



Istituto di Metodologie per l'Analisi Ambientale



CNR Consiglio Nazionale delle Ricerche

*Life Cycle Assessment and Comprehensive Analysis for
an integrated evaluation of environmental impact of
anthropogenic activities.*

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jointly organized by EMF/IEA(ETSAP)/IIASA
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Context of the research

Methodology

Case Study

Results

The context of research

- # Kyoto Protocol (Italy): -6.5% compared to 1990 levels;
- # Sixth Community Environmental Action Programme;
- # Intelligent Energy for Europe;
- # Fifth and Sixth Framework Programmes of Research and Technological Development.



Qualitative and quantitative evaluation of environmental sustainability;

European Environment Agency
Information for Improving Europe's environment

SINA.net

Necessity to internalize environmental costs (externalities) (ExternE): monetarization of environmental damage.

ExternE

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Methodological approach



Partial equilibrium model (MARKAL):

Comprehensive optimisation of commodities production system in term of:

- energy;
- economy;
- environmental effects.

Evaluation of the system sustainability and definition of action strategies

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Combined approach: LCA of Energy Systems

- To analyze in depth the environmental effects of the local energy system, describing both the internal environmental and the external impacts.
- To support decision makers in the definition of medium-long term scenarios for a sustainable development of energy systems.
- To include externalities in commodities costs.

External energy system,
LCA for the evaluation of environmental burdens

ExternE

Local energy system
MARKAL for finding out the optimal minimum cost solutions.

Impacts evaluation of all life-cycle stages from primary sources to commodities waste management

Comprehensive energy-environmental analysis of anthropogenic activity system

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Tools

Life Cycle Assessment:

Evaluates from "cradle to grave" the environmental burdens associated with products/processes/activities, by quantifying energy, materials and waste. The environmental burdens are organised in Impact categories (global warming, acidification, etc.).



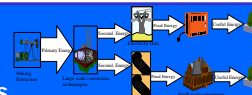
ExternE:

Evaluates the external costs associated with (a range of different fuel cycles of) electricity production.

ExternE
ExternE - Externalities of Energy, A Research Project of the European Commission

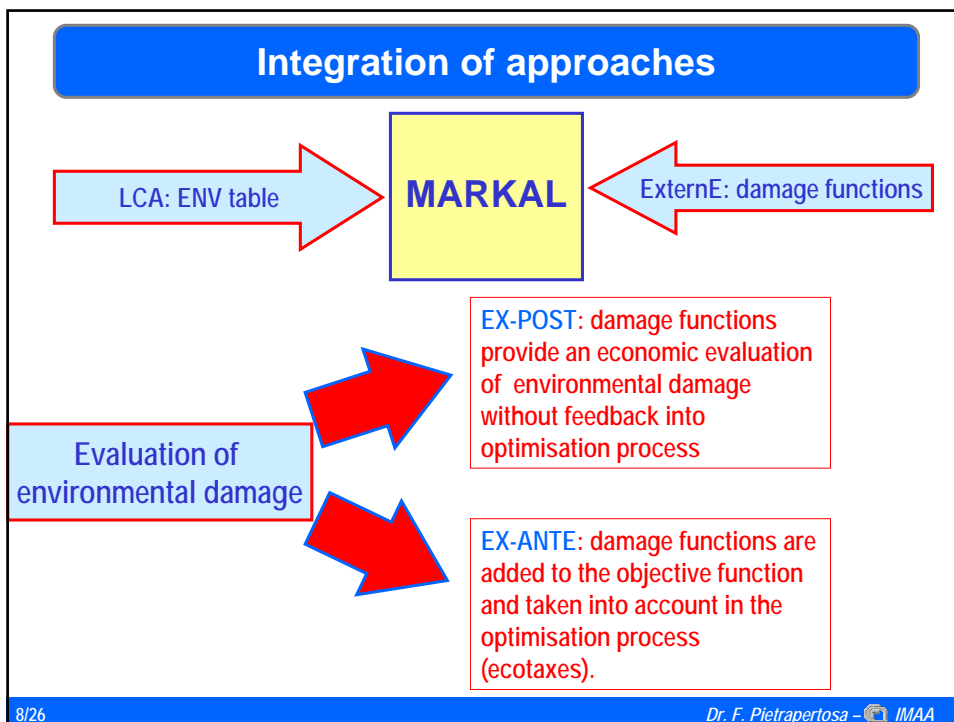
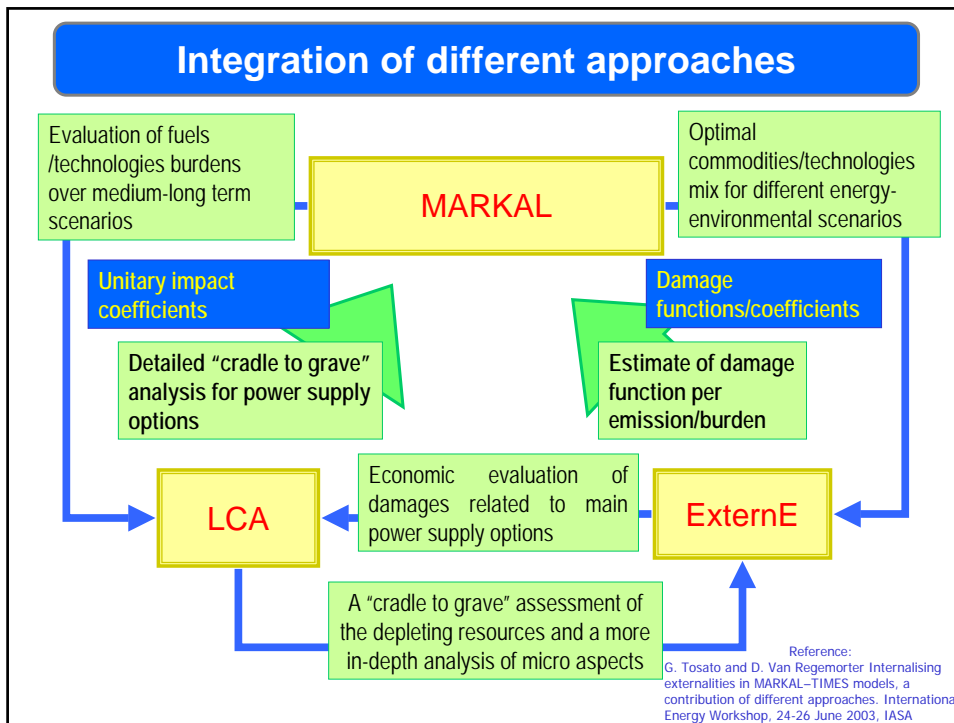
MARKAL:

