



AUTH



LHTEE

Design of a Geographic Information System as a tool for Enhanced Landfill Mining: An implementation in Central Macedonia, Greece

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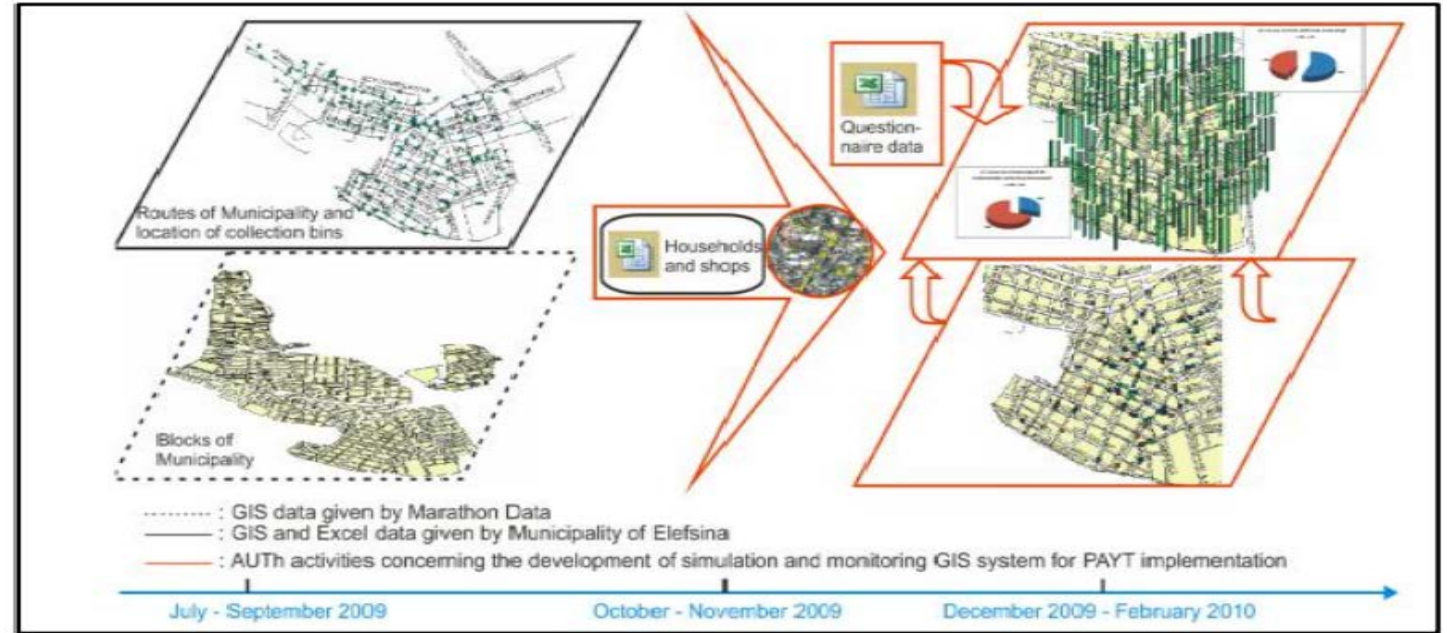
Laboratory of Heat Transfer and Environmental Engineering

Department of Mechanical Engineering

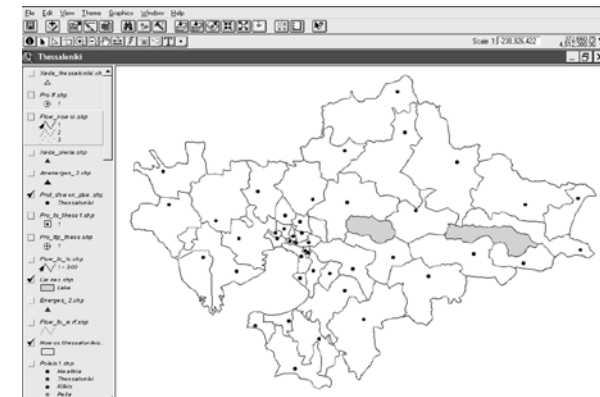
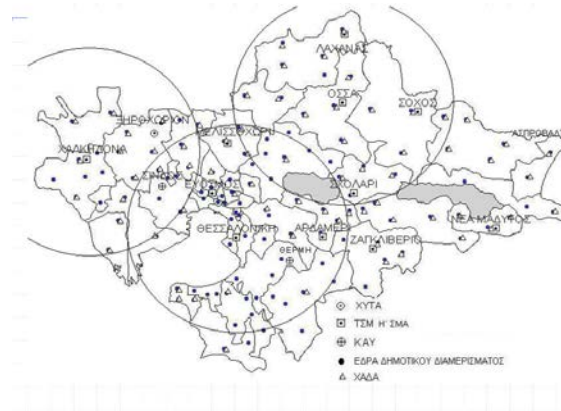
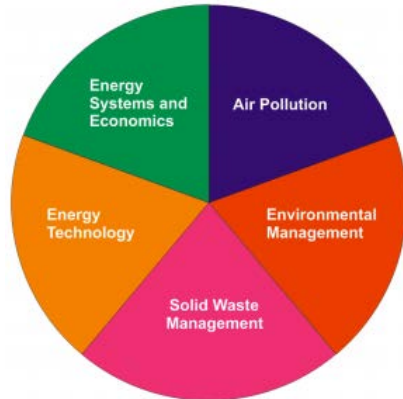
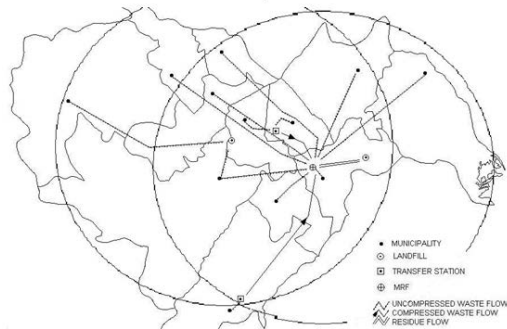
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Laboratory of Heat Transfer and Environmental Engineering (LHTEE)



