



***Local energy planning:
how to get started with Markal while
serving the community and interconnecting
University's expertise with the territory***

Overview

Overview

- **Why turning to Markal?** The need primarily comes from the obligation for local administrations to comply with national environmental requirements, turning more and more fastening, due to international activities and directives, but not only.
It seems to be a practical tool, widely spread and with a strong scientific background, benefiting of the I³ :Interesting International Interconnections.
- **How?** By interweaving the need of the local administration with ours: to help in the mission of giving students an interdisciplinary outlook on energy matters, while working on their thesis.
In case of success we would think to introduce its use in the master course

Overview

Overview

- What were we expecting to achieve in less than one year?

The idea was to start working with students, passing them the data we have been collecting and use the case study of our territory as a training field, as well as others have done.

Work on the RES and go through the residential sector which in our case represents the bulk of energy consumptions

By the end of the year work on the details of the system and produce a portfolio of scenarios and check how versatile the tool is

Objectives

Objectives

- What is it done in terms of energy planning at a local level?

The objectives come from a simple consideration: local administrations more than the Government have to face the day by day citizen issues (quality of life, livability of the environment) and are the first receptors of the society changing needs. They feel to need new tools and are aware of the lack of technical capabilities while increasing/changing their duties and range of action.

Besides, on energy issues at a local level currently there are no binding targets.

So how to cope with actions towards the well-known word "sustainability"? Where are we going?

"knowledge and planning"
... have been the answers

Objectives

Objectives

- **Tools for what?** Show there are tools able to assist in the choice on energy issues they can count on to have an idea of, depending on the evolution of the system they rule on, which the configuration of the energy supply and demand could be in the future if certain actions are taken;
- **Additional (or primary?) needs** What the results of their institutional activities can be and how to monitor and account for them
- **Test** Investigate the software by running a test on the residential sector

Introduction

Introduction

- **The Italian situation** Only 39 local administration out of 137 have complied to Law n.10/1991 which was also meant to enforce energy planning for cities of at least 50,000 inhabitants. Only 60% has gathered information on energy consumption and less than 30% have worked on their GHG inventory [Apat, 2004]
- **The targets** The residential and building sector were meant to be the major targets to be affected by the implementation of programming tools (i.e. by controlling boilers' efficiency)
We have been using these data while modeling the residential consumption for the city of Pavia
- **The failure and ...** Requirement has been highly neglected, mainly because of lack in the administration capabilities more than just because of unwillingness



Introduction

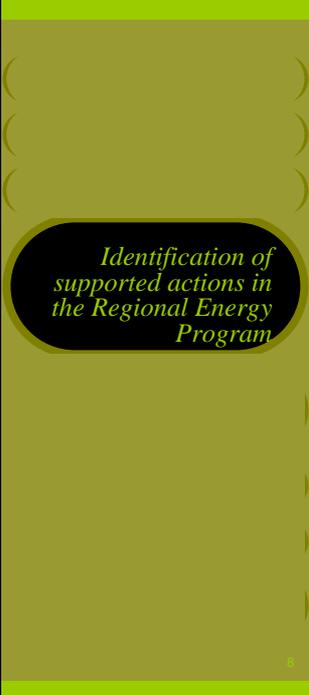
... other successful initiatives

Local Agenda 21
The Campaign of Italian cities for climate protection

• our proposal

At this pace, year 2010 is behind the corner and the evolution of the system -at a local level- seems to go on without any clue whether or not the situation of the consumption increase is under control.

Our aim is to get things started and ultimately answer to main questions like: plan the authorization of new power plants, verify the results of past controlling actions, what kind of subsidy can produce better results (incentives on renewable or on high efficiency equipment? Promoting ESCOs, changing the building rules ...)



Identification of supported actions in the REP

The provincial administration has several needs, all related with the energy use, but biased by the boundaries of their actions:

Provincial range of action

: to promote renewable energies and energy savings; to authorize the installation and operation of power plants; decisive role into the energy saving controls and rational use of energy (?);

To do:

analyze what it is currently done and can be additionally achieved.

Effects of Regional commitments

model the actions that the Lombardia Region wants to support, according with the March 2003 Regional Energy Program, and identify what this entails at a provincial level.