- **driven by the demand** of goods and services
- **technology and energy oriented**, to find the optimal mix of processes and fuels for each considered time period
- **multi-period and dynamic**, to take into account technology development and changes in the boundary conditions,
- **optimising** to find the most effective solutions.

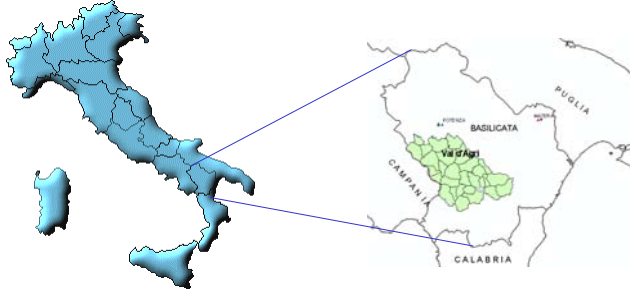


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Case study: Val d'Agri



Val d'Agri (Basilicata Region – Southern Italy):

- Area of naturalistic interest (National Park)
- Local economy based on agricultural and breeding activities
- huge oil fields



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Energy supply

In 1997, 10000 oil barrels per day were extracted, which correspond to 9.5% of the national production

Construction and start-up of the Monte Alpi oil pipeline, connecting Viggiano Oil center with Taranto refinery (a 136 km long pipeline with a transport capacity of 150 000 barrels/day)

PRODUCTION (barrels/day)	PROJECTS	
	Val d'Agri	Tempa Rossa
1997	7 500	2 500
2003-2004	104 000	50 000

