

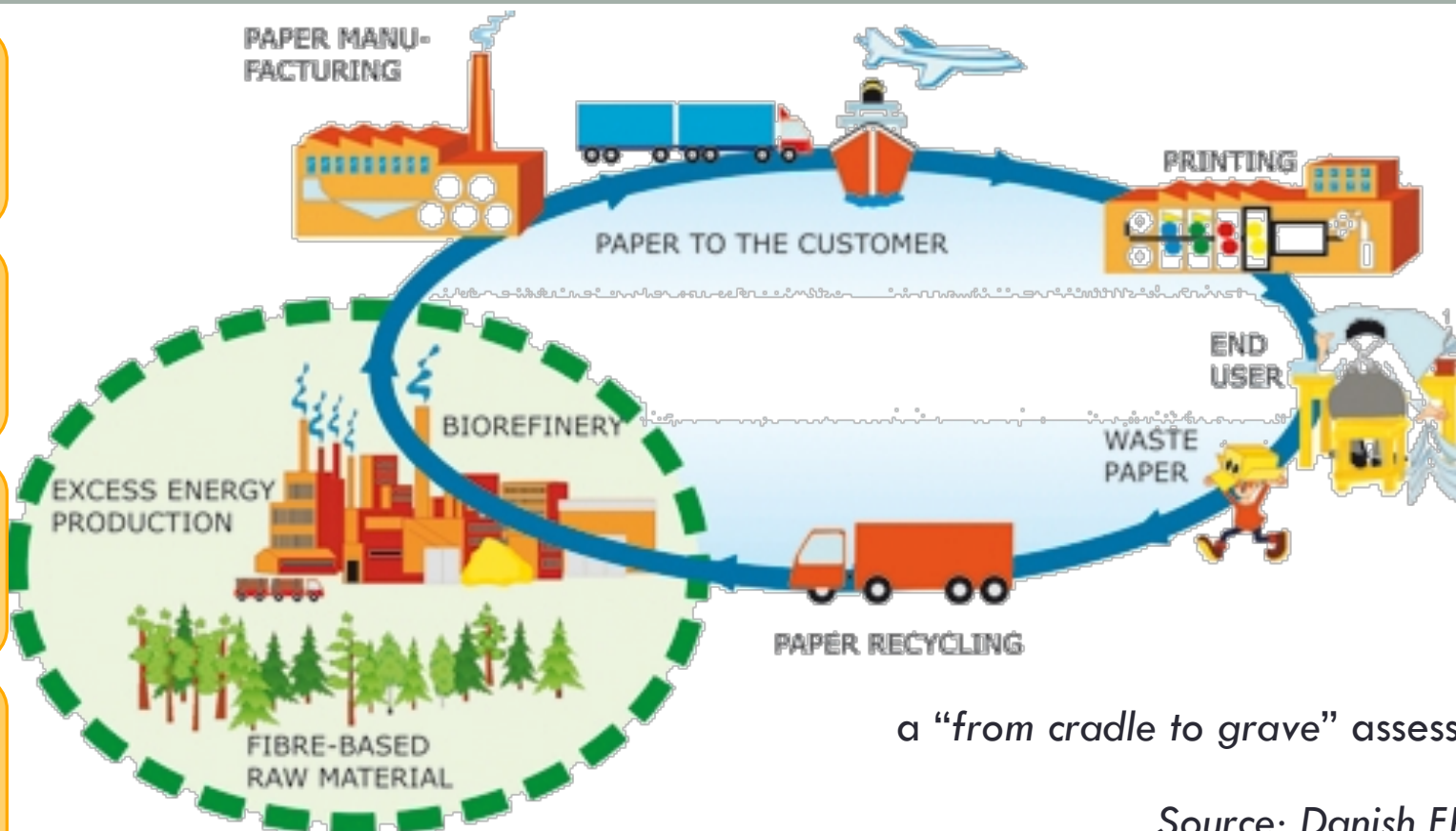
Summary Outline

- Introduction
- LCA Methodology
- SEA “vs” LCA
 - LCA as an integrated part of SEA
- LCA “in” SEA
 - Case studies
- LCA “for” SEA (ENEA project)
 - Methodology
 - Sectors
 - Indicators
 - Assessment
- Potential, Limits and further Research
- Conclusion

Introduction

- An SEA explicit purpose: *ensure that significant effects on the environment are taken into account in the preparation and adoption of plans* (SEA Directive);
- No definition of **system boundaries** of the environmental assessment, no definition of **impact prediction tools**
- At local level SEAs usually have **narrow perspective**, they don't take into account the influence on activities far beyond the immediate technical and geographical boundaries
- LCA has a wider system perspective (ISO2006) taking into account both **direct and indirect impacts**
- LCA vs. SEA?

