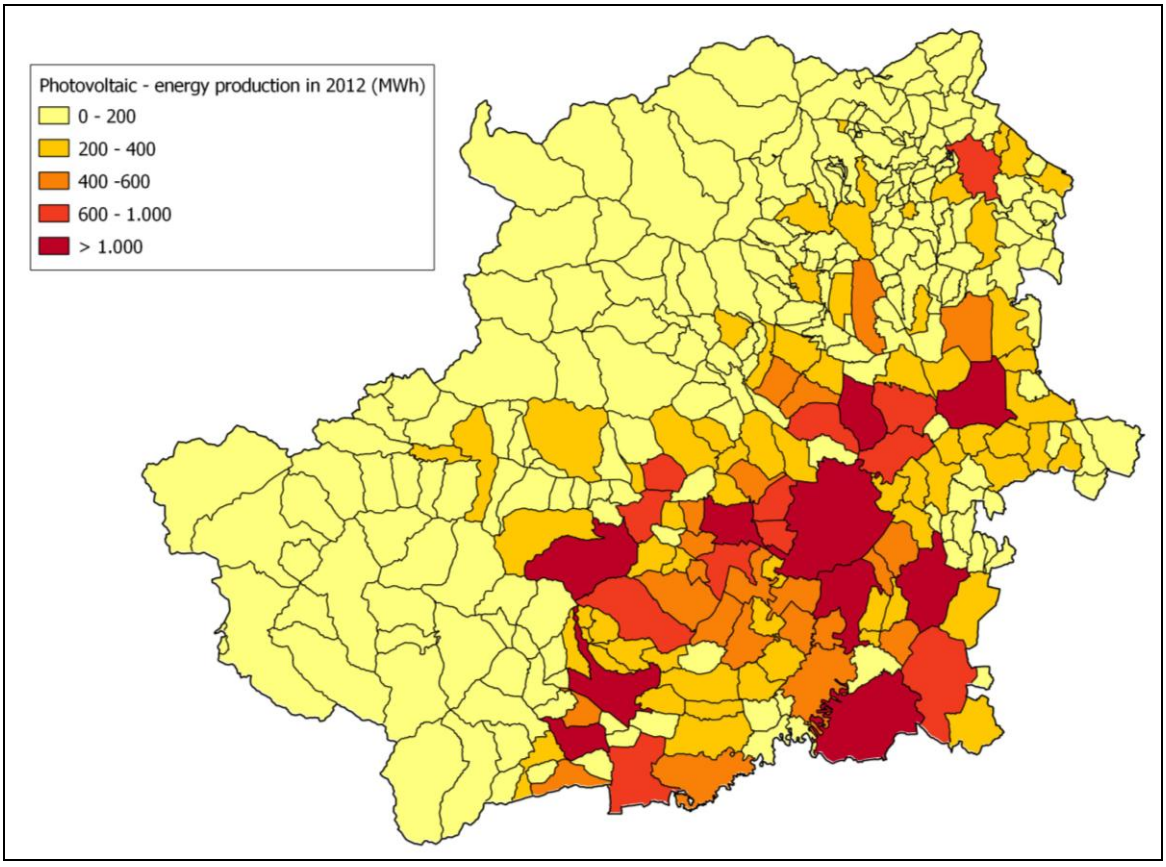



*Figure 2.1.2.Bm2 – Photovoltaic production in the Province (Municipal base - year 2012)*

In 2011, the economic quantification of the solar thermal market of the concept region is estimated in about 20,5 million €, with 206 employees involved. The estimation of solar thermal panels sold in the province in 2011 is 20.574 sqm. The residential market is about the 85% of the total.

### 2.1.2.C *Geothermal power*

The contribution of this source is lower than 1% of the total renewable in 2011, reaching 5,1 ktep supplied. As you can see from the picture below, the provincial territory is not one of the best places of the nation regarding this type of source. The existing capacity of its plants was about 29 MW as total power of more than 280 installations, in fact the current capacity is 32 times higher than ten years before capacity. In 2020, the expected trend will bring an increase in the geothermal final uses of about 190% in relation to 2011 and a installed capacity of 82 MW. According to the burding sharing target fixed at a regional level, in the Province of Turin a geothermal capacity of 310 MW should be achieved. Some technical data about this source: the average heat extraction potential for the vertical closed loop systems is 60 W/meter; the horizontal closed loop systems, instead, can exploit a potential of 30 W/square meter. Both of these values represents a good situation of the geological conditions for the low-enthalpy geothermal plants. According to actual ask for license, the open loop technology seems to be the most promising for large buildings (multifamily households or service and commerce skyscrapers).
About the future, the principal barriers found in the use of geothermal energy are the high capital costs for the installation of the geothermal plants and the huge documentation (with lengthy procedures) which has to be produced to obtain the license, mostly for open loop systems.
The economic quantification of the geothermal market of the concept region is estimated in about 2,7 million € in 2011, with 27 employees involved. The residential market is about the 40% of the total, with 1 M€.

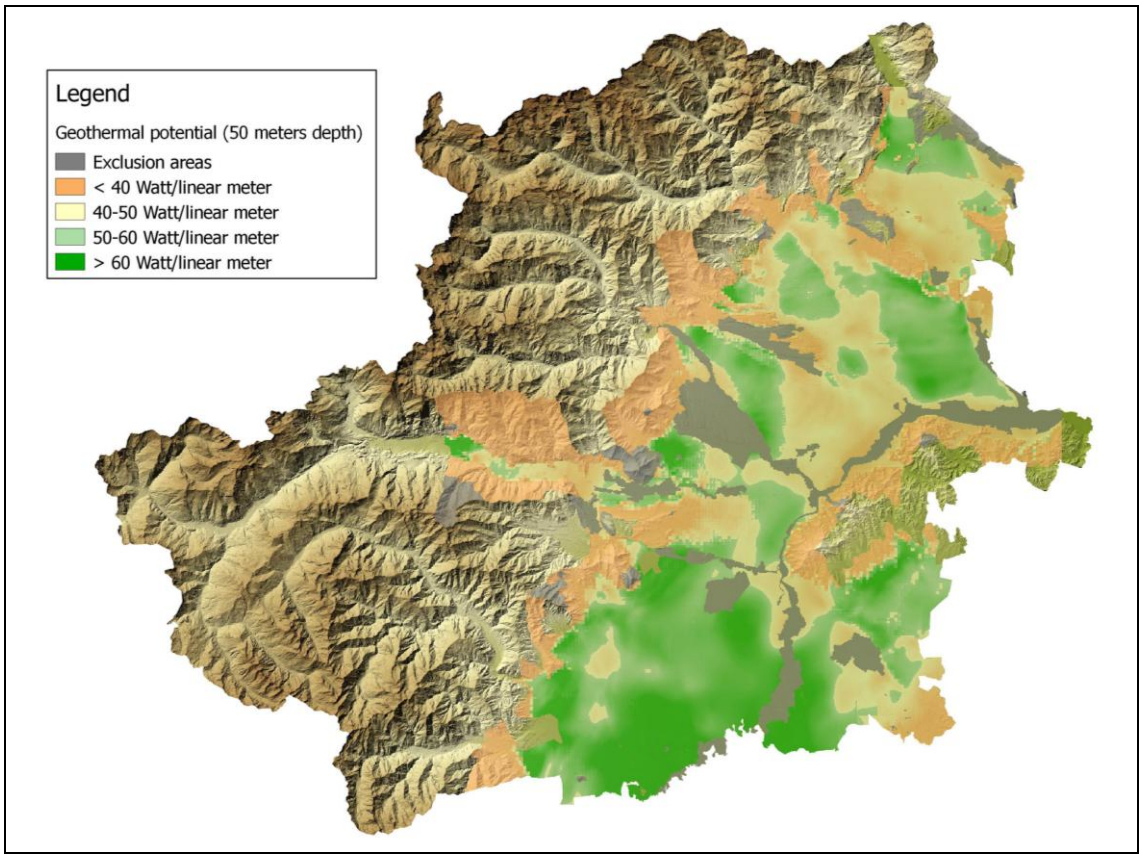



*Figure 2.1.2.Cm – Map of geothermal sources (low-enthalpy) at a depth of 50m*

### 2.1.2.D *Hydroelectric power*

From the Energy Report of the Province of Turin, in 2011, the hydroelectric power production was about 2.285 GWh. The contribution on the total RES supply is about 38%. From 2000 the production didn't change so much: in fact it was very similar, 2.153 GWh.
This source is historically established in the Province of Torino, mainly for the positive orographic situation and the very high drainage density. In 2020 the expected trend will not be much higher than in 2011: the

growth of the electricity production will be around 14%. This potential derive primarily from a more efficient exploitation of the existing plants and a rationalization of the system. The principal barrier hindering the use of hydropower energy is the environmental impact of new plants and the difficulty to obtain new licenses. About the storage system, it's important to underline that some storage hydropower systems are running for long time in our province pumping the water in the system during low peak hours and generating electricity during top peak hour.

| Hydro plants | MW | GWh | Storage GWh |
|---|---|---|---|
| Agnel Serrù villa | 40 | 80 | no |
| Ceresole | 100 | 250 | no |
| Bardonetto | 18 | 70 | no |
| Pont | 14,5 | 70 | no |
| Valsoera | 38 | 13 | 25 |
| Telessio | 82 | 200 | no |
| San Lorenzo | 4,3 | 8 | no |
| Pont Ventoux | 155 | 280 | 70 |
| La Loggia | 3,2 | 20 | no |
| San Mauro | 8 | 40 | no |
| **Total** | **463** | **1031** | **95** |

In the table (source GSE, 2012) is shown the list of the hydro power plants of one of the main electric operator of the province, where only two operate night pumping. In average the contribution of storage is around 20% of the overall energy production of plants.
Even if night pumping is considered one of the most effective technology for storage, as recommended by EU policies, too, and the technical feasibility of further pumping plant on existing basins, no investment are expected in the short period, because of environmental, public opinion and landscape ties.
Below it's reported the map indicating the spatial distribution of main hydropower plants and all the small hydro plants on the province territory.

