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Technological Trends - National Report for Italy

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TECHNOLOGICAL TRENDS

D.1.4

PART OF WORK PACKAGE 1: MAPPING OF ENERGY EFFICIENCY POLICY INSTRUMENTS AND AVAILABLE TECHNOLOGIES IN BUILDINGS AND TRANSPORT

NATIONAL REPORT FOR ITALY

DATE

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ACRONYMS

CHP: Combined Heat and Power.

GSE: Gestore dei Servizi Energetici.

GWh: Gigawatt-hour.

ITS: Intelligent Transport System.

LED: Light-Emitting Diode.

LPG: Liquified Petroleum Gas.

M: Millions.

M€: Million euro.

B€: Billion euro.

Mtoe: Million toe.

MISE: Italian Ministry of Economic Development.

MWh: Megawatt-hour.

NEEAP: National Energy Efficiency Action Plan.

NG: Natural Gas.

PV: PhotoVoltaic.

PVC: Polyvinyl chloride.

SEAP: Sustainable Energy Action Plan.

SEN: Strategia Energetica Nazionale (National Energy Strategy).

SME: Small and Medium-sized Enterprise.

T: ton.

TEE: Titoli di Efficienza Energetica (Energy Efficiency Titles, other name for the White Certificates issued within the related system).

TEP: tonnellata equivalente di petrolio (tonnes of equivalent oil).

TOE: tonnes of equivalent oil.

TWh: Terawatt-hour.

UPS: Uninterruptible Power Supply.

Please note that throughout the report, “SEN, 2013” is used to refer to the following reference: Ministry of Economic Development. (2013). National Energy Strategy 2013. Available at: http://www.encharter.org/fileadmin/user_upload/Energy_policies_and_legislation/Italy_2013_National_Energy_Strategy_ENG.pdf

Please note that throughout the report, “NEEAP, 2014” is used to refer to the following reference: Ministry of Economic Development. (2014). Italian Energy Efficiency Action Plan 2014. Available at:

https://ec.europa.eu/energy/sites/ener/files/documents/2014_neeap_en_italy.pdf

EXECUTIVE SUMMARY

The energy efficiency is targeted as 'priority action' within the last National Energy Strategy (2013), with the purpose to boost the capability of Italy to compete within the international scenery and to assure a sustainable growth.

Within this framework, some of the latest and more efficient technologies are recently finding application in the building and transport sectors, where different policy instruments display specific long-term strategies and support proper actions for energy efficiency.

Particularly, within the building sector, in Italy there are four main policy instruments to support and promote the energy efficiency improvement actions: the 'thermal account', the tax deductions, the so called 'Energy Efficiency Titles' (or 'white certificates') and the 'Kyoto Fund'.

These policy instruments support proper actions involving thermal insulation of building envelopes, replacement of fixtures and heat generators, installation of building automation systems, replacement of lighting systems and use of renewable energy sources.

On the other side, energy savings within the transport sector may be achieved by introducing more efficient vehicles as well as shifting towards more sustainable mobility modes. The 'Mobility Management', at both local and company level, as well as technological and behavioural changes within the marine transport are particularly important.

Anyway, among the existing innovative energy efficiency technologies, only some can be recognized as 'cost efficient'. The assessment of the investment 'Pay-Back Time' related to the main technologies for the residential sector proves that, among the different technologies considered, only new efficient lighting systems, building automation, fixtures with high efficiency, condensing boilers and thermal solar have an 'acceptable' Pay-Back Time. Furthermore, there are some technologies that, even if theoretically not economically sustainable, yet are widely diffused due to the presence of proper incentives. Among these, we can mention efficient appliances, opaque building (walls and roofs) surfaces, photovoltaic and thermal solar.

With regard to the transport sector, the technologies offering the lower running costs imply the use of alternative fuels, such as methane gas, LPG, bio-fuels and full electric traction. Such technologies recorded a progressive increase in sales during the years 2007-2010 due to the support from national incentive schemes.

The above mentioned economic analysis led to the development of a national energy efficiency market. With regard to the residential sector, the best market potentials are offered by opaque building surfaces, heat pumps, biomass boilers and efficient appliances. As to the transport sector instead, the expected savings are to be delivered by the main measures/programmes, which comprise actions to renew the road vehicle fleet, promote sustainable mobility and develop the railway infrastructure as well as advanced logistics management systems.

The report ends with a detailed description, through specific tables, of the technical and economic indicators of each technology recorded for the two sectors analyzed.

CHAPTER 1: TECHNOLOGICAL TRENDS IN THE BUILDING AND TRANSPORT SECTOR

In this task, for each country relevant technologies that are already used and promoted by corresponding energy efficiency policy instruments will be presented.

1.1 ENERGY EFFICIENCY POTENTIAL

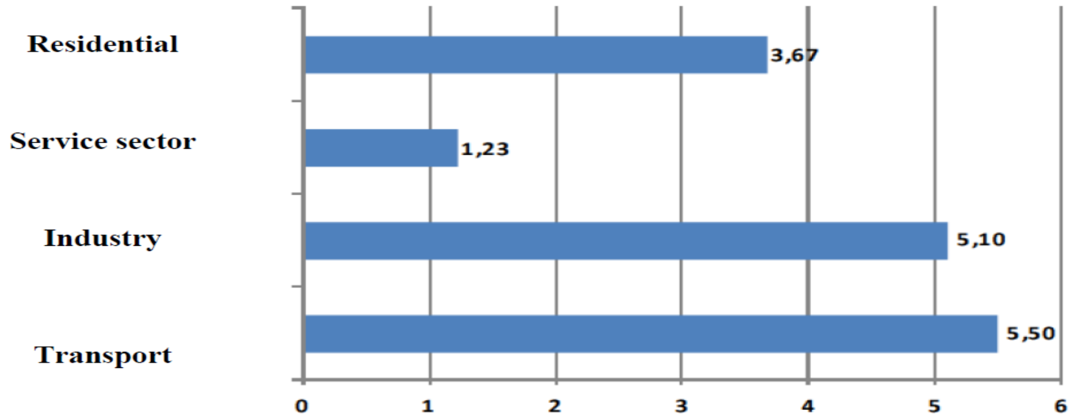
The National Energy Efficiency Action Plan (NEEAP) 2014, in line with the contents of the National Energy Strategy (SEN), sets out the national targets for the reduction of primary and end-use energy consumption and specifies the savings in end-uses of energy expected in 2020 by economic sector and by policy measures implemented for achieving them (Table A, Figure A).

Table A: Final energy savings (Mtoe/y) expected in 2020 by sector

Sector	PLANNED MEASURES FOR 2011-2020					CONVENTIONAL ENERGY DEMAND*	PRIMARY
	Regulatory standards	Measures and investments for mobility	Thermal account	Tax deductions	White certificates	SAVINGS EXPECTED by 2020	SAVINGS EXPECTED by 2020
Residential	1.60		0.54	1.38	0.15	**3.67**	**5.14**
Services	0.20		0.93		0.10	**1.23**	**1.72**
Public authorities	0.10		0.43		0.04	0.57	0.80
Private	0.10		0.50		0.06	0.66	0.92
Industry					5.10	**5.10**	**7.14**
Transport	3.43	1.97			0.10	**5.50**	**6.05**
TOTAL	**5.23**	**1.97**	**1.47**	**1.38**	**5.45**	**15.50**	**20.05**

Source: NEEAP, 2014

Figure A: Final energy savings (Mtoe/y) expected in 2020 by sector



Source: NEEAP, 2014

The following table (Table B) shows the estimates of electricity savings (GWh/y) and the economic energy efficiency potential expected in 2020 by sector.

