

WASTELANDS & CIRCULAR ECONOMY

landfills as a reused, 'recycled' or restored space



active landfill of Jesolo - Piave Nuovo, Gruppo Veritas, November 2022 (© Eliki Diamantouli)



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doctoral student (UniNa - DiCea)

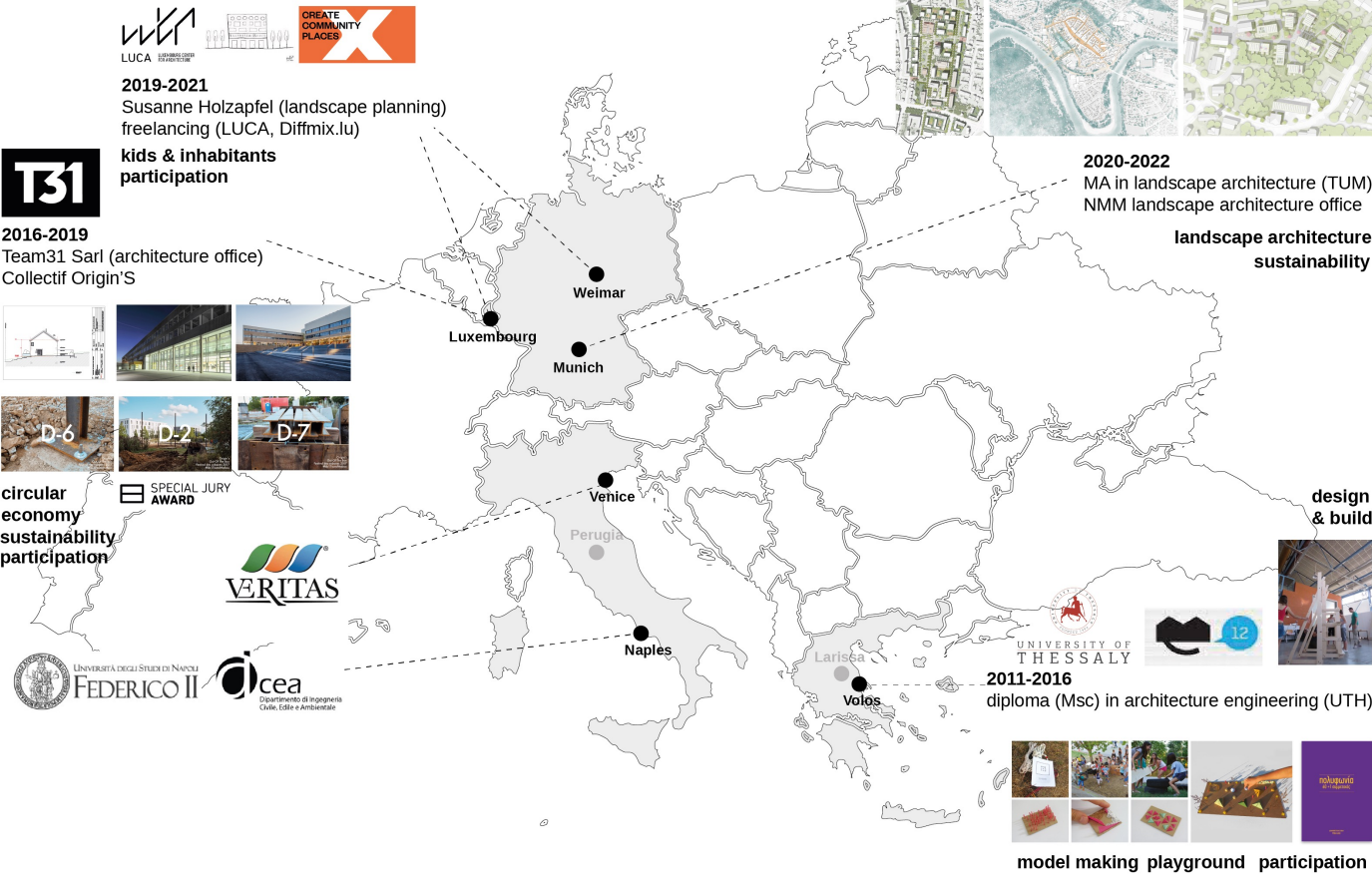
TABLE OF CONTENTS

●	CONTEXT
●	METHOD
●	DISCUSSION
●	RESEARCH



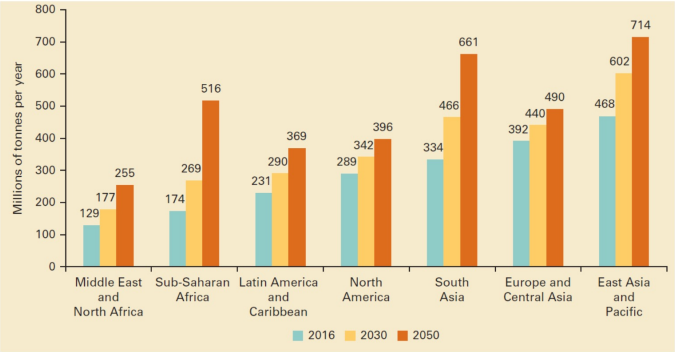
active landfill of Larissa (Google Maps)

BACKGROUND

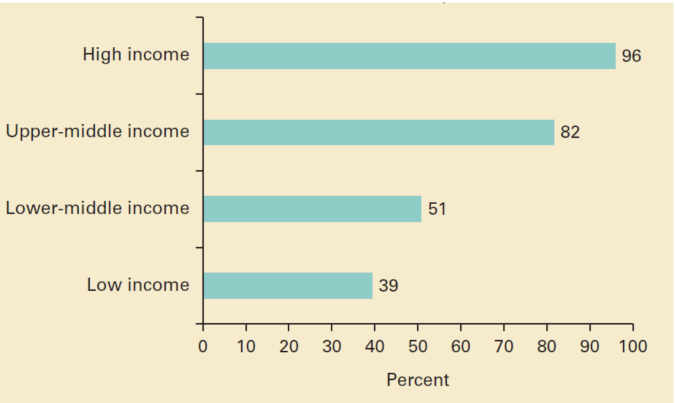


WASTE CULTURE IN THE WORLD

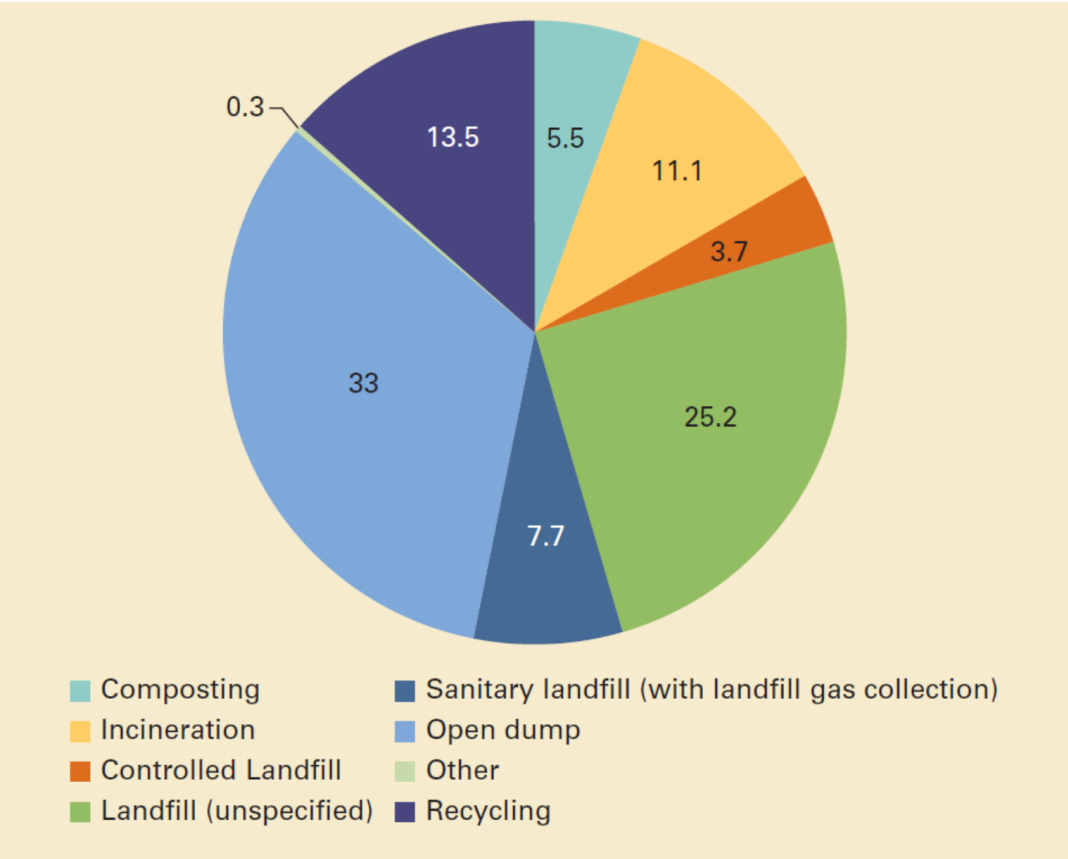
Waste Generation. Waste & Income. Waste Destination



Projected waste generation, by region (millions of tonnes/ year)



Waste collection rates, by income level (percent)