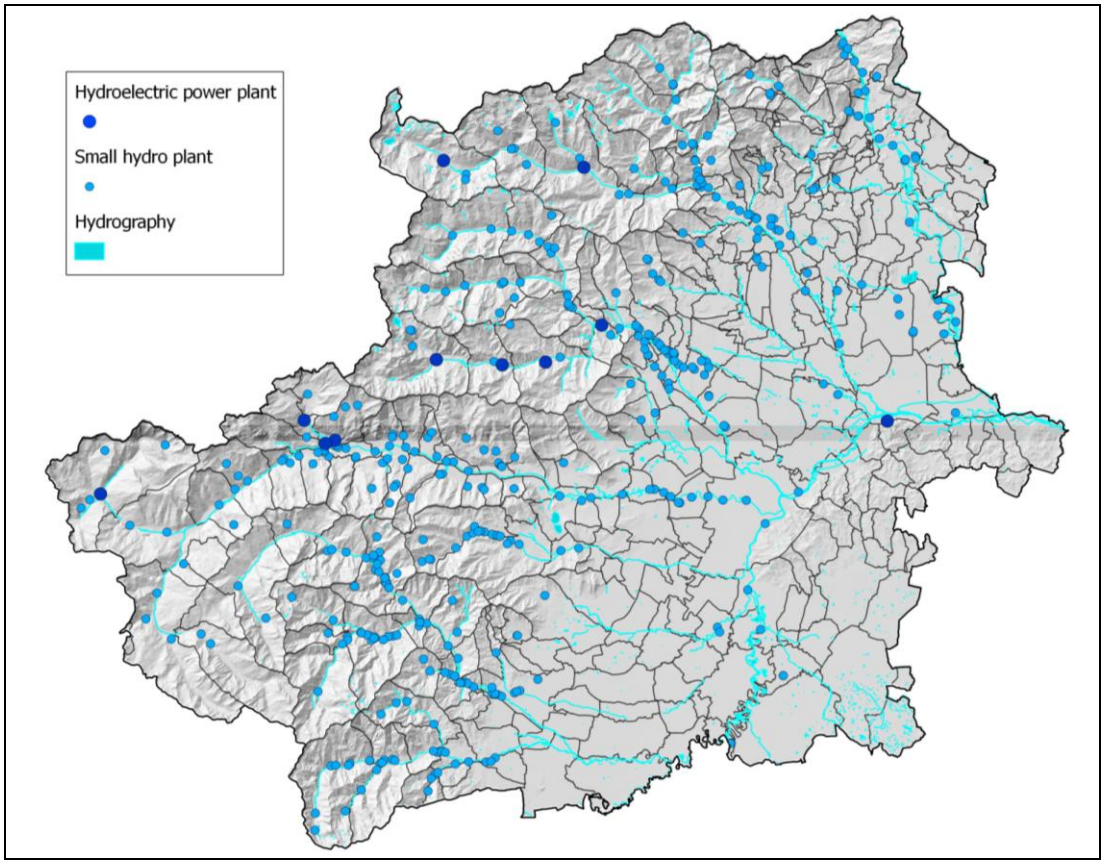



*Figure 2.1.2.Dm – Location of hydroelectric plants in the Province*

### *2.1.2.E Biomass energy utilization*

Biomass is the largest renewable source in the province with an energy contribution of almost 58% on the total of RES. The annual supply of biomass in the province is about 301 ktoe. This use of such supply consist

of 2/3 of energy used directly by end-users (log wood, pellets and wood chips used in boilers) and 1/3 from the processes of production of electricity and heat (from wood chips, biogas and oils power plants). According to current estimation we can assume that only half of the biomass is produced locally, whereas the rest is imported from other Italian regions and foreign countries.
The use of forestry wood as energy source is historically ingrained in the province population, in fact the most important form of utilization of forests in the region and in the entire Piedmont is linked to the production of timber wood and for energy source. The wood biomass that could be draw back is divided into different types, by excluding the roundwood that has a commercial value, the remaining residues potentially available for the energy supply chain are the stumpwood (41%) and the firewood (36% of the total). The poplar grove is the only example of supply chain established in Piedmont for the production of timber wood, with a share of volumes used approximately 400,000 m3/year.
According to the data of the Map of Piedmont forest (1:100,000-IPLA) in the Province of Turin the forest area extends over 220.164 hectares, accounting for 32% of the total Regional forest area with an average index of woodiness of 29%. The high forests amounted to approximately 78,000 acres (43%), of which nearly 50,000 of conifers and the rest of broadleaf or mixed (of which, over 10,000 hectares of poplar and 1600 hectares of chestnut groves). The coppice takes up more than 100,000 hectares (57%), with beech, chestnut, black locust, oak. As is known, the public properties (approximately 40%) are prevalent in mountain areas, while in the low valleys, hills and plains prevail distinctly private ownership, with deciduous and traditionally as coppice. All the data required and obtained about every type of biomass are reported in the table “Energy supply data”.
The plants using biomass (with capacity over 110 kW) to produce electricity and heat are located overall in the plain part of the province territory, as it shown in brown in the image below.

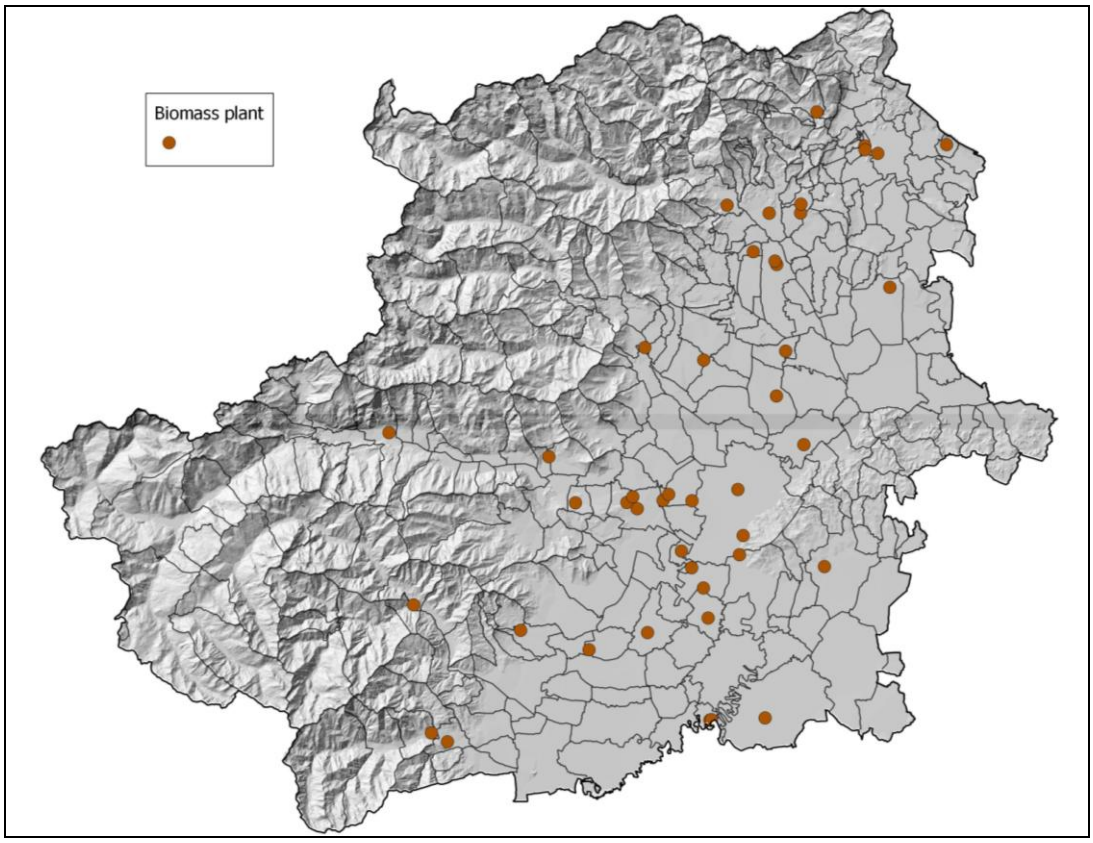
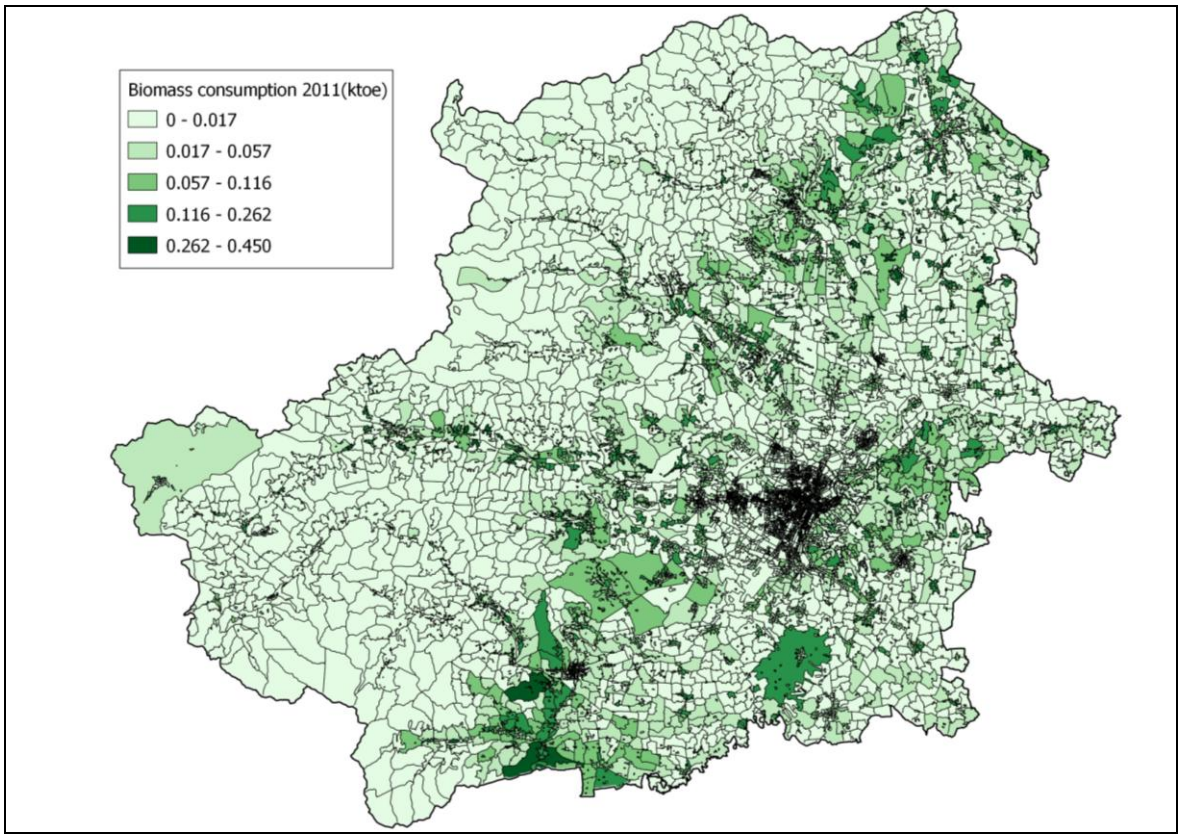



*Figure 2.1.2.Em – Location of biomass plants in the Province*

According to the recent survey coming from EU RENERFOR project (Alcotra Program), it was possible to elaborate maps with spatial distribution of biomass installations in residential buildings in 2011 and the potential development in 2020. Two maps, indicating these dynamics, are reported in the next page.



