Towards a sustainable society by adequate measures to reduce impact of NORM

EFRAT User meeting, JRC, Geel, December 4-7 (2017)

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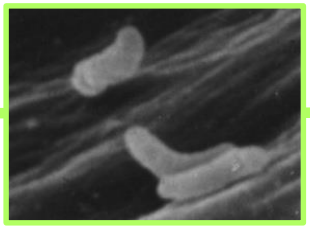
European Commission

Outline

- **Introduction**
- Methodology: a database to screen the potential impact of NORM
- Results & discussion
  - By-products
  - Building materials
- Conclusion

Centre of Environmental Sciences: Research Themes

1. Effect of environmental stressors on organisms




2. Sustainable and Clean Technologies





3. Biodiversity, Ecosystem Services and Climate Change




NuTeC Nucleair Technologisch Centrum
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Introduction

- During the 20th Century
  - ➔ **fossil fuel use** of the world increased **12 times**
  - ➔ **34 times** more **raw materials** were extracted

- An average European consumes 16 tons of materials per year (2011)

- Era of cheap and abundant resources is ending.
  - Europe, as a resource poor continent is particularly vulnerable

- To holistically tackle its raw materials challenge, the EC has proposed action on the level of:
  1. ***Trade and investment policy***
  2. Increased use of ***secondary raw materials***
  3. Increased ***sustainable mining*** within the EU.

[1] COM(2011) 571 (*Roadmap to a Resource Efficient Europe*)
[2] COM(2011) 25 (*Communication on Commodity Markets and Raw Materials)*
[3] COM(2011) 25 *(Communication on Commodity Markets and Raw Materials)*

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The NORM4Building Network

- Exchange of multidisciplinary knowledge and experiences (radiological, technical, economical, legislative, ecological, …)

Stimulate the **reuse of by-products in new tailor-made sustainable building materials**	While **assuring (radiation) protection of the population / environment**

Use of by-product in Alkali Activated Materials (AAMs)

Industrial by-products
Solid aluminosilicate source

Red Mud
Fly ash
Slags
Phosphogypsum
Siliciumdioxide waste

From NORM processing industries

+

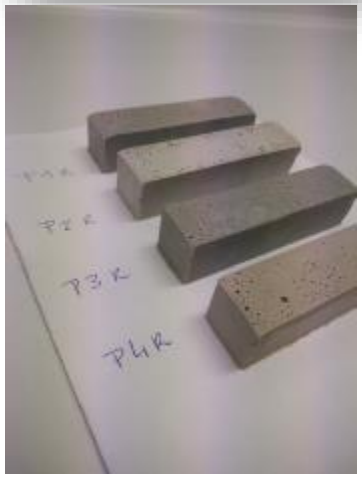
Alkali silicate/hydroxide
Activation solution

NaOH
KOH
Na_2SiO_3/NaOH
…

T, t

Curing

Inorganic (Aluminosilicate) polymer



Production
@MTM
KULeuven

Ongoing PhD research

By-products (NORM)

Alkali activation

Use in publicly accessible environment

Use in nuclear safety applications

- gamma dose evaluation

Tom.Croymans

- Radon exhalation
- Leaching

Katrijn.Gijbels

- Leaching

Niels Vandevenne

- Durability prediction in gamma radiation field

Bram Mast

European Commission

KU LEUVEN UHASSELT KNOWLEDGE IN ACTION

Collaboration NORM4Building - JRC

- METRONORM – NORM4Building
  - Strong collaboration & exchange of information
  - Joint meeting: Vienna, 11/06/2015
  - On the final meeting of MetroNORM (Brussels, 21-22 June 2016)

- Eufrat projects directly linked to collaboration with NORM4Building:
  - Eufrat project [Gamma-ray spectrometry analysis of NORM residues that are candidates for inclusion in construction materials] (2015)
  - Eufrat project [Development and testing of inorganic polymers for construction materials using NORM-residue (slag) from novel source in Belgium] (2016)
  - Eufrat project [Radiological characterisation of geopolymers produced using NORM residue.] (2016- 2018)