LCA Methodology (1/2)



a “from cradle to grave” assessment

Source: Danish EPA



Ecolndicator 99



EPS 2000



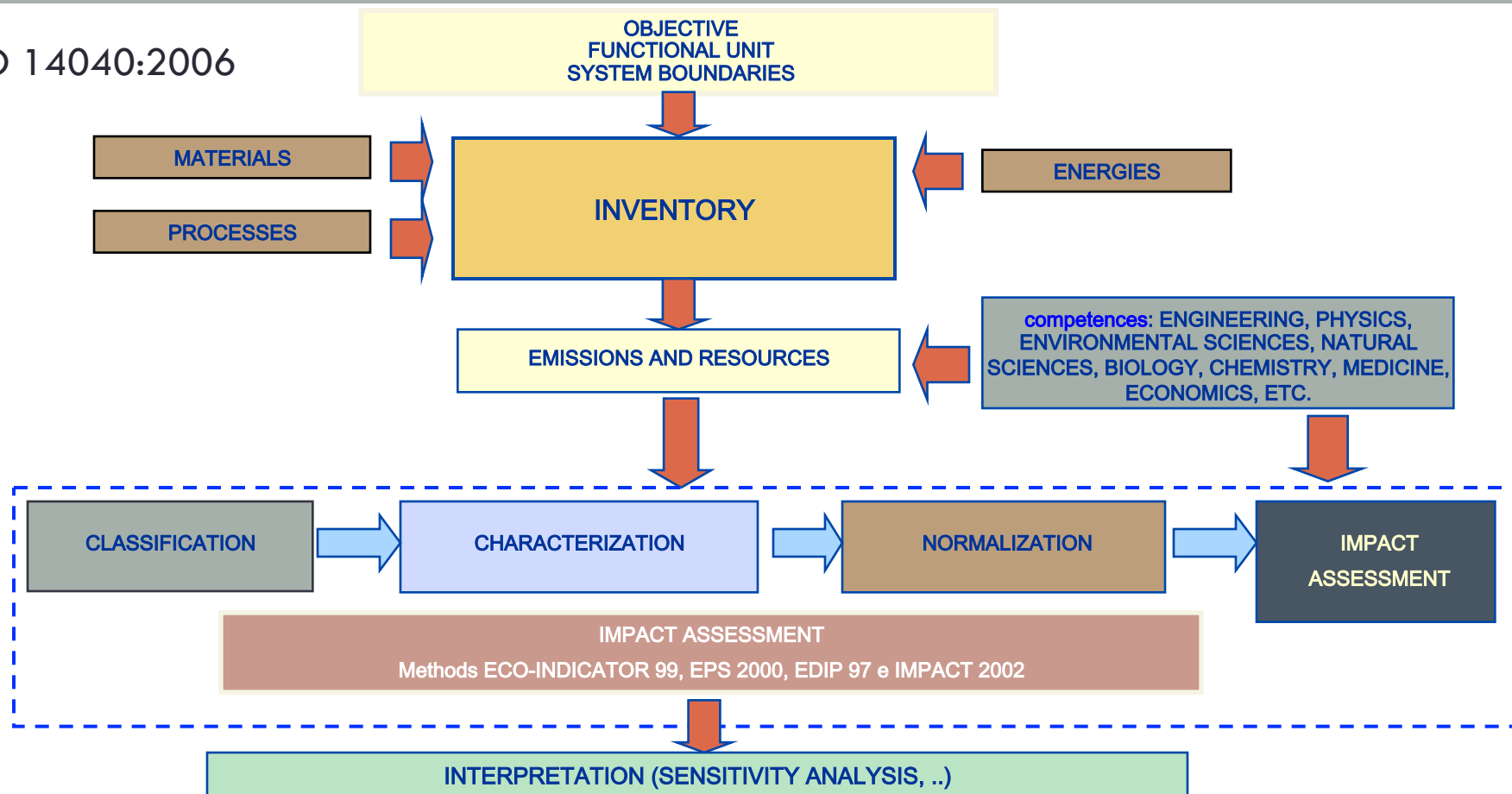
Impact 2002+



EDIP 97

LCA Methodology (2/2)

ISO 14040:2006



SEA vs LCA?

Various Scales

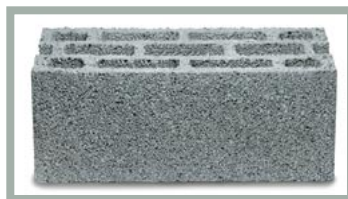
Assessment of a region,
a city, a neighborhood



Assessment of a
project, a building,
an infrastructure, a
service



Assessment of a
process, a material



SEA vs LCA



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SEA

- Plans and Programmes (and Policies..)
- Public participation
- Scenario planning, strategic view
- Non quantitative aspects (social, landscape, etc.)

LCA

- (certain) Plans, Products, Processes, Activities, ...
- Direct and indirect impact
- Hardly includes non-quantitative issues
- Time consuming (i.e. expensive)

LCA as an integrated part of SEA?

LCA as an integrated part of SEA?



