

TEP PROJECT

REGIONAL ENERGY POLICIES AND BUILDING RETROFITTING: THE TOWNS OF UMBRIA (ITALY)

Urban Policies and Energy Retrofitting: the Towns of Umbria (Italy)

1. General Information

Having a population of about 800.000 inhabitants, a surface of 8.456 km², Umbria is one of the smallest region of Italy. Its territory is covered for 94% with mountains and hills; its economy is basically founded on small industries, artisanal activities, and services. The high density of historical towns - like Perugia, Assisi, Gubbio, Spoleto and Orvieto - is a peculiarity of this region, affecting its image, the beauty of its lands and its touristical economy.

In the last forty years, following the industrialization process of the Italian economy, Umbria suffered of a vigorous trend towards the abandonment of rural villages and houses, with disordered population growth for the nine bigger towns. This contributed to a further decrease of inhabitants in the most peripheral areas of the region, with major problems in maintaining the broad silver and forestal heritage of Umbria. Now, it is plausible that, without consistent policy in favour of the marginal areas of the region, the actual demographic trends could persist, with further population concentration, particularly in Perugia. The residential building stock figure is substantially favourable: a large quota of dwellings are in property, with adequate construction standards and comfortable living space per person. Less favourable is the housing condition of some historical towns, where rehabilitation projects are under implementation.

The energy figure of the residential sector in Umbria shows the following main characters:

Energy Sources	Consumption (MWh/y)
Natural Gas	1,750,471
Petroleum derivates	915,900
Biomass	661,479
Electricity	664,155
TOTAL	3,992,005

Energy Supply- Residential Sector - 1990

Electricity

The percentage of dwellings connected to the electric grid and the actual distribution, between resident and non-resident users, approaches the Italian average. The electricity consumption per dwelling averages the 2,200 kWh/year.

Natural gas

In 1990, the natural gas network was covering 47 towns over 92, where lives the 88% of the population. At present, the 46% of the regional dwelling stock is connected to the gas network, while the 54% of the dwellings of the region use other types of fuels (petroleum derivates and wood). In many towns of the region, such as Perugia, the natural gas is supplied to more than 75% of the houses. The average gas consumption per dwelling corresponds to

1,436 m³/year, in the colder province of Perugia, and equals 808 m³/year, in the warmer province of Terni. The natural gas consumption in the region is still increasing.

Petroleum derivatives and wood

In 1990, the consumption of petroleum derivatives was 80,000 TOE, corresponding to the 23% of the domestic energy supply. Particularly high was the estimate of the contribution of biomass resources: 57,000 TOE, the 17% of the share.

2. Main Objectives

The energy study had a very pragmatical, but very ambitious goal: to provide to the Region and to the towns of Umbria the guidelines of a multi-annual energy and environmental planning for the residential sector, which shall encourage energy substitution and emission reduction, by promoting local investments, marketing of energy technologies and new employment. Priority was given to the substantial reduction of fossil fuel utilization for the residential sector, where oil or gas burning is extremely inconsistent due to the low temperature of the end-use. A major reference was provided by some recent international agreements, grouped in the AGENDA 21 programme, in which the governments involved declared that major efforts would be made in order to maintain the CO₂ emissions at the 1990 levels. The aim of the Umbria Region was to promote its governmental role, by respecting the international conventions, which have many consequences on land use, resources exploitation, structural and infrastructural change.

3. Description of the Project

3.1. Energy System Analysis

In this area, an innovative tool, purposely developed for this project, is the so called dwelling energy code, which allows to classify the regional building stock in various categories, each of them representing a particular building type.

The dwelling energy codes could be seen as energy labels worked out for each building category.