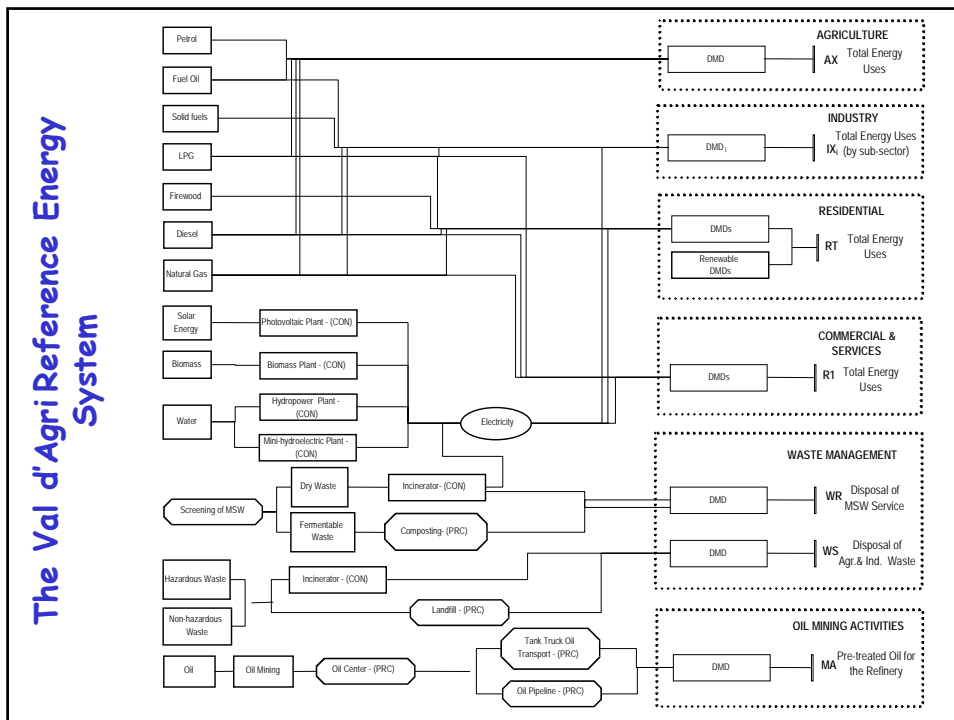
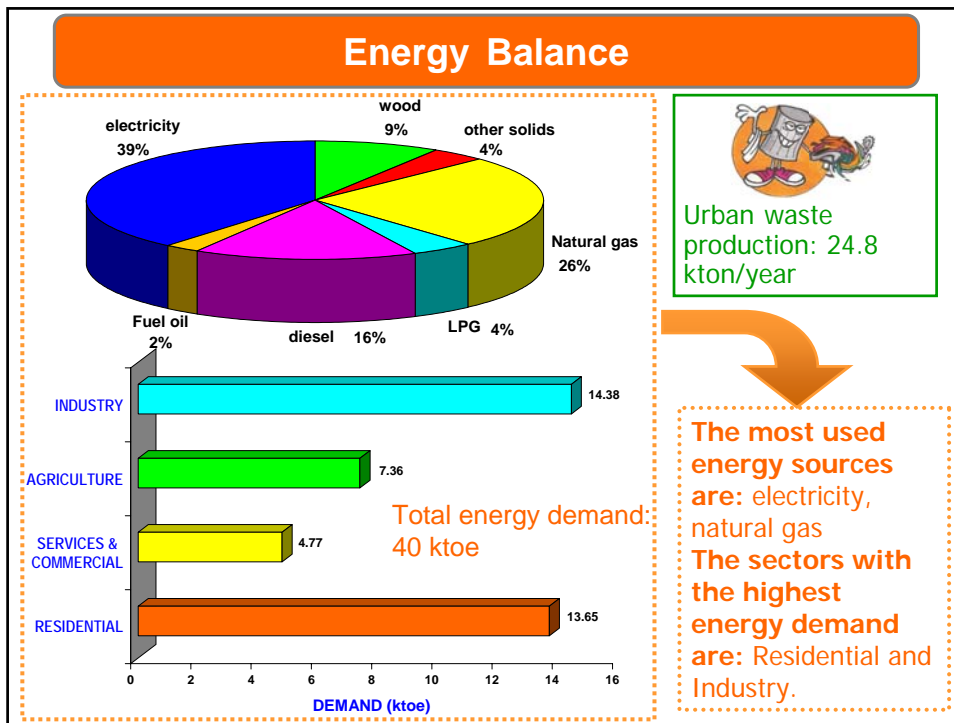
Electricity production by renewable sources in VdA

