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Green walls for greywater treatment: contributions to the circular economy

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Lisbon, Portugal

World Green Infrastructure Congress 2023

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- Urban challenges
- Reshaping green walls
- Contributions to circular economy

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CITIES OF THE FUTURE

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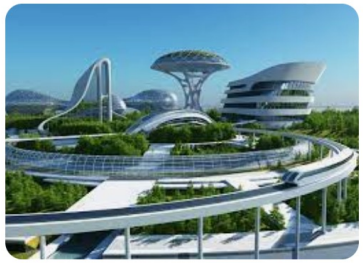

New Jersey Digest
Sustainable Cities of the Future ...

Plug and Play Tech Center
Cities Are Becoming Smart Cities ...

TKE blog - TK Elevator
Cities of the future: what will urban ...

Eco Tech Daily
Welcome to the City of the F...

Smart Cities World
Dreaming of the future cities - Smart ...

Arch2O
5 Visions Of The Future Cities - Arch2O.com

Zipcar
9 Breathtaking City Concepts Tha...

Google search, 26 June 2023

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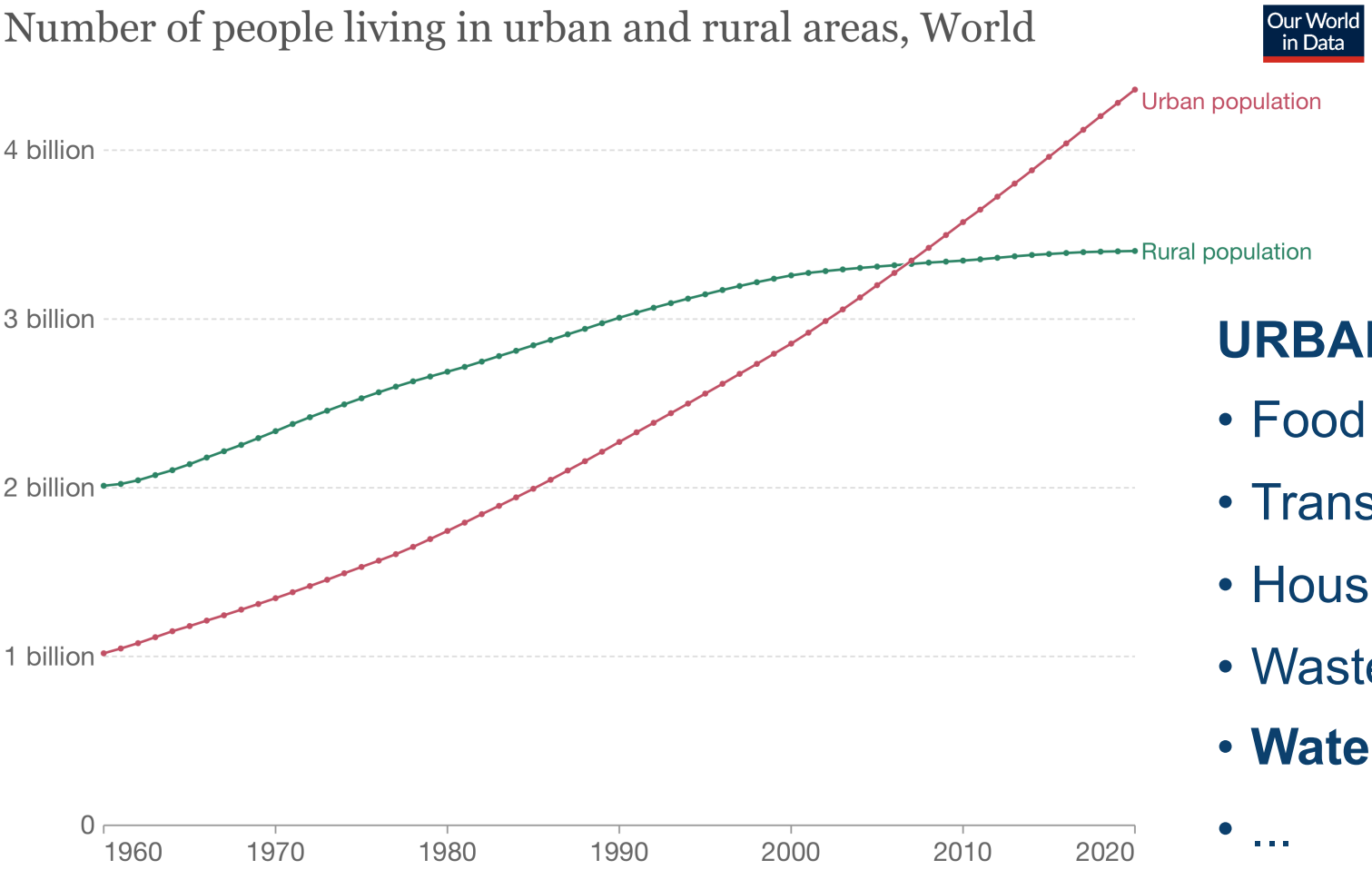