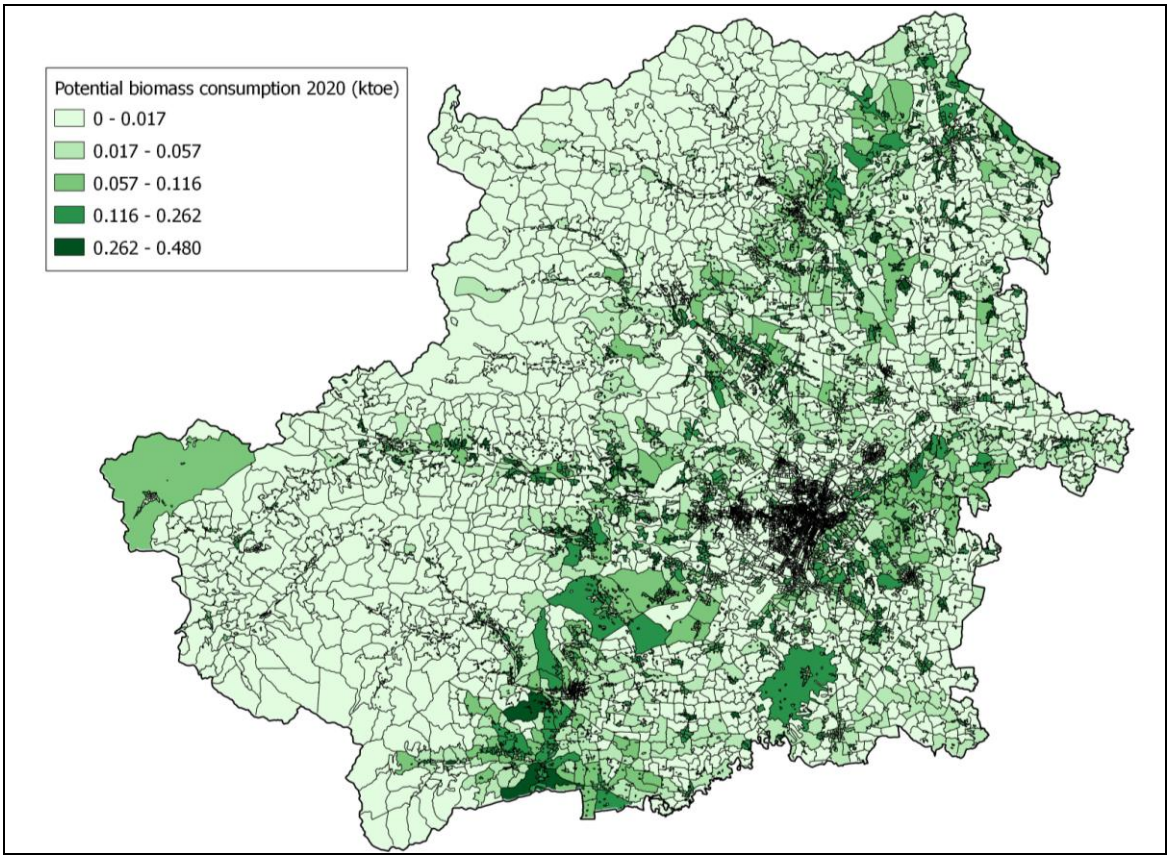




*Figure 2.1.2.Em2 – Actual biomass consumption (2011) and potential (2020)*

### *2.1.2.F Waste and other renewable energy sources*

Another renewable source that deserves to be mentioned for the energy production is the "waste".
Based on the data collected by the Waste Observatory of the Province of Turin and the ATO-Rifiuti Torinese, the total production of municipal waste in 2011 decreased by 2,3% compared to 2010 (about 26,000 tons less).
The residual urban waste after recycling is reduced as much 3.1%, and therefore the need for disposal. The percentage of waste collection, for the whole province, rose to 50.1%, while remaining below the targets set by Provincial Program 2006 (52.1%) and national legislation (55%) for 2011.
It's represented a table indicating some data about the provincial waste collection.

| CONSORTIUM | INHABITANTS (dec 2010) | Total waste 2011 (ton) | Total waste per capita - 2011 (kg/inh/y) | %recycling 2010 | %recycling 2011 | Recycling waste 2011 (ton) |
|---|---|---|---|---|---|---|
| ACEA | 151.554 | 73.606 | 486 | 50,56% | 53,92% | 39.687 |
| BACINO 16 | 237.012 | 104.595 | 441 | 52,62% | 54,29% | 56.782 |
| BACINO 18 | 907.563 | 477.895 | 527 | 42,41% | 42,93% | 205.164 |
| CADOS | 334.304 | 155.658 | 466 | 53,03% | 52,28% | 81.379 |
| CCA | 191.757 | 82.161 | 428 | 58,17% | 54,78% | 45.007 |
| CCS | 123.478 | 49.019 | 397 | 66,35% | 68,21% | 33.436 |
| CISA | 99.049 | 41.915 | 423 | 52,67% | 52,75% | 22.111 |
| COVAR 14 | 258.527 | 108.473 | 420 | 61,88% | 62,84% | 68.166 |
| **Provincia di Torino** | **2.303.244** | **1.093.322** | **475** | **50,01%** | **50,46%** | **551.732** |

A part of the total amount of these waste are used to produce electrical and thermal Energy in a plant near Turin City: the so called "Gerbido incinerator".
This one is a plant for the combustion of municipal solid waste (MSW) residues from recycling and waste similar to urban (RSA). The heat of combustion of waste is recovered and converted into electricity and heat (cogeneration), to be placed in electrical networks and district heating.
Below are reported some relevant data about this plant.

| **Main data of the plant** | |
|---|---|
| Total waste load (Residue - RD and RSA) | 421.000 t/a |
| Number of lines | 3 (gemelle) |
| PCI nominal | 11 MJ/Kg |
| Rated thermal load total | 206 MWt |
| Total nominal capacity | 67,5 t/h |
| Production of total steam | 220 t/h |
| Vapor Pressure | 60 bar(a) |
| Steam temperature | 420 °C |
| | |
| **Main characteristics** | |
| Type of technology | Moving grate furnace |
| Grinding system bulky | Hydraulic guillotine shearing machine |
| Type of grid | Grid air-cooled with recirculated flue gas |
| Boiler | Boiler with horizontal convective channel |
| Flue gas treatment | Electrostatic - Injection reagents (sodium bicarbonate and activated carbon) - Bag Filter - DeNOx catalytic (SCR) |
| Solid waste treatment | Mechanical treatments of waste (recovery of metals) |
| | Contribution of ashes to dedicated systems for inerting. |
| Type of turbine | A condensation spills regulated |
| Condensation system | Condensing water loop and cooling towers such as "wet-dry". |

| Energy data | |
|---|---|
| Electricity produced | 350.000 MWh |
| Supply of Electricity | 175.000 medium loads |
| Thermal energy produced | 170.000 MWh |
| Housing units heated | 17.000 medium loads |
| Conventional fuel saved | > 70.000 Toe/y |

From waste management, on the territory of the province, comes out another type of thermoelectric plant. This is the biogas power plant. There are 12 plants spread through the Province of Turin and they use biogas to produce mainly electricity. This is the list of those plants with some relevant data.

| Enterprise | Typology | Municipality | Input Capacity kW | Electricity kWe |
|---|---|---|---|---|
| AMIAT | Biogas from waste management | Torino | 35.000 | 11.500 |
| ASJA AMBIENTE ITALIA | Biogas from waste management | Pianezza | 4.300 | 1673 |
| Bio Powerstock | Biogas from waste management | Pianezza | 2.450 | 999 |
| Cassagna | Biogas from waste management | Pianezza | 2.750 | 990 |
| SMAT | Biogas from wastewater process | Castiglione | 13.500 | 5636 |
| MARCOPOLO (ASA) | Biogas from waste management | Castellamonte | 1.572 | 625 |
| SERVIZI ECOLOGICI | Biogas from waste management | Beinasco | | 472 |
| SMAT (ex AIDA) | Biogas from wastewater process | Pianezza | ? | 160 |
| INSER | Biogas from waste management | Cambiano | 1718 | 560 |
| ACEA PINEROLESE (Polo ecologico) | Biogas from waste management | Pinerolo | 8.530 | 3156 |
| ASJA BIZ | Biogas from waste management | Grosso | 1578 | 625 |
| MARCOPOLO | Biogas from waste management | Strambino | 933 | 350 |

## 2.2 SECONDARY ENERGY

#### *2.2.1.A Electricity*

In 2011, in the province of Turin, 12.3 TWh of electricity were produced, slightly less than the average of the last five years, but nearly 1.6 TWh more than in domestic demand.
More than 80,2% of electricity comes from thermal power plants, 18.5% from hydro plants and 1,3% from photovoltaic, the contribution of wind energy is negligible, in fact the first plants came into operation from 2010. The thermoelectric sector is largely also cogeneration, so they should be added about 3.7 TWh of useful heat energy produced. The heat generated is more than two-thirds distributed or sold to end-users through district heating networks and the remainder self-consumed by users industrial. Finally, a residual amount of heat (291 GWh in 2011) comes from thermal power stations, mainly up and integration of the existing district heating networks. The absolute peak of electricity production was recorded in 2008 with 13.296 GWh, while the peak in the balance between production and electricity consumption was recorded in

2009 with +1781 GWh. The data for 2011 confirms the positive balance with foreign countries, with a surplus close to the peak of the previous two years, while in 2010 for the first time since 2005, net provincial falls below 12 TWh.
For both the 2010 and the 2011 net production of electricity from renewable nearly 20% of what is produced, slightly lower than the peak of 21.6% in 2009, but much higher than previous years (around 15%). Even more important is the share of domestic electricity needs met with local renewable energy production, which, for both years, is higher than 23%. The 2010 datum is particularly important because in Europe there was a 21% target of electricity production from renewable total electrical consumption. Just as it was for Europe as a whole in the province of Turin this objective therefore has been reached and exceeded.
It's always hydropower to hold the largest share of renewable energy electricity with 85% of the total production.

| Electricity produced | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydro power plants | 2.153 | 2.106 | 2.187 | 1.819 | 2.181 | 2.058 | 1.906 | 1.930 | 19.725 | 2.674 | 2.276 | 2.285 |
| Thermal power plants | 254 | 167 | 79 | 45 | 1.714 | 5.525 | 5.581 | 5.499 | 4.837 | 3.013 | 2.482 | 2.638 |
| CHP plants | 2.792 | 2.813 | 2.783 | 2.892 | 3.034 | 4.588 | 4.996 | 5.117 | 6.484 | 6.762 | 7.058 | 7.258 |
| Photovoltaic | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 14 | 29 | 159 |
| Wind power | | | | | | | | | | | 0 | 0 |
| **Total production** | **5.199** | **5.086** | **5.049** | **4.756** | **6.929** | **12.172** | **12.484** | **12.548** | **31.049** | **12.463** | **11.845** | **12.340** |

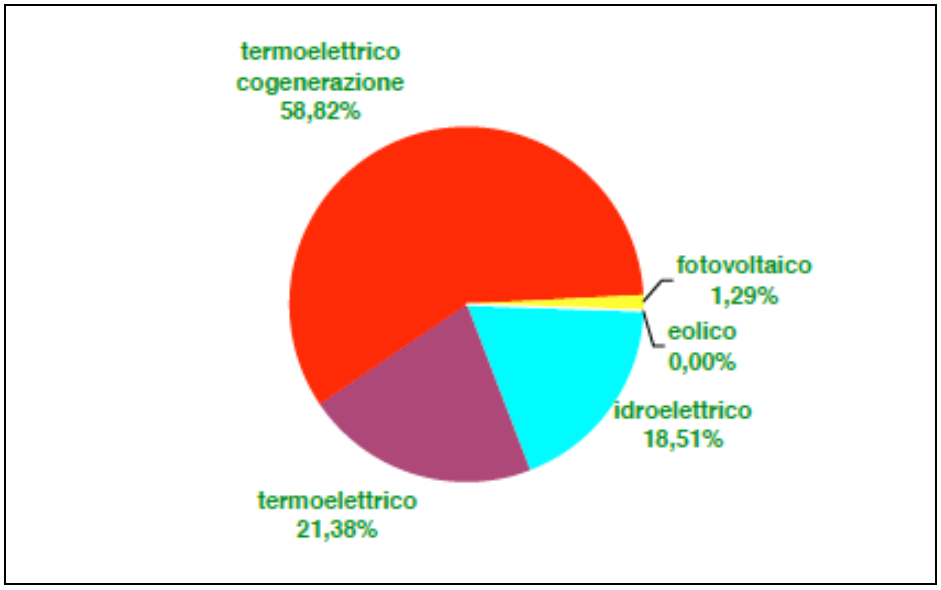



*Figure 2.2.1.gr1 - Breakdown of net production of electricity in 2011*

### *2.2.2.A Heat*

Heating is becoming more and more important in the overall energy balance of the province of Torino. A total amount of 3.000 GWh of heating was generated and distributed in 2010 mainly to private households customers. Heating represents more than 5% of total final energy consumptions and nearly 12,5% of total thermal consumptions of buildings.
In 2011, the share of self-production of heat for the province amounted to 27% of the total heat, in sharp decline (from a point of relative and absolute terms) compared to what was happening only two years earlier. This negative trend is pursued in the contraction of the overall energy demand of the industrial sector.
The total useful energy produced by the thermoelectric sector is, therefore, equal to slightly less than 1,4 Mtoe (16,1 TWh), with a primary energy consumption of nearly 1,9 Mtoe and with a return of about 62%. The total energy consumed is made up of 94,4% for natural gas and 5,3% from biomass (including biogas). The remainder is attributable to petroleum products (fuel oil and diesel fuel).