Table B: Estimates of energy savings and economic energy efficiency potential expected in 2020 by sector

Sector	Primary energy consumption expected in 2020 (Mtoe/y)	Electricity savings expected in 2020 (GWh/y)	Economic energy efficiency potential[1] expected in 2020 (M€/y)
Industry	32,4	28.678	4.129
Transport	41,5	49.175	7.081
Residential	30,2	77.121	11.105
Services	19,6	29.698	4.276

Source: data processed by IEFE on ENEL, 2013

The key technologies for achieving energy efficiency in the *buildings sector* in Italy, as indicated in Energy Efficiency Report (Energy Strategy Group, 2013), are:

- *For space heating and air conditioning: heat pump, opaque building surfaces, fixtures with high efficiency, solar cooling, solar thermal;*
- *For energy production and energy saving: small wind turbines and photovoltaic;*
- *For water heating: building automation, condensing boilers and biomass boilers;*
- *For cooking, washing machines, laundry dryers and dishwashers: induction cooking and efficient and pre heated appliances;*
- *For lighting: efficient lighting systems.*

As regards the *transports sector*, the main fuel-efficient technologies, as identified by numerous sources (such as ENEL, 2013; ENEA, 2015; Marciani et al., 2014) are:

- For *road transport*: *low emission vehicles* (natural gas, hybrids, hydrogen and electric), *innovative vehicles based on automation*, *tire pressure monitoring*, awareness of "*eco-driving*" and *mobility management actions*;
- For *rail transport*: *power magnetic induction* and *recovering energy from braking*;
- For *navigation*: *hull antifouling systems*, *replacement of propeller and rudder*, *engine auto tuning*, *optimizers of hydro-dynamic flow*, *information system for the optimization of consumption*, *Air Cavity System* and *Waste Heat Recovery System*;
- For *aviation*: *biofuels, energy efficiency aircraft design*, *aerodynamic resistance reduction*, *high efficiency motors* and *aircraft with long life cycle.*

[1] Savings expected in 2020 have been calculated considering an average price of electricity in Italy for 2012 of 0,144 €/kWh. (Source: QualeEnergia, 2013. I prezzi dell'elettricità e del gas in Europa e in Italia. Available at *http://www.qualenergia.it/articoli/20130528-i-prezzi-dell-elettricit%C3%A0-e-del-gas-europa-e-italia*)

1.2 Technologies And Policy Instruments

Policy instruments

Buildings sector

Nowadays in Italy, existing technologies that enable an energy efficiency improvement within the buildings sector are supported by four main policy instruments: the so called 'thermal account', the tax deductions, the so called 'Energy Efficiency Titles' (or 'white certificates') and the 'Kyoto Fund'.

The following table (Table C) shows a summary view of the policy instruments supporting each existing energy efficiency technology.

Table C: Policy instruments for each existing energy efficiency technology (buildings sector)

Technologies	Policy instruments
Condensing boilers	Thermal account, tax deductions, white certificates, Kyoto fund
Heat pump	Thermal account, tax deductions, white certificates
Biomass boilers	Thermal account, tax deductions, white certificates, Kyoto fund
Fixtures with high efficiency	Thermal account, tax deductions, white certificates, Kyoto fund
Opaque building surfaces	Thermal account, tax deductions, white certificates, Kyoto fund
Solar Thermal	White certificates, Kyoto fund
Small wind turbines	White certificates, Kyoto fund
Solar cooling	Thermal account, white certificates
Building Integrated Photovoltaic BIPV	White certificates, Kyoto fund
Photovoltaic	Tax deductions, white certificates, Kyoto fund
Solar thermal	Thermal account, white certificates, Kyoto fund
Induction cooking	White certificates
Efficient appliances	White certificates, energy labeling of households appliances
Efficient lighting systems	White certificates, national Fund for Energy Efficiency (public lighting)
Combined Heat and Power (CHP)	Thermal account, tax deductions, white certificates, Kyoto fund
Uninterruptible Power Supply (UPS)	White certificates
Building automation	White certificates

Source: data processed by IEFE

In addition to the above mentioned technologies, new technologies and innovative systems are meeting an increasing success, such as building automation, the *'active building envelope'* and the *'smart buildings'*. In particular, among the innovative technologies we can mention:

- *Cool materials*: the use of 'cool materials' for the roofs and the façades of the buildings limits the solar amount and therefore the energy demand for cooling in the air conditioning;
- *Innovative cements* (es, *'I.light'*, *'TXD Active'*, *'Tx Aria'*), that allow a great energy efficiency improvement due to the low thermal conductivity, the high permeability to steam and the high thermal inertia;
- *Composite materials* (*'bio-bricks'*, chipboard panels, special clay blocks), that greatly reduce the building energy consumption and are produced through the recycling and reuse of waste materials.

Currently the use of such materials is supported by several policy instruments (thermal account, tax deductions, white certificates, Kyoto Fund), nevertheless it is still limited because we are in the initial phase of market penetration.

Transport sector

During the last years several actions have been taken, at both local and national level, aimed at the disincentivation of the private transport, the promotion of use of ‘low emission’ fuels, the purchase of ‘low emission’ vehicles, an increase of diversification in the offer of public transport.

Table D below displays a summary view of the energy efficiency technologies and policy instruments (described in Task 1.2) supporting them, within the transport sector.

Table D: Technologies and policy instrument supporting them (transport sector)

Sector	Technologies	Policy instruments
Road transport	*Electric and hybrid vehicles*	National infrastructure plan to set up electric vehicle charging points, Road tax, Renewable energy in transport sector (D.lgs 28/2011)
	Biofuel vehicles	Incentives for the promotion of biofuels in transport sector, Law n.81/2006
	Methane and LPG vehicles	Road tax, Guide to fuel saving and decreasing CO2 emission by cars
	ITS – Intelligent Transport System	National Action Plan for Intelligent Transport System (2014), National Law nr.221/2012, National Logistics Platform[2]
	Bike-sharing	Funding for energy efficiency, renewable energy and bike-sharing
	Mobility management actions[3]	Italy's National Plan for Logistics, Urban traffic plans, National “Smart Cities and Communities and Social Innovation” funds
	Car-pooling, car sharing and bike sharing	National electric car sharing project in cities
	Electric Bus	Five years bus fleet renewal plan, National funds for local public transports
	Innovative vehicles based on automation[4]	n.a.
	Eco-driving	Eco-driving Guide
Rail transport	*Power magnetic induction*	n.a.
	Recovering energy from braking	n.a.
Navigation	*Information system for the optimization of consumption*	National technological maritime platform
Aviation	*Biofuels*	n.a.
	Aircraft with long life cycle	n.a.

Source: data processed by IEFE

[2] https://www.uirnet.it/uirnet/

[3] For example: encouraging the use of bicycles and public transport; company buses, teleworking, company kindergarten and grocery shopping online, etc.

[4] Cyber car, personal rapid transport (PRT), high-tech bus, high-tech lorry and dual-mode vehicles.

With regard to the **road transport sector**, among the innovative technologies we can mention:

- *Low resistance tyres*, that together with the tyre pressure monitoring could lead to a 3% reduction of fuel consumptions[5];
- *Start & stop systems,* that turn on and off automatically the internal combustion engine to reduce the time in which the motor rotates and the car is stopped, so decreasing fuel consumption and reducing pollutant emissions;
- *Eco-driving* (changing gears as soon as possible, maintaining a steady speed, frequently checking the tire pressure and decelerating smoothly) allows to save on average 5-10% of fuel, in addition to ensuring an economic saving, reducing the likelihood of accidents, noise pollution and emissions[6].