Identification of supported actions in the Regional Energy Program

Identification of supported actions in the REP

on the supply side: need of new power plants, the utilization of renewable (biomass, waste, hydro power) and the distributed generation (like small CHP plant);

on the demand side: intervention on buildings, to analyze the role that ESCOs can play in the market, the potential penetration of high efficient household appliances;

In general, the financial aspects of the needed investments versus the achievable saving results.

The program estimates that in the chosen scenario (B) the costs for implementing actions in the residential sectors are roughly 1650 €/TOE, in the commercial sector 1800 €/TOE, 825 €/TOE in the industrial sector and 1290 €/TOE in the agricultural one.

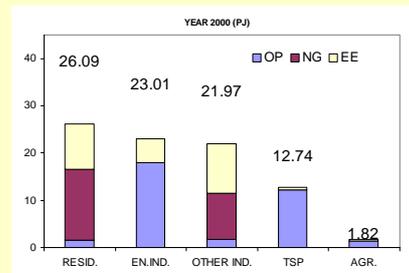
The case study of the Province of Pavia

The case study of the Province of Pavia

We will investigate if the main outcome of the program sized on the province can be considered the best achievement at the lowest costs.

The territory covers up to 2965 km², which represents almost 12.4% of the Regional extension. Almost 500.000 people live here (5.5% of the Regional overall), the final demands are reported below

Since 1990 the growth rate of the electricity, natural gas and oil product has been equal to 3.3 %, 1.9%, 1.3% respectively



The case study of the Province of Pavia

The case study of the Province of Pavia

Data research

The residential sector

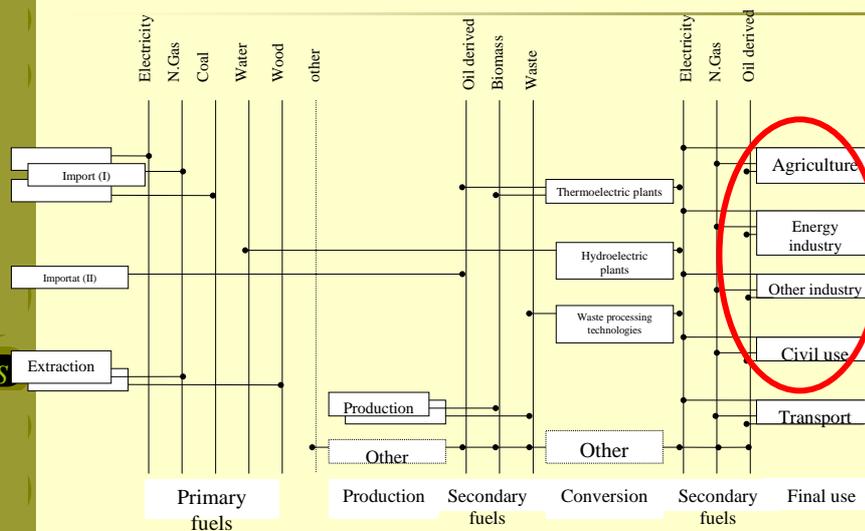
Modeling of the residential thermal sector with the setting of new technologies with a lower environmental impact.

Simulation of scenarios with and without environmental limits (BASELINE and CO2LIMIT cases)

Distinguish between two areas in the Province which have been here aggregated in their results, with different details