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- Need to transform SEA planning policies into **practical actions** and **consequences** (processes, activities, etc.) - [estimation, approximation]
- Environmental assessment with LCA, **qualitative indicators** of selected measures;
- **Alternative** scenarios
- Sensitivity analysis (ISO 14040-14046:2006)
- > Into SEA Report, for further consultation

LCA “in” SEA: case studies

By ENEA, Italian National Agency for New
Technologies, Energy and Sustainable Development

LCA of a Redevelopment Plan (1/5)



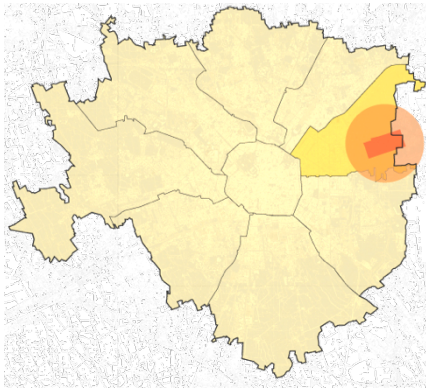
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**“Rubattino”
Redevelopment Plan
(MILAN), 2006-2010**

Area: 611.207 mq

Building area: 301.975 mq



Special Conference on Strategic Environmental Assessment
Prague, 21 - 23 September 2011

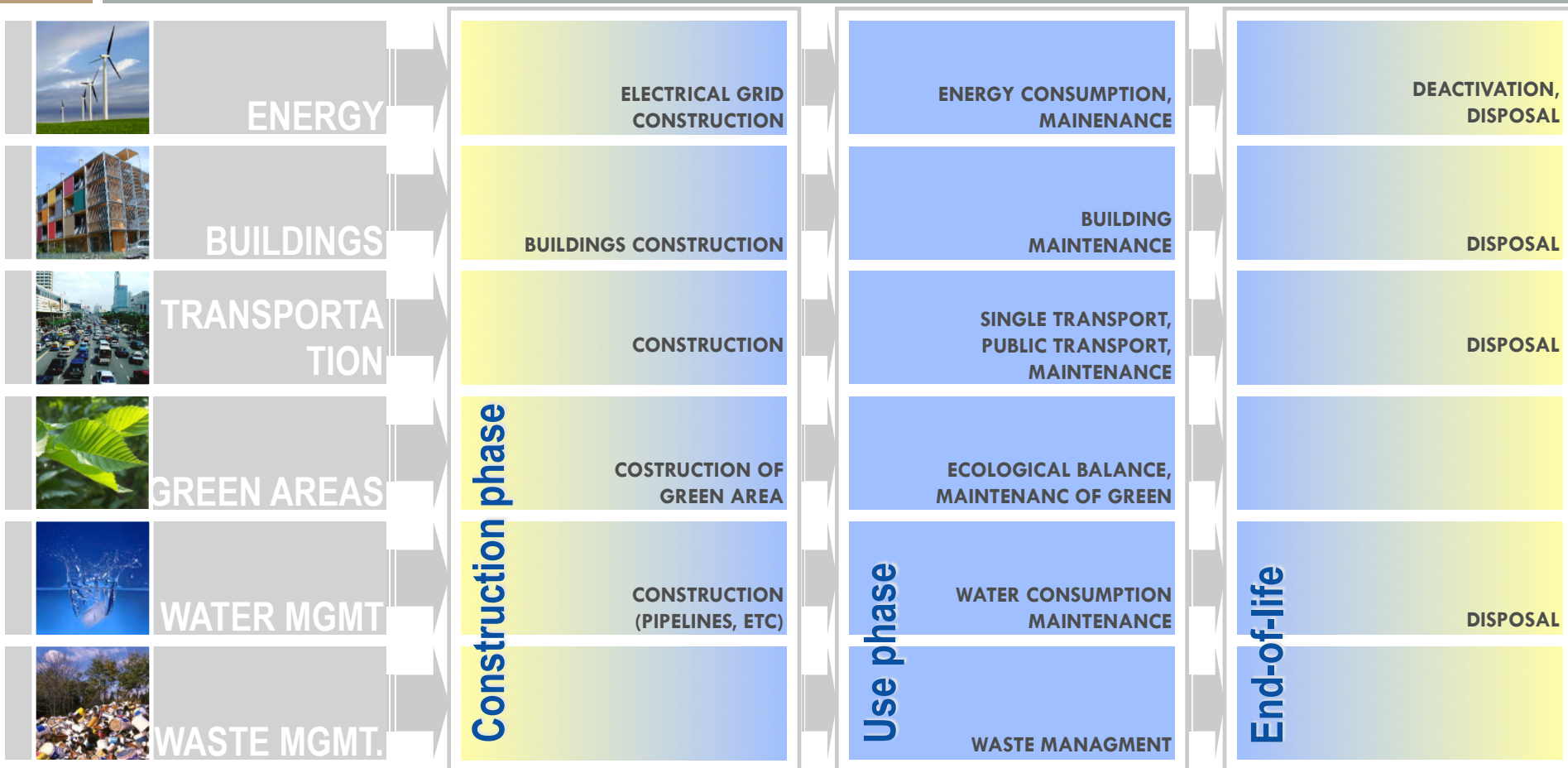
IAIA

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LCA of a Redevelopment Plan (2/5)



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LCA of a Redevelopment Plan (3/5)



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ENERGY

✓ THERMAL AND ELECTRIC ENERGY FOR HEATING, COOLING, LIGHTENING, ETC. (software Recal10 e PAN2)