These technologies are supported by an information and awareness instrument implemented by the Ministry of Economic Development: the *Eco-Driving Guide*.

As regards **navigation**, the ENEA annual energy efficiency report (2015) provides a mapping of main innovative technologies:

- *Hull antifouling systems;*
- *Replacement of propeller and rudder;*
- *Engine auto tuning;*
- *Optimizers of hydro-dynamic flow;*
- *Air Cavity System and Waste Heat Recovery System.*

Despite the implementation of some international actions (e.g. the Rules for CO_2 emission reduction from the overseas marine transport), the marine transport sector seems to suffer from the lack of a proper strategy supporting the design and building of true ‘green ships’, that is, ships capable to remarkably reduce the main environment polluting factors as well as, more in general, to reduce the overall external costs of the marine transport. Even the Legislative Decree nr. 102/2014 (actuating the Directive 2012/27/UE on the energy efficiency) does not foresee any specific measure supporting technology and management innovations for the marine sector focused on the reduction of energy consumption, despite the relevant potential energy savings offered by this sector[7].

Finally, with regard to the **road aviation** sector the innovative technologies, which are finding large development in recent years, are[8]:

- *Energy efficiency aircraft design.* The use of lightweight materials and the reduction of the weight of the non-essential components may lead to a decrease of fuel consumption equal to approximately 9%;
- *Aerodynamic resistance reduction.* The new models of simulation of aerodynamics allow for performance optimization;
- *High efficiency motors (e.g. use of open rotor).* Each new generation engine has provided improved efficiency ranging from 5% to 15%.

[5] ENEA, 2011a.

[6] ECODRIVEN, 2008.

[7] ENEA annual energy efficiency report, 2015.

[8] Source: *http://www.fondazionesvilupposostenibile.org/f/Documenti/CO2+Trasporti/cap_10.pdf.*

Cost efficiency

Buildings sector

The energy efficiency improving technologies relevant to the buildings sector that are 'cost efficient' to the consumer have been recorded[9] in the 2013 Energy Efficiency Report (Energy Strategy Group, 2013). The assessment of the cost efficiency of each technology (Table E) has been made considering the following indicators:

- *Pay-Back Time*, which is the time period[10] when the investment in the energy efficiency improving solution is entirely paid back;
- *Average cost of kwh saved and produced* (c€/kWh), that is the ratio between the costs of the implementation and use of the energy efficiency improving solution (*Capex ed Opex*) and the amount of energy saved or produced by its use[11].

Table E: Cost efficiency for each energy efficiency existing technology (buildings sector)

Technology	Pay-Back Time (years)	Average cost of kwh saved and product (c€/kWh)
Efficient lighting systems	0,1-0,5	0,6-1
Building automation	2,9-4,6	4,8-7,2
Fixtures with high efficiency	13-15	12,4-21
Opaque building surfaces	8,5-11	10-13
Heat pump	6-9	7-9,5
Condensing boilers	4,5-7	2,7-4,1
Solar Thermal	5-7	6-13

Source: Energy Strategy Group, 2013

Table E shows that only the efficient lighting systems, the building automation, the fixtures with high efficiency, the condensing boilers and the solar thermal have an 'acceptable' Pay-Back Time. The resulting values for the Average cost of kwh saved or produced (c€/kWh) show that, with the only exception of the fixtures with high efficiency and the opaque building surfaces, all the current technologies prove to be cost-sustainable, even when the resulting Pay-Back Time is greater than the threshold value assumed as 'acceptable' (e.g. heat pumps, condensing boilers, solar thermal).

Transport sector

With regard to the transport sector, the following table (Table F) offers a comparison among the different traction fuel types (considering a 'Fiat Punto' city car). The table shows that the methane gas grants the longer journeys with a given expense (1 €).

Table F: Journey for 1 € for each traction fuel type

	Gasoline	Diesel	LPG	methane
Journey/1€	7.07 km	9.91 km	12.87 km	20.98 km

Source: FIAT, 2012[12]

[9] The recording refers to the case of voluntary replacement of a traditional technology in absence of incentives.

[10] The resulting values for this indicator are to be compared with a 'threshold' value that is equal to 4-6 years for the buildings sector.

[11] This indicator is to be compared with a 'threshold' value that for the buildings sector is equal to 19c€/kWh (electricity purchase cost) and 9 c€/kWh (heat generation cost) respectively.

Further to this table, we could also observe that a 'class B' electric vehicle would offer even longer journeys (40 km/1€). Anyway, the purchase cost of a full electric vehicle currently is 2-3 times higher than that of a traditional car, due to the cost of the batteries (e.g. a 30 kWh battery, adequate to a 'class C' car with journey about 150 km, will cost about 9,000 €). With regard to hybrid vehicles instead, the purchase extra-cost would be lower and easily paid back by the lower fuel consumption, but only when the kilometers traveled annually are greater than a certain 'threshold' value that depends from the current fuel prices[13].

As regards the navigation sector, the following table (ENEA, 2015) shows the energy and cost savings potential connected to the improvement of innovative technologies in maritime transport, with reference to three types of ships: containers, passengers and tanker.

Table G: expected energy and cost savings connected to the improvement of technologies

Technologies	**Types of ships**		
	containers	**passenger**	**tanker**
Hull antifouling systems	132 tons/years	511tons/years	295 tons/years
Replacing propeller and rudder	79 tons/years	307 tons/years	177 tons/years
Engine Auto Tuning	26 tons/years	102tons/years	59 tons/years
Optimizers flow hydro-dynamic	80 tons/years	310 tons/years	180 tons/years
Information system for the optimization of consumption	158 tons/years	614 tons/years	354 tons/years
Air Cavity System	92 tons/years	n.a.	207 tons/years
Waste Heat Recovery System	211 tons/years	818 tons/years	472 tons/years
Total fuel saved	200-780 tons/years	1200-2.660 tons/years	700-1.740 tons/years
Total costs savings	173.000-455.000 €/year	683.000- 1.456.000 €/year	364.000-856.000 €/year

Source: ENEA, 2015

<u>Penetration grade of the different existing technologies</u>

Buildings sector

With regard to the technologies performing a relevant penetration grade due to the support from proper incentives, reference is made to the report 'Stato e prospettiva dell'efficienza energetica in Italia' (*State-of-art and perspectives of the energy efficiency in Italy*) - ENEL, 2013. The report records the different technologies that, even if not economically sustainable, yet are widely diffused due to the presence of proper incentives and highlights which policy instrument has contributed to their diffusion. Among these:

- The *efficient appliances* with pre-heating for washing and cold, that recorded a remarkable diffusion (16% of the theoretical market potential) mainly due to the incentive scheme as well as effective communication & pricing policies;

[12] http://www.zavattarello.org/trasparenza/ambiente/campagna_auto.pdf.

[13] ENEA, 2011a.

- The *opaque building (walls and roofs) surface* technologies recorded a good penetration grade (about 20% of the theoretical market potential) due to the support granted by the incentive scheme (tax deduction);
- The *photovoltaic* (PV) – with its high potential of savings through the purchase of electricity from the grid – 17 TWh – recorded a good penetration grade during these years, mainly due to incentivating scheme of the so called ‘energy accounts’ (“Conto Energia”);
- The *solar thermal* followed - but with a lower performance - the trend of the ‘PV’, anyway a rapid increase could happen (about 11,5 TWh) due to the prolonged incentive regime and the development of proper ‘heat storage’ technologies that could help filling the gap between the generation and the use of thermal energy for heating.