As mentioned before, the thermoelectric sector is largely also cogeneration. In fact the heat generated is more than two-thirds distributed or sold to end-users through district heating networks and the remainder self-consumed by industrial users. Finally, a residual amount of heat (291 GWh in 2011) comes from thermal power stations, mainly up and integration of the existing district heating networks.

| Heat produced | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industrial CHP | 1.946 | 2.185 | 2.252 | 2.177 | 2.127 | 2.002 | 1.531 | 1.518 | 2.041 | 1.825 | 1.611 | 1.243 |
| CHP for district heating (DH) | 909 | 1.087 | 1.095 | 1.137 | 1.182 | 1.197 | 1.310 | 1.359 | 1.697 | 1.810 | 2.222 | 2.194 |
| Thermal production for DH | 293 | 266 | 269 | 323 | 348 | 396 | 291 | 334 | 434 | 487 | 469 | 291 |
| **Total production** | **3.148** | **3.538** | **3.616** | **3.637** | **3.657** | **3.595** | **3.132** | **3.211** | **4.172** | **4.122** | **4.302** | **3.728** |

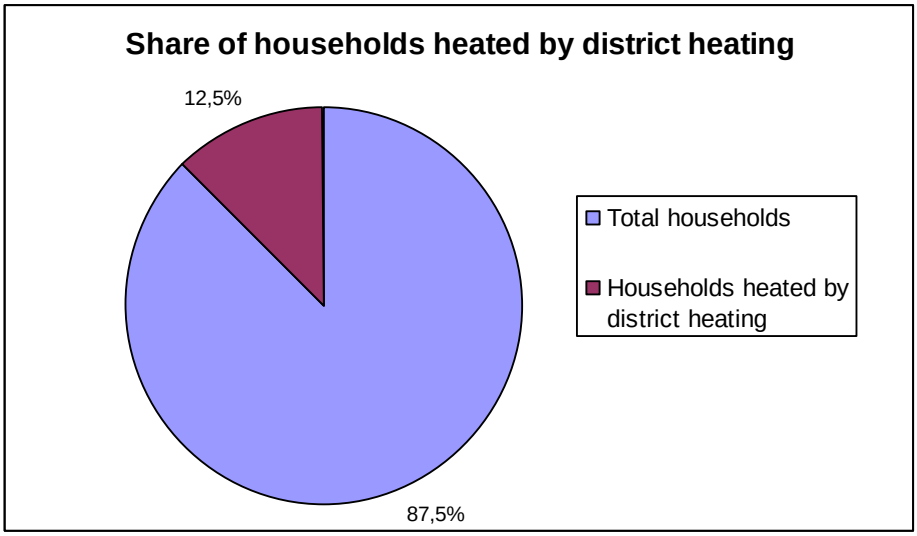



*Figure 2.2.2.gr1 – Share of households heated by DH on total households.*

### *2.2.3.A Refined and synthetic fuels*

The fuels used in the province of Torino are: gasoline, diesel, liquid petroleum gas and fuel oil. No refinery process take place within the provincial borders and all fuels are imported from other regions and foreign countries.

The transport sector is the main one to use this type of sources. The total energy supply for mobility decreased by 16.5% in the period from 2000 to 2010. The reduction of supply was driven by the fall of the demand occurred in the last two year of the decade. In 2009 oil products supply was 23% less than 10 years before. The reduction was particularly evident between 2007 and 2008 were a reduction by 10% occurred just in one year. More than half of consumptions are related to diesel, which is by far the most important product required and by consequence supplied. Its importance grew along the years taking place of gasoline, whose use decreased by nearly half. The preference of people moved from gasoline to diesel as prices of fuel raised up during nineties and the last decade, so that a lot of diesel cars were sold taking place of traditional petrol ones. Assumed that situation, what is surprising is the decrease of diesel consumptions from 2008 on. This can be explained only by taking into consideration the transport of goods. Freight transport was affected by economic crisis as well as industry and this situation is clearly reflected in the energy demand/supply.

Transport sector has a dependency from oil products which was up to 99% in 2000 and decreased to 92% in 2009, as alternative fuels (natural gas) or energy carriers (electricity) were required by the market.

Below it's reported the total amount of oil products supply divided for type of carrier. The first three (LPG, Diesel, Petrol) are linked with the transport sector mentioned till now. The other one is fuel oil. It's used in domestic or industrial sector, but its supply is decreasing in the last years for the substitution with other energy carriers such as natural gas mainly.

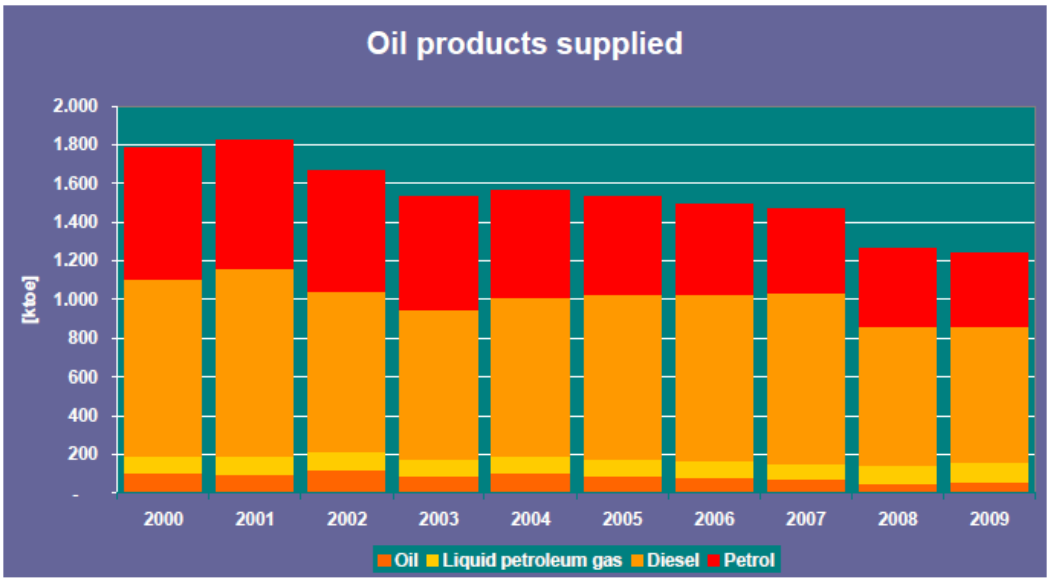



*Figure 2.2.3.Am – Oil products supplied in the Province*

In 2010 the total amount of energy derived from fuel sold in the province for the transport sector was 11.870.258 MWh, precisely 4.187.974 MWh from gasoline and 7.682.284 MWh from diesel. In this analysis we consider only the two main carrier (gasoline and diesel).
It's possible to represent these data on a municipal base, so two maps are reported below to represent the situation on a local level about the transport energy supply.