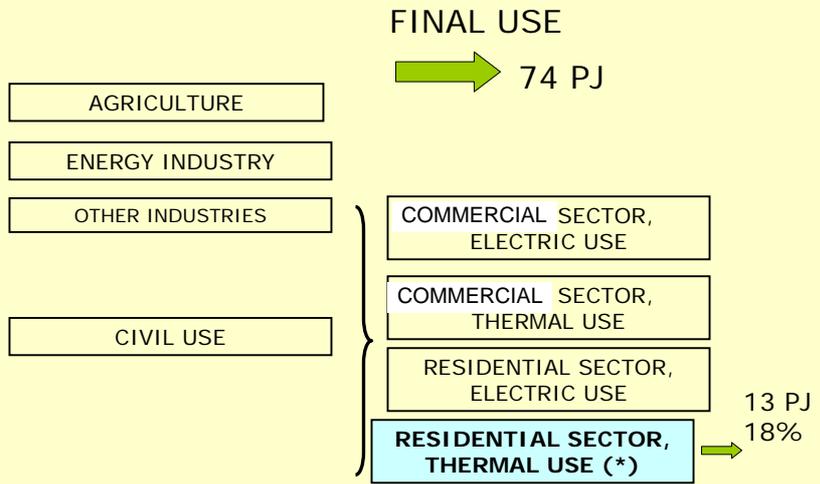
Modeling the Provincial RES

Modeling the RES



Modeling the Provincial RES

Modeling the RES



Heat commodities

Modeling the Provincial RES

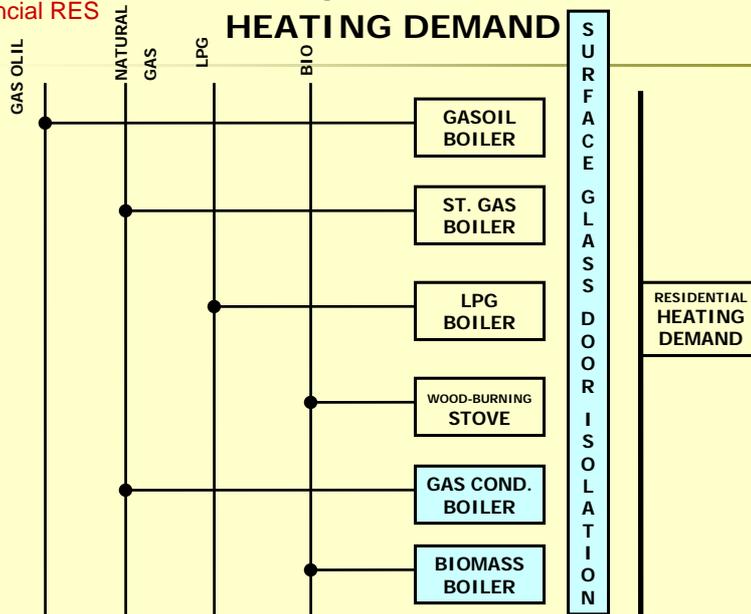
RESIDENTIAL THERMAL SECTOR: DEMANDS

Modeling the RES

- SINGLE APARTMENT HEATING → 44%
- CENTRALIZED HEATING → 43%
- HOT WATER PRODUCTION → 8%
- COOKING → 5%

Modeling the Provincial RES

RESIDENTIAL HEATING DEMAND



Modeling the RES

Modeling the Provincial RES

SCENARIOS SIMULATION

Starting from 2000, over a 30 years time span divided in three periods

BASE scenario

- the energy system configuration is built for the base year
- the system evolution is optimized with the minimization of the cost function

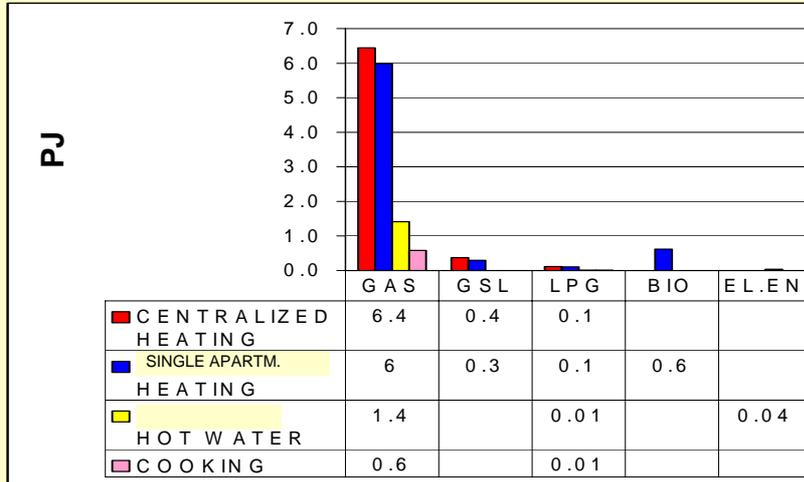
CO2LIMIT scenario

- same configuration as in the BASE
- the limit on the CO2 emissions is imposed starting from 2010: to be less equal than 718 kt
- system evolution is optimized with the minimization of the cost function with respect to the emission limit