Transport sector

Within the transport sector, the technologies with the best penetration grade due to the support from national incentive schemes are the LPG- and NG-fuelled vehicles, which recorded a progressive increase in sales during the years 2007-2010 (2010 is the year when the incentive schemes came to an end) (ENEA, 2011b).

1.3 Market Perspectives due to Technological Trends

Buildings sector

According to the Energy Efficiency Report 2013 (Energy Strategy Group, 2013), the potential saving displays the energy saved (TWh) through to the implementation of energy efficiency technology solutions. This potential has been assessed for the buildings sector, considering two different scenarios (Table H):

- 'Theoretical' scenario, referring to the implementation of energy efficient solutions to replace or integrate all the less efficient technologies currently used;
- 'Expected' scenario that reviews the estimates of the 'theoretical' potential on the basis of a reasonable penetration grade for each technology solution (related to the cost effectiveness, the technological maturity grade and the 'perception' of the market operators).

Table H: 'Theoretical' and 'expected' potential savings in 2020 (TWh) of each technology within the buildings sector

Technologies	'Theoretical' potential savings			'Expected' potential savings		
	Residential sector	Services	Total	Residential sector	Services	Total
Lighting	8,57	6,13	14,7	4,47	3,68	8,15
Building Automation	11,6	2	13,6	1,2	0,62	1,82
Fixtures with high efficiency	20,2	2,2	22,4	4,94	0,36	5,3
Opaque building surfaces	70,35	3,95	74,4	29,6	1,4	31
Heat pump	101	10	111	36,73	4,37	41,1
Condensing boilers	55,2	6,6	61,8	11,12	2,58	13,7
Solar thermal	17,5	4,4	21,8	5,39	0,65	6,34

Source: Elaboration data from Energy Strategy Group 2013

The residential sector is the buildings sector showing the greater 'expected' potential in 2020. The technologies related to the greater 'expected' potential savings are heat pumps (36,73 TWh per year) and condensing boiler (11,12 TWh per year).

A further analysis of the economic effects of the energy efficiency improvement actions has been made by ENEL with the report 'Stato e prospettive dell'efficienza energetica in Italia' (*State-of-art and perspectives of the energy efficiency in Italy*), 2013. Once again it has been investigated and assessed the business (billion euro) generated by the implementation of energy efficiency technologies in two different development scenarios: 'optimal' and 'moderate' (Table I).

Table I: Business (B€) generated by the implementation of energy efficiency technologies within the buildings sector in 2020

Technologies	Type of energy (energy vector)	**'Optimal' development scenario**		**'Moderate' development scenario**	
		Potential annual savings (TWh)	**2020 business (B€)**	**Potential annual savings (TWh)**	**2020 business (B€)**
Heat pump	Thermic	53,30	78,11	33,30	56,61
Condensing boilers	Thermic	34,70	31,75	22,10	22,84
Induction cooking	Electric	1,00	10,48	0,75	8,23
Building automation	Electric	2,74	0,76	2,06	0,63
	Thermic	13,36	3,84	10,04	3,22
Solar control	Thermic	12,40	56,20	4,00	18,13
Small wind turbines	Electric	3,90	15,60	2,70	10,80
Solar cooling	Electric	0,76	2,75	0,46	1,66
Building Integrated Photovoltaic BIPV	Electric	0,02	0,04	0,01	0,02
Opaque building surfaces	Thermic	63,40	115,68	39,60	72,26
Photovoltaic	Electric	17,00	33,79	11,30	22,46
Solar thermal	Thermic	11,40	32,18	7,60	23,85
Efficient appliances	Electric	3,70	37,75	3,00	31,44
Biomass boilers	Thermic	38,60	44,79	32,20	37,84
Efficient lighting systems	Electric	17,00	2,42	14,20	2,06
TOTAL		273,28	466,14	183,32	340,77

Source: ENEL, 2013

The picture shown above points out that about the 45% of the total business generated by the energy efficiency actions comes from the electric energy vector, while the other 55% comes from the thermal energy vector. With regard to the technologies granting relevant business figures, within the general framework we can mention opaque building surfaces (72,26 B€), heat pumps (56,61 B€), biomass boilers (37,84 B€) and efficient appliances (31,44 B€).

Transport sector

As to the transport sector, the NEEAP (2014) reports that the expected savings will be delivered by the main measures/programmes, which comprise actions to renew the road vehicle fleet, promote sustainable mobility and develop the railway infrastructure and advanced logistics management systems. In particular, the improved energy performance of the new cars and light commercial vehicles and implementation of the measures to encourage the uptake of low-emission and electric vehicles should, taken together, save about 3,43 Mtoe of energy by 2020. The measures for sustainable mobility will contribute by some 1.97 Mtoe, broken down into the following sectors: local public transport and renewal of the bus fleet (0,9 Mtoe), railway infrastructure (0,45 Mtoe), services of the National Logistics Platform (0,5 Mtoe), and the 2009 incentives for renewing the national car fleet 2009 (0,12 Mtoe) (see Table A, pag. 5). Considering an average price of the toe equal to 545€[14] the business (M€) generated by the implementation of energy efficiency technologies in transport sector is equal to 1.870 M€ for the measures which encourage the uptake of low-emission and electric vehicles and to 1.074 M€ for the measures for sustainable mobility.

1.4 Data for the Buildings Sector

Sector	**Buildings**
Sub-Sector	Residential sector
Category	*Space heating*
Technology	***Condensing boilers***
Number of technology used	It is estimated that in mid-2013, about 20%-30% of total heating units in use (19 million units, including central heating systems) were condensing boilers Source: Energy Strategy Group, 2013
Origin of technology	Condensing boilers have a high rate of production in Italy (more than 60% of producers based in Italy) Source: ENEL, 2013
Cost of purchase	Condensing boilers are 35-40% more expensive than traditional boilers because of the higher costs of materials and design (es. the different models of Beretta Vaillan cost approximately 800-1.500€) Source: *http://www.caldaie-climatizzatori.com/prodotti.php?id=14*
Cost per kWh	2,7 - 4,1 c€/kWh Source: Energy Strategy Group, 2013
Energy consumption	24 - 33 KWh Source: *http://www.caldaie-climatizzatori.com/prodotti.php?id=14*
Advantages / disadvantages of use	The main advantage of the condensing boilers is in high yield (from 105% to 109%) compared to traditional boilers (from 90% to 93%) Source: Energy Strategy Group, 2013
Easiness to use	No difference with traditional boilers
Energy efficiency policies that supports this technology	Tax deductions, thermal account, white certificates, Kyoto fund

Sector	**Buildings**
Sub-Sector	Residential sector
Category	*Space heating*
Technology	***Heat pumps***
Number of technology used	Heat pumps are now in about 2% of the stock of production equipment installed in Italian buildings. There are indeed 400.000 installations of heat pumps compression and 150.000 installations of absorption heat pumps

[14] Value calculated by assuming an average oil price of 105 $/barrel and an exchange rate of 1,4 $/€. (Source: data processed by IEFE).