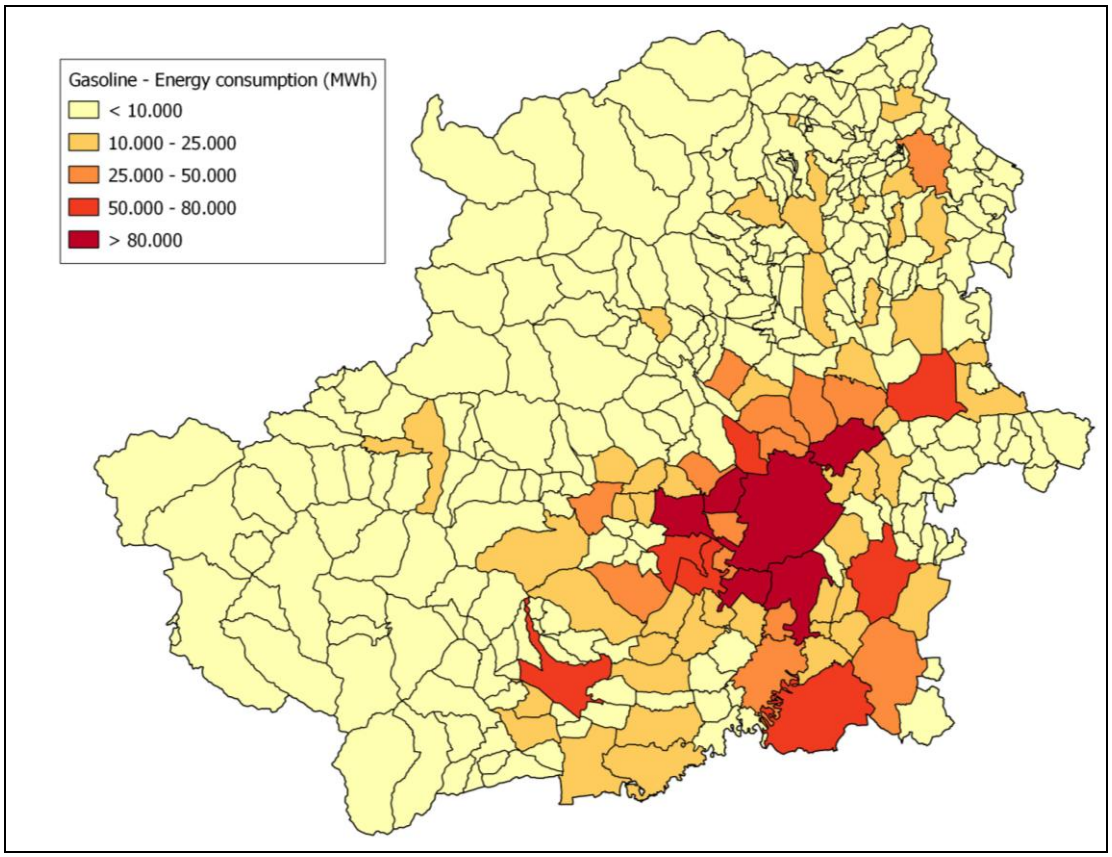



*Figure 2.2.3.Am2 – Gasoline consumption in the Province*

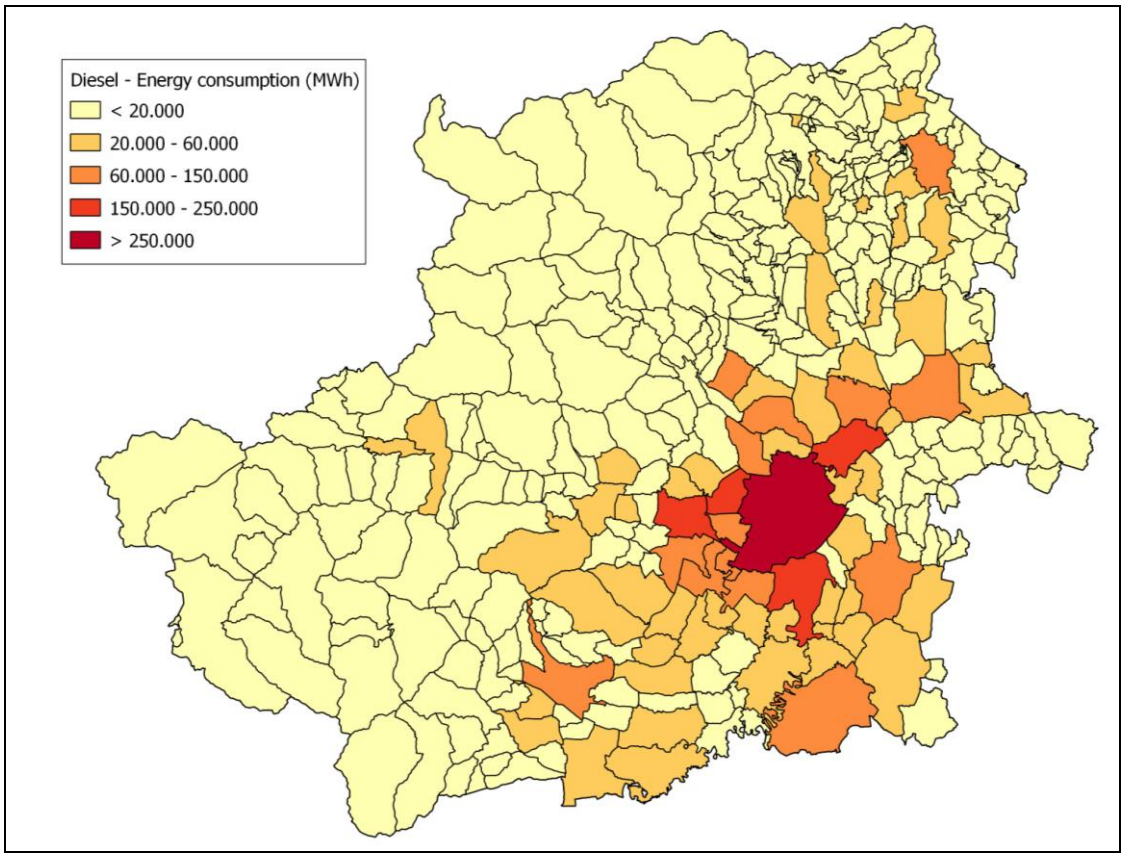



*Figure 2.2.3.Am3 – Diesel consumption in the Province*

# 3 Mapping of main energy producers and distributors

## 3.1 PRIMARY ENERGY PRODUCERS AND DISTRIBUTORS

### ***3.1.A*** *Main fossil energy producers*

There aren't any producers on the provincial territory.

### ***3.1.B - E*** *Crude oil and refined oil products*

The crude oil is not used and produced directly on the territory of the province, as already mentioned.
The energy supply system of refined oil products derived from it (gasoline, diesel, ect..), is performed entirely with road transport (tanker trucks) so there isn't a real grid. Clearly, among the province, there are a network of gas station that guarantee the distribution to the citizens within the entire province territory.

### *3.1.C - D Natural gas and Gas services companies*

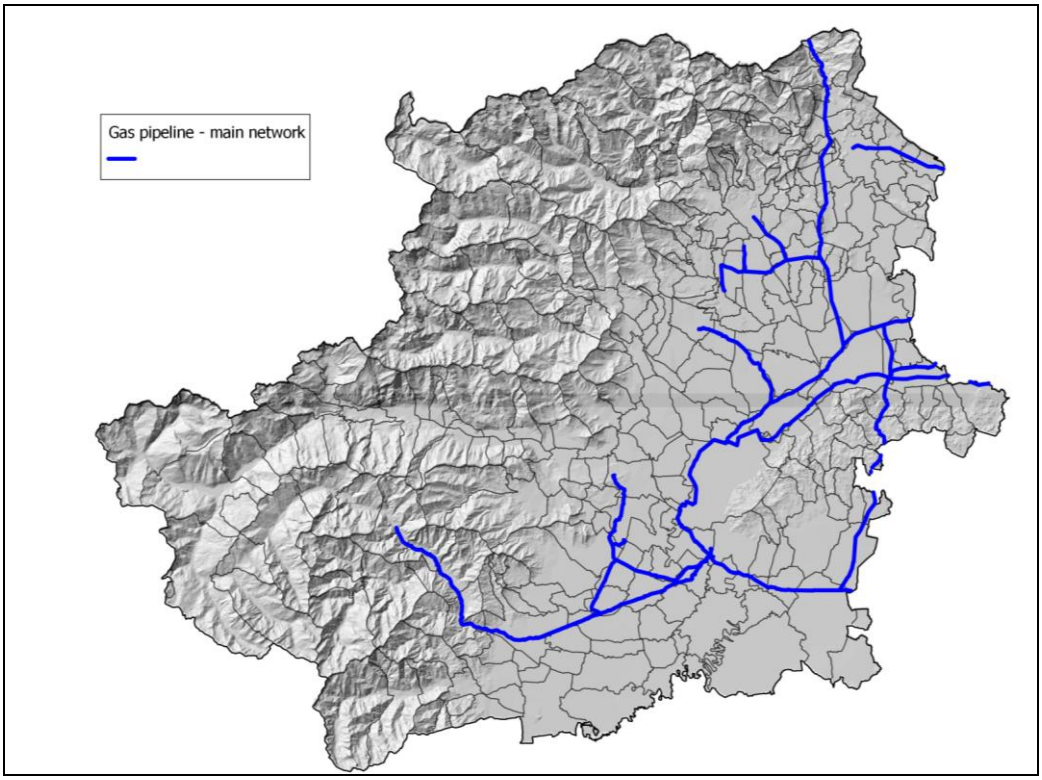



*Fig 3.1.cm – Gas pipeline network in the Province*

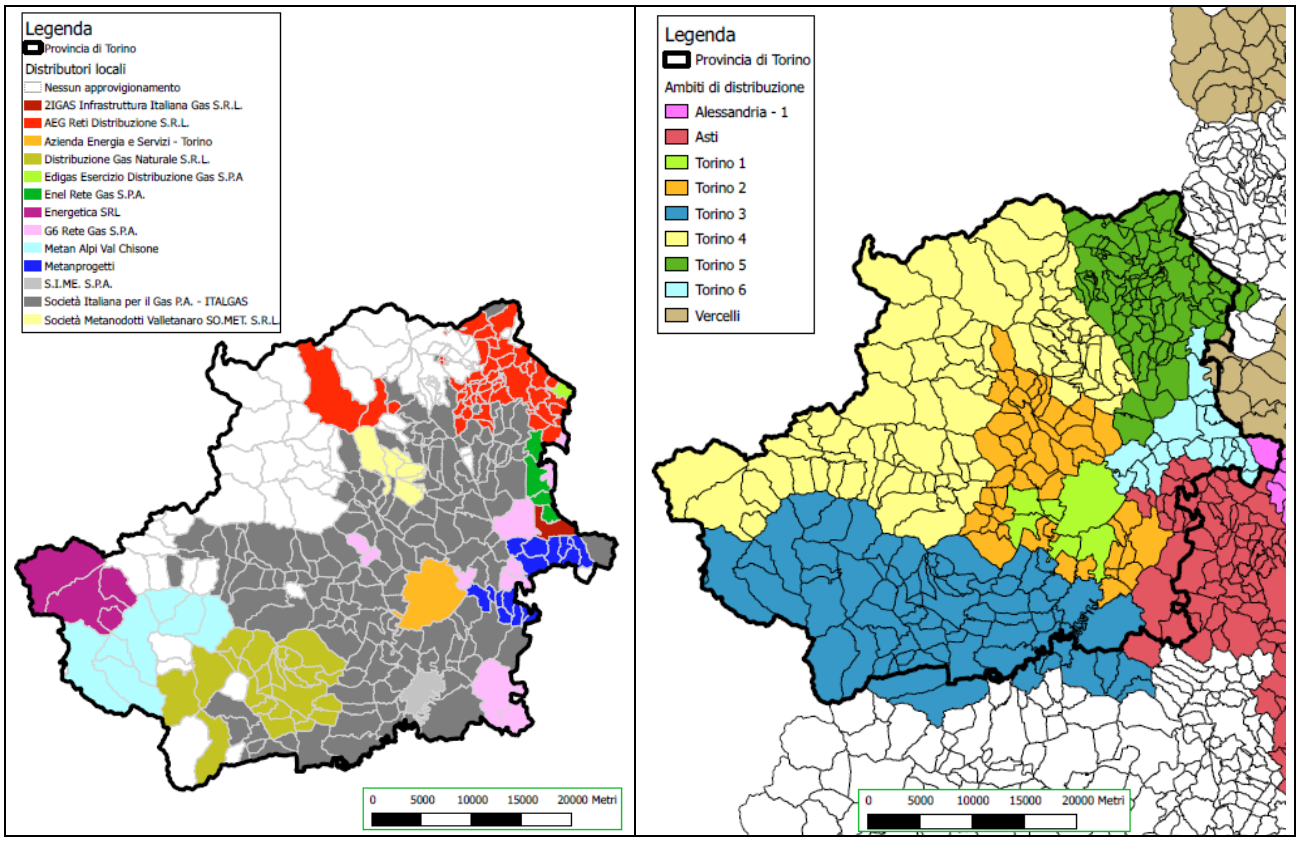



*Figure 3.1.dm - Actual gas distributors map and foreseen situation in coming years*

The figure on the left shown the actual situation of the gas distribution in the province of Turin, while the other one represent the future plans, as established by the national law.
The article 46/bis of Decree n.159/2007, converted in the Law. n.222/2007 and subsequent amendments represents the turning point in the evolution of the legal framework in the field of gas distribution. With this provision the Legislature has delegated to the next ministerial decrees the definition of race rules uniform throughout the country and the introduction of minimum geographical areas of competition (ATEM) according basins optimum user to be identified according to criteria of efficiency and reduction of costs, thereby leading to the municipal dimension of competitive race. With the enactment of the Ministerial Decree of 19 January 2011 were identified the minimum geographical areas for the conduct of tenders and awarding concessions for the distribution and subsequent Ministerial Decree 18 October 2011 have been determined the municipalities belonging to each geographical area. In light of these decrees all the concessions, not already assigned by public tender, without exception expired on 31/12/2012.
The tenders for the gas distribution service should therefore be banned for minimum geographical areas and the Decree 226/2011 fixes the date by which each area has to initiate the procedure.
In the province of Turin, the law has identified six ATEM where they will be handled approximately 8,000 km of network and one million customers. Nineteen municipalities of the province belong to areas of other provinces, 12 municipalities in contrast to other provinces belong to the Turin's area.