Modeling the RES

Modeling the Provincial RES

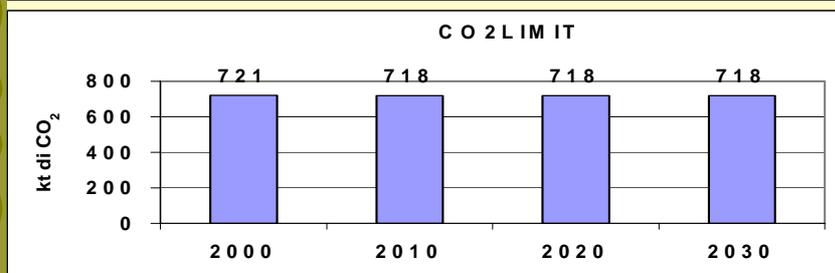
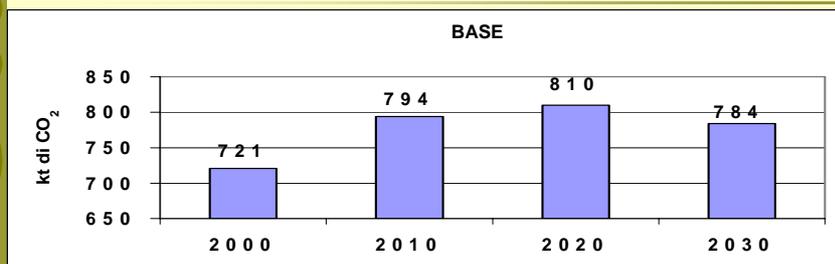
RESIDENTIAL THERMAL SECTOR: FINAL USE DEMAND, CONFIGURATION @ Y2K



Modeling the RES

Analysis of the results

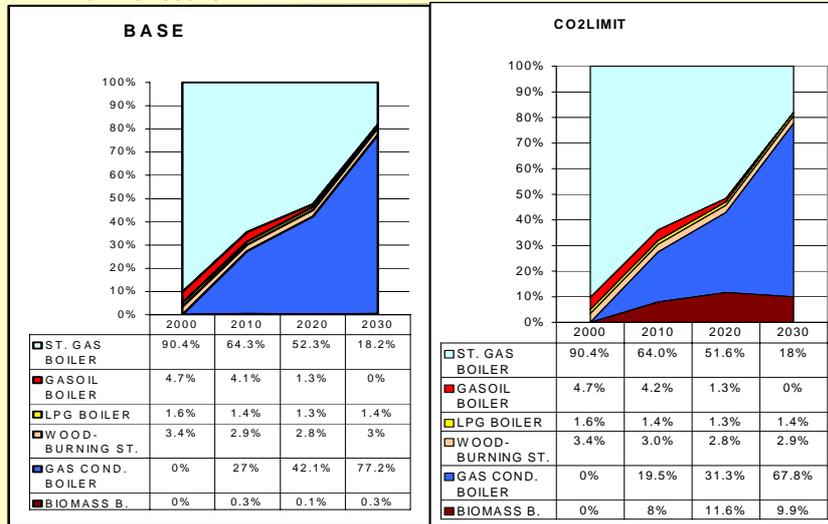
CO₂ EMISSIONS – THERMAL RESIDENTIAL SECTOR



Analysis of the results

Analysis of the results

DEMAND TECHNOLOGIES



Analysis of the results

Analysis of the results

HEATING REQUIREMENTS VS. TECHNOLOGIES

SIMILARITIES

- Increase of condensing boiler installations
- Complete replacement of gas oil boiler
- Trend of technologies with the exception of biomass boilers