<table>
<tr><td></td><td>Source: Energy Strategy Group, 2013
The number of sales of heat pumps for year is provided below:
Annual sales of heat pumps for year:
<table><tr><td>2004</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td></tr><tr><td>12.131</td><td>13.000</td><td>17.165</td><td>28.100</td><td>28.092</td><td>29.975</td></tr></table>Source: EnerData, 2010</td></tr>
<tr><td>Origin of technology</td><td>The percentage of heat pumps producers based in Italy is between 30 and 60%
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>A heat pump air-water for an apartment of 100 m^2, costs on average 8.000-12.000€
Source: http://www.idraulicapiatti.org/2012/05/costo-di-una-pompa-di-calore.html</td></tr>
<tr><td>Cost per kWh</td><td>7 - 9,5 c€/kWh
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Energy consumption</td><td>5 - 20 KWh
Source: http://www.viessmann.it/it/prodotti/Pompe_di_calore.html</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>The heat pumps transfer more energy than non-renewable energy used to operate. Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Easiness to use</td><td>The heat pumps require more maintenance than a traditional boiler</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>Tax deductions, thermal account, white certificates</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Space heating</td></tr>
<tr><td>Technology</td><td>Opaque building surfaces</td></tr>
<tr><td>Number of technology used</td><td>Currently in Italy about 50%-70% of buildings has levels of thermal insulation roofing, walls and ground higher than 1.5W/m^2K
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Origin of technology</td><td>Opaque building surfaces have a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td><table><tr><td>Type</td><td>Cost (€/m^2)</td></tr><tr><td>Synthetic organic insulating materials</td><td>1,3-4</td></tr><tr><td>Insulation materials natural organic</td><td>1,4-2,5</td></tr><tr><td>Natural inorganic insulation materials</td><td>0,9-4,4</td></tr><tr><td>Synthetic inorganic insulation materials</td><td>1,2-4,5</td></tr></table></td></tr>
</table>

	Source: Energy Strategy Group, 2013
Cost per kWh	10 - 13 c€/kWh Source: Energy Strategy Group, 2013
Energy consumption	-
Advantages / disadvantages of use	The opaque surfaces allow to reduce the heat exchange between the building and the outside. Source: ENEL, 2013
Easiness to use	No difference with traditional building surfaces
Energy efficiency policies that supports this technology	Tax deductions, white certificates, thermal account, Kyoto fund

Sector	**Buildings**
Sub-Sector	Residential sector
Category	*Space heating*
Technology	***Fixtures with high efficiency***
Number of technology used	Currently in Italy about 40%-60% of buildings has levels of thermal insulation closures windows more than 3W/m^{2}K Source: Energy Strategy Group, 2013
Origin of technology	The percentage of fixtures with high efficiency producers based in Italy is between 30 and 60% Source: ENEL, 2013
Cost of purchase	<table><tr><td>Type</td><td>Cost (€/door)</td></tr><tr><td>Metal</td><td>250-1000</td></tr><tr><td>Wood</td><td>300-600</td></tr><tr><td>PolyVinyl Chloride (PVC)</td><td>150-350</td></tr></table>Source: Energy Strategy Group, 2013
Cost per kWh	12,4 - 21 c€/kWh Source: Energy Strategy Group, 2013
Energy consumption	-
Advantages / disadvantages of use	The fixtures with high efficiency allows to reduce the heat exchange between the building and the outside Source: ENEL, 2013
Easiness to use	No difference with traditional fixtures
Energy efficiency policies that supports this	Tax deductions, thermal account, white certificates, Kyoto fund

technology	

Sector	Buildings
Sub-Sector	Residential sector
Category	*Water heating*
Technology	***Solar thermal***
Number of technology used	In 2013 Italy has a total installed 2,5-3 GW capacity of solar thermal for the production of domestic hot water and heat for heating Source: Energy Strategy Group, 2013.
Origin of technology	Solar thermal has a low rate of production in Italy (less than 30% of producers based in Italy) Source: ENEL, 2013
Cost of purchase	Type / Cost (€/door): Unglazed collectors: 70-100 Glazed collectors: 350-450 Vacuum collectors: 450-600 Source: Energy Strategy Group, 2013
Cost per kWh	6 - 13 c€/kWh Source: Energy Strategy Group, 2013
Energy consumption	-
Advantages / disadvantages of use	Solar thermal systems use solar radiation to produce heat, allowing a saving in consumption of gas or electricity Source: ENEL, 2013
Easiness to use	-
Energy efficiency policies that supports this technology	Thermal account, white certificates, Kyoto fund

Type	Cost (€/door)
Unglazed collectors	70-100
Glazed collectors	350-450
Vacuum collectors	450-600

Sector	Buildings
Sub-Sector	Residential sector
Category	*Water heating*
Technology	***Biomass boilers***
Number of technology used	In 2014, biomass boilers are 2,4% of the total water heating systems Source: ISTAT, 2014
Origin of technology	Biomass boilers have a high rate of production in Italy (more than 60% of producers based in Italy) Source: ENEL, 2013

Cost of purchase	3.000 - 4.000 € Source:*http://www.riscaldarecasa.it/category.php~idx~~~15~~CALDAIE+A+BIOMASSA+_POLICOMBUSTIBILI~.html*
Cost per kWh	-
Energy consumption	4 - 100 kWh Source: *http://www.viessmann.it/it/prodotti/Caldaie_a_biomassa.html*
Advantages / disadvantages of use	-
Easiness to use	Difficulty of use linked to the supply and storage of biomass
Energy efficiency policies that supports this technology	Thermal account, white certificates, tax deduction, Kyoto fund

Sector	**Buildings**
Sub-Sector	Residential sector
Category	*Energy production*
Technology	***Photovoltaic***
Number of technology used	The current situation of the photovoltaic market in Italy is characterized by the presence of more than 526.463 plants scattered throughout the country, with a capacity corresponding to 17.080.255 kW Source: Energy Strategy Group, 2013
Origin of technology	The percentage of photovoltaic producers based in Italy is between 30 and 60% Source: ENEL, 2013
Cost of purchase	The average price of a photovoltaic system ranges on average between 2.000 and 3.500 €/kW Source: *http://www.enerpoint.it/solare/fotovoltaico/costi-fotovoltaico.php*
Cost per kWh	0,33 c€/kWh Source: *http://www.tettosolare.it/?ids=9*
Energy consumption	-
Advantages / disadvantages of use	Advantages: photovoltaic panels requires little maintenance Disadvantages: intermittent energy production and dependent on seasons Source: *http://www.fotovoltaiconorditalia.it/idee/vantaggi-e-svantaggi-di-un-impianto-fotovoltaico*
Easiness to use	-
Energy efficiency policies that supports this	White certificates, tax deduction, Kyoto fund

technology	

Sector	Buildings
Sub-Sector	Residential sector
Category	*Cooking*
Technology	***Induction cooking***
Number of technology used	The induction cookers represent about 10% of the actual sale of kitchens Source: ENEL, 2013
Origin of technology	Induction cooking has a high rate of production in Italy (more than 60% of producers based in Italy) Source: ENEL, 2013
Cost of purchase	The price of induction cooking is about 800 - 1200 € Source: *http://taglialabolletta.it/il-piano-di-cottura-ad-induzione*
Cost per kWh	-
Energy consumption	1,8 - 3,3 KWh Source: *http://www.recensioni-piano-cottura-ad-induzione-magnetica.it/piano-cottura-induzione.asp*
Advantages / disadvantages of use	The main advantages of induction cookers are the high energy efficiency (90-95%) compared to traditional technologies (30-60%), greater security, the absence of domestic pollution and ability to control consumption. The disadvantages are the high initial cost, the high absorption of electrical power and the generation of electromagnetic fields. Source: ENEL, 2013
Easiness to use	-
Energy efficiency policies that supports this technology	White certificates

Sector	Buildings
Sub-Sector	Residential sector
Category	*Efficient appliances*
Technology	***Washing machines***
Number of technology used	The stock of washing machines (Millions) for years is provided below:

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
20,72	21,12	21,56	21,98	22,40	22,83	23,25	23,67	24,00	24,31	25,53

Source: EnerData 2010

The percentage of washing machines for class is (Source: ENEA, 2011b):

<table>
<tr><td></td><td>A++ (16.9%), A+ (31.9%), A (21.3%), other energy classes (29.2%)</td></tr>
<tr><td>Origin of technology</td><td>Washing machines have a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase depends on the brand and the energy class, as shown by the table below which lists the prices for major brands in the Italian market:
<table>
<tr><th>Brand</th><th>Price</th><th>Brand</th><th>Price</th></tr>
<tr><td>AEG (Electrolux)</td><td>€ 802,91</td><td>Miele</td><td>€ 1.392,97</td></tr>
<tr><td>Beko (Arcelik)</td><td>€ 291,38</td><td>Nardi Elettrodomestici</td><td>€ 378,00</td></tr>
<tr><td>BSH (Bosch)</td><td>€ 550,64</td><td>Ocean (Fagor-Brandt Italia)</td><td>€ 339,50</td></tr>
<tr><td>Candy (Candy Group)</td><td>€ 463,06</td><td>Rex (Electrolux)</td><td>€ 510,00</td></tr>
<tr><td>Electrolux</td><td>€ 689,00</td><td>Samsung</td><td>€ 484,72</td></tr>
<tr><td>Gorenje</td><td>€ 332,67</td><td>SanGiorgio (Fagor-Brandt Itali</td><td>€ 387,00</td></tr>
<tr><td>Haier</td><td>€ 248,75</td><td>Smeg</td><td>€ 620,76</td></tr>
<tr><td>Hoover (Candy Group)</td><td>€ 550,31</td><td>Whirlpool</td><td>€ 486,08</td></tr>
<tr><td>Hotpoint-Ariston (Indesit)</td><td>€ 512,86</td><td>Zoppas (Electrolux)</td><td>€ 419,15</td></tr>
<tr><td>Ignis (Whirlpool)</td><td>€ 340,78</td><td>Average price</td><td>€ 483</td></tr>
<tr><td>Indesit</td><td>€ 388,16</td><td>Maximum</td><td>€ 2.460</td></tr>
<tr><td>LG</td><td>€ 629,03</td><td>Minimum price</td><td>€ 116</td></tr>
</table>
Source: Marchi, Menconi, 2010</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>300 KWh for 4 washes/week
Source: CESI ricerca, 2009.
Es. Washing machine 6 kg - 220 cycles/year
<table>
<tr><th>Class</th><th>Annual consumption (kWh/y)</th></tr>
<tr><td>A+++</td><td>153</td></tr>
<tr><td>A++</td><td>163</td></tr>
<tr><td>A+</td><td>185</td></tr>
<tr><td>A</td><td>212</td></tr>
<tr><td>B</td><td>242</td></tr>
<tr><td>C</td><td>273</td></tr>
</table>
Source: Ceceditalia http://www.ceceditalia.it/area-consumatori/risparmio/quanto_si_risparmia/1%2C614%2C1%2C</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>-</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Efficient appliances</td></tr>
<tr><td>Technology</td><td>Dishwashers</td></tr>
<tr><td>Number of technology used</td><td>The stock of dishwashers (Millions) for years is provided below:
<table>
<tr><td>2000</td><td>2001</td><td>2002</td><td>2003</td><td>2004</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td></tr>
<tr><td>5,47</td><td>5,93</td><td>6,37</td><td>6,88</td><td>7,43</td><td>8,01</td><td>8,57</td><td>9,06</td><td>9,17</td><td>9,27</td><td>9,36</td></tr>
</table>
Source: EnerData, 2010
The percentage of dishwashers for class is (Source: ENEA, 2011b):
A++ (9,7%), A+ (18,9%), A (13.3%), other energy classes (58,1%)</td></tr>
<tr><td>Origin of technology</td><td>Dishwashers have a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase depends on the brand and the energy class</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>314 KWh/y for 4-6 washes/week
Source: CESI ricerca, 2009
Es. Dishwasher 60 cm - 280 cycles/year
<table>
<tr><td>Class</td><td>Annual consumption (kWh/y)</td></tr>
<tr><td>A+++</td><td>230</td></tr>
<tr><td>A++</td><td>245</td></tr>
<tr><td>A+</td><td>275</td></tr>
<tr><td>A</td><td>309</td></tr>
<tr><td>B</td><td>348</td></tr>
<tr><td>C</td><td>393</td></tr>
<tr><td>D</td><td>416</td></tr>
</table>
Source: Ceceditalia http://www.ceceditalia.it/area-consumatori/risparmio/quanto_si_risparmia/1%2C614%2C1%2C</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>-</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates</td></tr>
</table>

Sector	**Buildings**

<table>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Efficient appliances</td></tr>
<tr><td>Technology</td><td>Freezers</td></tr>
<tr><td>Number of technology used</td><td>The stock of freezers (Millions) for years is provided below:
<table>
<tr><td>2000</td><td>2001</td><td>2002</td><td>2003</td><td>2004</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td></tr>
<tr><td>6,20</td><td>6,49</td><td>6,69</td><td>6,90</td><td>7,12</td><td>7,33</td><td>7,56</td><td>7,79</td><td>7,95</td><td>7,98</td><td>9,14</td></tr>
</table>
Source: EnerData 2010
The percentage of freezers for class is (Source: ENEA 2011):
A++ (4,9%), A+ (10,7%), A (8.3%), other energy classes (76,1%)</td></tr>
<tr><td>Origin of technology</td><td>Freezers have a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase depends on the brand and the energy class, as shown by the table below which lists the prices for major brands in the Italian market:
<table>
<tr><th>Brand</th><th>Price</th><th>Brand</th><th>Price</th></tr>
<tr><td>AEG (Electrolux)</td><td>€ 896,15</td><td>Nardi Elettrodomestici</td><td>€ 473,63</td></tr>
<tr><td>Beko (Arcelik)</td><td>€ 309,50</td><td>Rex (Electrolux)</td><td>€ 644,06</td></tr>
<tr><td>BSH (Bosch)</td><td>€ 664,26</td><td>SanGiorgio (Fagor-Brandt Itali</td><td>€ 416,00</td></tr>
<tr><td>Candy (Candy Group)</td><td>€ 506,95</td><td>Smeg</td><td>€ 709,59</td></tr>
<tr><td>DeDietrich (Fagor-Brandt Italia</td><td>€ 540,00</td><td>Whirlpool</td><td>€ 542,86</td></tr>
<tr><td>Electrolux</td><td>€ 848,50</td><td>Zoppas (Electrolux)</td><td>€ 466,00</td></tr>
<tr><td>Hoover (Candy Group)</td><td>€ 592,38</td><td>Average price</td><td>€ 568</td></tr>
<tr><td>Hotpoint-Ariston (Indesit)</td><td>€ 511,96</td><td>Maximum</td><td>€ 2.168</td></tr>
<tr><td>Ignis (Whirlpool)</td><td>€ 363,00</td><td>Minimum price</td><td>€ 239</td></tr>
<tr><td>Indesit</td><td>€ 423,54</td><td></td><td></td></tr>
<tr><td>LG</td><td>€ 490,00</td><td></td><td></td></tr>
<tr><td>Miele</td><td>€ 1.131,52</td><td></td><td></td></tr>
</table>
Source: Marchi, Menconi, 2010</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>
<table>
<tr><td>Capacity (l)</td><td colspan="3">Annual consumption (kWh/y)</td></tr>
<tr><td>400</td><td>350</td><td>260</td><td>175</td></tr>
<tr><td>350</td><td>320</td><td>240</td><td>155</td></tr>
<tr><td>300</td><td>300</td><td>225</td><td>150</td></tr>
</table>
Source: CESI ricerca, 2009
Es. Static combined refrigerator, total capacity 300 l
<table>
<tr><td>Class</td><td>Annual consumption (kWh/y)</td></tr>
<tr><td>A+++</td><td>160</td></tr>
<tr><td>A++</td><td>200</td></tr>
<tr><td>A+</td><td>280</td></tr>
<tr><td>A</td><td>360</td></tr>
</table>
Source: Ceceditalia http://www.ceceditalia.it/area-consumatori/risparmio/quanto_si_risparmia/1%2C614%2C1%2C</td></tr>
</table>