BUILDINGS

TRANSPORTATION

GREEN AREAS

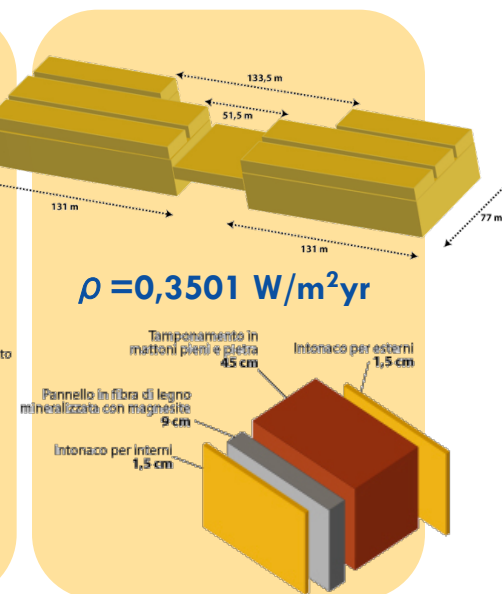
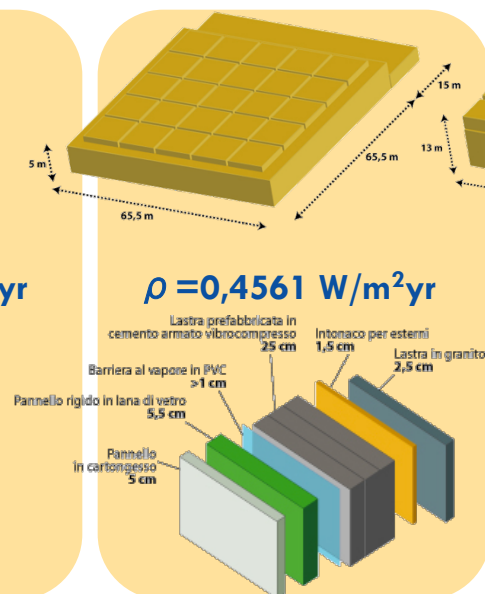
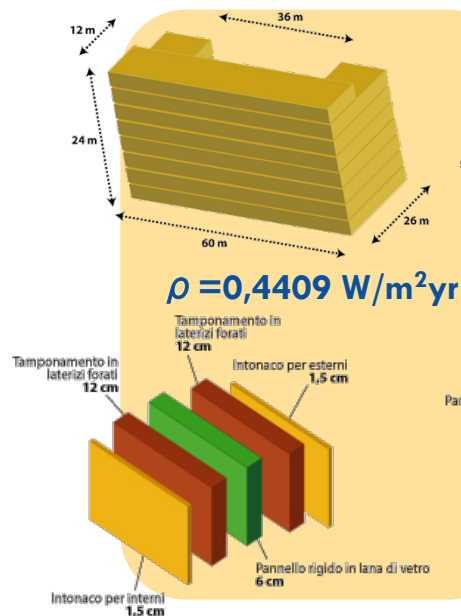
WATER MGMT

WASTE MGMT.

RESIDENTIAL

COMMERCIAL

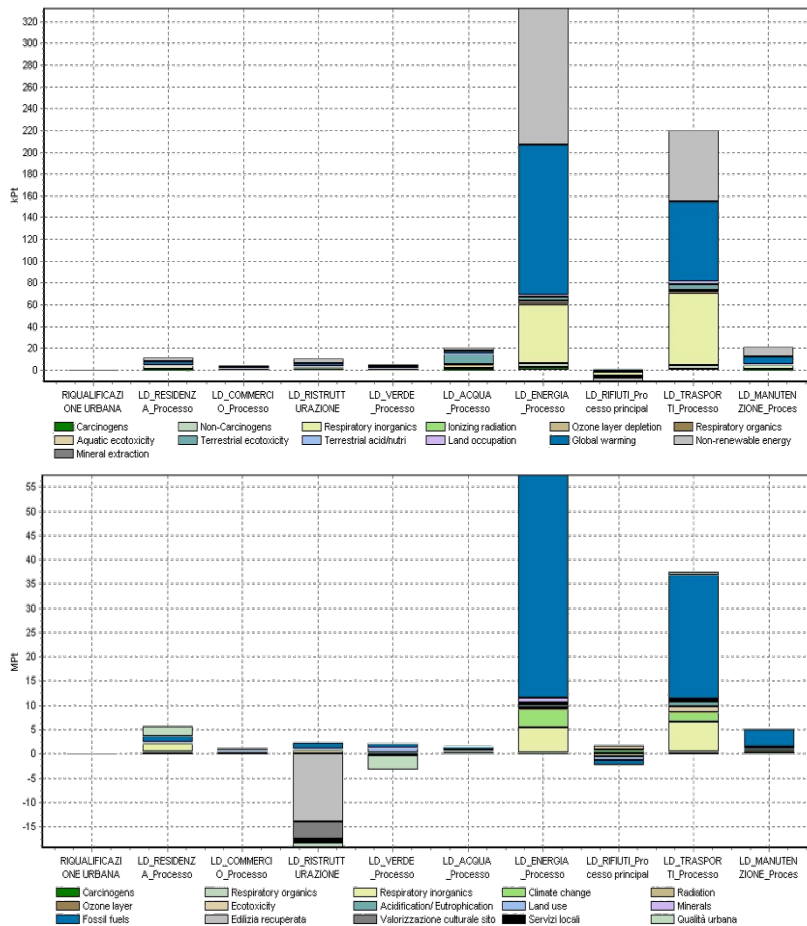
RENOVATION



LCA of a Redevelopment Plan (4/5)



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Impact Assessment (Impact 2002+)

- Total impact (6,16e5 Pt) is mainly caused by **ENERGY** (53,9%)
- **TRASPORTATION** (35,8%), has high impact because of the massive use of private cars
- The remaining impact of 10% is caused by **MAINTENANCE** and **WATER**

Impact Assessment (EcoInd. 99)

- Total impact (8,87e7 Pt) is mainly caused by **ENERGY** (64,8%) for winter heating and electricity consumption
- **TRANSPORTATION** (42,2%) has high impact because of the massive use of private cars
- **RENOVATION** has positive impact (-19,2%)

LCA of a Redevelopment Plan (5/5)



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ENERGY

BUILDINGS

TRANSPORTATION

GREEN AREAS

WATER MGMT

WASTE MGMT.