URBAN CHALLENGES:

- Food
- Transportation
- Housing
- Waste
- **Water**
- …

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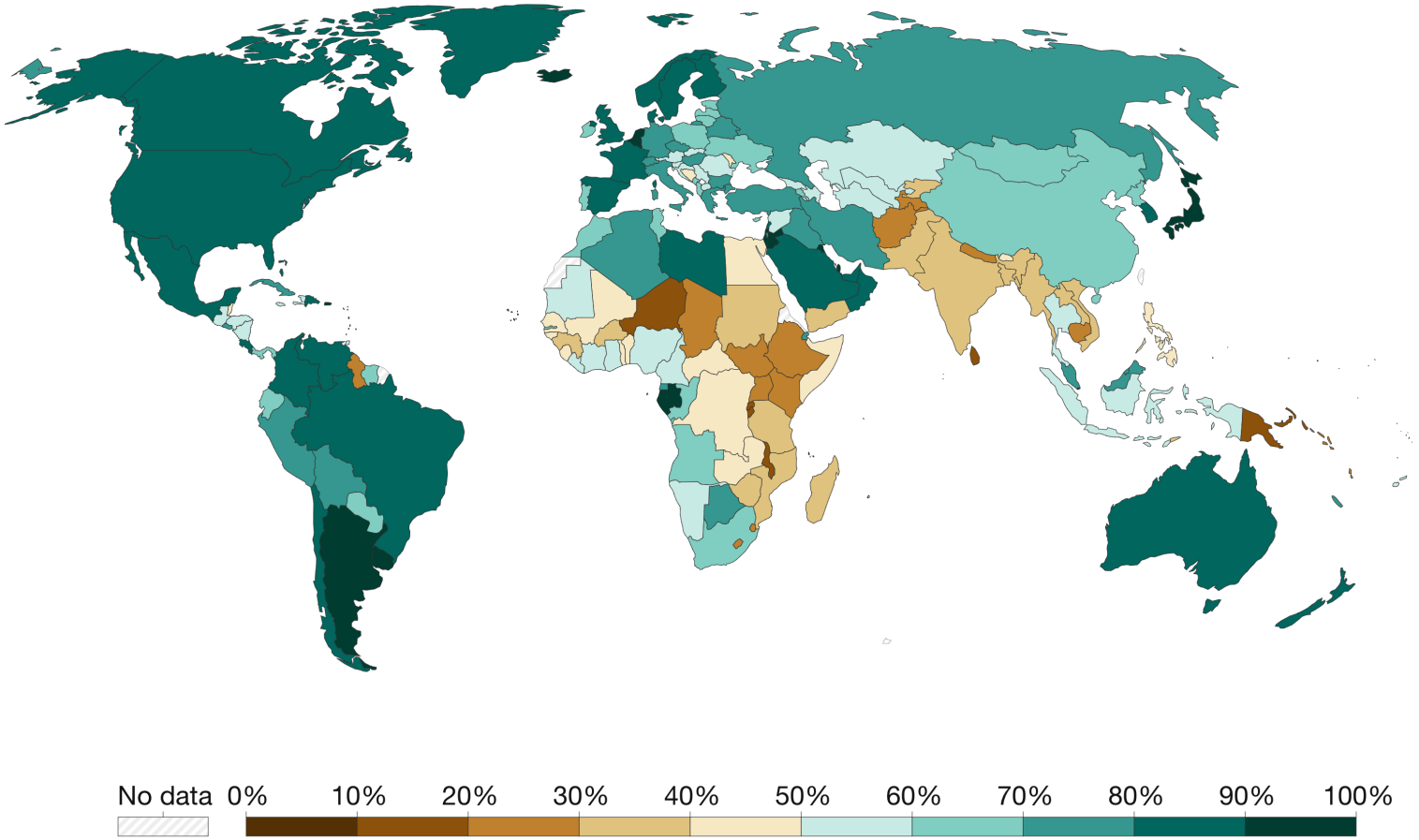
Share of people living in urban areas, 2020