## 3.2 SECONDARY ENERGY PRODUCERS AND DISTRIBUTORS

### ***3.2.A - C*** *Electricity producers and distributors*

#### *Production*

The Province of Torino turned to be a self sufficient region for electricity from 2005 on. In the past the electric deficit was around 60% of its needs. The gap was reduced thanks to few CHP groups that entered into force between 2004 and 2005. All those plants are fed by natural gas with energy efficiency standards in line with best available technologies. From that moment on, local generation of electricity has been higher than consumptions and the balance between import and export has grown significantly becoming more or less 15% of total consumptions. Historically the province of Torino had an important production of electricity coming from hydropower plants and the amount of energy generated remained quite stable along the period (around 2 TWh/y), with the exception of 2009 in which a top peak production from hydro was recorded (2.6 TWh). The share of this source of energy, at the beginning of the decade equal to 40% of total local production, turned to be 20% as the thermoelectric production doubled later on.
The energy generation system of the province of Torino is composed by several plants (about 300, PV excluded), most of which are quite small. Hydropower plants are 193, Thermoelectric power plants are 100, whereas wind power plants are only 4. Few CHP plants nearby the City of Torino give a mayor contribution to the overall production of electricity and are also feeding the large district heating system of the City of Torino and surrounding municipalities, which is on the way to be extended in the new few years with further important investments. Up to now, the district heating system of Torino is the largest in Italy and the extension planned will bring Torino as one of the leaders in Europe in this field.
In the following tables several details on three important energy suppliers will be provided. The sample chosen give an overview of the systems available. First of all the CHP system located in Moncalieri which is the main provider of energy for the district heating system of the City of Torino is described, secondly the Chivasso Power Plant was selected as a reference of bigger Power plants without heating recovering. Finally the description of the most important biomass power plant is provided.

**Moncalieri IREN CHP plant:**
Gross Electric Power: 800 MW and Thermic Power in combined asset: 520 MW,
Number of groups: 2 Combined Heat and Power and 1 Boiler for integration and reserves.

The system is the main source of energy for the district heating system of the City of Torino (400 km of net providing heating for almost 400.000 people).

**General description:**

Moncalieri CHP plant is operated by the company IREN, which is owned, as major shareholder by the City of Torino. The system is made of 2 highly efficient CHP groups and one boiler that support the district heating system of the City in peak load demand. The actual system is the result of a repowering process that was finished in 2005. This CHP plant is located in the surroundings of the City of Torino, close to its Southern border, but it is not the only supplier of the district heating system of the City.

The electricity production is increasing over the years as this plant has a dispatching priority in comparison to other Power plant locally installed, as it supplies district heating. In 2010 this plant was able to provide more than 30% of all domestic production of electricity and in the last year its production was really close to its potential with around 8.000 working hours equivalent.

## Chivasso Power Plant:

Gross Power: 1.179 MW,

Number of groups: 2 Combined Heat and Power, by which 1 with 2 turbo power sections and 1 steam section and the other with 1 turbo power and 1 steam section.

Originally the Plant had a 280 MW power. In 2005 the new rewamped plant entered into force. Nowadays heating is not produced.

**General description:**

Chivasso Power Plant is operated by the company Edipower, which was recently bought from the IREN group. The plant is the biggest of the province of Torino with more than 1 GW installed. The plant was originally built up in 1950 and the last retrofit took place in 2006.

The plant is working only with natural gas and its consumptions and production was really very relevant between 2006 and 2008, when the plant was generating almost 45% of all domestic production of electricity. The electricity generation dropped very much in the last years where its capacity is not at all properly used. The working equivalent hours dropped to around 2.000. This situation was the consequence of both the reduced demand of electricity and the increase of energy supply with dispatching priority (renewables and CHP plants).

## Airasca Power Plant highlights:

Gross Electric Power: 14 MW.

The plant is providing heating for a neighboring factory.

The plant is fed by wood chips with an additional diesel generator for emergency use.

**General description:**

Airasca wood-chip power plant is the biggest of these kinds in the province of Torino. Several new proposals for similar plants have been assessed and approved, but no concrete investments have

been made, yet. The plant is in operation from 2003 and is using wood-chip partly coming from abroad and partly withdrawn locally. The electricity put in the grid receive benefit from a subsidy scheme; this support is essential for its economic sustainability as without the plant will probably stop producing due to biomass cost in the market. The plant is CHP and provides heating for a neighboring factory. The overall energy efficiency of the system is quite low (between 22% and 26%) but in line with similar plants.

Airasca power plant gives a contribution of less than 1% of total domestic electric generation.

As the province of Torino is a region affected by a severe situation related to air quality, biomass power plant are not considered as a good solution because of their emissions of NOx and dust which are relevant in comparison to other generation plants.

*Distribution*

The National electricity grid is wide spread with more than 311 km of high voltage grid and 487 km of 220 kV in the province territory. This concept region is one of the cross border region of Italy and the exchange of electricity with France is one of the key point of the National electric system (more than 11.000 GWh are imported every year from France).

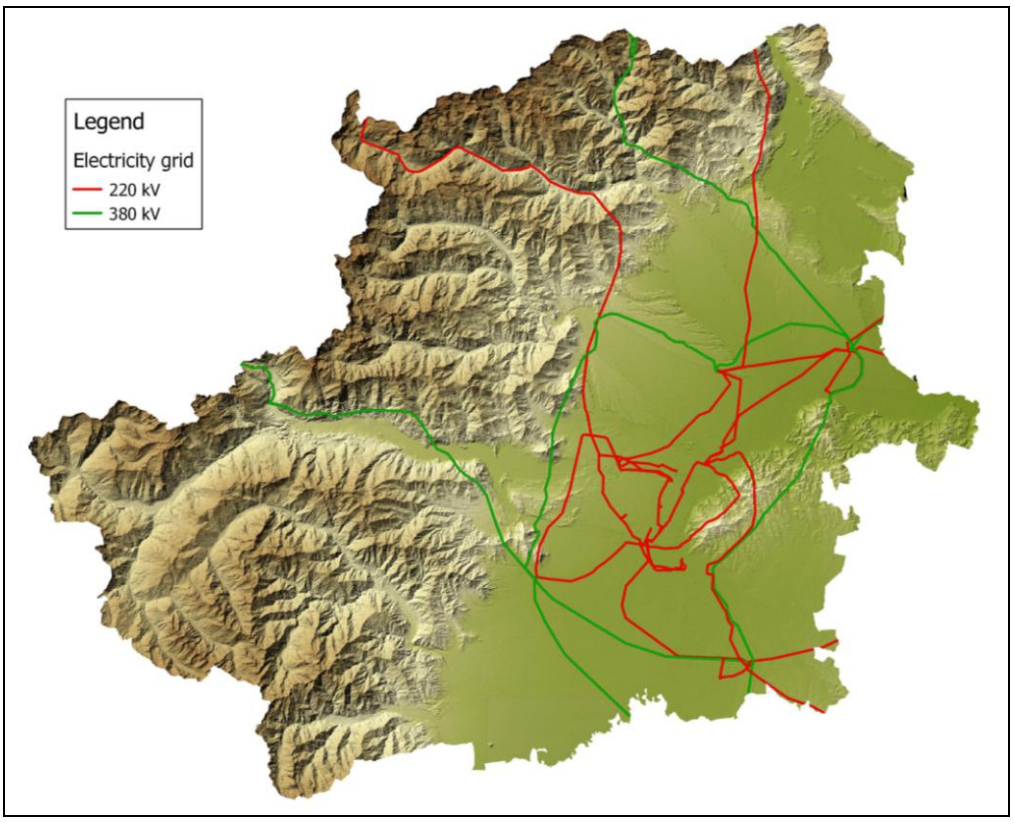



*Figure 3.2.cm - Electricity grid in the Province*

As far as the local electricity grid is concerned, nowadays 9 distributors are operating in the province of Torino. By those, seven are very small utilities owned by Municipalities and are operating only in their own city, whereas *Enel distribuzione* is supplying 307 municipalities. The other big company is *AEM*

*Distribuzione* which is supplying electricity mainly in Torino City and several areas belonging to neighboring cities.
Turin electricity grid is managed by the public utility company owned by the City of Torino itself and other public shareholders. AEM is a branch of *IREN Holding*, one of mayor energy utility company, controlled by several North Italian Public Authority.
Turin City grid is developed on 5000 km length, of which 2000 km operating under medium voltage (27 kV, 22kV e 6,3 kV), and the rest under low tension. On 2011 AEM distributed around 3.300 GWh of electricity.

### *3.2.B - D Heat producers and distributors (district heating)*

In the whole Province of Torino, as shown in the picture below, there are many different district heating grids, the oldest of them was built more than 30 years ago, whereas many of them are actually developing, some others are still in project.

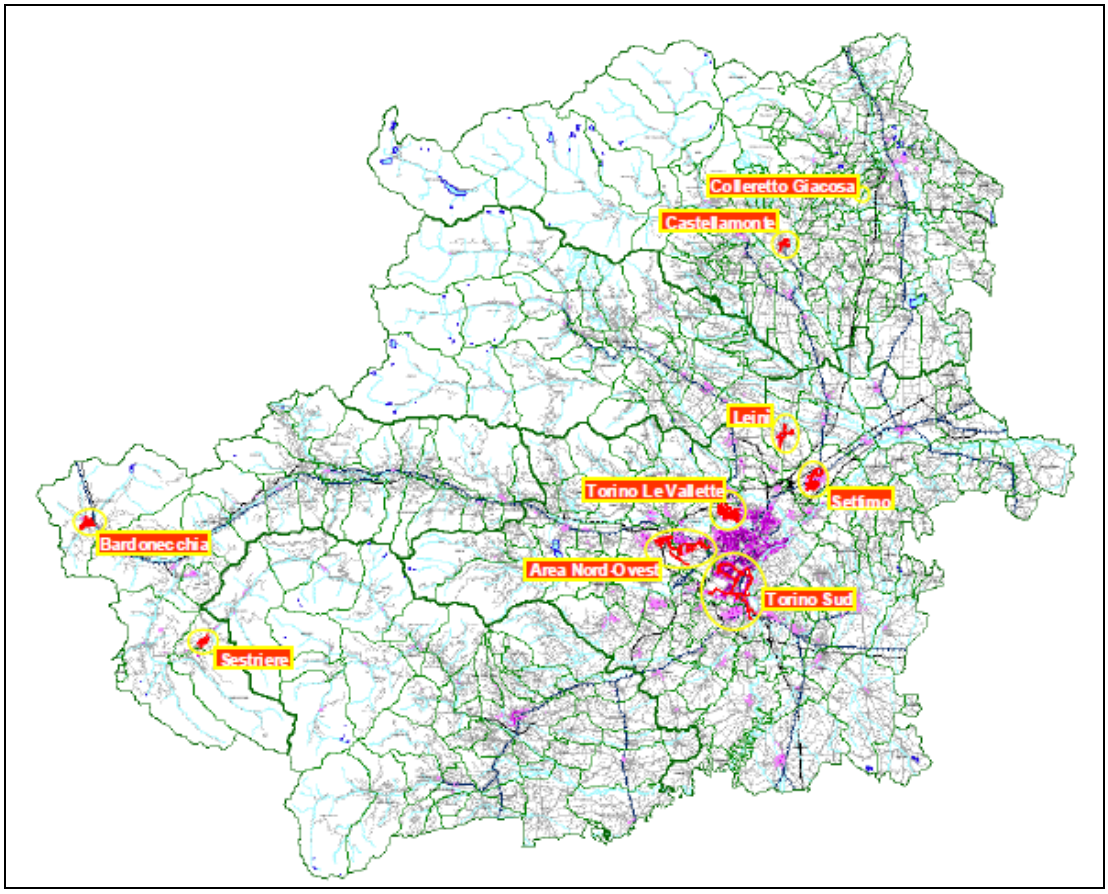



*Figure 3.2.dm - District heating services in operation in province of Torino*

For a complete overview of the situation of district heating in the province (year 2009), it's also shown the following map. In blue it's possible to see the areas serviced by the District heating nowadays, while in orange are represented the future developments in the short-medium period.