Main Research Topics



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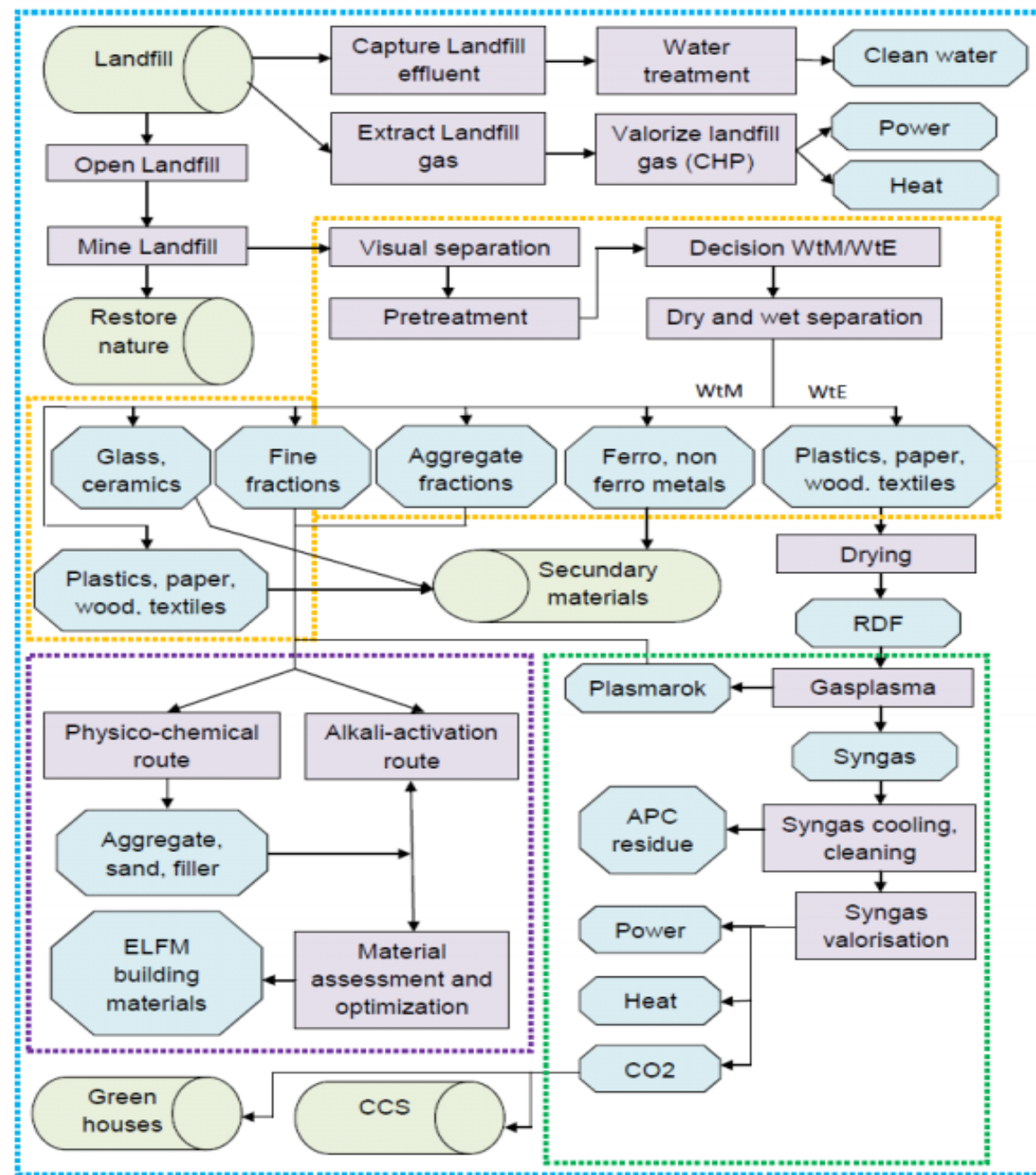
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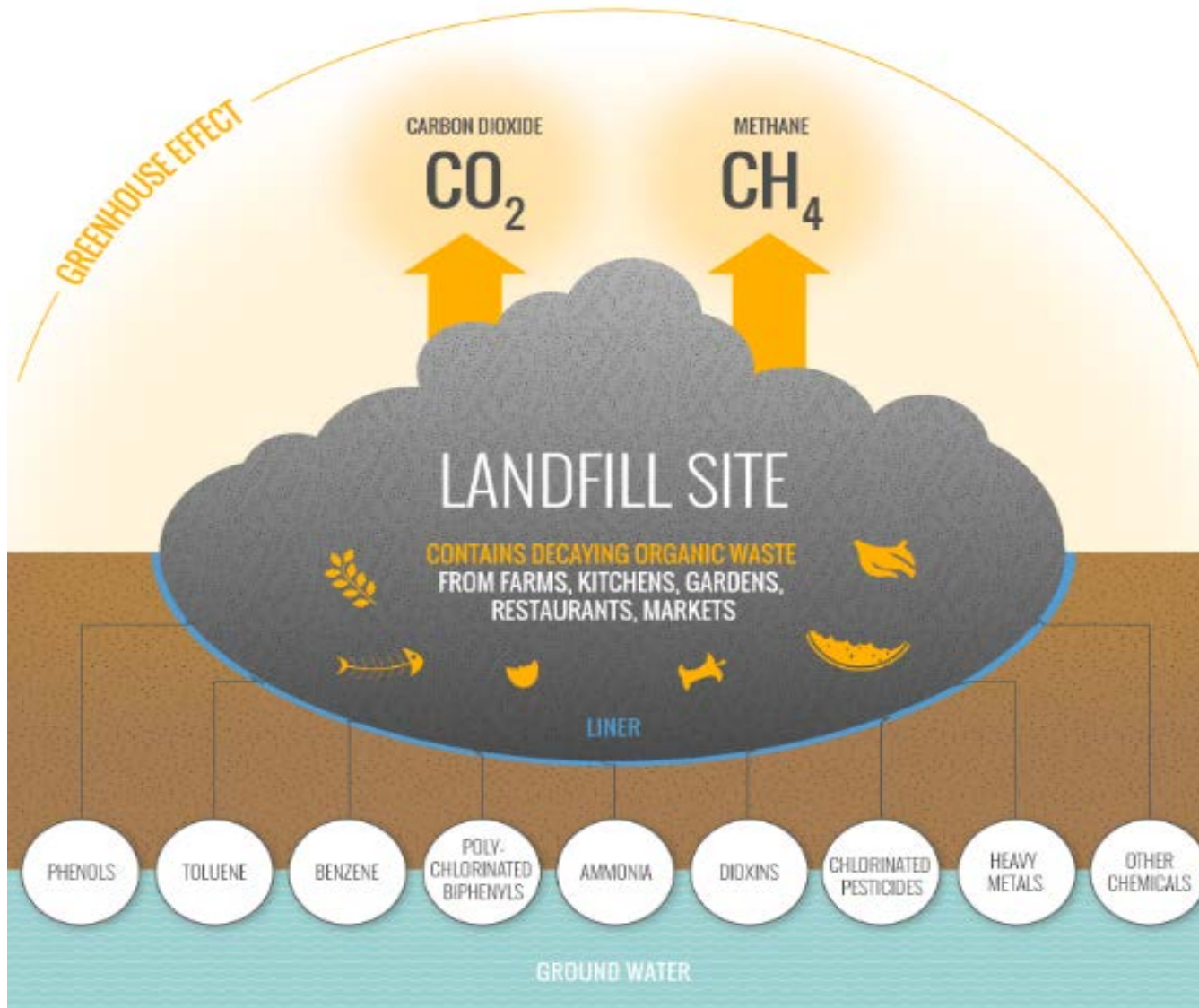
Enhanced Landfill Mining

- Enhanced Landfill Mining is defined as “the safe exploration, conditioning, excavation and integrated valorisation of (historic, present and/or future) landfilled waste streams as both materials (Waste-to-Material, WtM) and energy (Waste-to-Energy, WtE), using innovative transformation technologies and respecting the most stringent social and ecological criteria.”