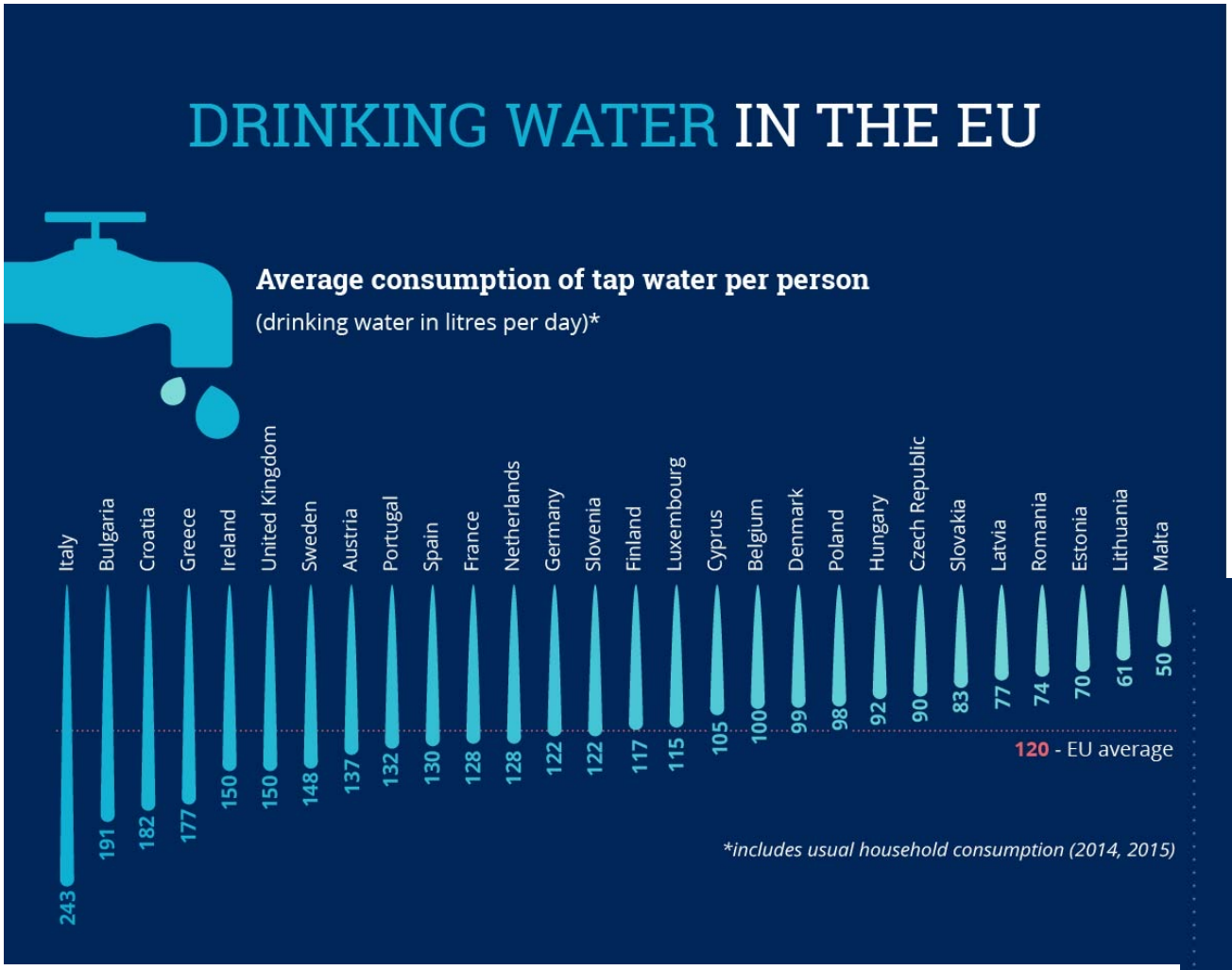
Our World in Data



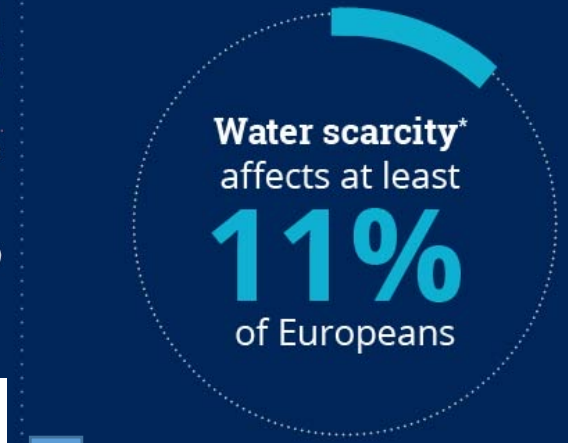
Source: UN Population Division (via World Bank)
OurWorldInData.org/urbanization • CC BY
Note: Urban populations are defined based on the definition of urban areas by national statistical offices.

UN 2018 Revision of World Urbanization Prospects:

- 68% of the world population projected to live in urban areas by 2050



https://www.europarl.europa.eu/resources/library/images/20181015PHT16033/20181015PHT16033_original.jpg



How will this be affected by Climate Change?

Water scarcity affected 29% of the EU territory during at least one season in 2019

https://www.eea.europa.eu/ims/use-of-freshwater-resources-in-europe-1

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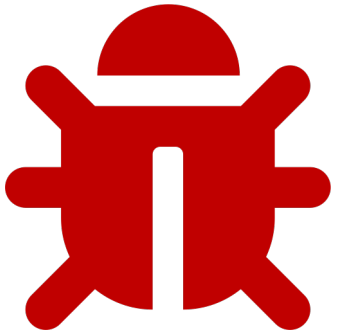
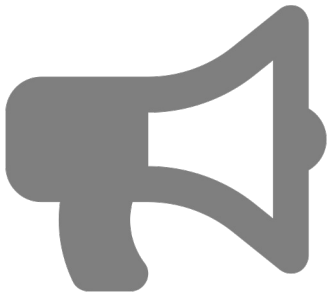
BENEFITS OF GREEN SYSTEMS





ALTERNATIVES?

https://aguasdotejoatlantico.adp.pt/sites/aguasdotejoatlantico.adp.pt/files/paginas_base/Caminho_18/4-alexandra_henriques_projetos_art_cml_26_09_2018.pdf