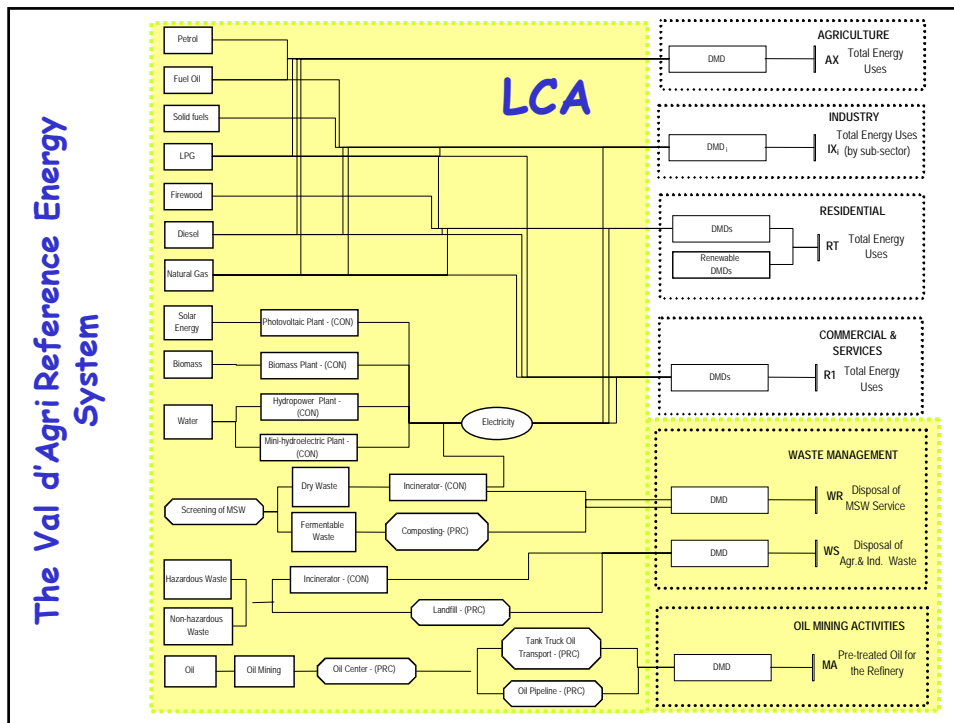
TECHNOLOGIES	2000 (GWh/year)	potential development* (GWh/year)
Hydroelectric	116.6	0
Mini-Hydro	0	16.4
Photovoltaic	0.06	20.78
Wind	16.58	181.7
Biomass	0	21.9

*source: Regional Energy Plan

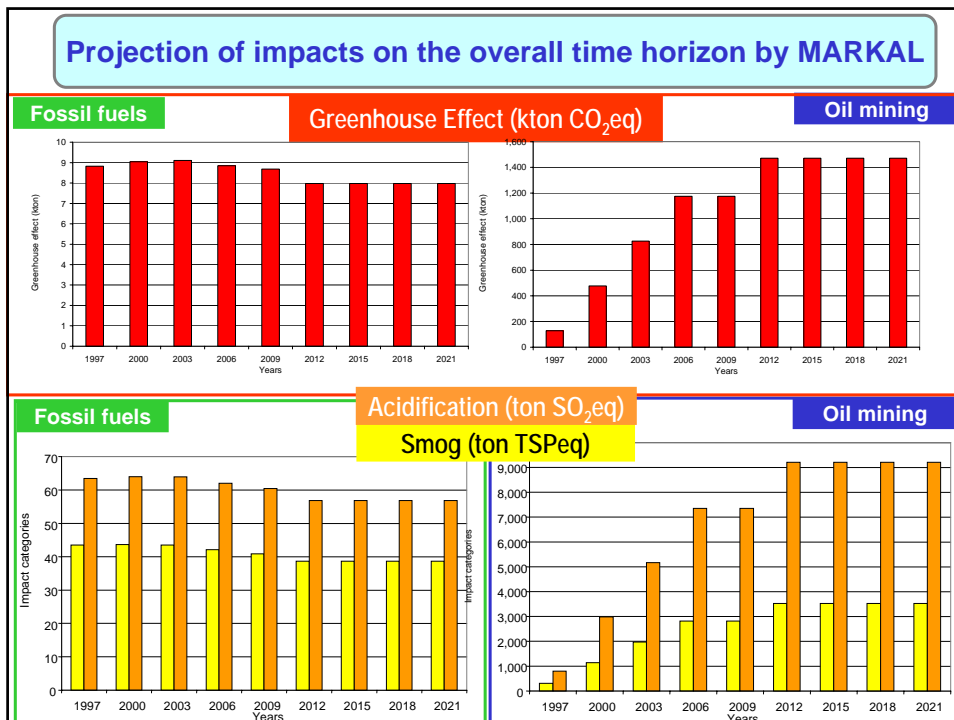
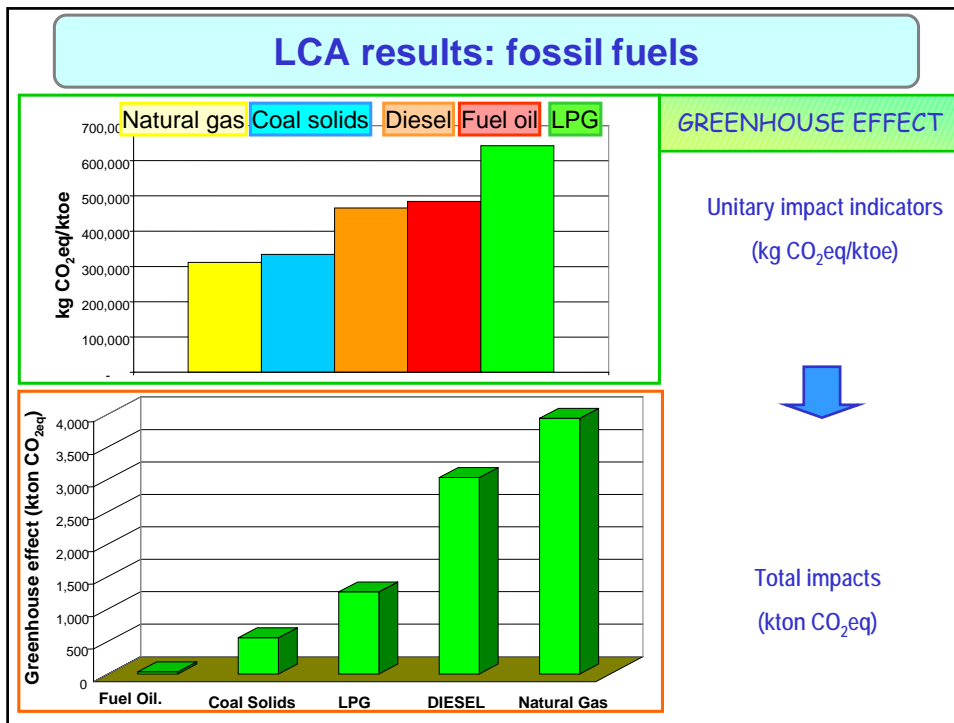
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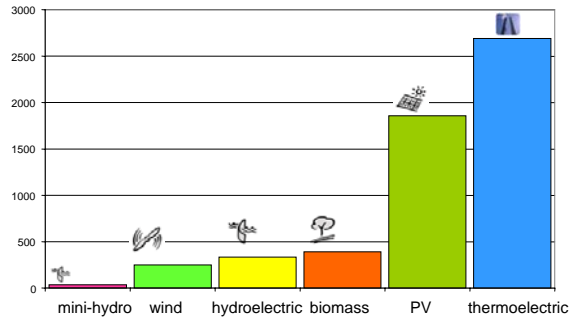
Scenarios assumptions			
●	Time horizon: 27 years (1996-2023)	●	base year: 1997
●	Regional Energy and Waste Management Plans	●	money discount rate: 4%
●	Increase of oil mining activities (ENI data)		
Scenario	Case	Main features	External costs
BASE	BAU	do nothing	yes (ex-post)
CO2	from CO2-1% to CO2-5%	constraint on CO ₂	yes (ex-post)
Impacts	Greenhouse Effect	constraint on greenhouse gases	yes (ex-post)
	Acidification	constraint on acidification	yes (ex-post)
	Smog	constraint on dust	yes (ex-post)
	Mix	combined constraint on environmental impacts	yes (ex-post)
Ecotaxes	Tax-CO2	19-139 Euro/tons on CO ₂	yes (ex-ante)
	Tax-NOx	7100 Euro/tons on NOx	yes (ex-ante)
	Tax-SO2	5000 Euro/tons on SO ₂	yes (ex-ante)
	Tax-TOT	tax on all emissions	yes (ex-ante)