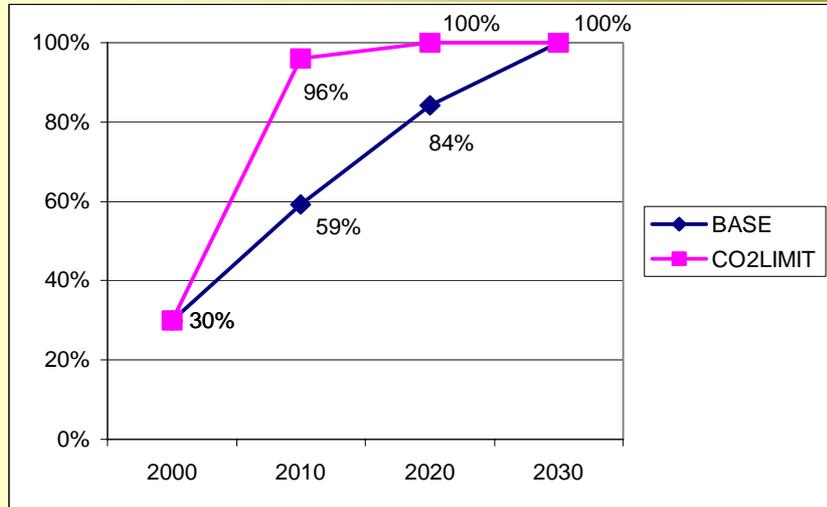
DIFFERENCES

- Biomass boilers become more competitive if the emission target needs to be achieved (in the CO2LIMIT scenario)

Analysis of the results

Analysis
of the results

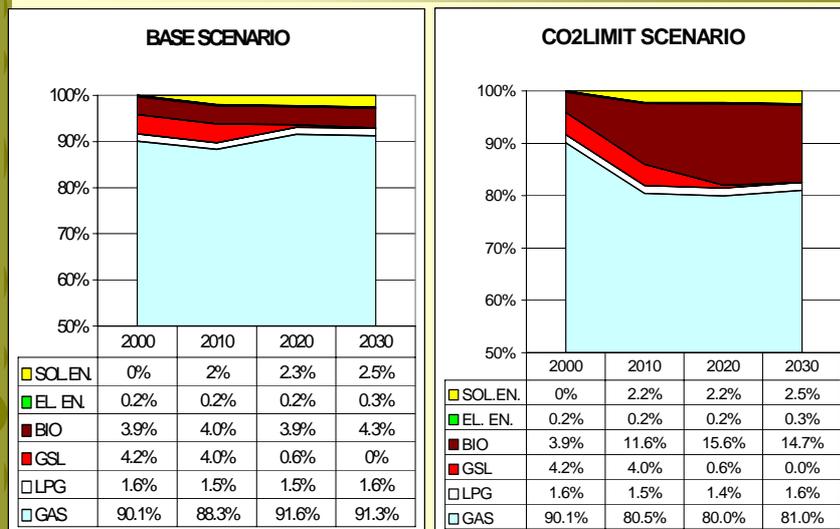
DISTRIBUTION OF DOUBLE GLAZED WINDOWS



Analysis of the results

Analysis
of the results

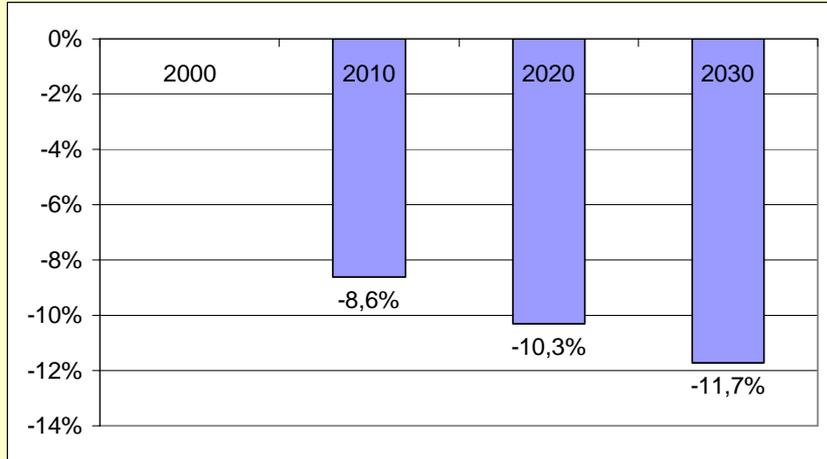
RESIDENTIAL: TREND OF ENERGY USE



Analysis of the results

Analysis of the results

VARIATION IN FOSSIL FUELS USE (CO2LIMIT VS. BASE SCENARIO)