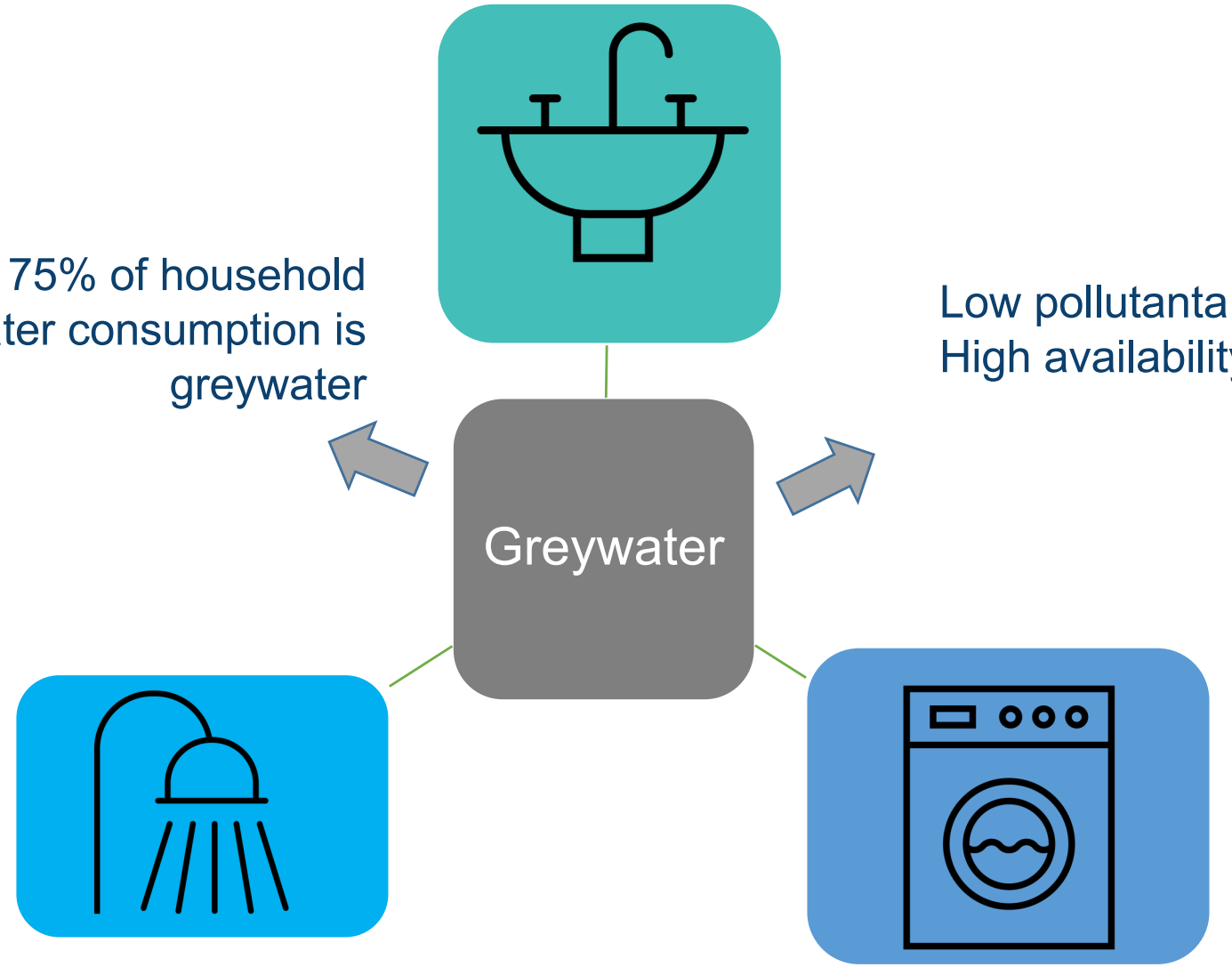
Parque Tejo

https://www.aguasdotejoatlantico.adp.pt/galeria/infraestruturas

GREYWATER: A DECENTRALIZED SOURCE

Up to 75% of household water consumption is greywater

Low pollutanta load
High availability



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RESHAPING GREEN WALLS

Insert this…

Constructed wetland

into this!