ALTERNATIVES:

- ✓ Construction of a new electric tram-line connected to existing public transport system of the area (metro, tram, bus)



Special Conference on Strategic Environmental Assessment
Prague, 21 - 23 September 2011

IAIA

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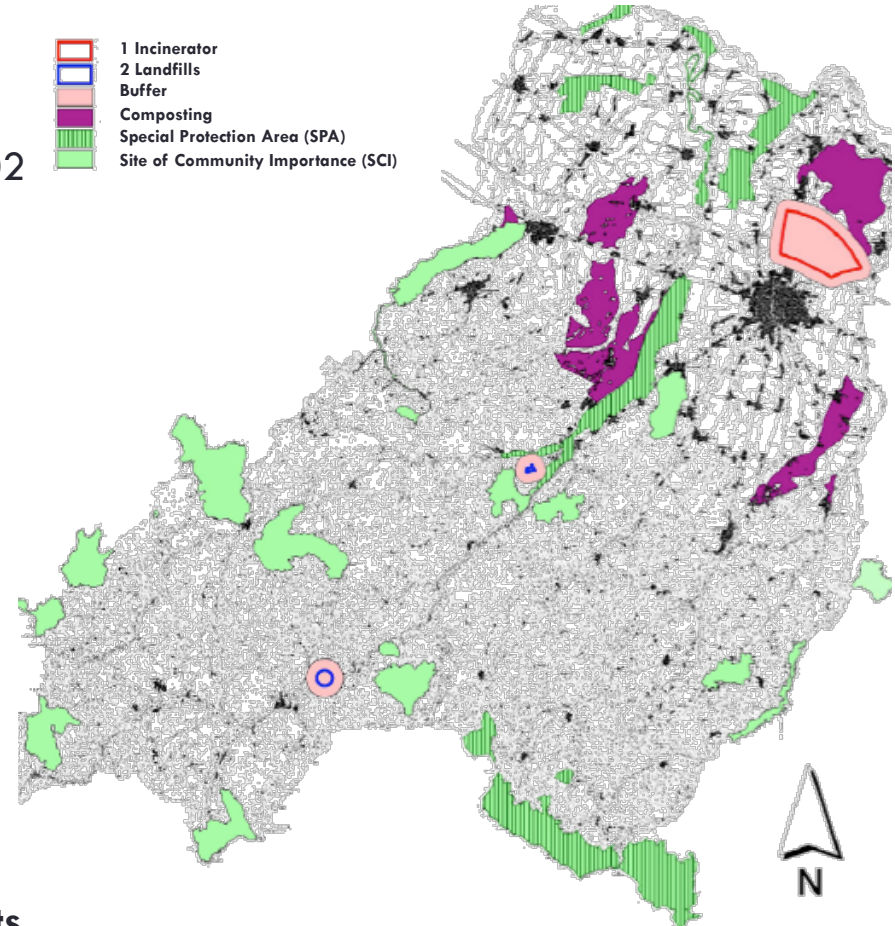
LCA of a Waste Management Plan



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- Province of Parma (2002-2012)
 - LCA provided the impact prediction tool to assess the first draft plan at 3 scenarios: 2002 (no action), 2005, 2012
 - LCA provided impact assessment of alternatives:
 - different recycling objective
 - different waste production rate
 - different paths for waste transportation
 - LCA provided economic assessment (internal and external cost)
 - did NOT include other aspects (social, local interference, etc.)
 - LCA is not site-specific
 - (Incinerator was not questioned)
 - **(young) SEA had to face many other aspects..**



LCA of a Mobility Plan (1/2)



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— Municipality of Florence (2006)