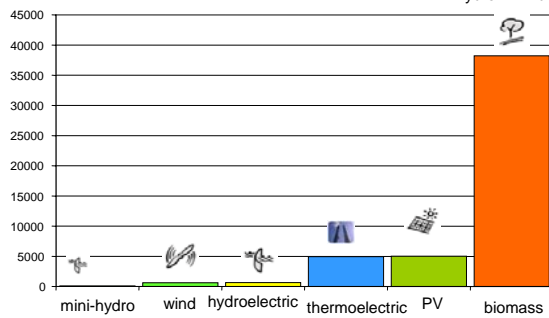
LCA results: conversion technologies

Unitary impact indicators

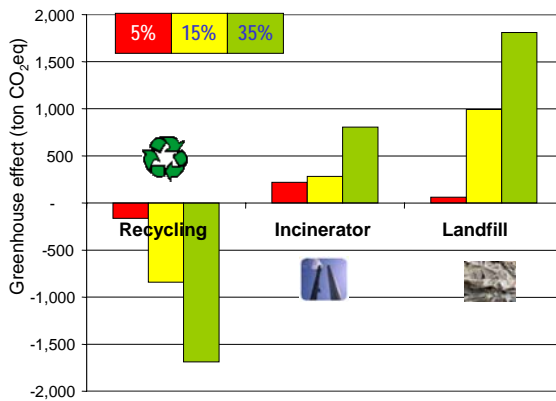
GREENHOUSE EFFECT
(ton CO₂eq/ktoe)



ACIDIFICATION
(kg SO₂eq/ktoe)