Module A
Module B
L1
L2
L3
L4
L5
L6


RESERVATÓRIO
DE SAÍDA
5
Efluente 5

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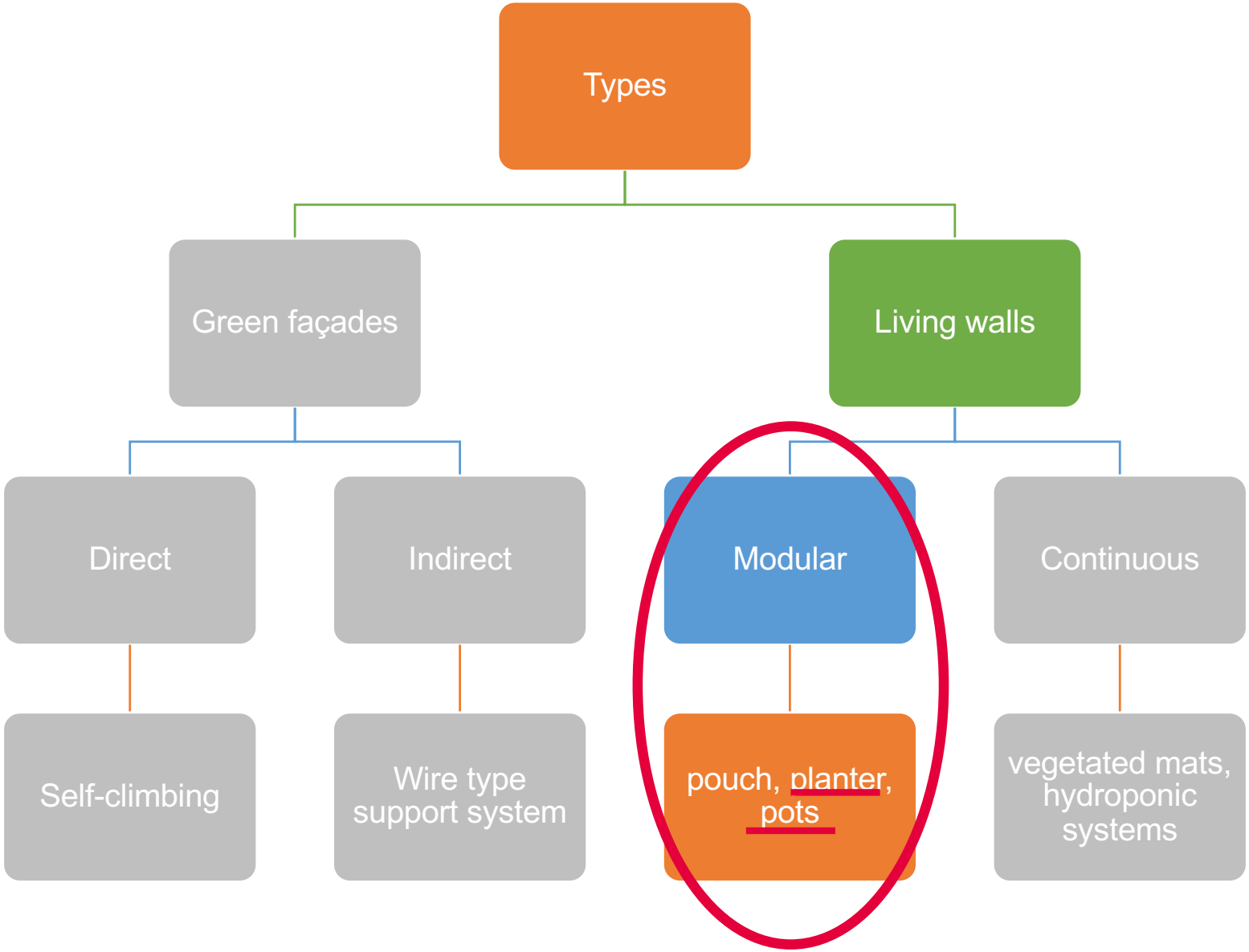
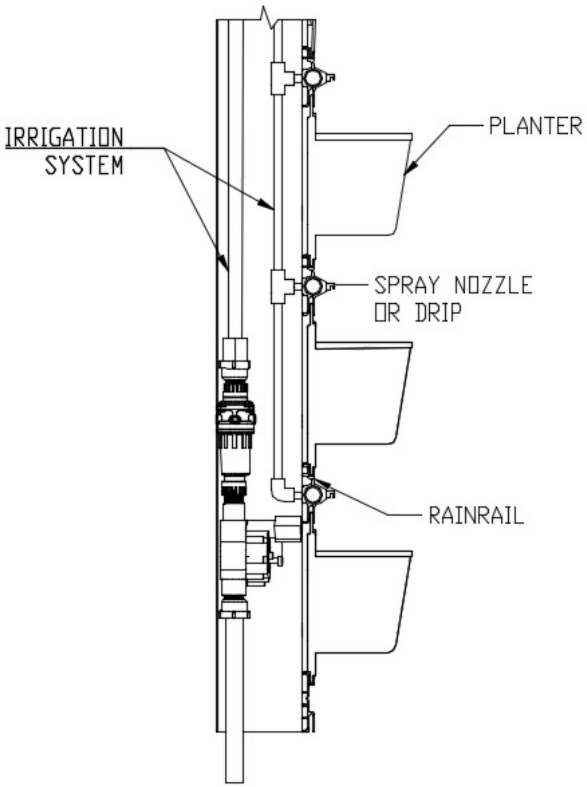
WHAT TYPES OF GREEN WALLS CAN BE USED?