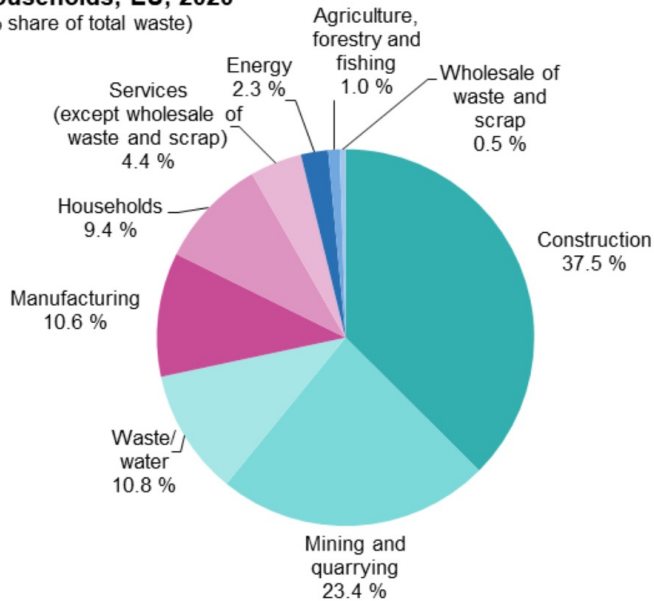


Global treatment and disposal of waste (percent)

WASTE GENERATION IN EUROPE

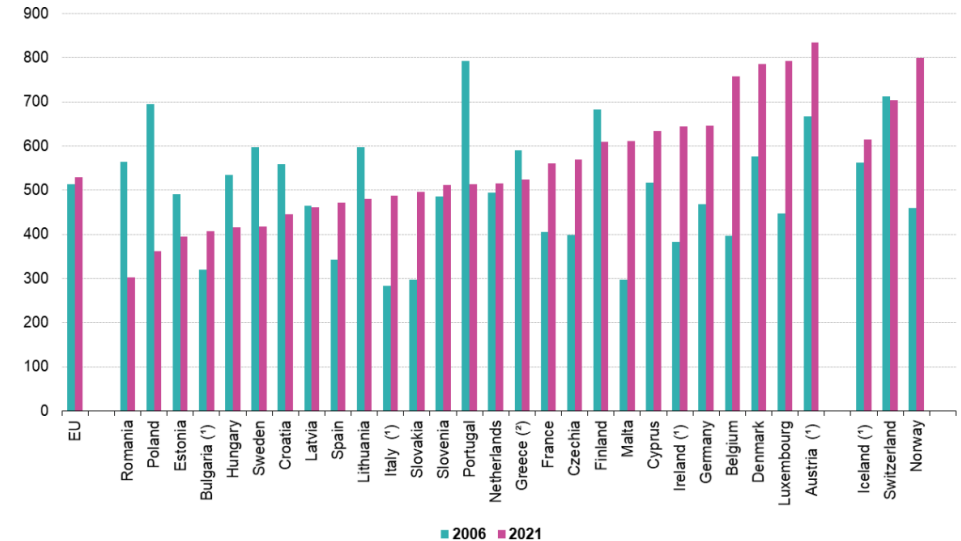
Waste generation by economic activities and households, EU, 2020

(% share of total waste)



Municipal waste generated, 2006 and 2021

(kg per capita)



Note: Countries are ranked in increasing order by municipal waste generation in 2020.
(*) Bulgaria, Italy, Portugal, Ireland, Austria, Iceland 2020 data.
(*) Greece 2019 data.
Source: Eurostat (online data code: env_wasmun)

Source: Eurostat (online data code: env_wasgen)



Figure 1: Waste generation by economic activities and households, EU, 2020

(% share of total waste)

Source: Eurostat (env_wasgen)

Figure 1: Municipal waste generated, 2006 and 2021

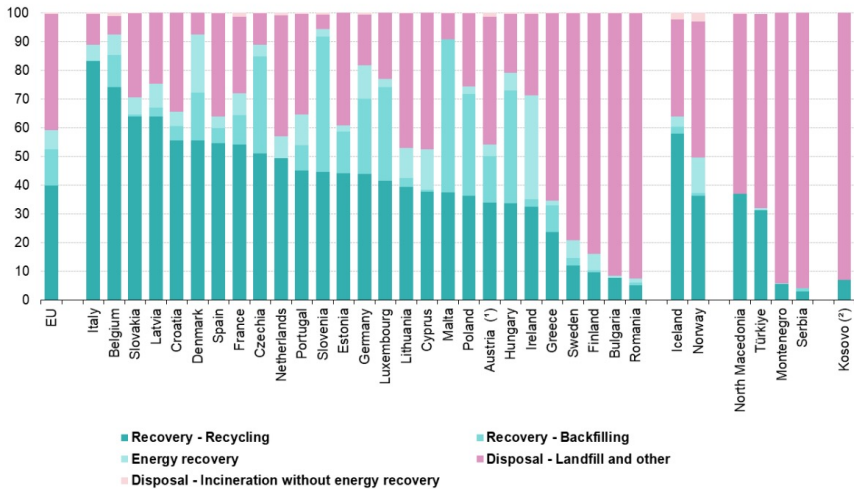
(kg per capita)

Source: Eurostat (env_wasmun)



WASTE TREATMENT IN EUROPE

Waste treatment by type of recovery and disposal, 2020
(% of total treatment)



(*) Value of incineration for Austria estimated by Eurostat.

(*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence.

Source: Eurostat (online data code: env_wastrt)

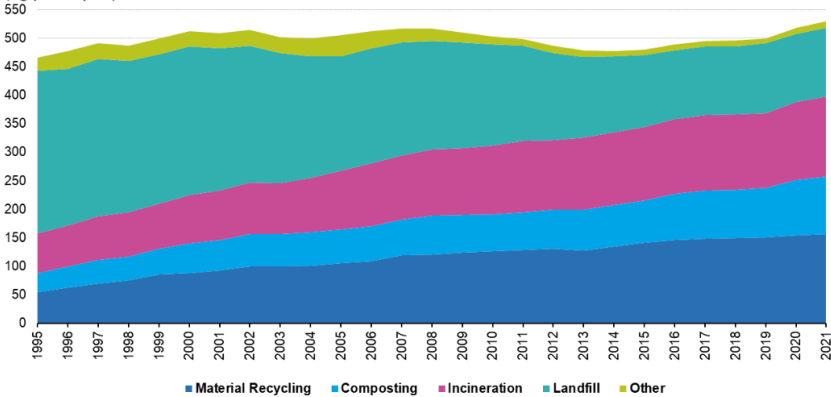
eurostat

Figure 6: Waste treatment by type of recovery and disposal, 2020

(% of total treatment)

Source: Eurostat ([env_wastrt](#))

Municipal waste treatment, EU, 1995-2021
(kg per capita)



Note: estimated by Eurostat.

Source: Eurostat (online data code: env_wasmun)

eurostat

Figure 2: Municipal waste treatment, EU, 1995-2021

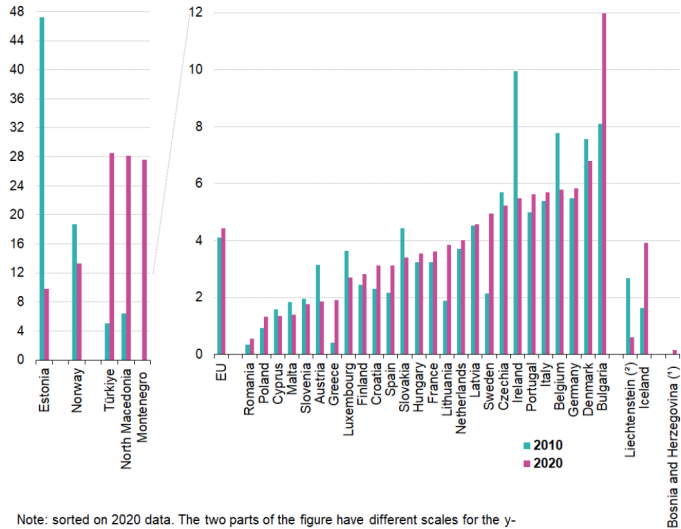
(kg per capita),

Source: Eurostat ([env_wasmun](#))

HAZARDOUS WASTE IN EUROPE

Generation & Treatment

Hazardous waste generated, 2010 and 2020
(% share of total waste)

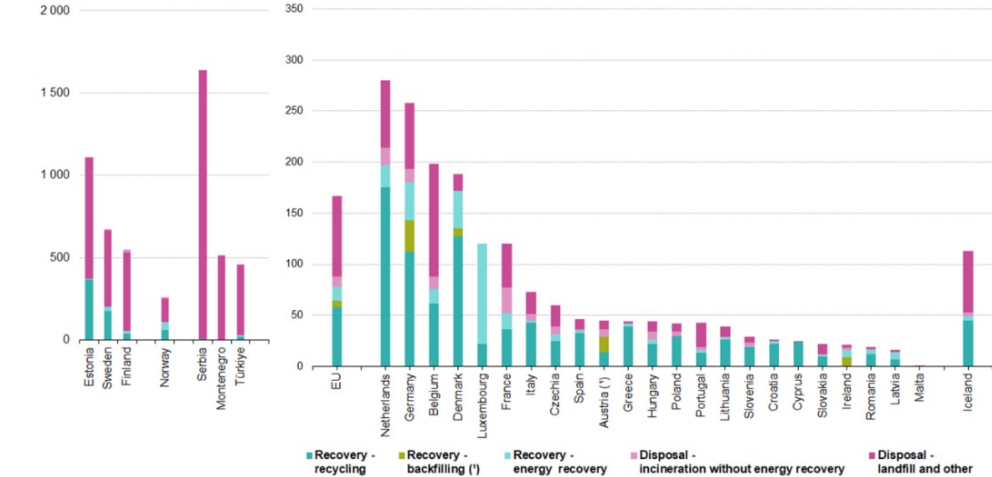


Note: sorted on 2020 data. The two parts of the figure have different scales for the y-axis.
(*) 2010: not available.
(*) 2018 value
Source: Eurostat (online data code: env_wasgen)

eurostat

Figure 4: Hazardous waste generated, 2010 and 2020
(% share of total waste)
Source: Eurostat (env_wasgen)