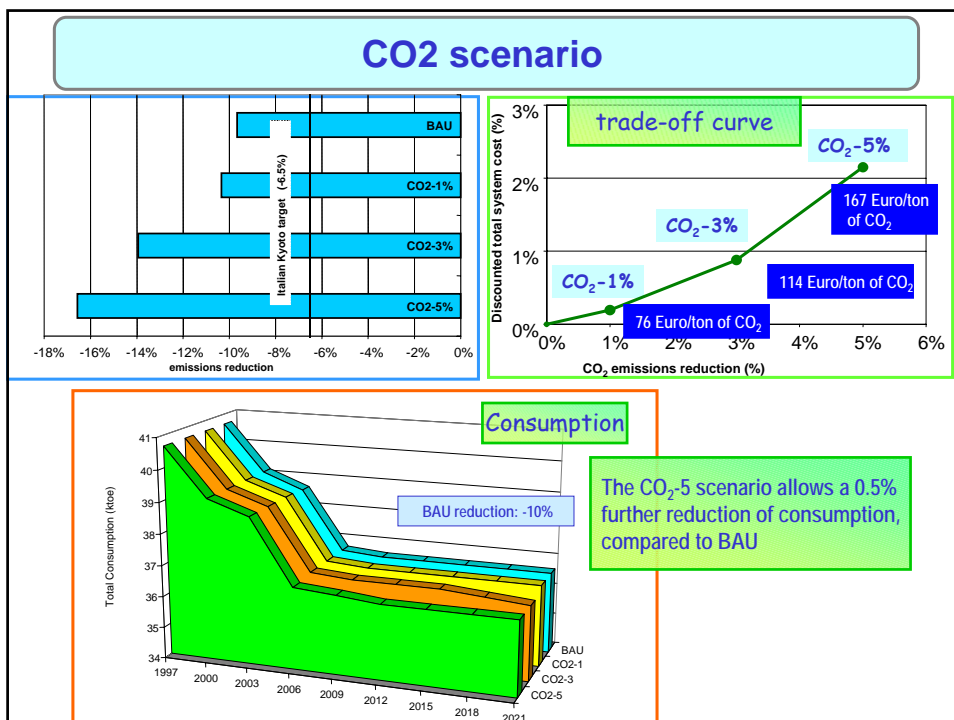
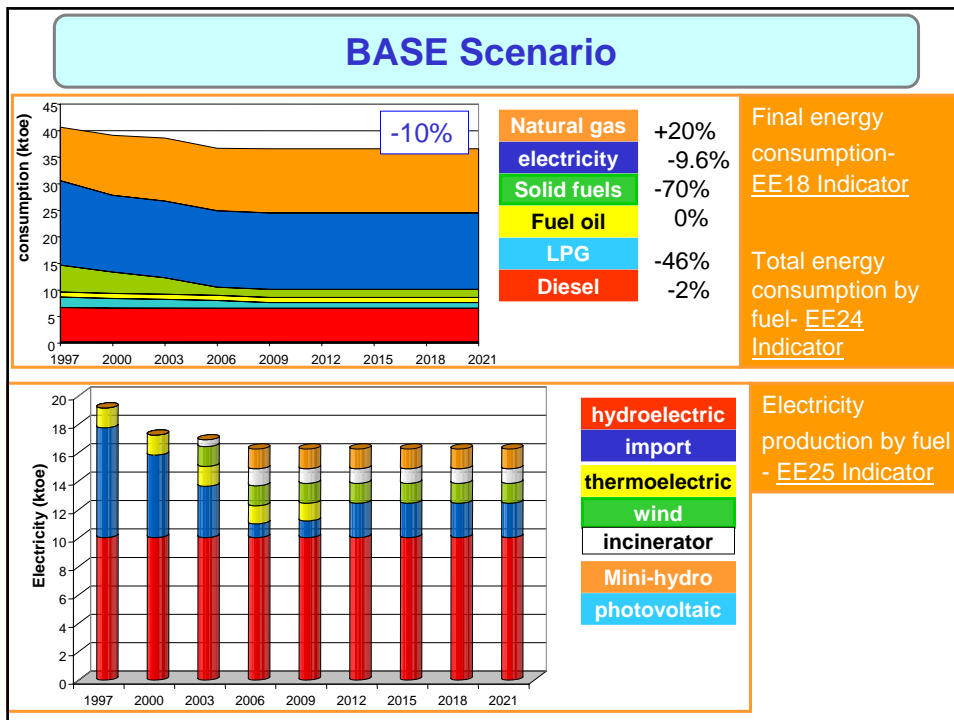
LCA results: waste management