Modular Living Walls

Individual pots



Livewall.com

Smith Group JJR Reception Area

Livewall.com

Modular Living Walls

Interconnected pots

Minigarden.net

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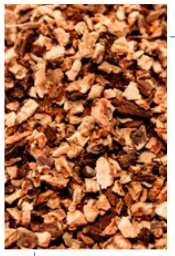
Filling media

Perlite

Coco coir

Expanded clay

Vermiculite



Granulated cork

construction materials

Ecological Engineering 102 (2017) 625–635

Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

Green walls for greywater reuse: Understanding the role of media on pollutant removal

Veljko Prodanovic [a,*], Belinda Hatt [b], David McCarthy [a], Kefeng Zhang [b], Ana Deletic [a]

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Cities, Monash University, 3800
[b] Department of Civil Engineeri

Journal of Environmental Management 300 (2021) 113646

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Evaluation of the influence of filter medium composition on treatment performances in an open-air green wall fed with greywater

Fulvio Boano [a,b,*], Elisa Costamagna [a], Alice Caruso [a], Silvia Fiore [a,b], Marco Chiappero [a], Ana Galvão [c], Joana Pisoeiro [c], Anacleto Rizzo [d], Fabio Masi [d]

[a] DIATI (Department of Environment, Land and Infrastructure Engineering), Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy
[b] CleanWaterCenter@PoliTo, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy
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[d] IRIDRA Srl, Via La Marmora 51, 50121, Fl

Science of the Total Environment 842 (2022) 156748

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Green walls with recycled filling media to treat greywater

Ana Galvão [a,*], David Martins [b], Andreia Rodrigues [b], Maria Manso [a], Joana Ferreira [b], Cristina Matos Silva [a]

[a] CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
[b] Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

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Plant species

- Tall sedge (*Carex appressa*)
- Queen fern (*Nephrolepsis obliterate*)
- Tasman Flax Lily (*Dianella tasmanica*)
- Agapanthus (*Agapanthus praecox*)
- Giant Lily turf (*Liriope muscari*)
- New Zealand Flax (*Phomium tenax*)
- Creeping myoporum (*Myoporum parvifolium*)

Irish spleenwort (*Asplenium onopteris)*

Maidenhair fern
(*Adiantum capillus-veneri)*

Plant role

Preferential paths

Aerial roots

Root network entrapping granulated cork filling media

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Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Performance of a green wall (Total Value Wall™) at high greywater loading rates and Life Cycle Impact Assessment

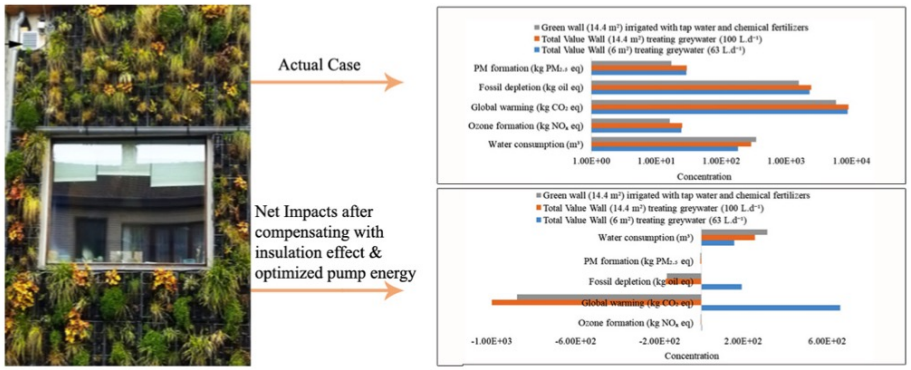
Fida Hussain Lakho [a,*], Asif Qureshi [b], Laura De Donno Novelli [a], Veerle Depuydt [c], Teun Depreeuw [d], Stijn W.H. Van Hulle [a], Diederik P.L. Rousseau [a]

[a] Laboratory for Industrial Water and Ecotechnology (LIWET), Department of Green Chemistry and Technology, Ghent University Campus Kortrijk, Sint-Martens Latemlaan 2B, B-8500 Kortrijk, Belgium
[b] Université du Québec en Abitibi-Téniscamingue (UQAT), 445 Boulevard de l'Université, Rouyn-Noranda, QC J9X 5E4, Canada
[c] Flanders Knowledge Center Water (Vlakwa), Leiestraat 22, B-8500 Kortrijk, Belgium
[d] Muurtuin, Vandenpeereboomstraat 16, 2140 Borgerhout, Belgium

HIGHLIGHTS

- Total Value Wall (TVW) was subjected to higher hydraulic and pollutant loads.
- Higher hydraulic loads caused excessive leakage.
- Higher pollutant loads still resulted in 82% COD, 95% BOD_5 and 90% TSS reduction.
- Life cycle assessment (LCA) was performed for different variants of the TVW.
- LCA showed that grey water irrigation of the TVW is a sustainable technology.