Hazardous waste treatment, 2020
(kg per capita)



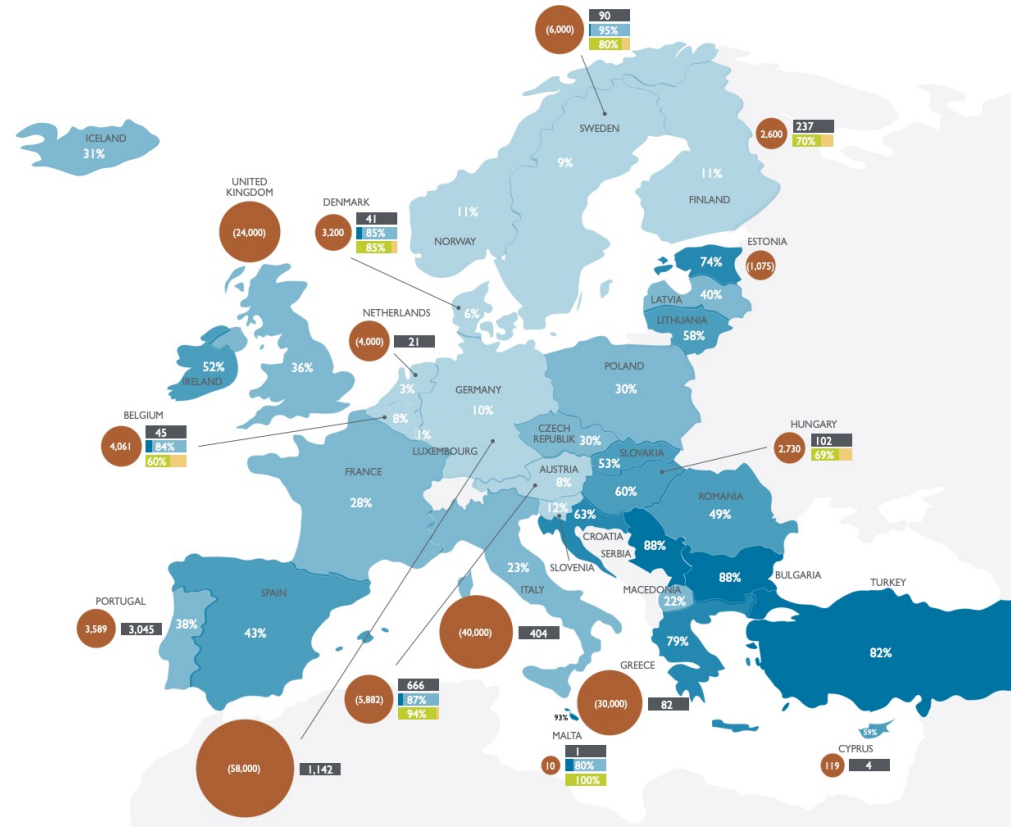
(*) value of incineration for Austria estimated by Eurostat.
Note: the two parts of the figure have different scales for the y-axis.
Source: Eurostat (online data code: env_wastrt)

eurostat

Figure 8: Hazardous waste treatment, 2020
(kg per capita)
Source: Eurostat (env_wastrt)

LANDFILL IN EUROPE

Estimated total amount of landfills, etc.



Source: Eurelco (2018)

CONTEXT METHOD DISCUSSION CONCLUSION

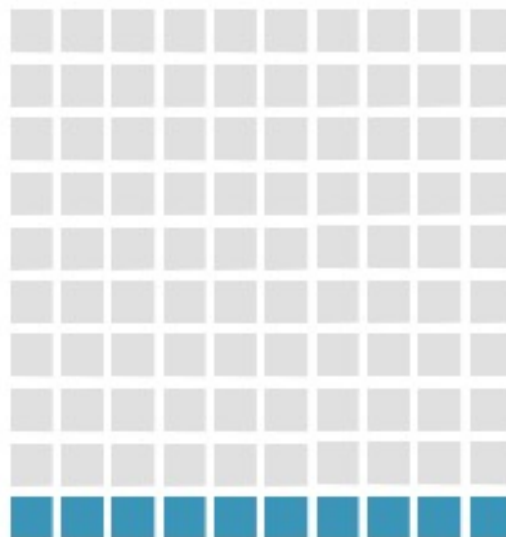
LANDFILLS IN EUROPE


sanitary and non-sanitary landfills



CONTEXT METHOD DISCUSSION CONCLUSION

EU(28): 500,000+ landfills

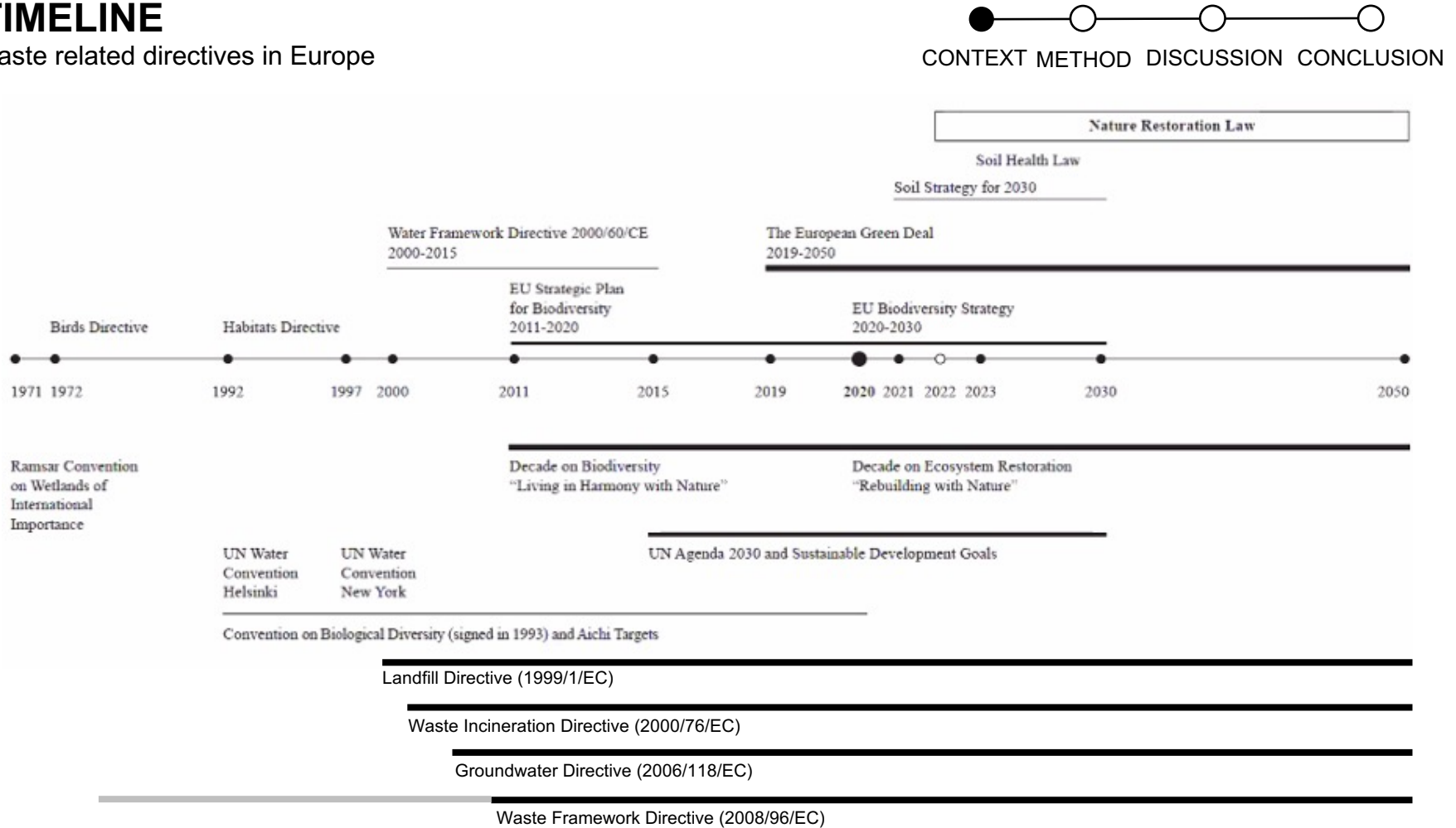


 Non sanitary landfills

 Sanitary landfills

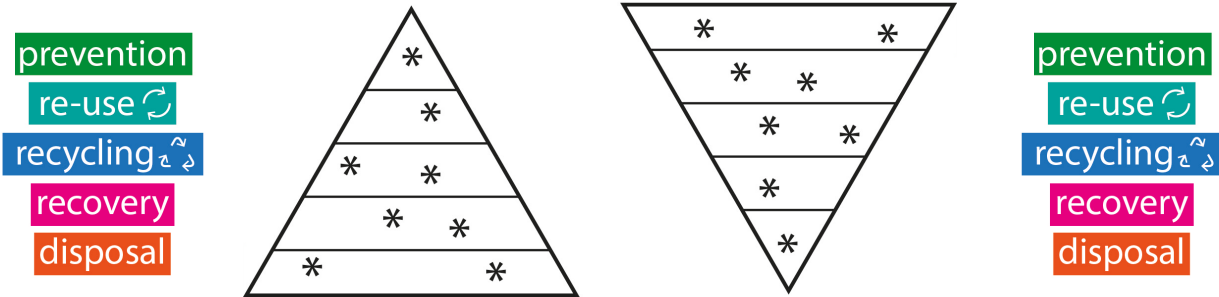
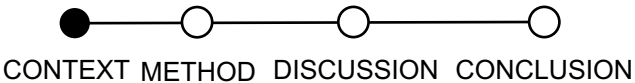
TIMELINE