— LCA provided the assessment tool to evaluate the first draft plan

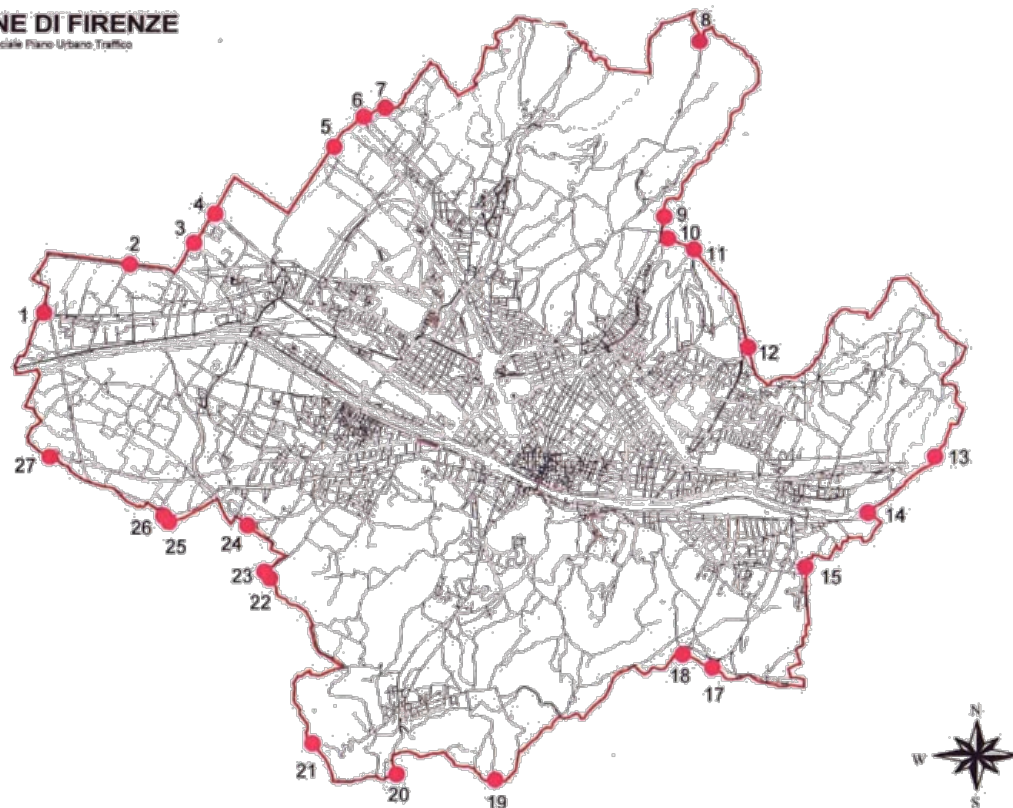
- Assessment of the current status
- Assessment of the first draft plan

— Economic aspects

- Cost evaluation for:
 - cars, buses
 - road maintenance
 - tickets fare system
 - Insurance, drivers pay

— Social aspects:

- Car accidents (and mortality)
- Consequent social costs



LCA of a Mobility Plan (2/2)



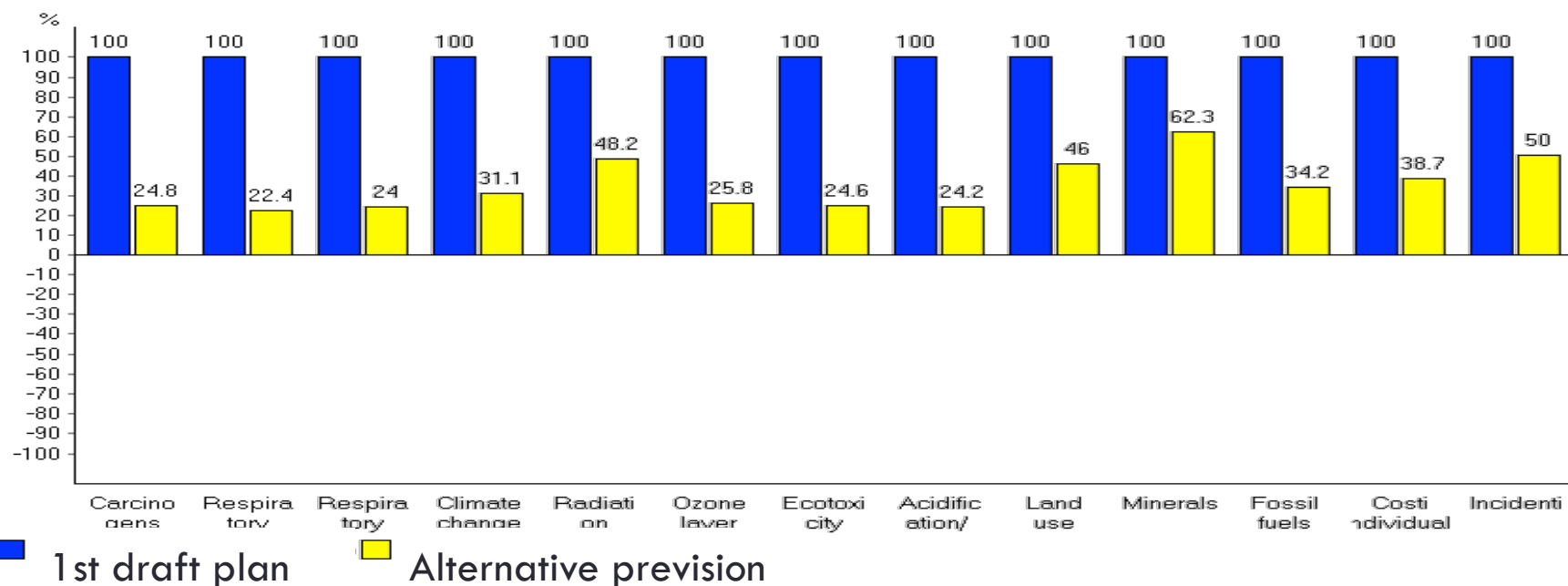
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Assessment of ALTERNATIVES:

- 50% decrease in flows;
- methane public buses (and cars);
- hybrid motors (electric, DITECH)

- new public buses;
- Increase in goods transportation in railways
- less car scrapping and more recycling