GRAPHICAL ABSTRACT



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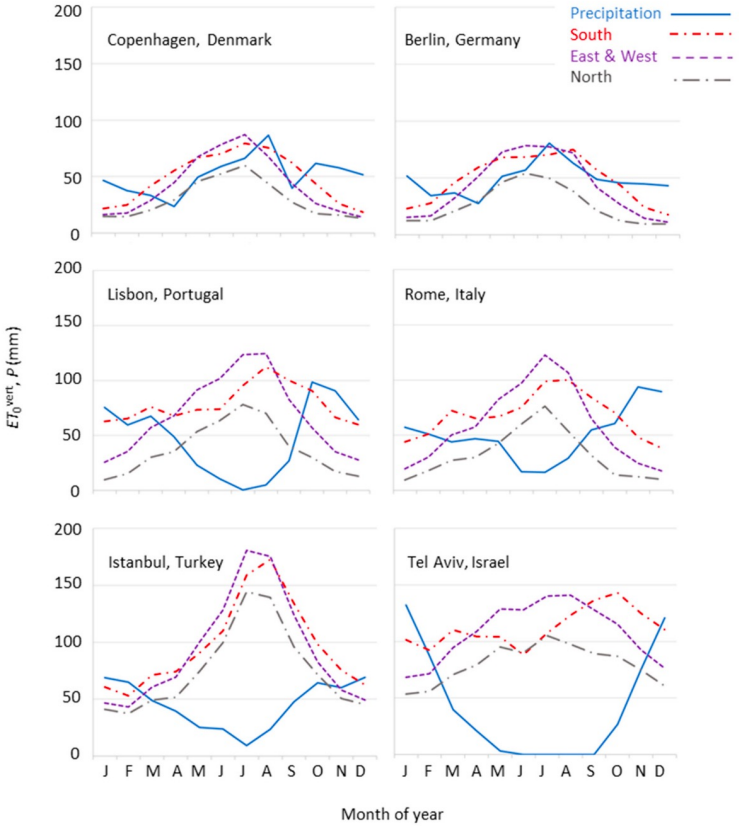
water

MDPI

Article

Closing Water Cycles in the Built Environment through Nature-Based Solutions: The Contribution of Vertical Greening Systems and Green Roofs

David Pearlmutter [1,†], Bernhard Pucher [2,†], Cristina S. C. Calheiros [3,*], Karin A. Hoffmann [4], Andreas Aicher [5], Pedro Pinho [6], Alessandro Stracqualursi [7], Alisa Korolova [8], Alma Pobric [9], Ana Galvão [10], Ayça Tokuç [11], Bilge Bas [12], Dimitra Theochari [13], Dragan Milosevic [14], Emanuela Giancola [15], Gaetano Bertino [16], Joana A. C. Castellar [17,18], Julia Flaszynska [19], Makbulenur Onur [20], Mari Carmen Garcia Mateo [21], Maria Beatrice Andreucci [7], Maria Milousi [22], Mariana Fonseca [23], Sara Di Lonardo [24], Veronika Gezik [25], Ulrike Pitha [26] and Thomas Nehls [4]



e_{GW}

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Istanbul	0.2	0.2	0.3	0.3	0.4	0.6	0.8	0.7	0.6	0.4	0.3	0.2
Berlin	0.4	0.4	0.7	1.1	1.4	1.6	1.5	1.4	0.9	0.6	0.3	0.3
Copenhagen	0.8	1.0	1.5	2.2	3.0	3.4	3.8	3.1	2.2	1.4	1.0	0.7
Lisbon	1.0	1.4	1.9	2.1	2.6	3.0	3.6	3.6	2.6	2.0	1.3	1.1
Rome	0.9	1.4	2.0	2.2	2.7	3.4	4.2	3.6	2.5	1.6	1.1	0.8
Tel Aviv	2.1	2.3	2.7	3.0	3.3	3.2	3.6	3.6	3.6	3.3	2.8	2.3

efficiency number describing how much greywater water can be evapotranspirated by VGS,

Figure 5. Long-time average standard evapotranspiration for vertical greening systems (VGS), ET_0^{vert} (L/m^2 = mm) for the different expositions in the different cities together with precipitation P (mm) (Meteonorm, 2021; for the years 2005–2019).

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Thank you!

Ana Galvão

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