waste related directives in Europe



WASTE HIERARCHY

from a linear to a circular economy



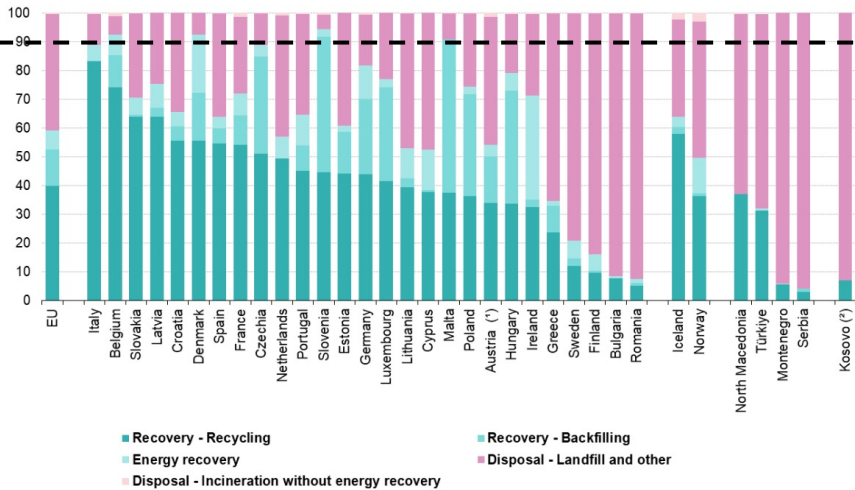
* Own graphics.

EUROPEAN GOALS

on landfilling (waste disposal)

10 %

Waste treatment by type of recovery and disposal, 2020
(% of total treatment)

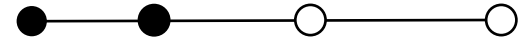


(*) Value of incineration for Austria estimated by Eurostat.
(*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence.
Source: Eurostat (online data code: env_wastrt)

Figure 6: Waste treatment by type of recovery and disposal, 2020
(% of total treatment)
Source: Eurostat ([env_wastrt](#))

RESEARCH TOPIC

From Wasteland to Landscape



CONTEXT METHOD DISCUSSION CONCLUSION



Can a landfill be transformed into a public space?

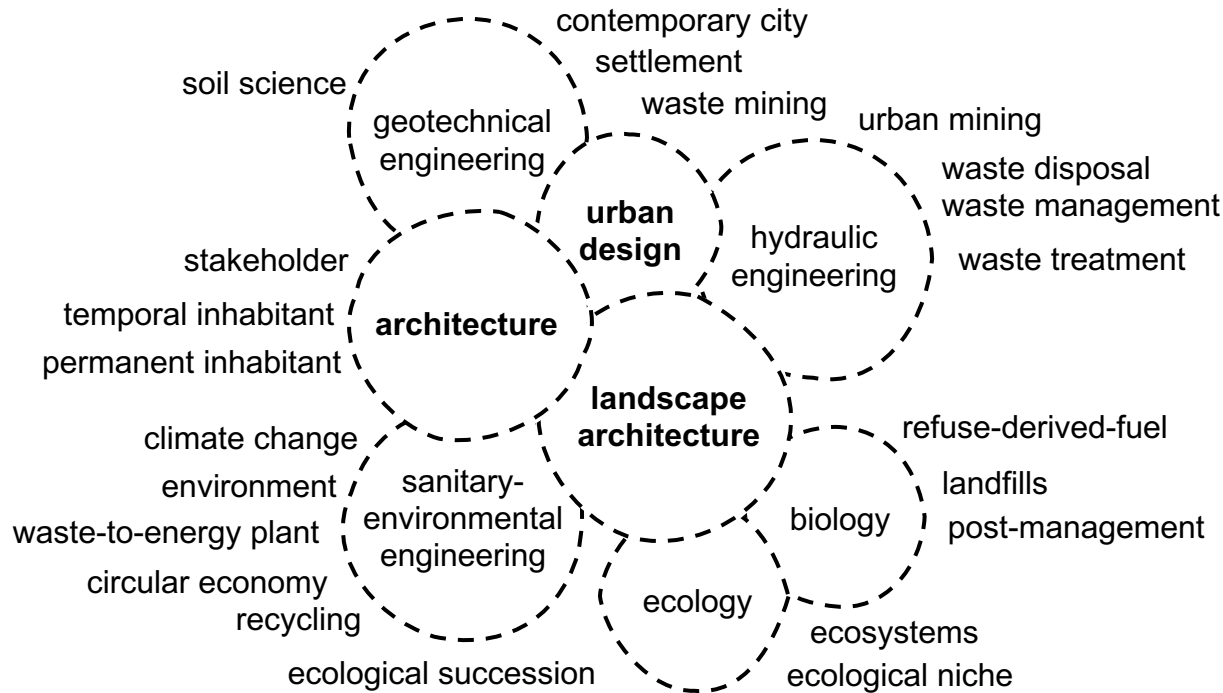
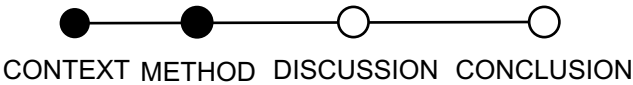
Can a landfill be “recycled” with a new life-cycle?

Can it carry a new function than disposal and “waste” digestion?



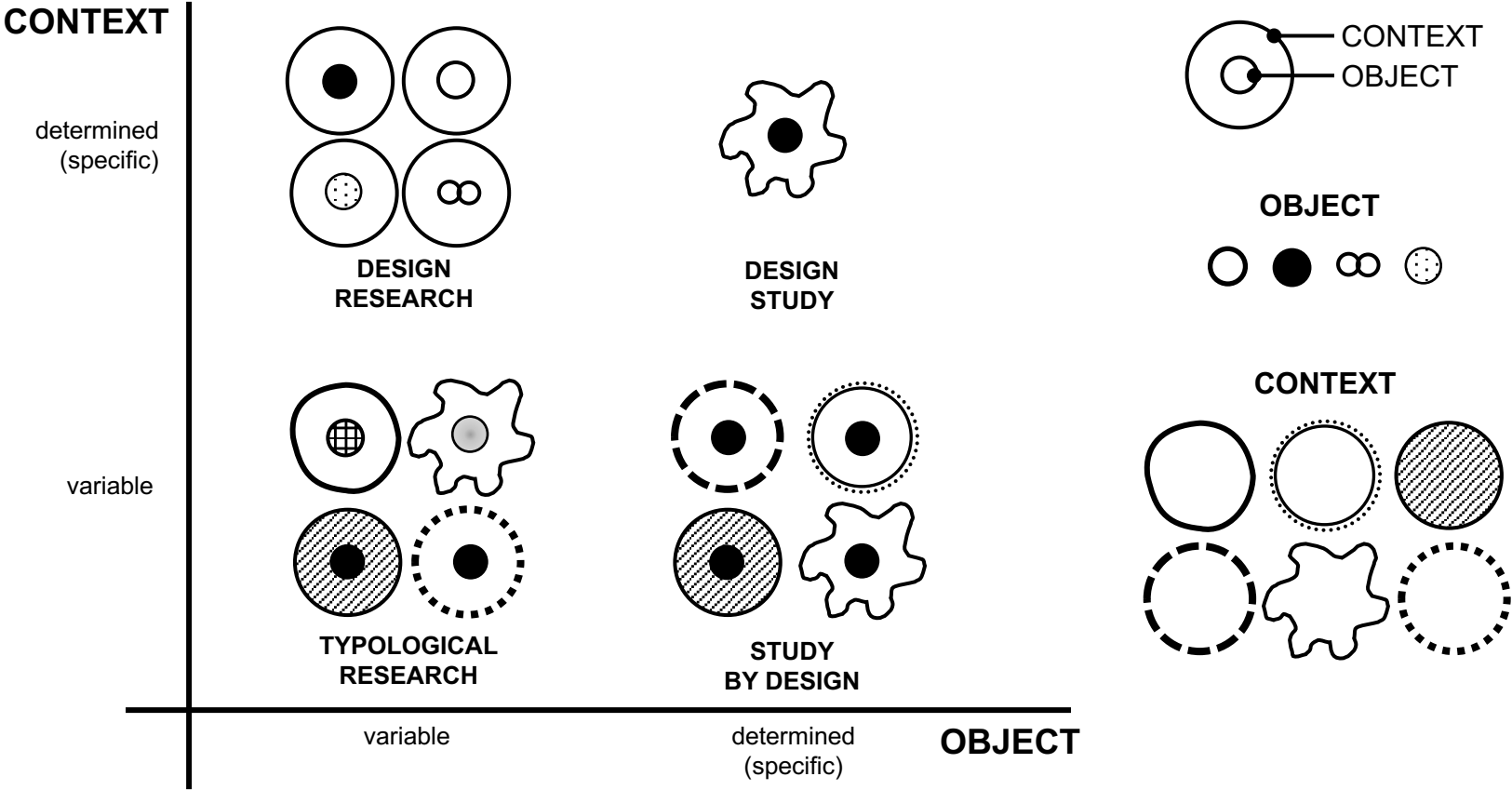
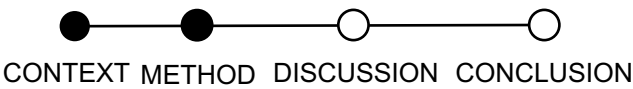
RESEARCH FIELDS

Design and Planning meets Science

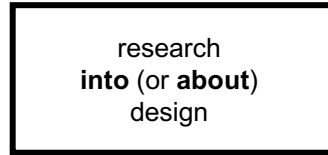
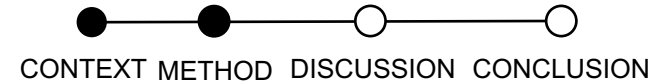


* Own diagrams.