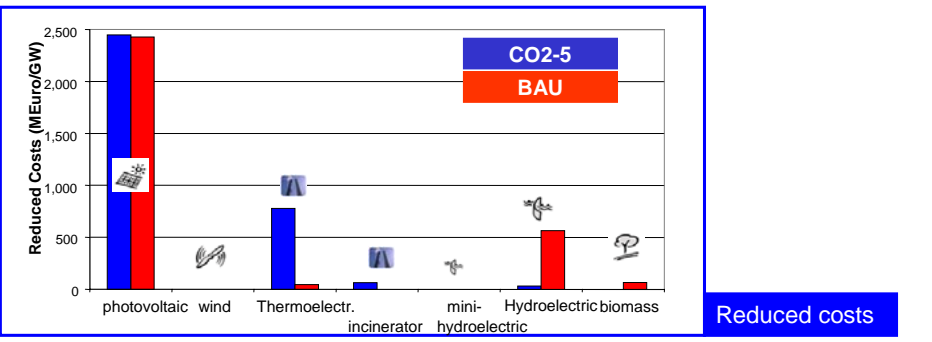
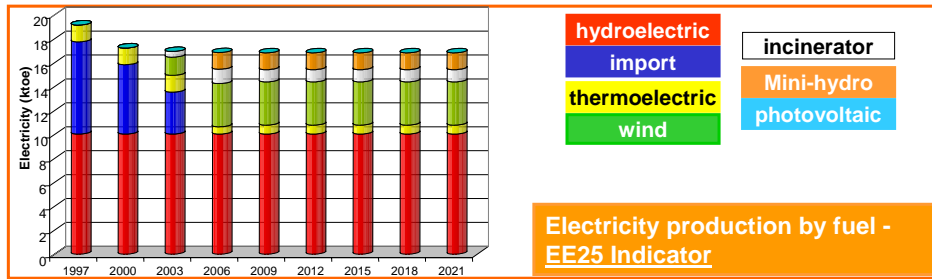
GREENHOUSE EFFECT

The disposal process more compatible with
the environment is recycling

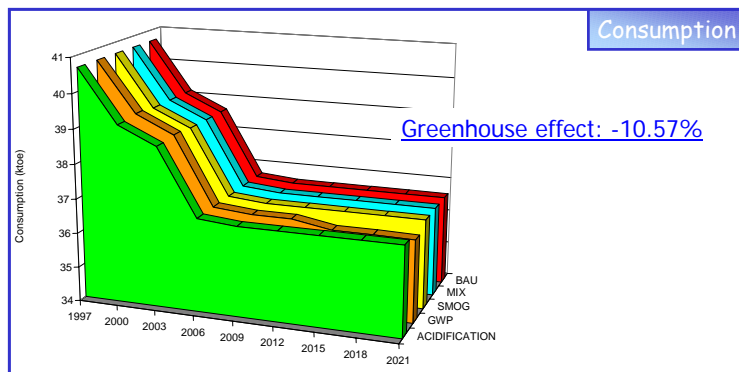




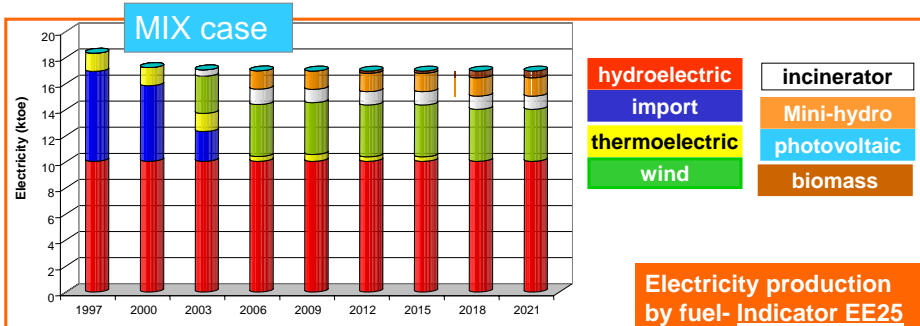
CO2-5 scenario



Impact scenario



Impact scenario



- Increase in endogenous production of electricity by renewable sources, which substitutes import from 2006
- In **Greenhouse effect** and **Mix** cases the biomass plant substitutes the thermoelectric production (the biomass plant is more favorable than thermoelectric relatively to greenhouse effect).