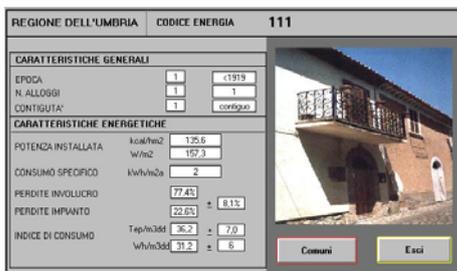
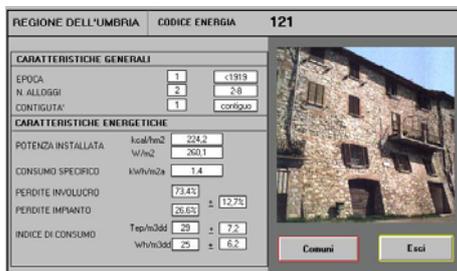
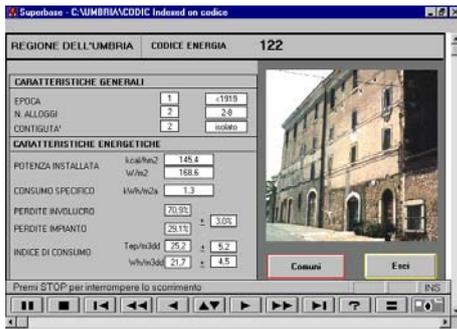
They are the basic references for implementing the energy balance of the residential sector and to evaluate different energy strategies.

The activities worked out in this area of the study are the following:

- detailed information on energy supplies for each of the 92 towns of Umbria;
- data set on the Umbria residential building stock from the Italian Census Data-Base, categorised through the dwelling energy code;
- comprehensive sectoral energy demand/supply model.

3.2. Energy&environment policy simulator

Once developed the energy balance for the residential sector, a new tool for energy policy simulation, at the regional and town level, was implemented. The simulation pointed out the energy conservation and substitution potential, taking into account: investment costs, local resources exploitation, and environmental benefits. Energy conservation and substitution strategies were selected and implemented through the energy code method: every dwelling



energy code was matched with the most compatible package of Energy Conservation and Substitution Opportunities, so that the effects of any policy could be easily estimated for the whole building stock. The TEP environmental data-base, then, was appropriately linked with the energy supply data, providing for each town the environmental balance. The balance of atmospheric emissions related to energy utilization can be regarded as a basis for the assessment of alternative energy policies, in order to estimate the environmental improvement related to different scenarios.

3.3. Result of energy and building maintenance strategies

Energy&building policies were implemented at the local level, to determine appropriate guidelines for each town.

The regional territory was subdivided in various homogeneous territorial units, which better reflect the land peculiarities and the local characters.

The following results are available for the regional policy makers:

- energy conservation/substitution potentiality on the local and regional scale;
- costs related to different energy policies for the residential sector;
- environmental assessment of the alternative energy conservation /substitution policies.

More than this, an interactive tool is available for decision making. TEP Model allows the full adaptation of the policies currently implemented, as well as the assessment of specific programmes of investment in the housing sector.

3.4. TEP Model configuration

The 92 towns of the Umbria Region were grouped into Homogeneous Territorial Units (HTU), with reference to:

- socio-economic characteristics;
- climatic conditions;
- asyismic risk of damage for the building stock as well as its current fuel utilization.

Each HTU (Homogeneous Territorial Unit) summarizes the basic energy-building data, such as: total number of dwellings; global dwellings surface and volume; annual thermal energy consumption; electricity consumption; global emissions; etc.

The building stock of each town is aggregated and subsequently processed by means of the dwelling energy code method.

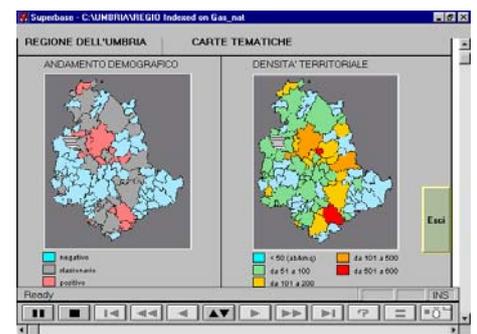
The 32 dwelling energy codes are indexed in a series of forms, reporting on their basic energy characteristics.

For each HTU is likely to associate a variety of Energy Conservation Opportunities, included into the TEP catalogue. These are measures that could be subsidised by the local Government within the Ten-years Energy Planning. The catalogue is the result of a selection among the most recurrent energy conservation and substitution techniques. Through the appropriate choice of a mix of Energy Conservation Substitution Opportunities, one can compare various energy-building policies at the town level, to yield the "energy-policy making" on a very detailed scale.