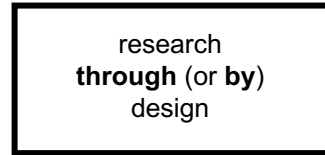
TYPES OF DESIGN-RELATED STUDY



TYPES OF DESIGN-RELATED STUDY

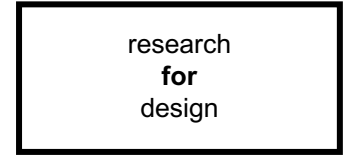


science **of**
design



design
science

- Material-based research
- Development work
- Action research



scientific
design

practical **experiments** in
laboratories (workshops) **+** step-by-step diaries
resulting in **reports**

||

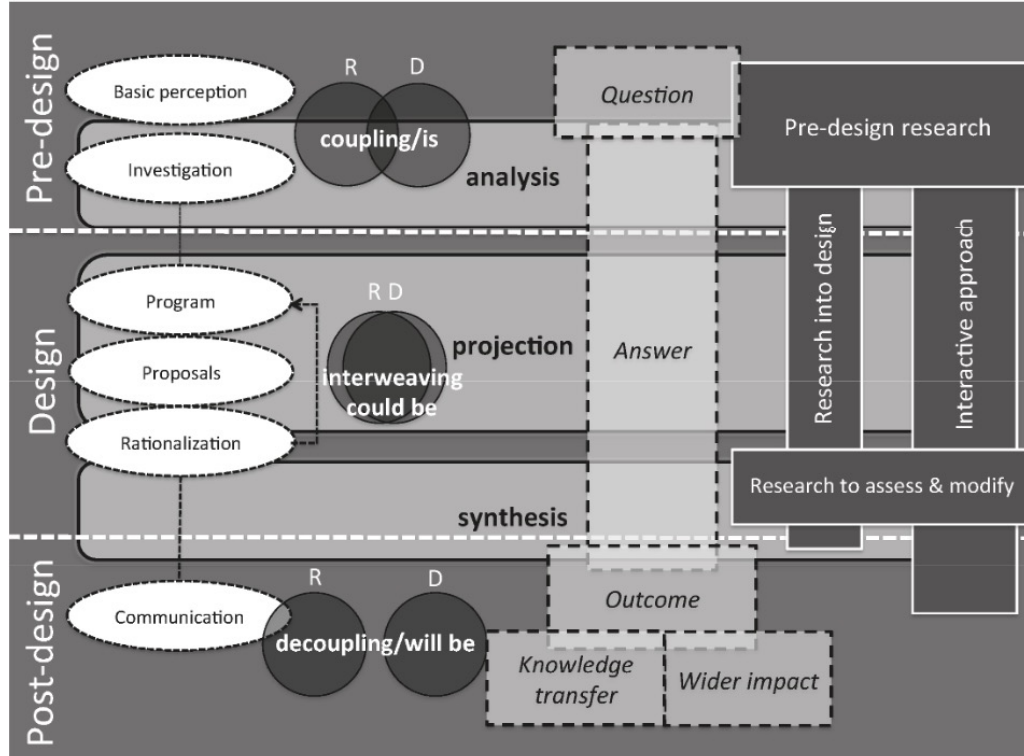
communicated through the
activity of design process

FOCUS:
making of an
artefact with the
intended goal of
societal change

RESEARCH BY DESIGN

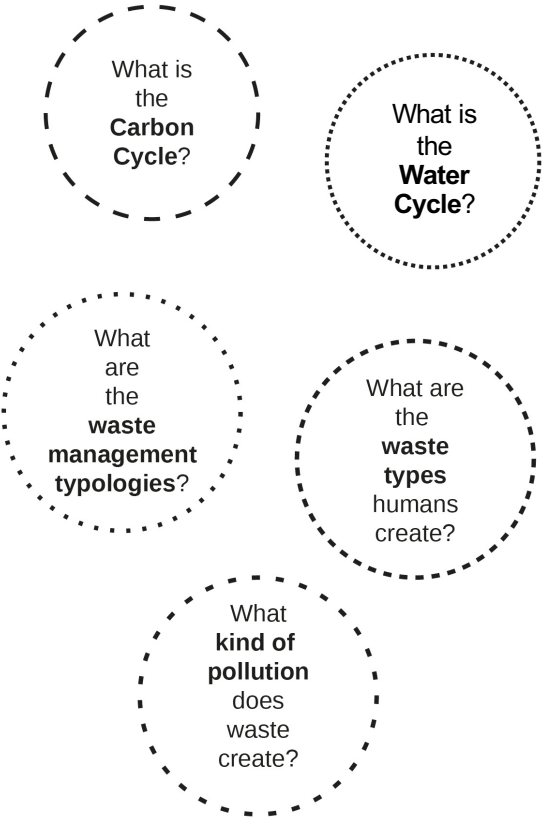
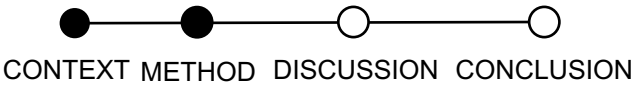
Phases of Research by Design & Conventional Design

CONTEXT METHOD DISCUSSION CONCLUSION

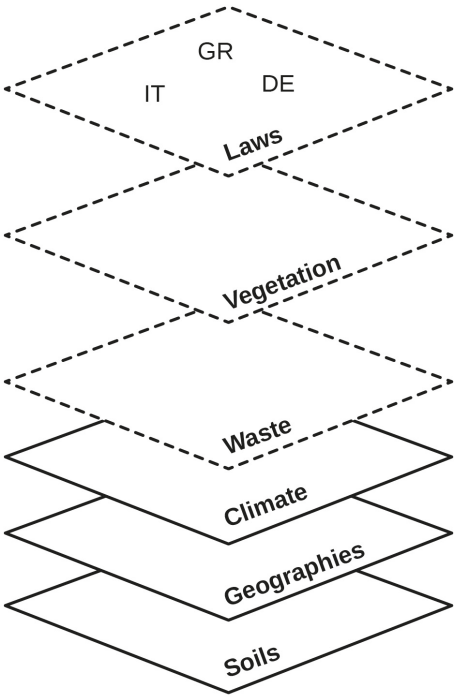


APPLYING RbD* APPROACH

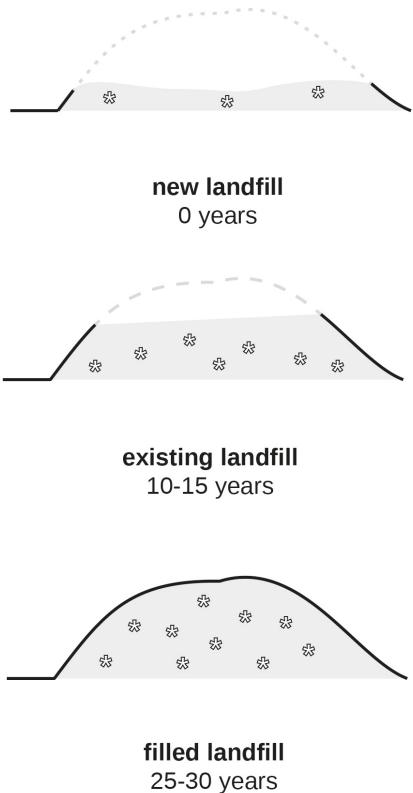
* Research by Design



explicative diagrams



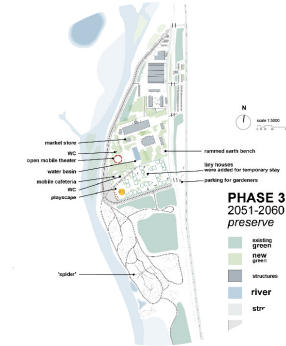
mapping



timeline in phases
& scenarios

* Own diagram.

plan in phases



Das Diagramm zeigt eine Draufsicht auf ein Gelände mit verschiedenen Flächen und Strukturen. Eine Legende unten rechts erklärt die Symbole:

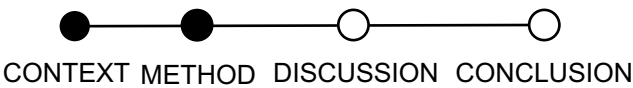
- 1 Projekt „Dach“**: Eine gestrichelte rote Linie, die eine große, unregelmäßige Fläche umschließt.
- 2 Erweiterung**: Eine gestrichelte grüne Linie, die eine kleinere Fläche innerhalb der roten Fläche umschließt.
- 3 Bauer**: Eine durchgezogene magenta Linie, die zwei rechteckige Strukturen umschließt.
