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Evaluation of environmental damage

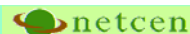
ExterneE

ExternE - Externalities of Energy, A Research Project of the European Commission

Emissions	Euro/ton
TSP	12000
NOx	7100
SO ₂	5000
VOC	2800
CO ₂	19-139



BeTa



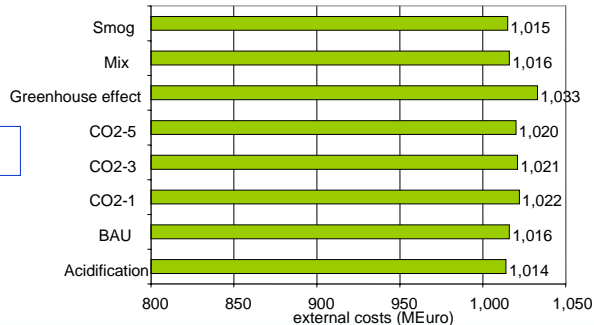
Benefits Table database:
Estimates of the marginal external costs of air pollution in Europe

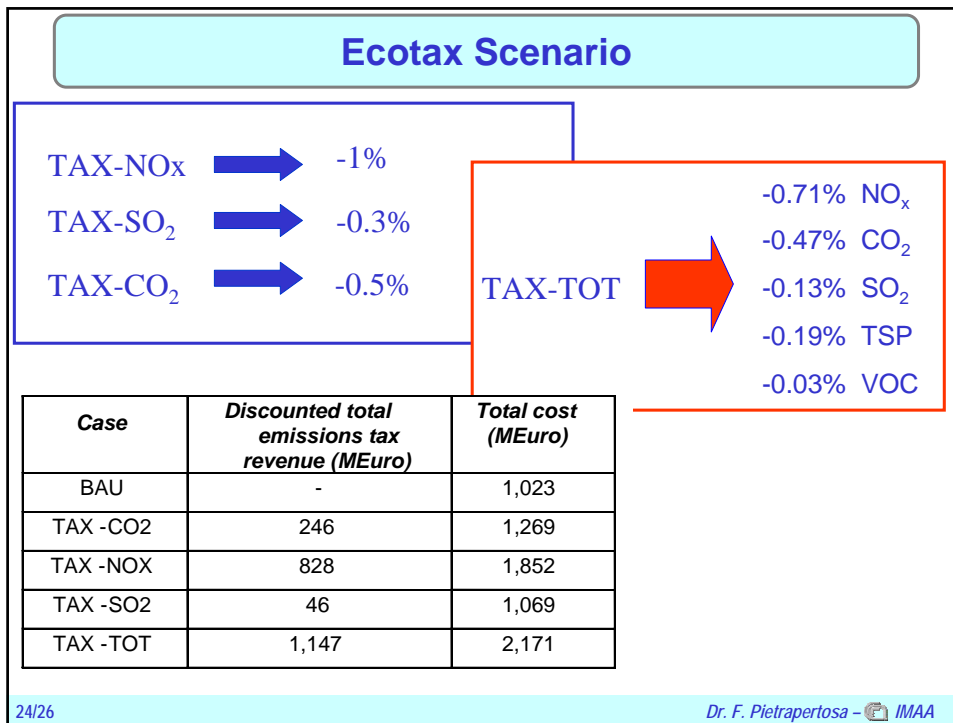
Hamacher T. et Al. A comprehensive evaluation of the environmental external costs of a fusion power plant. Fusion Engineering and Design. Issue 56-57 pp 95.103, 2001.

Saez R. et Al. SERF3: Socio-Economic Research on Fusion (2001-2002). Final Report on Task External costs of fusion. CIEMAT, 3/2003.

Ex-post evaluation

Environmental cost





Conclusions

- ⊗ the use of **renewables** allows to achieve the most important objectives of EU energy policy, being essential for air quality improvement since they **reduce atmospheric emissions from combustion processes** and the **dependence from fossil fuels**, increasing, at the same time, energy supply security,
- ⊗ to evaluate environmental impacts of technologies and products it is important to consider the **entire life cycle**, in order to **include the contribution of the building the disposal phases** of the technologies which produce commodities, to avoid a biased estimation of the global environmental effects.
- ⊗ Environmental benefits deriving from the avoided emissions must be evaluated by comparing the **external costs** with the cost increase necessary to reduce emissions, to minimise the cost gap between traditional and innovative technologies;
- ⊗ Ecotaxes can be effective tools to promote a real change in consumers and producers behaviour, to choose products, processes and services more compatible with environment.

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Projects



- ⊗ INFM - Progetto Sud “Tecniche ottiche innovative per il monitoraggio e Piani di Tutela e Risanamento” azione A
- ⊗ Regione Basilicata - Progetto e realizzazione operativa del Piano Regionale di Tutela e Risanamento della Qualità dell’Aria
- ⊗ Progetto PON – Cos(OT)- obiettivo realizzativo 3 INFM Sviluppo di modelli “comprehensive” per la definizione di strategie alla scala locale per l’abbattimento delle emissioni atmosferiche inquinanti e/o forzanti verso effetto serra

GRAZIE!!!