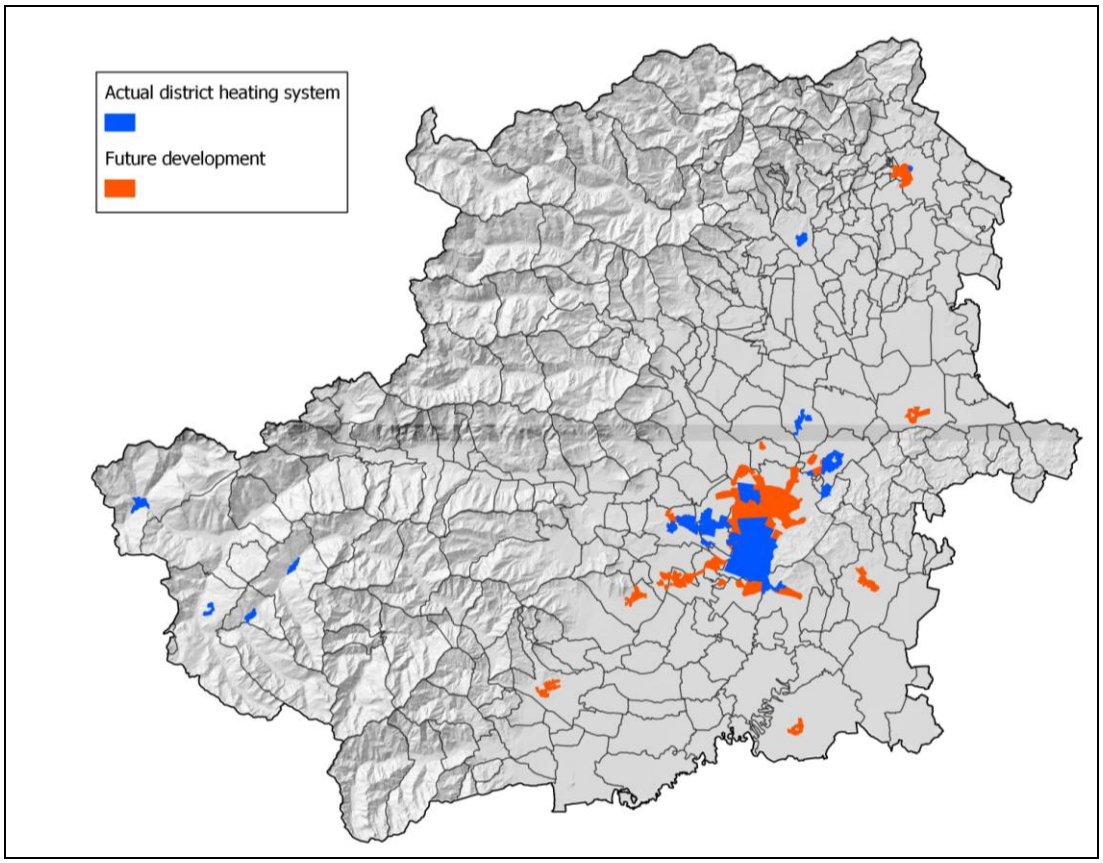



*Figure 3.2.dm2 - District Heating system in the province of Torino(actual situation and future development)*

The most important part of district heating grids is located in the city of Turin and in the surrounding municipalities, where there is the highest density of buildings and population (about 1.300.000 inhabitants, more than half of the whole Province).
Also with consideration to air quality concerns, the city is developing the largest district heating grid in Italy for two decades, connecting three thermoelectric power stations and supporting boilers. Energy facilities are fed by natural gas.

It is usually told that district heating in Turin started in the quarter named "Le Vallette" in 1982, when the Municipal Electric Society AEM (actually IREN) placed a combined heat and power plant with Diesel engines to increase the already existing small network (a group of popular houses heated by a central boiler), which reached in the following years the volume of 3 millions $m^3$ of served buildings (about 30.000 inhabitants). Another combined heat and power plant has been installed in 1988 in another part of the city (Mirafiori Nord) and the connected grid reached up to 2,25 millions $m^3$ of buildings. Later this grid has been included in the large grid named "Torino Sud", also owned by IREN, which has been developed gradually since 1994 reaching all the southern part of the city (27 millions $m^3$, 270.000 inhabitants), fed by the combined heat and power plant "Centrale Moncalieri" and by the backup boilers in "Centrale BIT".
Further development of "Torino Sud" network was implemented in "Torino Centro" starting from 2001 with the increase of power of the "Centrale Moncalieri", which reached the actual configuration (see table below), and the installation of backup boilers and heat storage at "Centrale Politecnico". The total building volume connected to the grid Torino Sud and Centro is around 36 millions $m^3$. In 2011 the old plant "Vallette" has been replaced by the new and much more powerful plant named "Torino Nord", constitued by combined heat and power unit, backup boilers and heat storage. The new plant allows to increase the grid in the northern area of the city and to connect it with the "Torino Centro" grid.

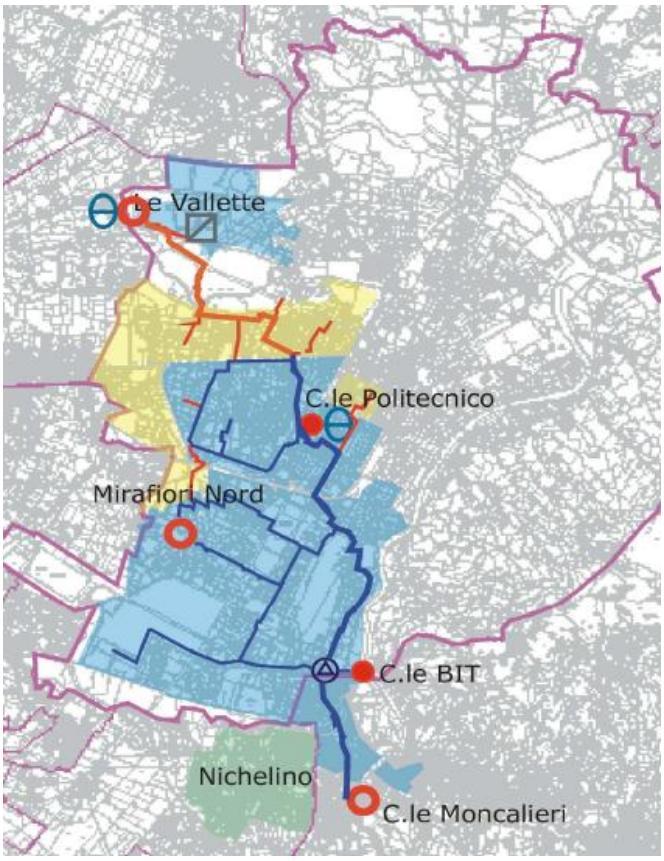



*Figure 3.2.dm3 – District Heating system in Torino city (in yellow/green the future development)*

| Plant | Electric MW | Thermal MW | Input P MW |
|---|---|---|---|
| Moncalieri 3 CHP | 390 | 260 | 700 |
| Moncalieri 2 CHP | 390 | 260 | 700 |
| Moncalieri boilers | - | 140 | 155 |
| BIT boilers | - | 255 | 280 |
| Politecnico boiler | - | 255 | 280 |
| Politecnico storage | - | - | 2500 $m^3$ |
| Torino nord | 390 | 220 | 700 |
| Torino nord boilers | - | 340 | 370 |
| Torino nord storage | - | - | 5000 $m^3$ |
| Mirafiori | - | 35 | 40 |

*Table 3.2.d1 - Actual status data of the city of Torino District heating grid*

Two storage system (at Politecnico and Torino Nord plants ) allow to store night heat production, contributing up to 5% of global heat demand and shaving heat peak demand on early morning hours.

| Heat source | Heat distributed (GWh) | Contribution |
|---|---|---|
| Boilers | 201 | 9,80% |
| Storage | 96 | 4,70% |
| cogeneration | 1.749 | 85,5% |
| **Total** | **2.046** | **100%** |

*Table 3.2.d2 - Actual status of the city of Torino District heating grid – generation plants*

On 2011-2012 around 2050 GWh have been distributed, covering the demand of 550.000 inhabitants, as 50 million of cubic meters of building connected by a 515 km distribution grid (double pipe system).
In comparison with distributed heating production and taking in account of recovery of waste heat from power station, average yearly environmental gains are estimated as follow:

- Energy saving: 280.000 toe/Y
- $CO_2$ emission reduction : 1.1 M Tons/Y
- NOx emission reductions : 1900 Tons/Y
- SOx emission reduction : 2700 Tons/Y

In the last 15 years also in the smaller towns in the area around Turin (some of them with more than 50.000 inhabitants), district heating grids have been developed by different companies, fed by combined heat and power generation and by boilers. The most important of these grids in the suburbs of Turin are located in:

Settimo Torinese: North-East of Turin, about 1,4 millions $m^3$ connected, which, as estimated, could rise up to 4,9 millions $m^3$. The heat is generated by the combined heat and power plant in Leinì and by some boilers. The plant in Leinì is powerful enough to heat a much larger volume.

North-West Area, including the municipalities of Rivoli, Collegno and Grugliasco, with about 3,6 millions $m^3$ connected, which, as estimated, could rise up to 6,3 millions $m^3$. The heat is generated by a small combined heat and power plant in Rivoli and by some boilers.

| **Plant** | **Electric MW** | **Thermal MW** | **Input P MW** |
|---|---|---|---|
| Leinì CHP | 390 | 170 | 700 |
| Heat exchanger at Antibioticos in Settimo Tor. | - | 21 | - |
| Boilers in Settimo | - | 31 | 35 |
| Rivoli CHP | 18 | 23 | |
| Rivoli boilers | - | 42 | 47 |
| Grugliasco boilers | - | 31 | 35 |

*Table 3.2.d3 - District heating grid system of the suburban area of Turin*

Outside the suburban area of Turin several small scale district heating systems are into operation as described in the following table. The location of these systems is reported in the map *3.2.dm2* at page 22.

| **System** | **Fuel** | **System** | **Heating delivered (GWh)** |
|---|---|---|---|
| Bardonecchia | Natural Gas | CHP | 75 |
| Sestriere | Natural Gas | CHP | 70 |
| Chieri | Natural Gas | CHP | 58 |
| Ivrea | Natural Gas | CHP | 30 |
| Castellamonte | Wood Chips | Boiler | 23 |
| Cesana | Natural Gas | CHP | 23 |
| Leinì | Wood Chips | Boiler | 17 |
| Borgaro Torinese | Natural Gas | CHP | 17 |
| Pragelato | Natural Gas | CHP | 14 |
| Banchette d'Ivrea | Natural Gas | CHP | 10 |
| Pinerolo | Biogas from waste management | CHP | 8 |
| Vico Canavese | Wood Chips | Boiler | 4 |

*Table 3.2.d4 - District heating grid systems in other areas of Turin province*

# 4 Analysis of power sector, distributor system, heat district systems and stakeholders

## 4.1 REGULATORY ENVIRONMENT

Nowadays the institutional framework is changing in Italy and a complete reform has been announced, even though it is not clear when it will be finalized.
Nevertheless, in the following lines the regulatory framework is described.
The EU provides the strategy and the regulative framework, which is adopted by the National State through the definition of acts and regulations adopting and adapting them to the national situation.
The Region makes specific laws in accordance with the regulative framework and planning tools provided by the State and consequently the Province and the Municipalities have to adapt their planning tools to the indications provided by the Region.