Die Flächen sind mit Zahlen in Kreisen markiert: 1 (oben links), 2 (unten links) und 3 (unten rechts). Die Flächen sind mit verschiedenen Symbolen gefüllt: grüne Kreise, grüne Quadrate und grüne Punkte.

Projekt 'The green entrance', TUM, WiSe 2021-22, by Diamantouli Elik

CREATION OF A TOOLBOX

through Research by Design Approach



TYPOLGY/ VARIABLE	typology 1	typology 2	typology 3	typology 4
 variable 1				
 variable 2				
 variable 3				
 variable 4				
 variable 5				

* Own diagram.

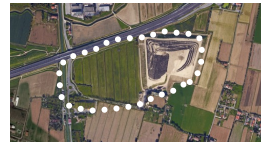
MAP OF VISITED LANDFILLS



Source: Google Maps

IDENTITY CARD

Layout



● ——— ● ——— ● ——— ○
CONTEXT METHOD DISCUSSION CONCLUSION

MORPHOLOGY

Size (hectares):

Disposal period:

Disposal quantity:

Height:

TECHNICAL INFORMATION

Type of waste:

☐ industrial

☐ urban solid

☐ inert materials

Type of landfill:

☐ non-sanitary ☐ sanitary

☐ sustainable

GENERAL INFORMATION

Name:

Location:

Management company:

Country: ☐ Italy ☐ Greece ☐ Germany ☐ other _____

Ownership: ☐ private ☐ public

State: ☐ on-going ☐ part on-going & part closure ☐ closure ☐ post-management

Function: ☐ grassland ☐ energy landscape ☐ park ☐ other _____

SPATIAL CHARACTERISTICS/ QUALITIES

Next to: ☐ city ☐ settlement ☐ nature

☐ river

☐ forest

☐ sea

☐ canyon

☐ flat

☐ relief

Boundary: ☐ fence ☐ dense ☐ plant-wall

EXAMPLE

Chania, Crete



CONTEXT METHOD DISCUSSION CONCLUSION

MORPHOLOGY

Size (hectares): 35 στρ. (A), 39 στρ. (B), 67 στρ. (C)
Disposal period: 2005-2020 (AB), 2020-today (C)
Disposal quantity: 1.000.000.000 tns waste, 200.000.000 tns of capping
Height: lowest point 85 m (sea level)
AB 113 m (above sea level)
AB + C 125 m (final estimated)

TECHNICAL INFORMATION

Type of waste: ☐ industrial ☒ urban solid
Type of landfill: ☐ non-sanitary ☒ sanitary ☒ sustainable

GENERAL INFORMATION

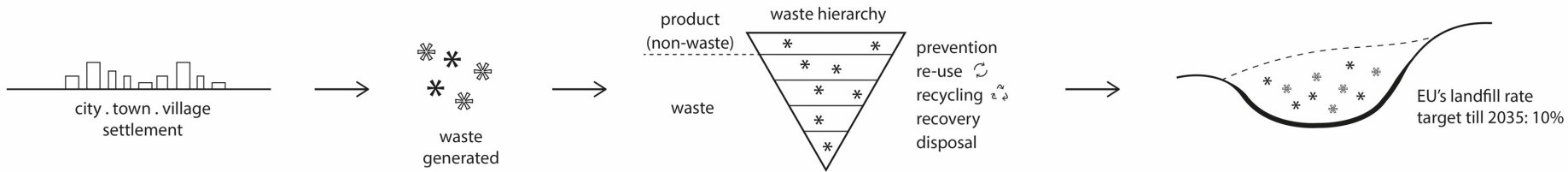
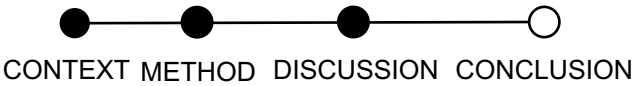
Name: CHYTY Chanion – XYTY Χανίων
Location: Chania, Crete – Χανιά, Κρήτη, νότια της χαράδρας του Κουρουπητού, τοποθεσία “Κορακιάς” Ακρωτηρίου
Management company: DEDISA Chanion - ΔΕΔΙΣΑ Χανίων (Διαδημοτική Επιχείρηση Διαχείρισης Στερεών Αποβλήτων)
Country: ☐ Italy ☒ Greece ☐ Germany ☐ other _____
Ownership: ☐ private ☒ public
State: ☐ on-going ☒ part on-going & part closure ☐ closure ☐ post-management
Function: ☒ grassland ☐ energy landscape ☐ park ☐ other

SPATIAL CHARACTERISTICS/ QUALITIES

Next to: ☐ city ☐ settlement ☒ nature
☐ river ☐ forest ☒ sea ☒ canyon
☐ flat ☒ relief
Boundary: ☒ fence ☐ dense ☒ plant-wall (southwest)

UNDERSTANDING LANDFILLS

through Research by Design



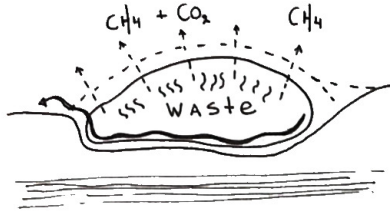
* Own diagram.

UNDERSTANDING LANDFILLS

through Research by Design

CONTEXT METHOD DISCUSSION CONCLUSION

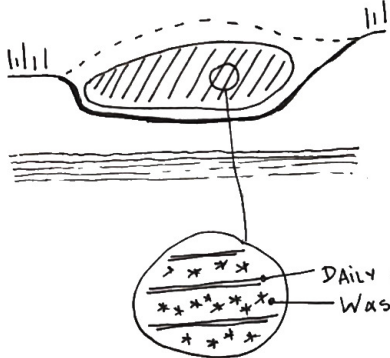
LANDFILL IN SHORT.
(IDEAL)
Sanitary or sustainable (if no organic waste)