Advantages / disadvantages of use	-
Easiness to use	-
Energy efficiency policies that supports this technology	White certificates

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Efficient appliances</td></tr>
<tr><td>Technology</td><td>Refrigerators</td></tr>
<tr><td>Number of technology used</td><td>
<table>
<tr><td colspan="11">The stock of refrigerators (Millions) for years is provided below:</td></tr>
<tr><td>2000</td><td>2001</td><td>2002</td><td>2003</td><td>2004</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td></tr>
<tr><td>21,11</td><td>21,46</td><td>21,79</td><td>22,13</td><td>22,46</td><td>22,79</td><td>23,12</td><td>23,45</td><td>23,80</td><td>24,07</td><td>27,69</td></tr>
</table>
Source: EnerData, 2010
The percentage of refrigerators for class is (Source: ENEA, 2011b):
A++ (5,4%), A+ (10,3%), A (9%), other energy classes (75,3%)
</td></tr>
<tr><td>Origin of technology</td><td>Refrigerators have a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase depends on the brand and the energy class, as shown by the table below which lists the prices for major brands in the Italian market:
<table>
<tr><td>Brand</td><td>Price</td><td>Brand</td><td>Price</td></tr>
<tr><td>AEG (Electrolux)</td><td>€ 1.113,54</td><td>Liebherr</td><td>€ 1.395,45</td></tr>
<tr><td>Beko (Arcelik)</td><td>€ 387,00</td><td>Miele</td><td>€ 1.013,40</td></tr>
<tr><td>BSH (Bosch)</td><td>€ 822,05</td><td>Nardi Elettrodomestici</td><td>€ 685,50</td></tr>
<tr><td>Candy (Candy Group)</td><td>€ 468,60</td><td>Rex (Electrolux)</td><td>€ 553,46</td></tr>
<tr><td>Electrolux</td><td>€ 440,00</td><td>Samsung</td><td>€ 489,00</td></tr>
<tr><td>Gorenje</td><td>€ 760,75</td><td>Sharp</td><td>€ 885,75</td></tr>
<tr><td>Haier</td><td>€ 748,25</td><td>Smeg</td><td>€ 1.125,77</td></tr>
<tr><td>Hoover (Candy Group)</td><td>€ 597,83</td><td>Whirlpool</td><td>€ 743,33</td></tr>
<tr><td>Hotpoint-Ariston (Indesit)</td><td>€ 628,32</td><td>Zoppas (Electrolux)</td><td>€ 516,00</td></tr>
<tr><td>Ignis (Whirlpool)</td><td>€ 553,50</td><td>Average price</td><td>€ 698</td></tr>
<tr><td>Indesit</td><td>€ 459,17</td><td>Maximum</td><td>€ 3.492</td></tr>
<tr><td>LG</td><td>€ 662,25</td><td>Minimum price</td><td>€ 330</td></tr>
</table>
Source: Marchi, Menconi, 2010
</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>
<table>
<tr><td>Capacity (l)</td><td colspan="3">Annual consumption (kWh/y)</td></tr>
<tr><td>400</td><td>350</td><td>400</td><td>350</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>350</td><td>320</td><td>350</td><td>320</td></tr><tr><td>300</td><td>300</td><td>300</td><td>300</td></tr></table>Source: CESI ricerca, 2009</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>-</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates</td></tr>
</table>

Sector	**Buildings**
Sub-Sector	Residential sector
Category	*Energy saving*
Technology	***Building automation***
Number of technology used	Currently in Italy the Energy Management Systems record low uptake; thanks to the integration of wi-fi technologies, the Building Automation System counts about 150.000-250.000 applications Source: Energy Strategy Group, 2013
Origin of technology	Building automation has a low rate of production in Italy (less than 30% of producers based in Italy) Source: ENEL, 2013
Cost of purchase	The prices of the building automation systems in the residential sector are variable depending on the size, on average between 2,000 and 7,000 € Source: Energy Strategy Group, 2013
Cost per kWh	-
Energy consumption	-
Advantages / disadvantages of use	The building automation system (BA) allows to maximize the energy efficiency of a building, on the basis of the use of the building itself and the ambient conditions Source: Energy Strategy Group, 2013
Easiness to use	-
Energy efficiency policies that supports this technology	White certificates

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Residential sector</td></tr>
<tr><td>Category</td><td>Lighting</td></tr>
<tr><td>Technology</td><td>Efficient lighting system</td></tr>
<tr><td>Number of technology used</td><td>To date in Italy, the lighting equipment in use is composed by about 15-18% gas lamps, LED lamps for 9-13% and for the remaining part fluorescent lamps
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Origin of technology</td><td>Efficient lighting system has a high rate of production in Italy (more than 60% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>
<table>
<tr><th>Technology</th><th>Light efficiency (lm/W)</th><th>Duration (h)</th><th>Price (€)</th></tr>
<tr><td>compact fluorescent</td><td>50-75</td><td>6.000-12.000</td><td>15</td></tr>
<tr><td>fluorescent tube</td><td>55-120</td><td>12.000-20.000</td><td>100</td></tr>
<tr><td>halides</td><td>40-100</td><td>12.000-20.000</td><td>100</td></tr>
<tr><td>high pressure sodium</td><td>70-150</td><td>10.000-12.000</td><td>100</td></tr>
<tr><td>low pressure sodium</td><td>125-200</td><td>10.000-12.000</td><td>100</td></tr>
<tr><td>LED</td><td>50-90</td><td>25.0000</td><td>10</td></tr>
</table>
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>-</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>-</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates</td></tr>
</table>

Commercial/services sector

Sector	**Buildings**
Sub-Sector	Commercial/services sector
Category	*Energy saving*
Technology	***Uninterruptible Power Supply (UPS)***
Number of technology used	The number of UPS installed in Italy is estimated at between 250.000 and 300.000 units, of which 20-30% attributable to high-efficiency devices