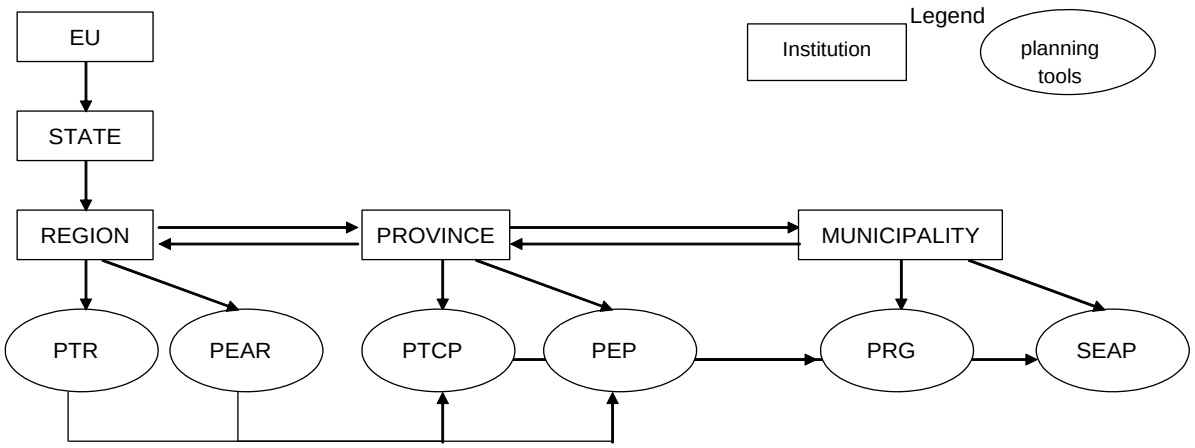



Figure 4.1 Hierarchy flow chart for Province of Torino

The Planning Tools available at regional and local level are:

- PTR - Piano Territoriale Regionale (L.R. 56/1977 e L.R. 45/1994): Regional Territorial Plan (Regional Law. 56/1977 and Regional Law 45/1994). It is defined in accordance with the European and national strategies for the territorial development. A thematic chapter of the PTR is composed by the PTCP (see).
- PTCP - Piano Territoriale di Coordinamento Provinciale (L.R. 56/1977 e L.R. 45/1994): Provincial Plan of Territorial Coordination (Regional Law. 56/1977 and Regional Law 45/1994). The PTCP defines possible scenario of development of the provincial territory in coherence with the objectives described in the PTR. The plan contains the actions to be implemented. It is a tool of coordination of the Municipalities planning.
- PEAR – Piano Energetico Ambientale Regionale (Regional Energy and Ambient Plan). The PEAR defines objectives, strategies, scenario development and actions to be undertaken in order to promote a sustainable use and production of energy.
- PEP – Programma Energetico Provinciale (Provincial Energy Program). The PEP defines objectives, strategies, scenario development and actions to be undertaken in order to promote a sustainable use and production of energy, limited to provincial competences on energy.

- PRG – Piano Regolatore Generale Comunale (Municipal General Regulator Plan). A PRG is an instrument that regulates the edificatoria activity in a municipality. It indicates the possible use of the territory or the imposed safeguards to protect it.
- SEAP – Sustainable Energy Action Plan. The SEAP defines objectives, strategies, scenario development and actions to be undertaken in order to promote a sustainable use and production of energy at local level.

## 4.2 ANALYSIS OF POWER SECTOR

The total amount of energy supplied in the Province of Torino in 2011 was 5 Mtoe. This value grew by 15% from 2000 to 2009 but after 2010 started to fall down. The increase was relevant between 2004 and 2005 when the amount of energy supplied overcame the 5,5 Mtoe and in the following year the peak value of nearly 5,7 Mtoe was reached. In 2009 a slow down was recorded but the total amount keeps on being far higher than the beginning of the decade.
In the concept region, there aren't any direct fossil sources or productions on its territory, so, as a consequence, the Province of Torino is strongly dependent from foreign supplies (about 93% in 2011), in particular natural gas, accounting for 68% in 2011. This dependency is thus increasing since natural gas is being used more and more for feeding CHP plants. Several of these plants entered into force or were rewamped in the second half of the decade (2004-2005) where local production of electricity overcame the local consumptions, turning the Province of Torino from and importing region to an exporting one. As natural gas increased a lot its contribution to energy supply (from 2.4 Mtoe in 2000 to 3.3 Mtoe in 2011), on the other hand oil products decreased their supply in a very relevant way. Their share turned to be in 2011 24% against the 38% recorded in 2000. Petrol and Oil are the two energy carriers having decreased more.
No refinery process take place within the provincial borders and all fuels are imported from other regions and foreign countries.
Because of the lack of fossil energy reserves, the only way to limit the external supply and consumption of fossil sources is to resort to a more consistent use of renewable energy and increase efficiency in the final use of energy.
According to the data reported in this document, renewable energy sources supply increased a little bit their share (from 8% in 2000 to 10,4% in 2011) even though in terms of absolute values they had a growth by nearly 50%. Biomass and hydropower are the most relevant renewable source (more than 95% of total supply in 2011) even though it is very probable that solar energy will start giving an important contribution in next years. In 2011 there were registered consumption from RES by about 520 ktoe, by which 370 ktoe from domestic production and about 150 ktoe imported from other regions.
The average annual rate of growth of renewables is about 4.5%. Renewable sources of energy allocated directly to end-users constitute 86% of total consumption, the remainder is the energy loss due to energy transformations. Considering only the portion destined to end-uses, it is important to note that 48% is represented by thermal energy, while 52% by electricity.

## 4.3 ANALYSIS OF DISTRIBUTOR SYSTEM

The distribution system in the concept region is composed by the gas pipeline network, the electricity grid the district heating system and the distribution of refined oil products.
The gas grid, nearly 8000 km of local grid, is operated by 15 gas distributors. The main one is Italgas and manages 139 municipalities, more than half of the 264 achieved by the network. 51 Municipalities are devoid of the network and in them resides about 1% of the population.
The distributors manage the local network, but the total amount of natural gas that passes in the province is transported by SNAM Rete Gas, which supplies the carrier, in addition to local distribution networks, also directly to end users, such as power plants or industrial plants or plant refueling for auto-vehicles. Overall, the natural gas transported in the province in 2011 was slightly more than 4 billion cubic meters.

The electric grid is composed by more than 311 km of high voltage grid and 487 km of 220 kV in the province territory. The concept region is one of the cross border region of Italy and the exchange of electricity with France is one of the key point of the National electric system (more than 11.000 GWh are imported every year from France).
As far as the local electricity grid is concerned, nowadays 9 distributors are operating in the province of Torino. By those, seven are very small utilities owned by Municipalities and are operating only in their own city, whereas *Enel distribuzione* is supplying 307 municipalities. The other big company is *AEM Distribuzione* which is supplying electricity mainly in Torino City and several areas belonging to neighboring cities.
The energy supply system of refined oil products (gasoline, diesel, ect..), is performed entirely with road transport (tanker trucks) so there isn't a real grid. Clearly, among the province, there are a network of gas station that guarantee the distribution to the citizens within the entire province territory.

## 4.4 ANALYSIS OF HEAT DISTRICT SYSTEM

In the whole Province of Torino there are many different district heating grids, the oldest of them was built more than 30 years ago, whereas many of them are actually developing, some others are still in project.
The most important part of district heating system is located in the city of Turin and in the surrounding municipalities, where there is the highest density of buildings and population (about 1.300.000 inhabitants, more than half of the whole Province). Also with consideration to air quality concerns, the city is developing the largest district heating grid in Italy for two decades, connecting three thermoelectric power stations and supporting boilers. Energy facilities are fed by natural gas.
In 2011 around 2.050 GWh have been distributed by the district heating system of Turin, covering the demand of 550.000 inhabitants (about half of the city), as 50 million of cubic meters of building connected by a 515 km distribution grid (double pipe grid).
In the last 15 years also in the smaller towns in the area around Turin (some of them with more than 50.000 inhabitants), district heating grids have been developed by different companies, fed by combined heat and power generation and by boilers. The most important of these grids in the suburbs of Turin are located in Settimo Torinese, north-east of Turin, about 1,4 millions $m^3$ connected, and Rivoli, Collegno and Grugliasco, north-west area, with about 3,6 millions $m^3$ connected.
Outside the suburban area of Turin, in the rest part of the province, several small scale district heating systems are into operation: for example in Bardonecchia, Sestriere and Pragelato (in the mountains) or in other medium size cities such as Ivrea and Pinerolo.

## 4.5 ANALYSIS OF STAKEHOLDERS

A lot of stakeholders deals with the energy topic in the province of Torino and the capacity of promoting an energy transition process is by far built on the willingness of cooperating among all stakeholders involved. This issue is crucial as the actual economic crisis is heavily affecting the concept region and lack of financial resources is a structural point. The rational use of financial incentives are, thus, essential. Province of Torino's actions targeted at promotion of use of incentives schemes vary on their nature and the nature of beneficiaries. Following, for each beneficiary category are described actions to be implemented in supporting incentives use.

- Nature persons (investment and generation based) actions are more related to information and support on incentive applications, with help desks that can also provide technical support in identification of intervention to be made. This action is also carried out by other local institutions and sometimes with the support of NGO and others non-profit organization. The feasibility of participative models will be explored as well.
- Enterprises (investment based): incentives targeted to ESCOs (i.e. soft loans for energy investments) are of mayor interest, because inside intervention they made, energy generation actions are often included. The role of the Province of Torino is to act as intermediary

between the company and the beneficiary (both public and private) with promotional activities and, if relevant, directly involved as owner of spaces or building. Inside this kind of incentive the collaboration with local cluster POLIGHT (managed by Environment Park) support the match between enterprises and owners, also supporting the elaboration of business models and intervention schemes to maximize financial and environmental sustainability of energy saving and RES generation interventions.

- Local Authorities and Public Bodies (investment based): in this case the Province of Torino have capacities to drive and support incentives application of Municipalities, in particular in the phase of identifications of intervention needs and elaboration of targets (like under CoM initiative and the elaboration of SEAPS), providing also support inside the procurement phases. In case of incentives implemented under a "third party interventions" (I.e. ESCOs or Energy Performance contracting), training activities are provided to local authorities in order to support their understanding and advantages of these opportunities. Bundling project approaches will be explored as a way to gather several investments from several issuing bodies and reach economy of scale which will attract ESCOs and improve value of money.

About the suitability of financial incentive today, due to limited direct investment possibilities of local institutions and private because Italian unfavorable economic conjuncture, incentives to third parts investments schemes are preferable, as they allows to reduce economical risk for owner and reduce its initial economical effort for investment. Recent announcement of National and Regional government state that this solution would be the main support scheme that will be implemented in the next future. Facing this situation it will be more and more necessary to further investigate implementation of these scheme inside the local energy plans, in particular designing contractual model able to achieve a favorable sharing of benefits between ESCOs and owners.

Such approach lay also on the fact that due to nowadays political instability at national level, financial schemes are often changing in terms of rules, procedures and availability so that it is not so easy to predict their availability for the upcoming years.

In this sense collaboration with local clusters, universities and NGOs play a prominent role so to analyze as better local context and design interventions able to trigger the maximum level of energy investments and maximize leverage offered by incentive schemes.

Synergies with other local institutions are fundamental in designing the implementation of the plan in particular:

- With local municipalities, in order to arise their needs giving concreteness to the targets of plans
- With Regional government, so to provide baselines for the design of incentive schemes
- With other local authorities in Italy and EU, to share and mutualize experiences and best practices on plan strategies and implementation of incentive schemes.