← - - - - LANDFILL GAS* (methane + CARBON Dioxide.)
 ~~~~~ Leachate\*\* (+ collection system)

\* can / should be collected for energy production  
 \*\* should be collected + treated.

DIAGRAM OF SANITARY LANDFILL



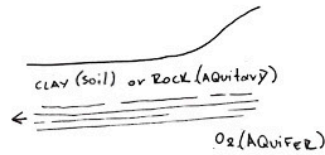
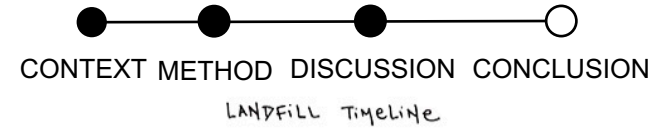
⊘ Waste (urban or industrial or inert materials)  
 --- cover . soil embankment . LANDFILL CAP.  
 ——— soil ground. LEVEL  
 |||| existing vegetation. in surrounding environment.  
 ——— LANDFILL BASIN. (existing CLAY HORIZON + BOTTOM LINER)  
 ===== AQUIFER (GROUNDWATER FLOW Stream)

\* Own diagram.

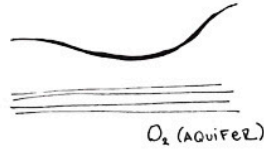


# UNDERSTANDING LANDFILLS

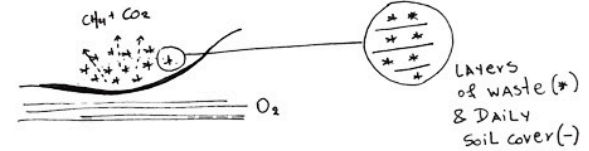
through Research by Design



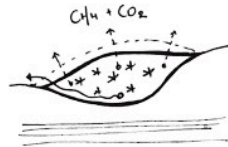
YEAR 1  
FIND a site



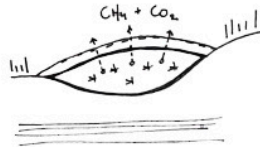
YEAR 2(5)  
PLANNING + DIGGING a BASIN  
Bottom LANDFILL Liner



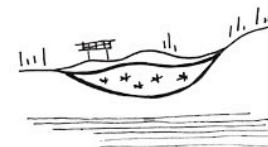
YEAR (2-25-40)  
Waste DISPOSAL + LEAKAGE treatment  
+ BIOGAS EXTRACTION.



YEAR (40\*)  
LANDFILL CAPPING. CLOSURE



YEAR 41-71 . 41-56  
Post-MANAGEMENT  
of SANITARY & SUSTAINABLE  
LANDFILL.



YEAR 72-57  
LANDFILL CONVERSION

# UNDERSTANDING LANDFILLS

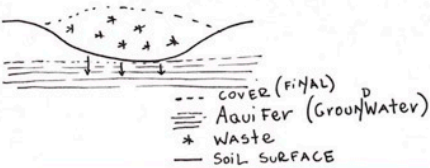
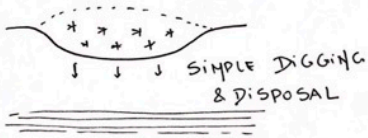
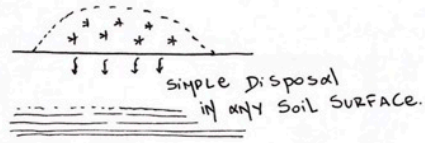
through Research by Design

CONTEXT METHOD DISCUSSION CONCLUSION

## EVOLUTION of LANDFILLING.

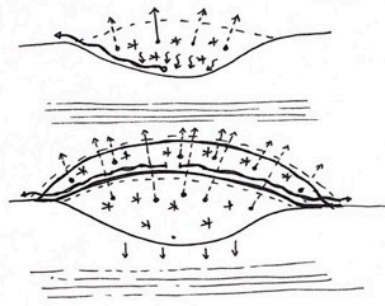
FIGURE 3a

### NON-SANITARY LANDFILLS



↓ Natural Attenuation

Restoration  
of a Non-Sanitary  
LANDFILL.

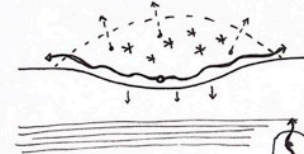
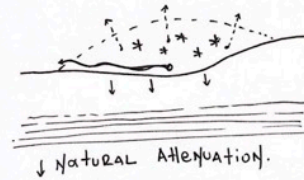


SANITARY LANDFILL  
RESTORED LANDFILL

VERTICAL  
LANDFILL  
GAS  
COLLECTION

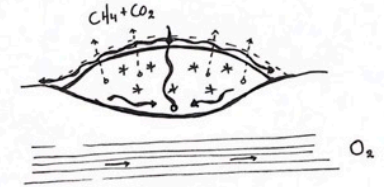
HORIZONTAL  
LANDFILL  
LEACHATE  
COLLECTION  
SYSTEM

### NON-SANITARY LANDFILL



Horizontal  
LEACHATE  
COLLECTION  
SYSTEM

### SANITARY LANDFILL \* FIGURE 3b



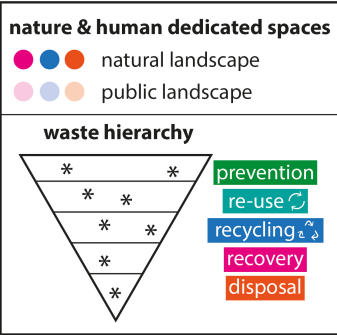
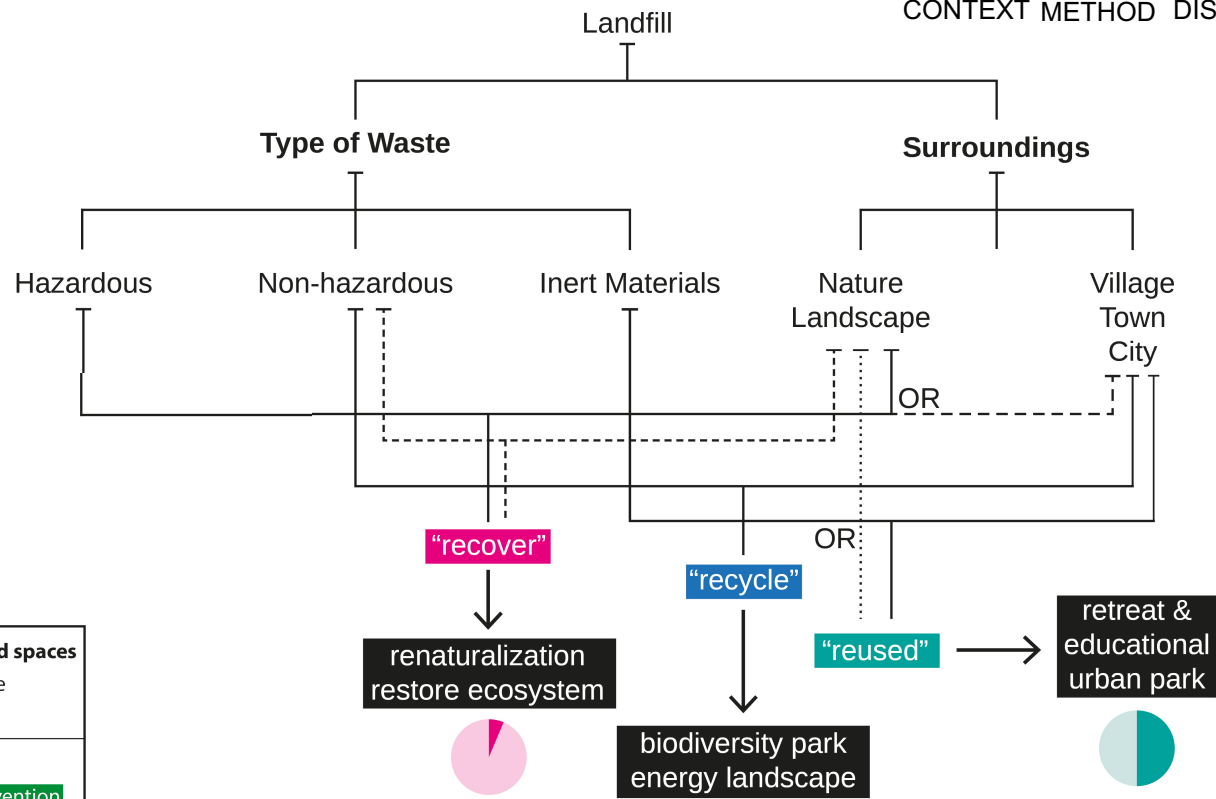
— LANDFILL BOTTOM LINER  
LANDFILL CAP.

### \* SUSTAINABLE LANDFILL

⇒ Biowaste (organic waste)  
is Not  
ENDING at the LANDFILL,  
BUT Composted.  
⇒ Very little leachate  
& BIOGAS.

# STRATEGIES OF LANDFILL CONVERSION

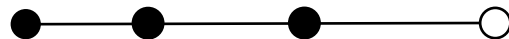
CONTEXT METHOD DISCUSSION CONCLUSION



\* Own diagram.

# CASE STUDIES IN ITALY

“recovered”, “recycled” and “reused” spaces



CONTEXT METHOD DISCUSSION CONCLUSION

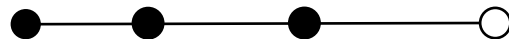


\* Landfills of Veritas S. p. A. in different stages at the indicated locations of the Metropolitan Area of Venice, September & November 2022 (own images).



# CASE STUDIES IN ITALY

“recovered”, “recycled” and “reused” spaces



CONTEXT METHOD DISCUSSION CONCLUSION



\* Landfills of FODSA Larissa and Central Macedonia in different stages at the indicated locations, February 2023 (own images).



# MAP OF VISITED LANDFILLS

conversion strategies of each landfill

## CONVERSION STRATEGY/ CASE STUDIES

**Moranzani** (*potential*)

**Chioggia** (*partially in post-gestion*)

**Jesolo** (*active*)

**Mirano** (*post-gestion completed*)

**Noale** (*post-gestion completed*)

**San Donà di Piave** (*post-gestion*)

**San Giuliano** (*closed*)

**Makrychori - Larissa** (*active*)

**Kioski - Larissa** (*closed landfill - non-sanitary*)

**Mavrorachi, Thessaloniki** (*active*)

**Tagarades, Thessaloniki** (*post-gestion*)

**Derveni** (*closed landfill - non-sanitary*)

**Thermi** (*closed landfill - non sanitary*)

**Katerini** (*post-gestion*)

"recover"



renaturalization  
restore ecosystem



"recycle"



biodiversity park  
energy landscape



"reused"



retreat &  
educational  
urban park



## LEGEND

- potential landfills
- active landfills
- partially in post-gestion landfill in post-gestion
- closed landfill
- possibly better conversion strategy

# INDUSTRIAL LANDSCAPE

examples of afterlife



## Geile Bierg\*

Differdange, LU

restoration of a iron mining area  
since 1977