<table>
<tr><td></td><td>Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Origin of technology</td><td>UPS has a low rate of production in Italy (less than 30% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase depends on size and efficiency class:
<table>
<tr><td rowspan="2"></td><td colspan="4">Size (kVA)</td></tr>
<tr><td>10</td><td>40</td><td>80</td><td>160</td></tr>
<tr><td>average efficiency</td><td>3.500-4.000</td><td>5.500-6.500</td><td>8.500-9.500</td><td>16.000-17.000</td></tr>
<tr><td>high efficiency</td><td>4.000-5.000</td><td>7.500-8.500</td><td>10.500-11.500</td><td>17.500-18.500</td></tr>
</table>
Source: Energy Efficiency Report, 2013</td></tr>
<tr><td>Cost per kWh</td><td>5,5 - 8,2c€/kWh (GDO); 5,4 - 8 2c€/kWh (hotel); 14 - 20,6 c€/kWh (bank); 3,3 - 4,9 c€/kWh (hospital)
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Energy consumption</td><td>-</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>UPS ensures the continuity and quality of power supply to loads</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Buildings</td></tr>
<tr><td>Sub-Sector</td><td>Commercial/services sector</td></tr>
<tr><td>Category</td><td>Space heating</td></tr>
<tr><td>Technology</td><td>Combined Heat and Power (CHP)</td></tr>
<tr><td>Number of technology used</td><td>Currently in Italy, cogeneration plants have an electrical power of about 10-12 GW
Source: Energy Strategy Group, 2013</td></tr>
<tr><td>Origin of technology</td><td>CHP has a low rate of production in Italy (less than 30% of producers based in Italy)
Source: ENEL, 2013</td></tr>
<tr><td>Cost of purchase</td><td>The cost of purchase (€/KW) depends on type and electrical power:
<table>
<tr><td rowspan="2">Power</td><td colspan="4">Type</td></tr>
<tr><td>steam plants (€/KW)</td><td>Gas turbines (€/KW)</td><td>combined cycles (€/KW)</td><td>internal combustion engines (€/KW)</td></tr>
<tr><td>> 1MW</td><td>500-1.300</td><td>500-1.000</td><td>800-1.500</td><td>800-1.100</td></tr>
<tr><td>< 1MW</td><td>800-1.500</td><td>1.300-1.600</td><td>10.50-11.500</td><td>500-1.300</td></tr>
</table></td></tr>
</table>

	Source: Energy Strategy Group, 2013
Cost per kWh	2 – 3 c€/kWh (GDO); 0,7 – 1,5 c€/kWh (hotel); 0,6 – 1,1 c€/kWh (hospital) Source: Energy Strategy Group, 2013
Energy consumption	-
Advantages / disadvantages of use	Advantages: low emissions, high efficiency, low noise Disadvantages: high cost, short useful life Source: Energy Strategy Group, 2013
Easiness to use	-
Energy efficiency policies that supports this technology	Thermal account, tax deductions, white certificates, Kyoto fund

1.5 DATA FOR THE TRANSPORT SECTOR

<table>
<tr><td>Sector</td><td>Transport</td></tr>
<tr><td>Sub-Sector</td><td>Vehicle efficiency for passenger and freight transport</td></tr>
<tr><td>Category</td><td>Road transport</td></tr>
<tr><td>Technology</td><td>Hybrid and electric vehicles</td></tr>
<tr><td>Number of technology used</td><td>According to data from CEI-CIVES circulating in Italy a total of about 53.150 hybrid and electric vehicles
Source: ACI-CENSIS, 2012

In 2014 the percentage of electric cars sold in Italy was 0.1% of total sales. Source: http://www.fierabolzano.it/klimamobility/mod_moduli_files /Klimamobility_2015_Pietro_Menga.pdf

The number of sales of hybrid and electric cars per year is provided below:
<table>
<tr><td>Type</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>Hybrid</td><td>1.112</td><td>2.192</td><td>3.467</td><td>3.354</td><td>7.621</td><td>4.845</td><td>5.127</td><td>5.165</td></tr>
<tr><td>Electric</td><td>28</td><td>27</td><td>23</td><td>132</td><td>62</td><td>114</td><td>302</td><td>438</td></tr>
</table>
Source: ACI-CENSIS, 2012</td></tr>
<tr><td>Origin of technology</td><td>-</td></tr>
<tr><td>Cost of purchase</td><td>15,450 € (Toyota Yaris Hyibrid Cool) – 64.000€ (Tesla mod. D).
For more car models consult: http://www.tuttogreen.it/auto-elettriche-2015-il-listino-completo/</td></tr>
<tr><td>Cost per kWh</td><td>400-800€/kWh
Source: ieri, oggi e domani della trazione elettrica stradale. ENEA, 2010</td></tr>
<tr><td>Energy consumption</td><td>Average consumption electric cars (final energy): 155.3 Wh/km
Source: CE Delft, 2011</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>Hybrid and electric vehicles allow a reduction in consumption and emissions. The main disadvantage is the cost of the batteries, for a 150 km-range battery, for example, the cost is estimated around 9.000€
Source: Marciani et al., 2014</td></tr>
<tr><td>Easiness to use</td><td>-</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>White certificates, national infrastructure plan to set up electric vehicle charging points, Road tax, Renewable energy in transport sector (D.lgs 28/2011)</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Transport</td></tr>
<tr><td>Sub-Sector</td><td>Vehicle efficiency for passenger and freight transport</td></tr>
<tr><td>Category</td><td>Road transport</td></tr>
<tr><td>Technology</td><td>LPG and methane vehicles</td></tr>
<tr><td>Number of technology used</td><td>The number of sales of LPG and methane cars per year is provided below:
<table>
<tr><td>Type</td><td>2005</td><td>2006</td><td>2007</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>LPG</td><td>1.826</td><td>3.482</td><td>29.991</td><td>74.247</td><td>339.596</td><td>280.720</td><td>56.399</td><td>106.596</td></tr>
<tr><td>Methane</td><td>22.679</td><td>26.617</td><td>60.659</td><td>79.171</td><td>127.171</td><td>65.713</td><td>38.350</td><td>45.063</td></tr>
</table>
Source: ACI-CENSIS, 2012</td></tr>
<tr><td>Origin of technology</td><td>-</td></tr>
<tr><td>Cost of purchase</td><td>A modern system of LPG costs 1.500 to 2.000€, while the cost of a good natural gas system varies between 2.000 and 2.600€</td></tr>
<tr><td>Cost per kWh</td><td>-</td></tr>
<tr><td>Energy consumption</td><td>-</td></tr>
<tr><td>Advantages / disadvantages of use</td><td>Advantages: fuel economy
Disadvantages: long refueling times
Source: http://www.sicurauto.it/esperto-di-sicurauto/news/auto-a-metano-o-gpl-costi-vantaggi-e-svantaggi.html</td></tr>
<tr><td>Easiness to use</td><td>No difference with traditional fuel</td></tr>
<tr><td>Energy efficiency policies that supports this technology</td><td>Road tax, Guide to fuel saving and decreasing CO_2 emission by cars</td></tr>
</table>

<table>
<tr><td>Sector</td><td>Transport</td></tr>
<tr><td>Sub-Sector</td><td>Vehicle efficiency for passenger and freight transport</td></tr>
<tr><td>Category</td><td>Road transport</td></tr>
<tr><td>Technology</td><td>Car sharing</td></tr>
<tr><td>Number of technology used</td><td>The number of users, vehicle fleets and parking lots of car sharing per year is provided below:
<table>
<tr><td>Car sharing</td><td>2009</td><td>2010</td><td>2011</td></tr>
<tr><td>Users</td><td>17.993</td><td>19.123</td><td>22.693</td></tr>
<tr><td>Vehicle fleet</td><td>573</td><td>567</td><td>618</td></tr>
<tr><td>Parking lots</td><td>383</td><td>382</td><td>422</td></tr>
</table>
Source: ACI-CENSIS, 2012</td></tr>
</table>

Origin of technology	-
Cost of purchase	-
Cost per kWh	-
Energy consumption	-
Advantages / disadvantages of use	Advantages: car sharing involves a drastic reduction in costs arising from the ownership of a car Disadvantages: car sharing is a service provided only in some cities Source: *http://www.6sicuro.it/auto/car-sharing*
Easiness to use	No difference than traditional cars
Energy efficiency policies that supports this technology	National electric car sharing project in cities

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