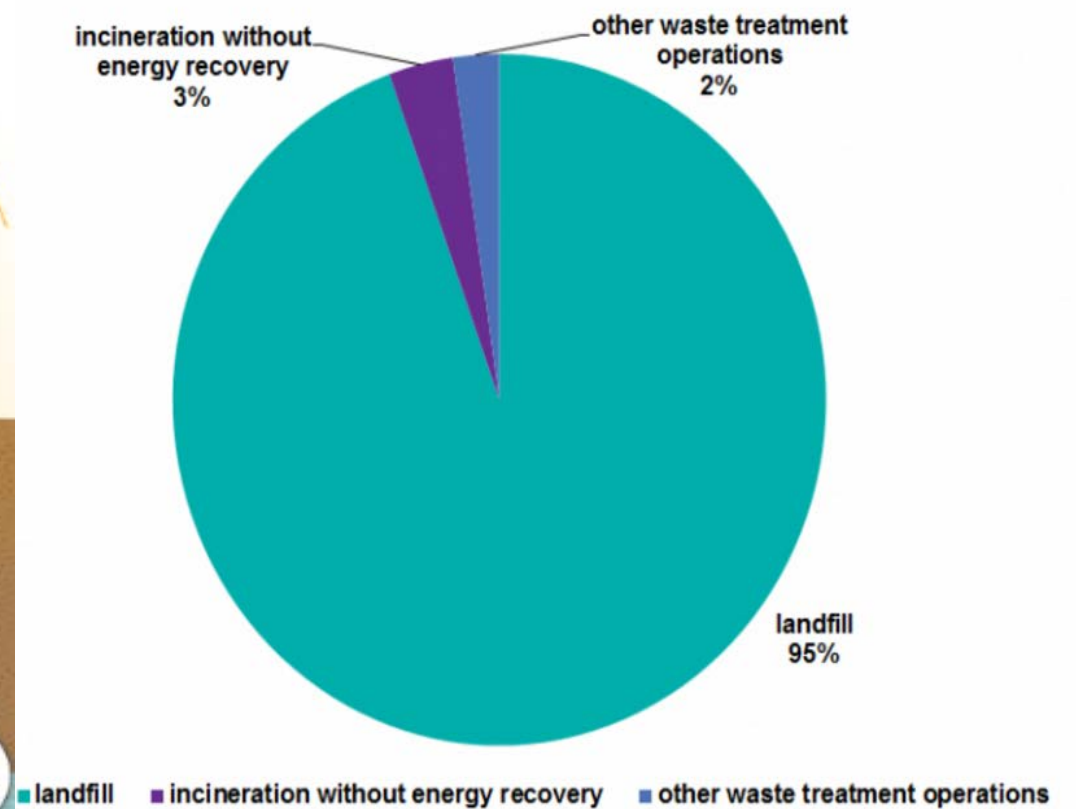


Contribution to global warming - Major cost to society 1/3



Estimated share of the three waste disposal operations in GHG emissions (2011)

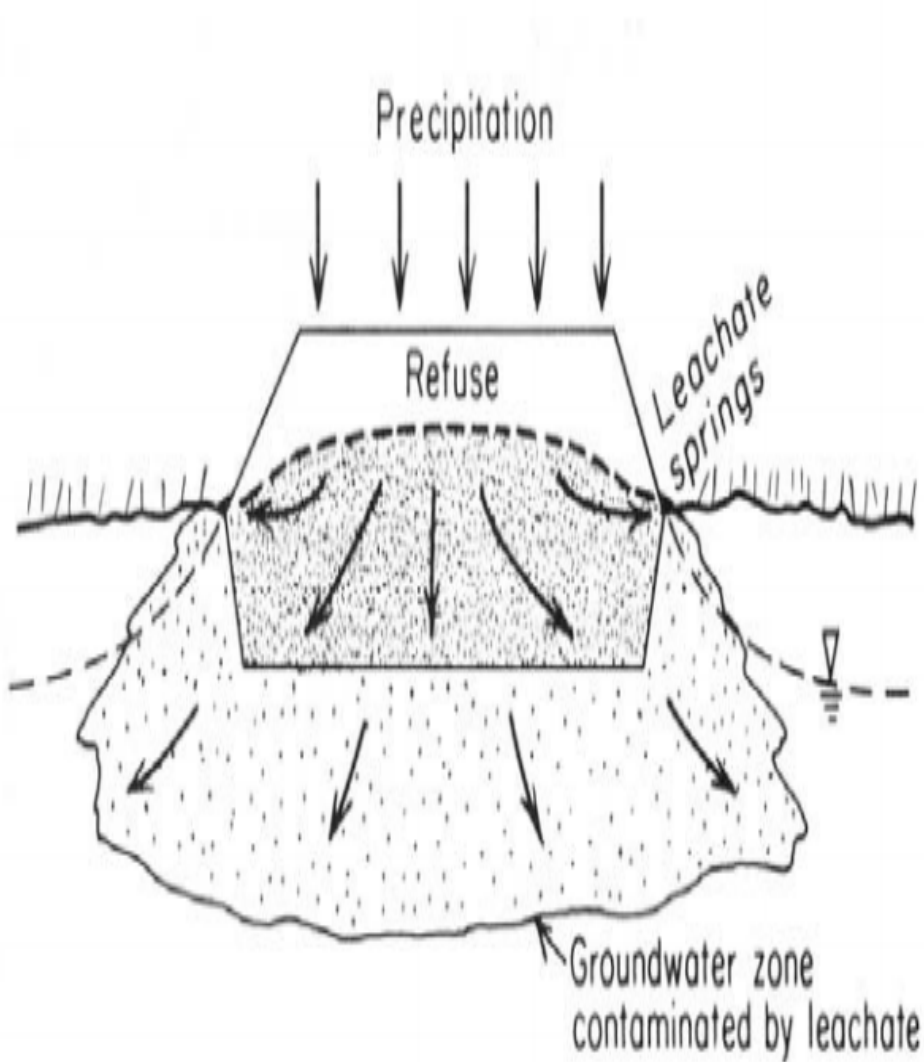
Source: EEA Greenhouse gas data viewer, March 2014



Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Archive:Greenhouse_gas_emissions_from_waste_disposal



Groundwater pollution – Major cost to society 2/3



ΣΥΝΟΛΟ ΠΡΑΓΜΑΤΙΚΟΥ ΠΛΗΘΥΣΜΟΥ	1.057.825
ΑΡΙΘΜΟΣ ΔΗΜΩΝ	45
ΑΡΙΘΜΟΣ ΔΗΜΟΤΙΚΩΝ ΔΙΑΜΕΡΙΣΜΑΤΩΝ	126
ΑΡΙΘΜΟΣ ΧΑΔΑ	80
ΑΝΑΛΟΓΙΑ ΚΑΤΟΙΚΩΝ ΑΝΑ ΧΑΔΑ	13.223
ΑΝΑΛΟΓΙΑ ΧΑΔΑ ΑΝΑ ΔΗΜΟ	1,78
ΑΝΑΛΟΓΙΑ ΧΑΔΑ ΑΝΑ ΔΗΜΟΤΙΚΟ ΔΙΑΜΕΡΙΣΜΑ	0,63



Occupation of valuable land – Major cost to society 3/3

Οι παράνομες χωματερές στην Ελλάδα

Οι παράνομες χωματερές σε όλες τις χώρες της Ε.Ε. θα έπρεπε να έχουν κλείσει έως το 2000.

Η Ελλάδα ήταν η πρώτη χώρα στην οποία το Ευρωπαϊκό Δικαστήριο επέβαλε χρηματικό πρόστιμο (το 2000, 5,4 εκατ. ευρώ για την παράνομη χωματερή στον Κουρουπτό Χανίων).

1.125

χωματερές λειτουργούσαν το 2005, με αποτέλεσμα να καταδικαστεί η Ελλάδα από το Ευρωδικαστήριο.



Πρόσφατα ξεκίνησε η διαδικασία νέας προσφυγής της Ευρωπαϊκής Επιτροπής στο Ευρωδικαστήριο που θα οδηγήσει στη δεύτερη καταδίκη της Ελλάδας, άρα και στην επιβολή προστίμου.



ΣΥΝΟΛΟ ΠΡΑΓΜΑΤΙΚΟΥ ΠΛΗΘΥΣΜΟΥ	129.846
ΑΡΙΘΜΟΣ ΔΗΜΩΝ	13
ΑΡΙΘΜΟΣ ΔΗΜΟΤΙΚΩΝ ΔΙΑΜΕΡΙΣΜΑΤΩΝ	55
ΑΡΙΘΜΟΣ ΧΑΔΑ	48
ΑΝΑΛΟΓΙΑ ΚΑΤΟΙΚΩΝ ΑΝΑ ΧΑΔΑ	2.705
ΑΝΑΛΟΓΙΑ ΧΑΔΑ ΑΝΑ ΔΗΜΟ	3,69
ΑΝΑΛΟΓΙΑ ΧΑΔΑ ΑΝΑ ΔΗΜΟΤΙΚΟ ΔΙΑΜΕΡΙΣΜΑ	0,87



A best practice to follow...



Background for Stirling

Waste Profile and History

- ~40,000 Tonnes Household Waste p/a
- ~60,000 Tonnes of MSW p/a
- In 2002-3 Only 8-10% Recycling Rate (90%+ still landfilled)



Forth Valley Area Waste Plan approved 2003

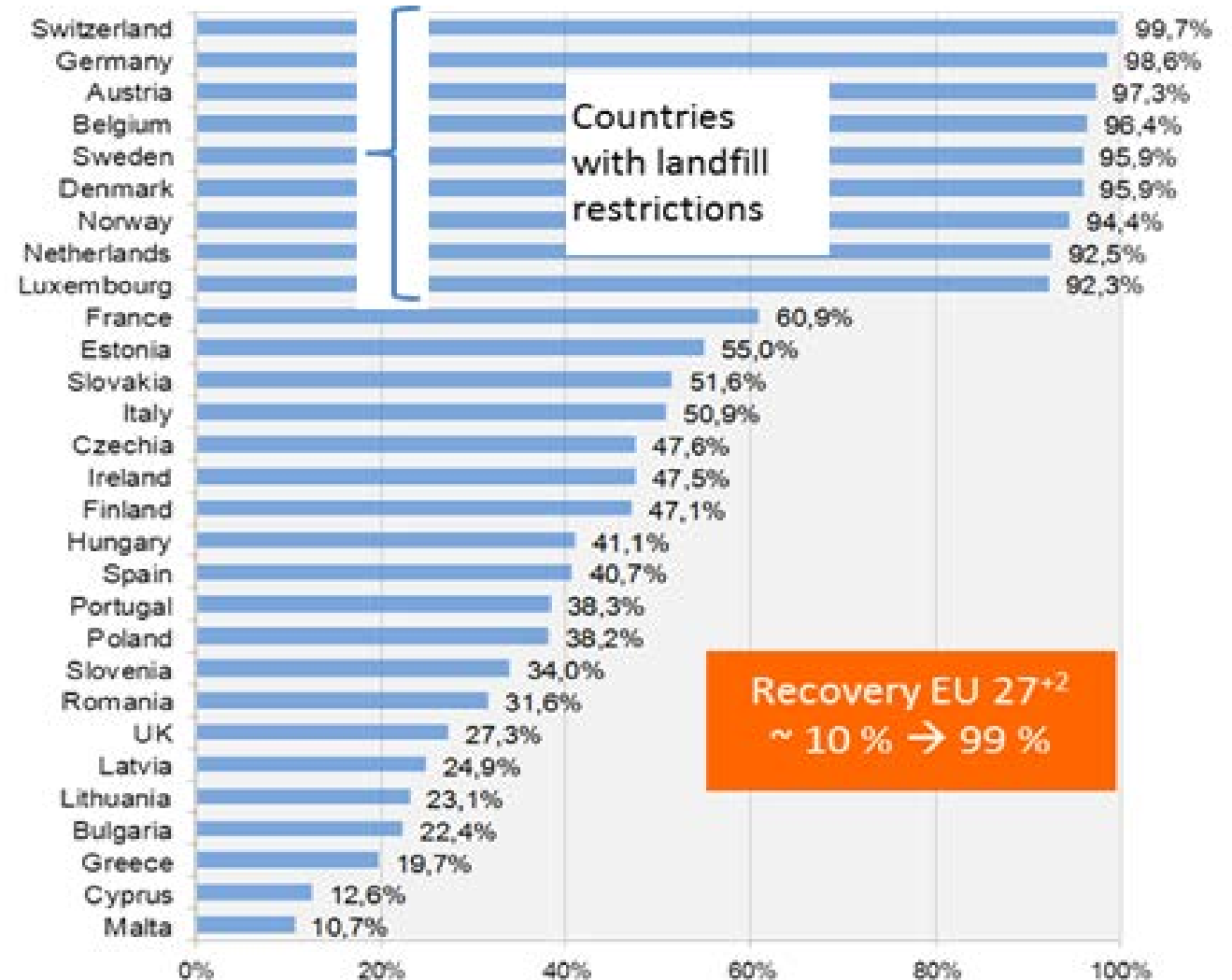
- "Intensive Recycling and Composting"