The actual energy balance, as well as the emission balance, could be displayed in conjunction with the results of alternative energy supply scenarios, in order to estimate the potential energy saving, the global cost of the policy, and the environmental benefits.

REGIONE DELL'UMBRIA		INTERVENTI DI RISANAMENTO ENERGETICO	
Tipo: INSTALLAZIONE/RIPIRISTINO DELLE GUARNIZIONI DEI SEPRAMENTI			
Sede: CHIUSURE VERTICALI ESTERNE		Codice: 2.3	
DESCRIZIONE: Installazione in rispetto delle guarnizioni o riparo di materiale di battuta nei serramenti, per ridurre le perdite di energia dovute alle infiltrazioni d'aria.			
REQUISITI MINIMI: Riduzione della permeabilità all'aria (a 100 Pa) per metro lineare di giunto a valori inferiori a 0,10 m ³ /h; durata minima garantita degli elementi di tenuta: 15 anni.			
APPLICABILITA': Tutti gli edifici con serramenti ancora in buone condizioni ma privi di guarnizioni o con le stesse deteriorate.			
Contr. Economica A		Comp. Operative ---	
Intervento: 3.4 3.5		Costi stimati: 1500 5000 min L/m max	
Pacchetti		ESCI	

REGIONE DELL'UMBRIA		INTERVENTI DI RISANAMENTO ENERGETICO	
Tipo: SOSTITUZIONE DELLA CENTRALE TERMICA OBSOLETA			
Sede: IMPIANTO TERMICO		Codice: 5.2	
DESCRIZIONE: Sostituzione della centrale termica obsoleta (generatori, caldaie, boiler, centraline di regolazione in pompieri, con una nuova ad alta efficienza, costantemente dimensionata).			
REQUISITI MINIMI: Prestazione classe > 22 Caldaie: rendimento annuo > 90% Boiler: rendimento periodo riscaldamento > 90% rendimento fase periodo riscaldamento > 80%			
APPLICABILITA': Tutti gli impianti centralizzati, ed in particolare quelli al termine della loro vita utile.			
Contr. Economica B		Comp. Operative ---	
Intervento: 5.3 5.4 4.1 4.3		Costi stimati: 6 min max	
Pacchetti		ESCI	



4. Impact and application

The result of the Ten-years Energy Policy for the residential sector in Umbria Region consists of a global budget to be invested of more than 600 million Euro. In order to appreciate the entity of such investment a term of reference is useful: the current Italian expenditure in building renovation is 15,000 million Euro per year, so that the provisional energy policy budget amounts to the 12-15% of the annual building renovation investment in Umbria.

Such a very effective policy could reduce of more than 38% the global energy dependency of the residential sector on conventional fossil fuels. In fact, the amount of energy saved or substituted with renewable sources, through the full implementation of the ten-years strategy, corresponds to almost 2,000,000 MWh/year.

The environmental benefits of the fossil substitution strategy are also significant in the medium term: the abatement of CO₂ totals 400,000 tons per year, while 2,500 tons per year is the equivalent of particulate pollutants reduction, and 332 ton/y that of nitrogen oxides. Finally, the plans of investment must rely on private financial resources, while the regional energy policy will assist the start up, by allocating the funds of the Italian law 10/91.

REGIONE DELL'UMBRIA		COMUNE DI:		ASSISI		
Codice Energia	Numero abitazioni	Superficie abitazioni (mq)	Popolazione (abit. stab.)	Capacità (imp. ric.) (kW)	Consumi esterni (MWh)	Potenza installata (kW)
111	192	17177	15116	6527	1202	2006
121	554	44004	25128	13666	3066	5993
121	91	7549	5912	2793	928	1195
122	525	42293	21147	12600	2115	4897
131	15	1022	501	206	72	99
132	10	728	269	197	29	79
141	0	0	0	0	0	0
142	2	205	49	43	62	16
211	166	15290	12538	6422	1276	997
212	170	12891	12246	4770	1289	967
221	89	7445	7457	2659	794	1209
222	164	13778	10610	4271	985	2443
231	6	540	427	119	49	13
232	0	0	0	0	0	0
241	1	94	78	24	8	9
242	0	0	0	0	0	0