“recover”



## Ökologische Vorrangfläche\*

Baumkirchen Mitte  
Munich, DE

a new typology of park  
dedicated to biodiversity  
completed in 2018

“recycle”



## Open Museum of Mining Art

Dionissos, Penteli  
Munich, DE

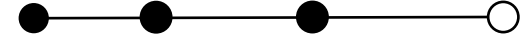
a “reused” quarry designed by Aspasia  
Kouzoupi, Nella Golanta  
in 1994

“reused”

\* Visit field exercise in the course *Urban Biodiversity* (TUM) in July 2022 and visit in Luxembourg in March 2021 (own images).

# "REUSED" LANDSCAPES

examples of public parks



CONTEXT METHOD DISCUSSION CONCLUSION



**Moerenuma Park**  
Sapporo, JP

a municipal park designed by Isamu Noguchi  
construction began in 1988; opened in 2005



**Garraf Controlled Waste Landfill**  
Barcelona, ES

landscape restoration of the designed  
by Batlle I Roig in 2011



**Play Landscape be-MINE**  
Beringen, BE

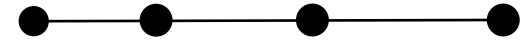
a park designed by Carve + OMGEVING  
In 2016

"reused"



# WASTELANDS TO WASTESCAPES

A toolbox of synergic functions



CONTEXT METHOD DISCUSSION CONCLUSION



**BOUNDARIES  
SHAPES & SPACES**

**ENERGY LANDSCAPE  
BIO-MANAGEMENT**

**BIOTIC & ABIOTIC  
BIODIVERSITY**

# LANDSCAPE

typomorphies



**τοπίο**  
landscape

**ανθρωπογενές**  
anthropogenic

**φυσικό . αυθόρμητο . γηγενές | αυτοφυές**  
natural . spontaneous . native

**καλλιεργήμενο**  
cultivated

**βιομηχανικό**  
industrial

**δάσος**  
forest

**λιβάδι**  
grassland

**δενδροκαλλιέργεια**  
arboriculture

**φρύγανα**  
grassland

**λιβάδι**  
grassland

**ενεργειακό**  
energetic

**εξόρυξη**  
mining

**καλλιέργεια από θάμνους**  
shrub cultivation

**προσθήκη**  
addition

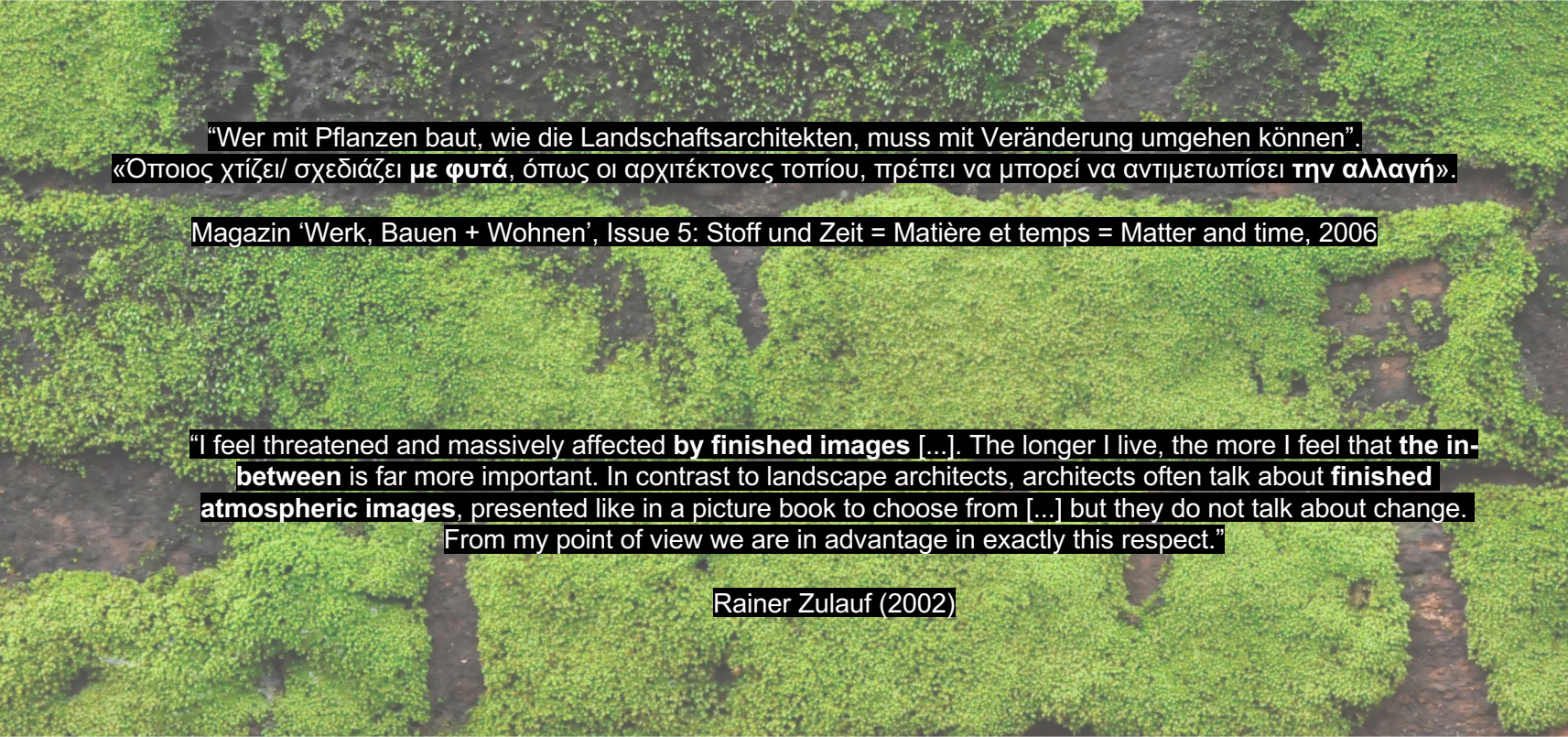
**αφαίρεση**  
subtraction

\* Own diagram.



# LANDSCAPE ARCHITECTURE THEORIES

open & unfinished, atmosphere, ruins



“Wer mit Pflanzen baut, wie die Landschaftsarchitekten, muss mit Veränderung umgehen können”.  
«Όποιος χτίζει/ σχεδιάζει **με φυτά**, όπως οι αρχιτέκτονες τοπίου, πρέπει να μπορεί να αντιμετωπίσει **την αλλαγή**».

Magazin ‘Werk, Bauen + Wohnen’, Issue 5: Stoff und Zeit = Matière et temps = Matter and time, 2006

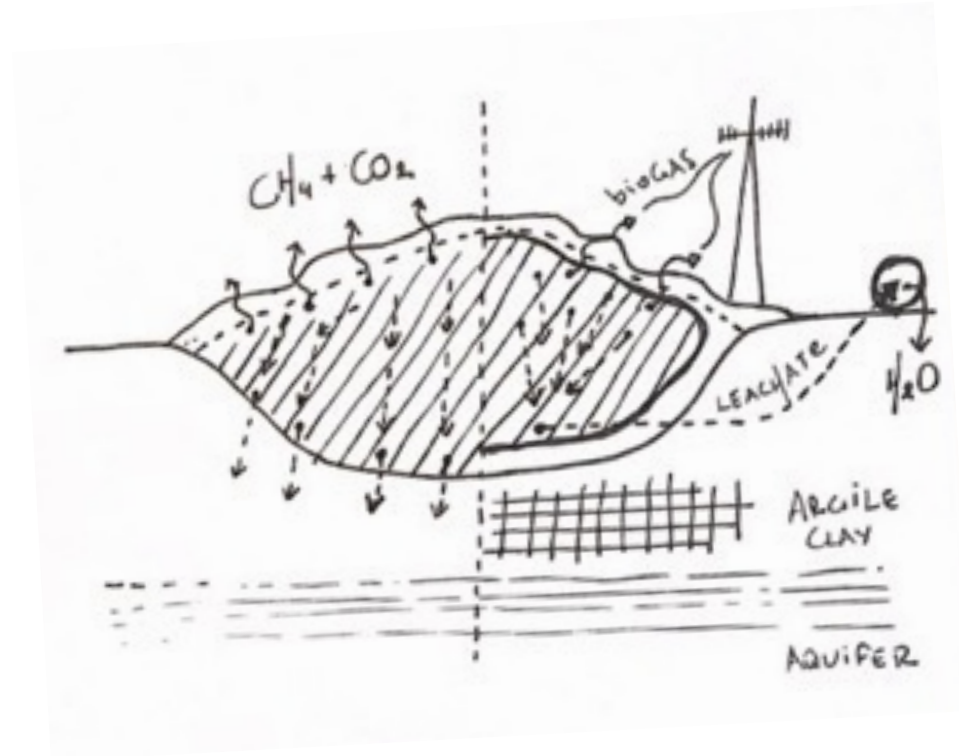
“I feel threatened and massively affected **by finished images** [...]. The longer I live, the more I feel that **the in-between** is far more important. In contrast to landscape architects, architects often talk about **finished atmospheric images**, presented like in a picture book to choose from [...] but they do not talk about change. From my point of view we are in advantage in exactly this respect.”

Rainer Zulauf (2002)

# LANDFILL AS A MOVEABLE GROUND

a digester of leachate and producer of biogas

● — ● — ● — ●  
CONTEXT METHOD DISCUSSION CONCLUSION



\* Own diagram.



**Thank you very much for your attention!**

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**Prof. Luigi Stendardo**



UNIONE EUROPEA  
Fondo Sociale Europeo



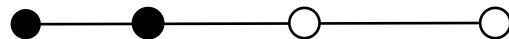
UNIVERSITÀ DEGLI STUDI DI NAPOLI  
FEDERICO II



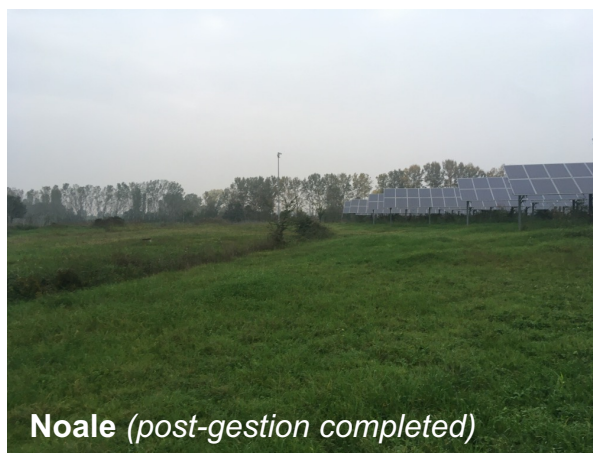


# FIELD TRIPS

Veneto, Italy



CONTEXT METHOD DISCUSSION CONCLUSION

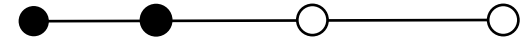


\* Landfills of Veritas S.p. A. in different stages at the indicated locations of the Metropolitan Area of Venice, September & November 2022 (own images).



# FIELD TRIPS

Thessaly & Macedonia, Greece



CONTEXT METHOD DISCUSSION CONCLUSION



**Makrychori - Larissa** (*active*)



**Mavrorachi, Thessaloniki** (*active*)



**Tagarades, Thessaloniki** (*post-gestion*)



**Derveni** (*non sanitary landfill*)



**Thermi** (*non sanitary landfill*)



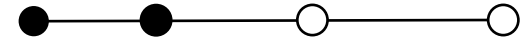
**Katerini** (*post-gestion*)

\* Landfills of FODSA Larissa and Central Macedonia in different stages at the indicated locations, February 2023 (own images).



# FIELD TRIPS

Thessaly & Macedonia, Greece



CONTEXT METHOD DISCUSSION CONCLUSION



\* Landfill of FODSA Larissa, waste water treatment of Thessaloniki, February 2023 (own images).