Benefits of excavating and processing solid wastes from landfills



- Recovery of secondary materials and energy
- Elimination of an existing or potential contamination source
- Conservation of landfill space
- Reduction in landfill area
- Reduction of post-closure costs
- Site redevelopment





Methodology



Results from pilot implementation

Valuable recyclable materials
(metals and plastics) (t)

Composition (%)

Profit from selling recyclables (€)

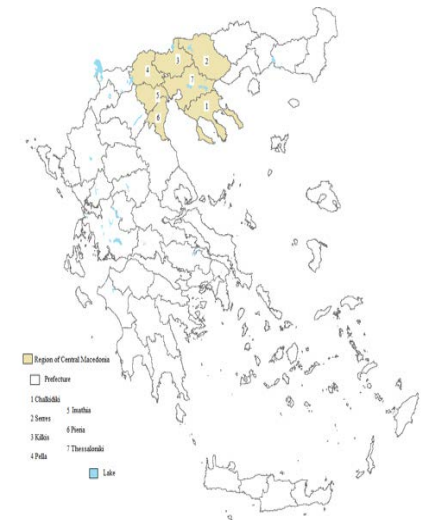
Mining and treatment cost (€/t)

Indices for material recovery (%)

Eventual revenues index of the mining mass (€/t)

Index for actual net mining cost (€/t)

Other active
or inactive
uncontrolled
landfill site





Case study data

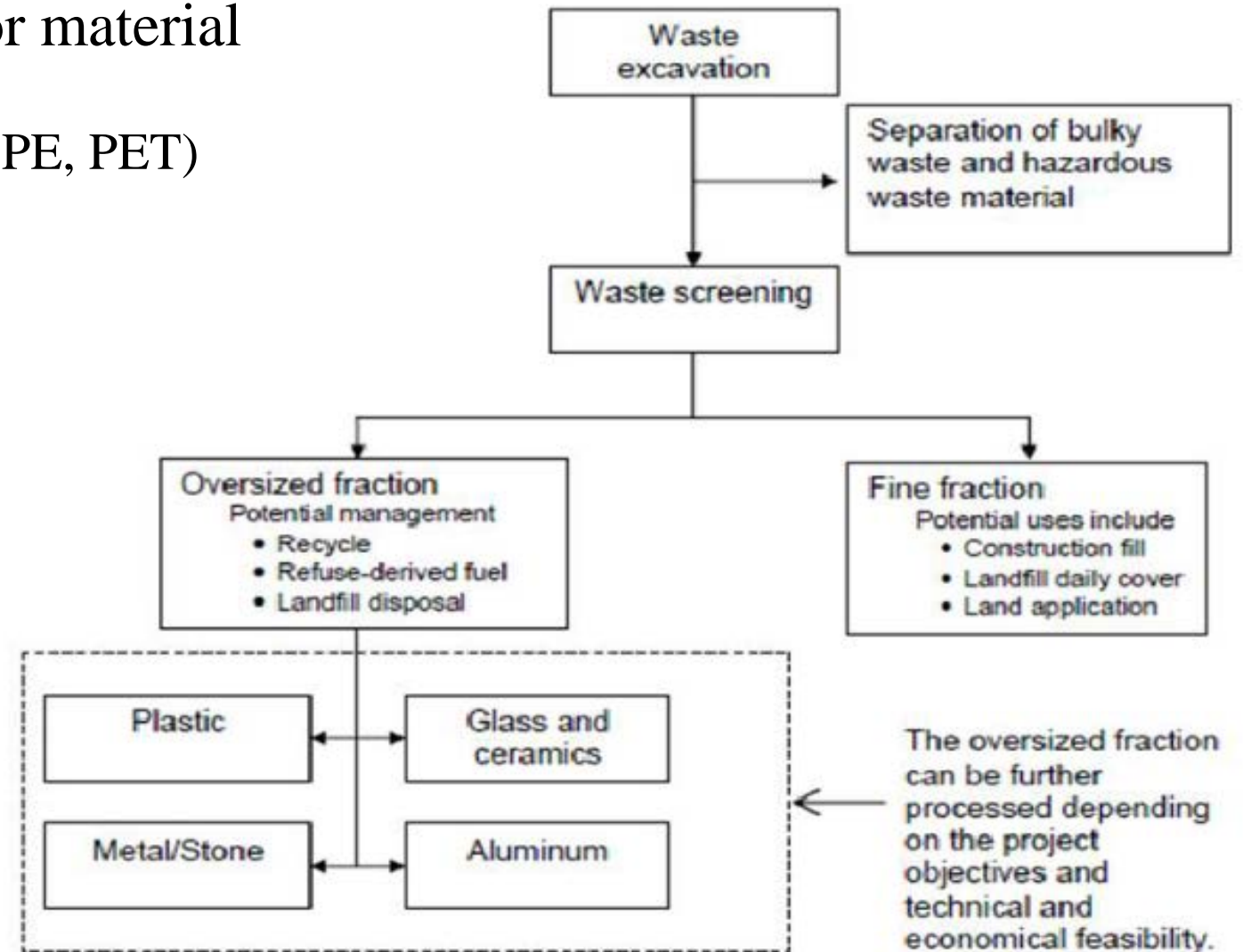


- Percentages indicated the indices for material recovery:

- 3.4% w/w mixed hard plastic (PP, HDPE, PET)
- 5.6% w/w plastic film (bag)
- 0.3% w/w aluminum cans
- 1.0% w/w ferrous material
- 0.3% w/w glass



www.reclaim.gr



www.researchgate.net



Profit – Eventual revenues – Net mining cost



- For the amount of 581 t (1,280 m³) of pilot mining, the profit varied from 383 – 4,603 €
- By dividing profit by the mining mass, the eventual revenues index was given: 0.66 – 7,92 €/t.
- In view of the fact that the mining and treatment cost was 35 €/t, the net cost was determined from 27.1 to 34.3 €/t.