REGIONE DELL'UMBRIA		COMUNE DI:		PASSIGLIANO SUL TRASIMENO		POLITICHE DI INTERVENTO															
Codice Energia	Numero abitazioni	Superficie abitazioni (mq)	Popolazione (abit. stab.)	Capacità (imp. ric.) (kW)	Consumi esterni (MWh)	Potenza installata (kW)	Pacchetti di intervento											Risp. %	Risparmio energetico (MWh/anno)	Costo (MLit.)	AOI
							1	2	3	4	5	6	7	8	9	10	11	12			
111	6978	1437	146	1676	*	*	*	*	*	*	*	*	*	*	*	*	*	21	396	120	
112	8050	1837	245	2572	*	*	*	*	*	*	*	*	*	*	*	*	21	541	172		
121	2504	563	101	1127	*	*	*	*	*	*	*	*	*	*	*	*	15	174	67		
122	3283	1288	216	1359	*	*	*	*	*	*	*	*	*	*	*	*	15	298	125		
131	0	0	0	0	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0		
132	88	10	2	15	*	*	*	*	*	*	*	*	*	*	*	*	60	9	2		
141	0	0	0	0	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0		
142	0	0	0	0	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0		
211	4918	592	78	1127	*	*	*	*	*	*	*	*	*	*	*	*	25	295	24		
212	1689	335	30	426	*	*	*	*	*	*	*	*	*	*	*	*	25	109	22		
221	9072	1526	851	4079	*	*	*	*	*	*	*	*	*	*	*	*	28	1122	241		
222	2441	301	75	526	*	*	*	*	*	*	*	*	*	*	*	*	27	141	47		
231	280	24	1	28	*	*	*	*	*	*	*	*	*	*	*	*	44	12	67		
232	0	0	0	0	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0		
241	288	26	2	31	*	*	*	*	*	*	*	*	*	*	*	*	43	13	8		
242	582	45	0	45	*	*	*	*	*	*	*	*	*	*	*	*	47	21	11		
311	28744	3363	634	5262	*	*	*	*	*	*	*	*	*	*	*	*	26	1354	962		

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REGIONE DELL'UMBRIA		SINTESI REGIONALE									
RISULTATI DELLA SINTESI REGIONALE											AOI
Are Omogenee Intervento	Energia primaria MWh/a	Risp. %	Energia risparmiata MWh/a	Costo MLit.	-Particol. Ton/a	-SO ₂ Ton/a	-CO Ton/a	-CO ₂ Ton/a	-NO _x Ton/a		
PERUGIA	1370930	40,2	550764	312822	287	73	1198	97365	83		
TERNI	575063	42,0	241709	156671	31	30	129	35975	30		
GUBBIO - SPOLETO CITTA' di CASTELLO	769302	44,3	340931	151005	700	93	2925	77398	66		
ASSISI-UMBERTIDE-AMELIA	722475	32,3	233555	126864	342	52	1429	48233	41	Piano	
FOLIGNO - NARNI	734306	32,6	239671	116447	259	43	1083	46820	40		
VALNERINA-MONTE CUCCO	285916	36,8	105206	47923	251	29	1049	24511	21		
TUDERTE - TRASIMENO SAU	727348	28,3	205500	102776	465	60	1944	49355	42		
ORVIETO	254822	25,6	65232	29314	129	17	539	14846	12	Esci	
Totale Regione	5440162	36,4	1982568	1043822	2464	397	10296	394503	335		

5. Project Outcomes

- The dwelling energy code methodology, a key aspect of the current study, has produced excellent results and would be substantially the same in case of replication.
- Since the goal was to provide "tools for action" to the Regional Energy Policy, a detailed (town based) and easy to access data-base for energy-building planning was essential.
- The interaction among the Technical Services of the Region and the Consultants was deep and fruitful.