Comparing 1 p life cycle 'E* lca traffico situazione attuale' with 1 p life cycle 'E* lca traffico situazione proposta'; Method: Eco-indicator 99 (E)CWMD / I

LCA “for” SEA: ENEA Proposal

‘Proposal of an Impact Prediction tool for the environmental assessment of projects and spatial planning, based on LCA’ by ENEA Bologna (Italy)

Assessment tool based on LCA (1/8)



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- Research commissioned by the Municipality of Florence (Jan 2011) had the aim to define an **assessment tool** to be used by local authorities (Florence and other surrounding municipalities) in order to evaluate the **environmental impact of projects** and **spatial planning** that needs preliminary approval, like the construction permit of a building, the EIA (Environmental Impact Assessment), the **SEA (Strategic Environmental Planning)**.
- The proposed assessment tool makes an estimation of the environmental impact, even if with approximation, **without using life cycle software and methodology** (specific 'ad-hoc' LCA), assessment methods (such as IMPACT2000) and other software that requires time and specific competences (such as using SimaPro software).
- The proposed tool also estimates the **externalities**, which can be useful for public policies in order to help the decision making process

Assessment tool based on LCA (2/8)



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- LCA can help avoid a narrow outlook on environmental concerns by:
 - compiling an inventory of relevant inputs and outputs,
 - evaluating the potential environmental impacts associated with those inputs and outputs,
 - interpreting the results of the inventory and impact phases in relation to the objectives of the study.
- When using LCA methodology, an **estimation of many variables** is made:
 - emission to air, to water, to soil, natural resources (minerals, fossil fuels, water, wood, land use, solar and wind energy);
- The **characterization** process is made using impact categories:
 - such as global warming, acidification, eutrophication, ozone production, human health, ecosystem toxicity, land use, biodiversity, mineral consumption, non renewable energy consumption, etc.
- **Impact Assessment:**
 - Each **impact category** is measured with its specific unit. Damage categories are later identified by giving weight to human health, ecosystem quality, resources, etc.
 - Finally, the **damage categories** are normalized, in order not to have units of measurement and obtain a value for the total impact of the process.

Assessment tool based on LCA (3/8)



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- Choice of **INDEPENDENT VARIABLES** (INPUT) (most challenging part)
 - choice of the reference process, or processes, for each sector considered (house, incinerator, etc.);
 - analysis of the main characteristic of the selected process, in order to **understand from which data its impact is mostly affected**;
 - **Network assessment** of the impact of the process: using the network, it is possible to analyze the process life cycle considering all the **sub-processes** involved.
 - Among the sub-processes, the ones that contribute the most to the total impact are selected and further studied, in order to obtain independent variables;
 - Variables have to be well-known and shared, according to the information available by the user, and to the level of current knowledge (such as **law requirement, protocol**, etc.).
 - the process is never related to a specific area: the environmental effects are referred to the European area for local impact, to the planet area for global impact (global warming, depletion of resources).

Assessment tool based on LCA (4/8)



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- Choice of **INDICATORS** (OUTPUT) (from internationally available indicator):
 - Human Health: unit DALY, number of years lost by the European population (384E6 inhabitants);
 - Ecosystem Quality: unit PDFm2yr, the percentage of European species disappeared, multiplied by the European area ($2.16 \times 10^{12} \text{m}^2$) and the time of the emissions.
 - Climate change: unit kgCO_2eq ;
 - Resources: unit MJ primary;
 - Total Impact: unit Pt, that is obtained by multiplying with a normalization factor the four above categories, normalizing and weighting the results.
 - Total energy or Renewable energy or non renewable energy: in Eco-indicator 99
 - External cost, unit ELU (year 2000);
 - Internal cost;

Assessment tool based on LCA (5/8)



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- Choice of **SECTORS** (available database, local area characteristic)
 - **Building and Urban structure:** new house (passive house), new house (type 1 and 2), emergency house, new public building, industrial building, renovation of existing house, renovation of existing public building, urban renewal;
 - **Infrastructure:** roads, railways, electricity pipeline, water pipeline;
 - **Mobility:** passenger transport, good transport, public transport (bus), urban traffic (management);
 - **Energy:** electric energy production from natural gas, heating from natural gas, heating from solar energy, heating from heat pump, electric energy from photovoltaic panel Multi-Si, electric energy from photovoltaic panel CdTe, electricity energy production from hydropower powerplant, electricity energy production from biomass powerplant, electricity energy production from wind powerplant;
 - **Waste treatment:** landfill, incinerator, composting, iron recycling, aluminum recycling, sewage treatment, waste management;
 - **Industrial production:** wood production, paper production, cement production, paint production, bricks production, plastic production, fabric production, mechanics production;
 - **Farming and agriculture:** milk production, ham production, grass production, crop production, corn production, oil production, wine production, apricots jam production;

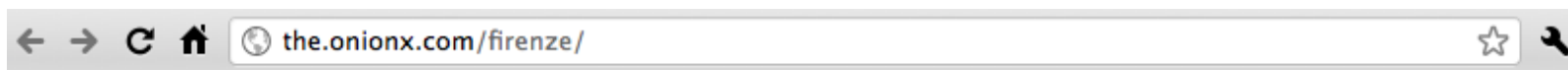
Assessment tool based on LCA (6/8)



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- **USER INTERFACE** (spreadsheets converted into a website)
 - Interactive and easy-to-use tool for the municipality decision makers, in order to have a preliminary assessment of projects/plans/programmes



Indicatori di impatto ambientale per l'uso del territorio



sceita del comparto:

allevamento
coltivazione
rifiuti
industria
energia
infrastruttura
traffico
edilizia

Assessment tool based on LCA (7/8)



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- User interface (spreadsheets converted into a website)
 - Quick assessment without using time consuming LCA evaluation, especially when detailed data is not available, or the project/plan is at its preliminary phase

- Quick comparison of different alternatives can be made, by modifying some indicators and analyzing the different results obtained.