Cost for mining waste per citizen and year

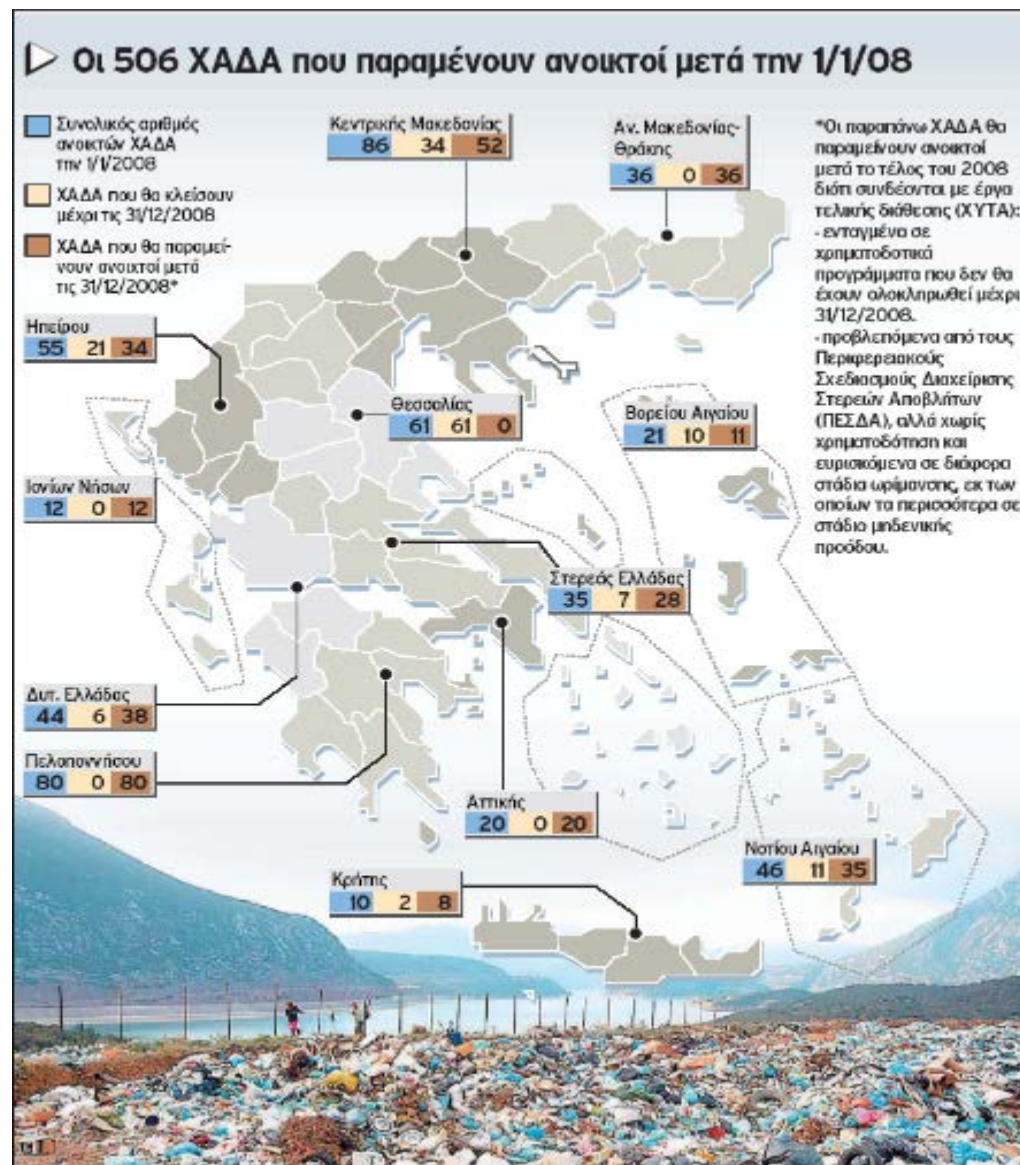
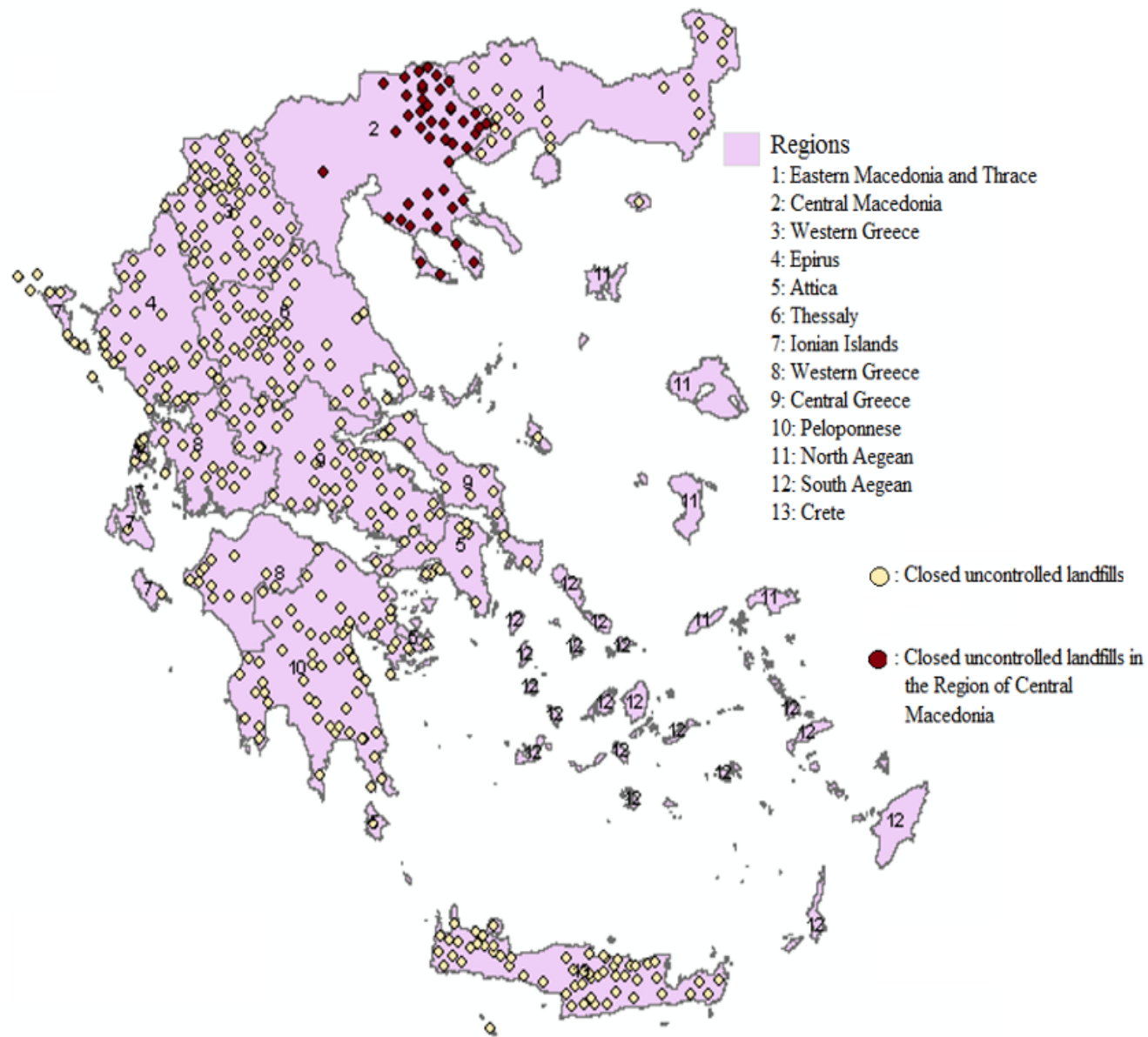