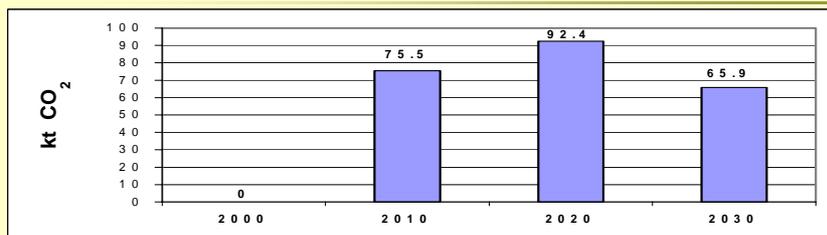
Analysis of the results

The target is mainly achieved by the biomass technology boilers in the CO2LIMIT scenario

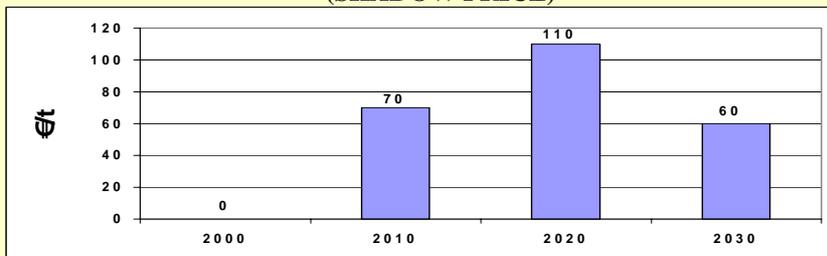
ETSAP MEETING, Paris June 21st /25th

Analysis of the results

kt OF AVOIDED CO₂ IN THE CO2LIMIT SCENARIO



(SHADOW PRICE)



Analysis of the results

ETSAP MEETING, Paris June 21st /25th

Analysis of the results

- Analysis is independent but easily fits to the general analysis that includes all sectors of the model of the Province of Pavia
- It is desirable to add technologies such as **district heating distributed generation (cogeneration) and roof gardens**
- As expected, highly polluting and less efficient technologies are replaced and the economic burden evaluated.
- Importance of the monitoring of energy consumptions by local administrations

Analysis of the results

Final Remarks

**“If the targets are not ambitious
also the results will be not”**

These results come out from a very first attempt to model the system: further details are needed, but they show that there is room for actions.

The alternative scenario CO2LIMIT shows the entity of the system improvement from an environmental point of view and gives a better idea of the costs.

Differently from what is stated in the REP we are less keen to assume a deeper impact of biomass for thermal use because the territory is extensively harvested with traditional crops, therefore the change of destination is less likely to happen, unless incentives are proposed.

**Competing
needs vs.
technologies**

Our interest turned to be focused also on how to model the relationship between competing needs versus technologies

*Final remarks and
ongoing activities*

...and ongoing activities

- The activity of modeling the system is going on with further details about the demand side;
- Additional needs are coming out from the open channel between administration and University and services which can be provided for the forthcoming Energy Observatory;
- The knowledge on the tool is progressing and we are keen to make the most of the international community's experience, although the majority of the targets are different;
- The interest in knowing how certain needs can be modeled into linear programming is arising, as far as they show up
- Getting more and more experienced the aim is to target the Regional offices which has already been approached and seem to show a true interest

Final remarks and ongoing activities

ETSAP MEETING, Paris June 21st /25th

...and ongoing activities

- The experience has turned out to be positive (both students and administration have been satisfied by the first outcomes and usefulness of the tool) and we are working to establish a new course broadly named

“Planning of energy conversion systems and demand”

which will include an outlook on Markal. As far as we know, this is the first of its kind activity to be set up for students of electrical engineering in Italy

- We understand that the use of this tool would be much easier and could be better spread if we could share some extra time and effort working side by side with ETSAP people that is why we are about to create a fund to sponsor sabbatical visit abroad (and viceversa), to finance study grant and to host seminars on the matter .. Therefore

... WE HOPE TO HOST YOU SOON IN PAVIA!

Final remarks and ongoing activities

ETSAP MEETING, Paris June 21st /25th