■ riqualificazione urbana

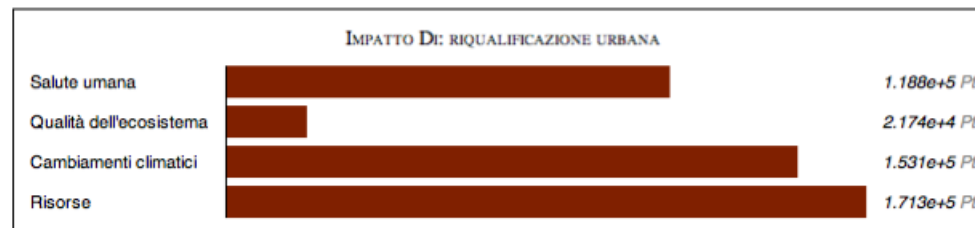
dati di input

500000	m2area
5000	inhabitants
75	years

options: size (surface), population, lifetime, residential/commercial rate, transport systems, etc.

impatto

SALUTE UMANA	QUALITÀ DELL'ECOSISTEMA	CAMBIAMENTI CLIMATICI	RISORSE	DANNO TOTALE	COSTI ESTERNI	COSTI INTERNI	QUALITÀ DELLA VITA	FATTORI CULTURALI
(DALY)	(PDF•m ² •anno)	(kg CO ₂ eq)	(MJ primari)	(Pt)	(ELU)	(€)	(p)	(p)
842.4	2.978e+8	1.516e+9	2.603e+10	4.649e+5	1.275e+9	9.939e+8	-2.055e+5	-3.605e+8



Assessment tool based on LCA (8/8)

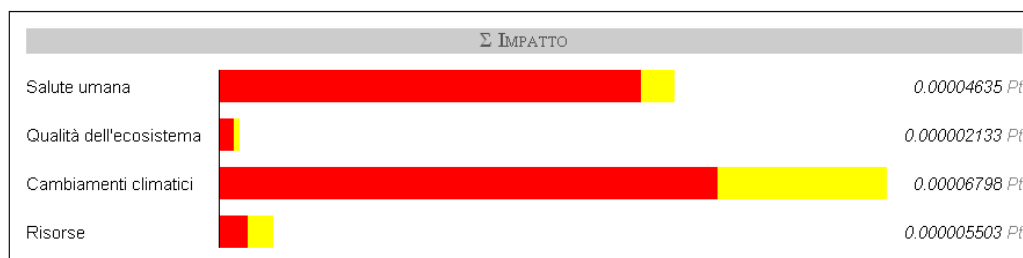
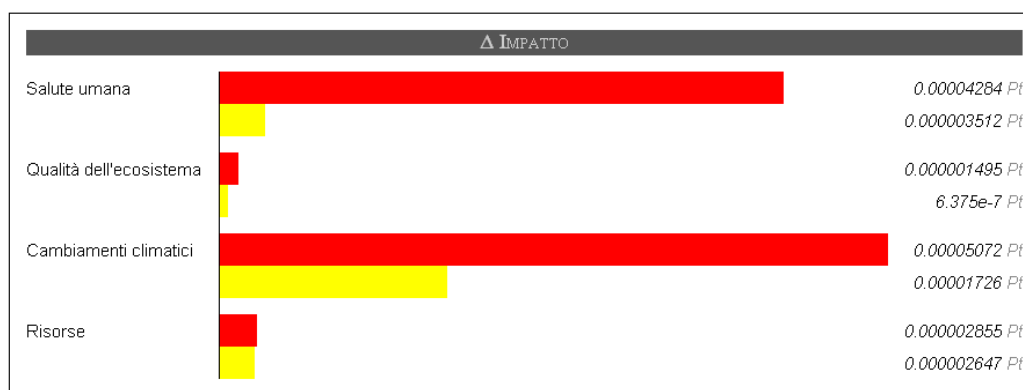


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Impact comparison

■ inceneritore + ■
■ discarica + ■



Cumulative impact

Potential, Limits, Further Research



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Potential

- Innovative approach to designing the scope of the environmental assessment
- help defining assessing **alternatives** for SEA
- support tool for decision makers at various scales
- more **transparency** to SEA
- no border limits, indirect impact, etc.

Limits

- Can be NON-transparent
- not site-specific
- lack of geographical resolution of **inventory** data
- high estimation, high errors
- LCA need to be complemented with other tools

Further Research

- methodological development
- practical experience
- integration with other assessment tools
- ...

References

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- ISO 14044:2006 “Environmental management - Life cycle assessment - Requirements and guidelines”.
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Thanks for attention

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