- Year of the start-up of the waste disposal site: 1994
- 168,000 t (= 21 years x 8,000 t/y) were disposed in 21 years.
- From the disposed mass of 168,000 t, the recyclable waste was calculated to 16,800 t (= 10% x 16,800 t)
- Based on statistical data, the average Greek citizen produces 0.51 t/y
- The index giving the cost for mining waste per citizen and year was calculated from 13.82 to 17.49 €





Location of closed uncontrolled landfills



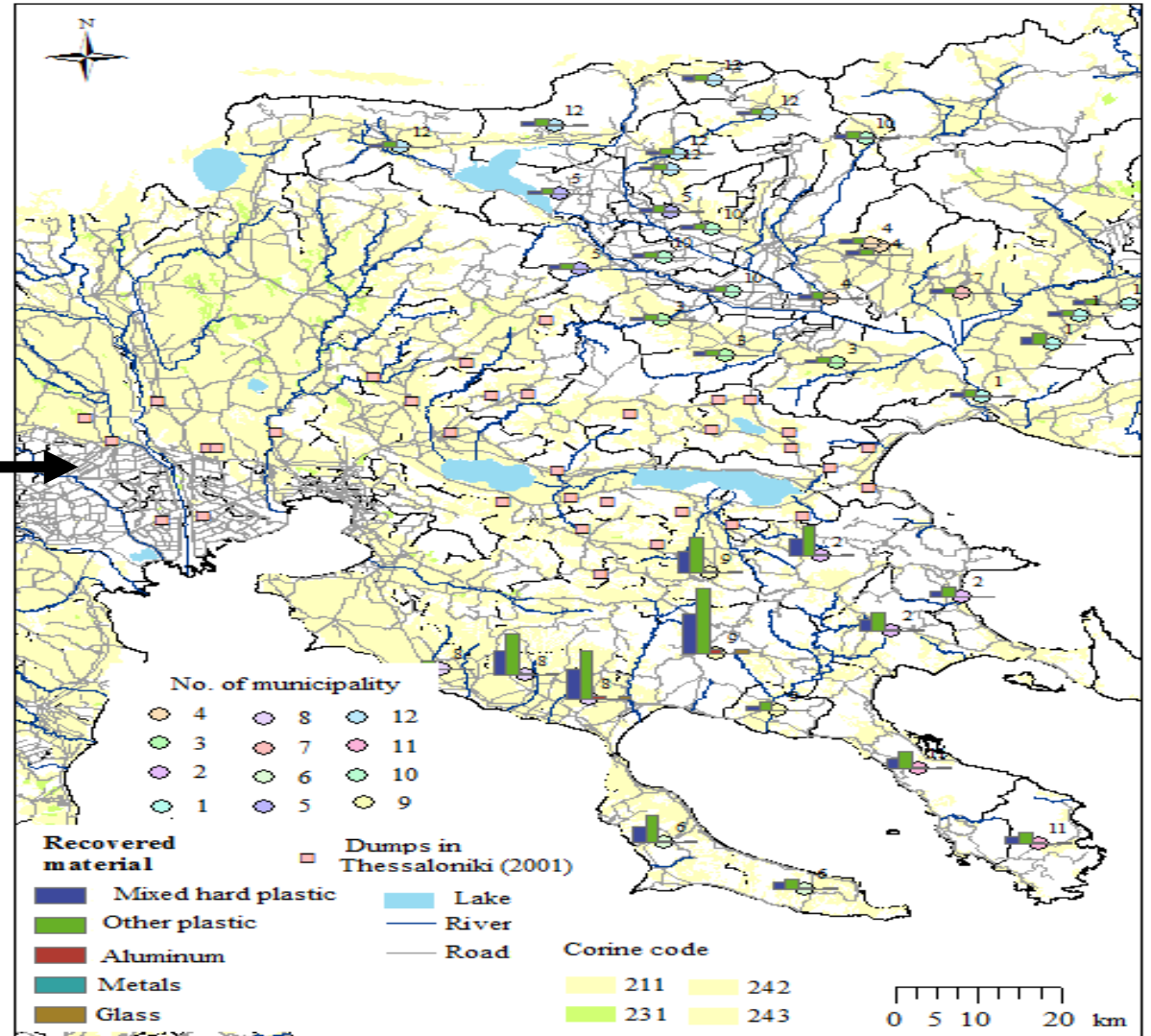
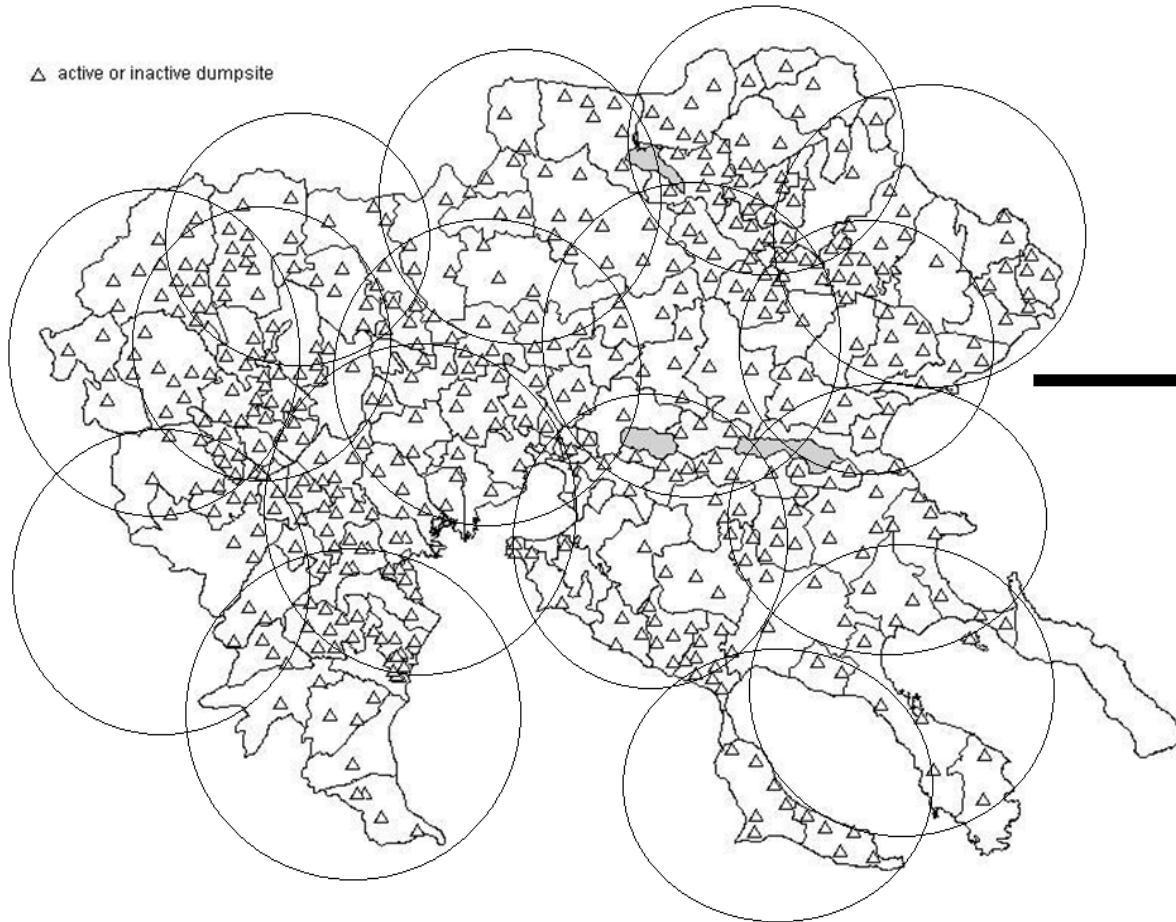


Material recovery from registered sites



From the location of local transfer stations (2006) ...

... to landfill mining





Conclusions – Future works



- The designed system was used as a tool for enhanced landfill mining due to the fact that

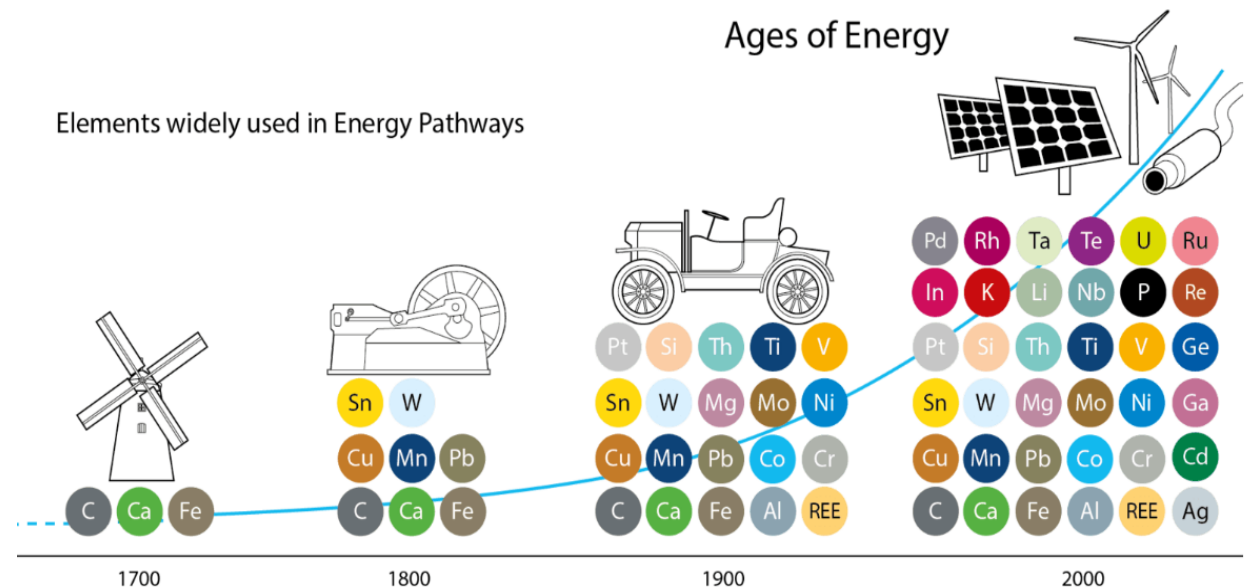
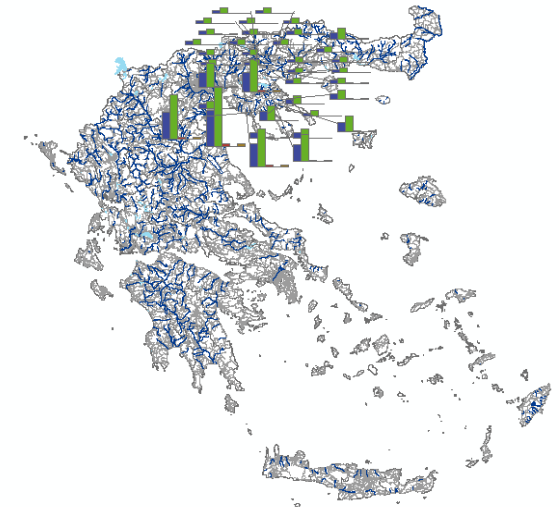
- it utilised indices as
 - actual net mining cost (€t),
 - eventual revenue of the mining mass (€t) and
 - material recovery (%) and
- it was implemented for evaluating the potential of recovered materials in the prefectures of
 - Chalkidiki and
 - Serres.

- Geographic information system can be used for reclamation planning in the Region of Central Macedonia for improving logistics because it can supply:

- access roads,
- water crossing and
- waste volume

Future works:

- The disposal year should be taken into account for other landfills because the ‘age of energy’ affects the quality of mined waste
- The energy recovery should be evaluated with MCDA tools





Thank you very much for your attention!



https://www.academia.edu/6240106/Zero_Waste_and_the_Circular_Economy_The_Future_of_Resource_Management

<http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=87429>