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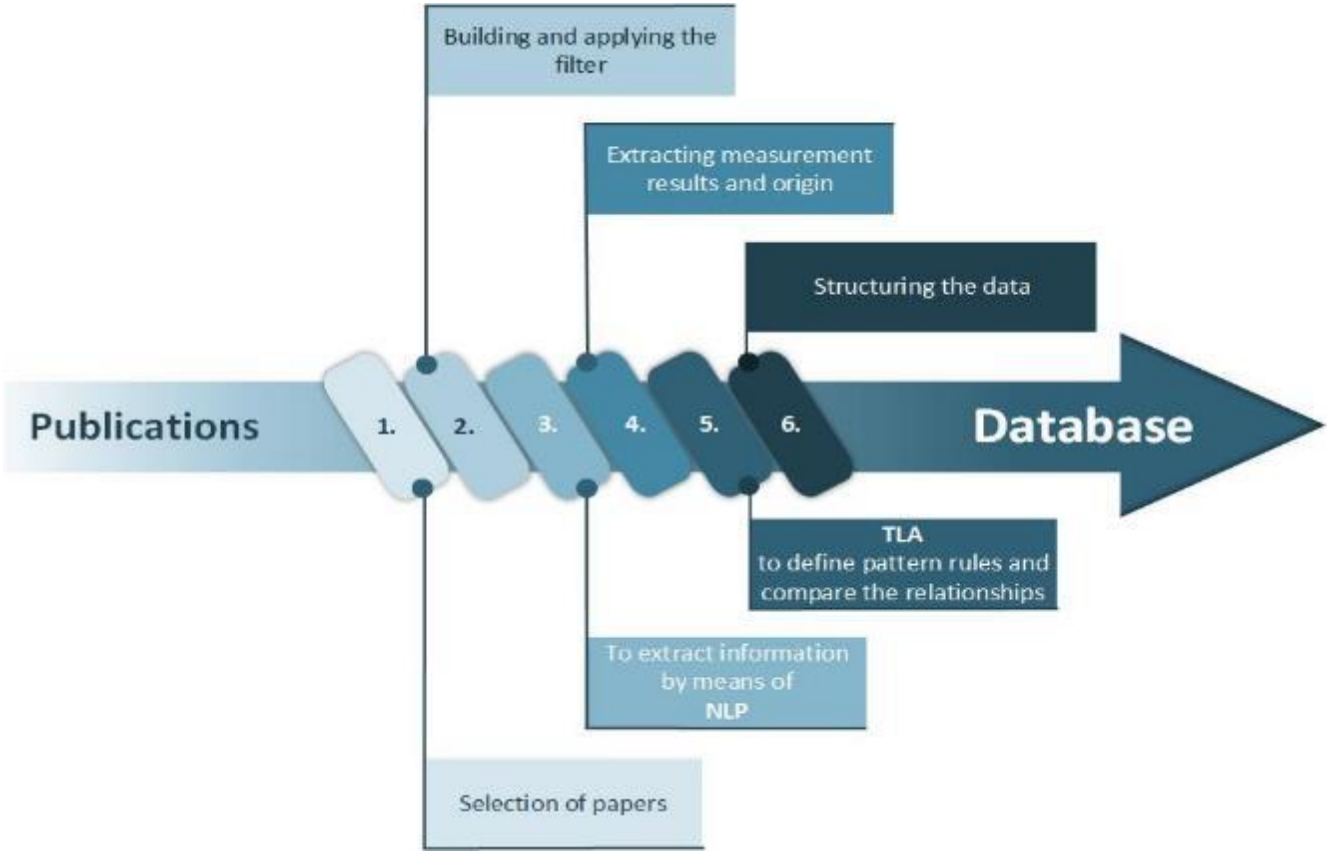
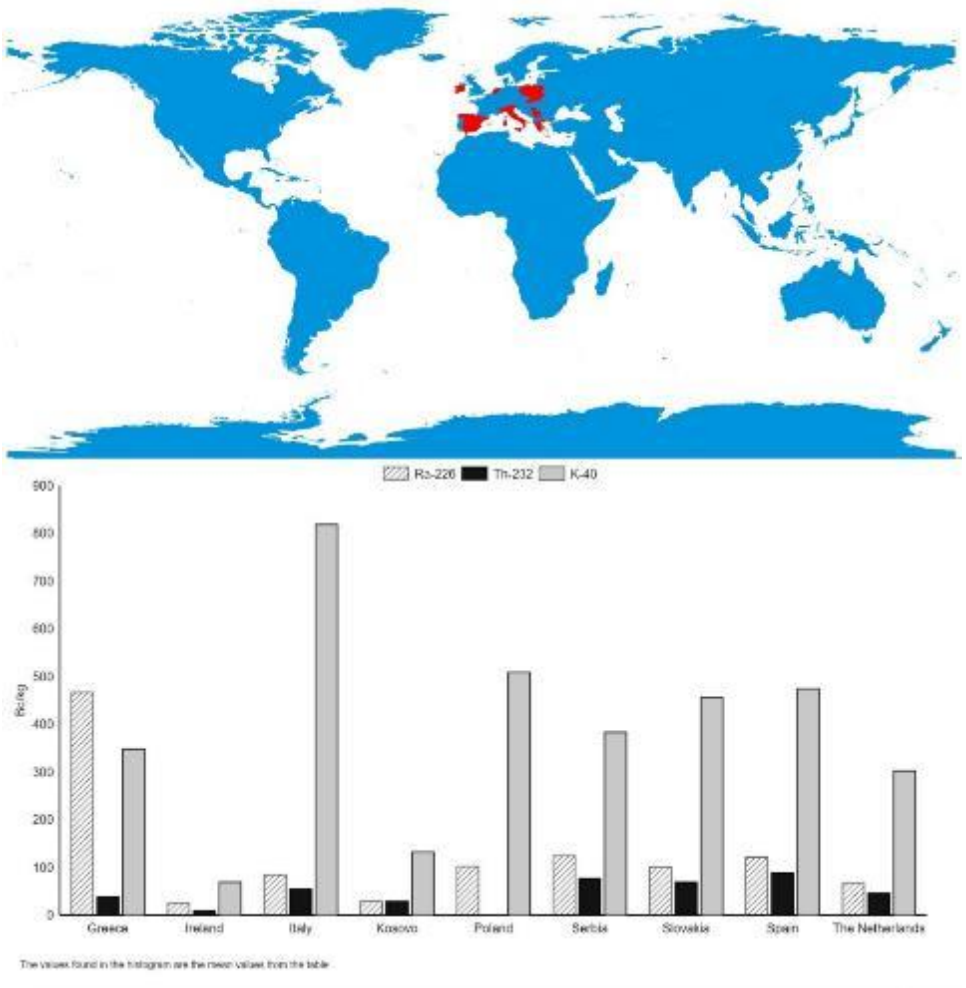
NORM4Building database (www.norm4building.org)



- Number of entries: 1452 (date: 01/07/2017)
- Current presentation: limited dataset (490 entries)
- 'More realistic' scenarios

General NORM4Building database



www.norm4building.org

Database team:
Tibor Kovacs
Gergo Bator
Zoltan Sas

Verification team:
Cristina Nuccetelli
Rosabianca Trevisi
Federica Leonardi

W. Schroeyers et al. Construction and building materials, 2017, Accepted paper

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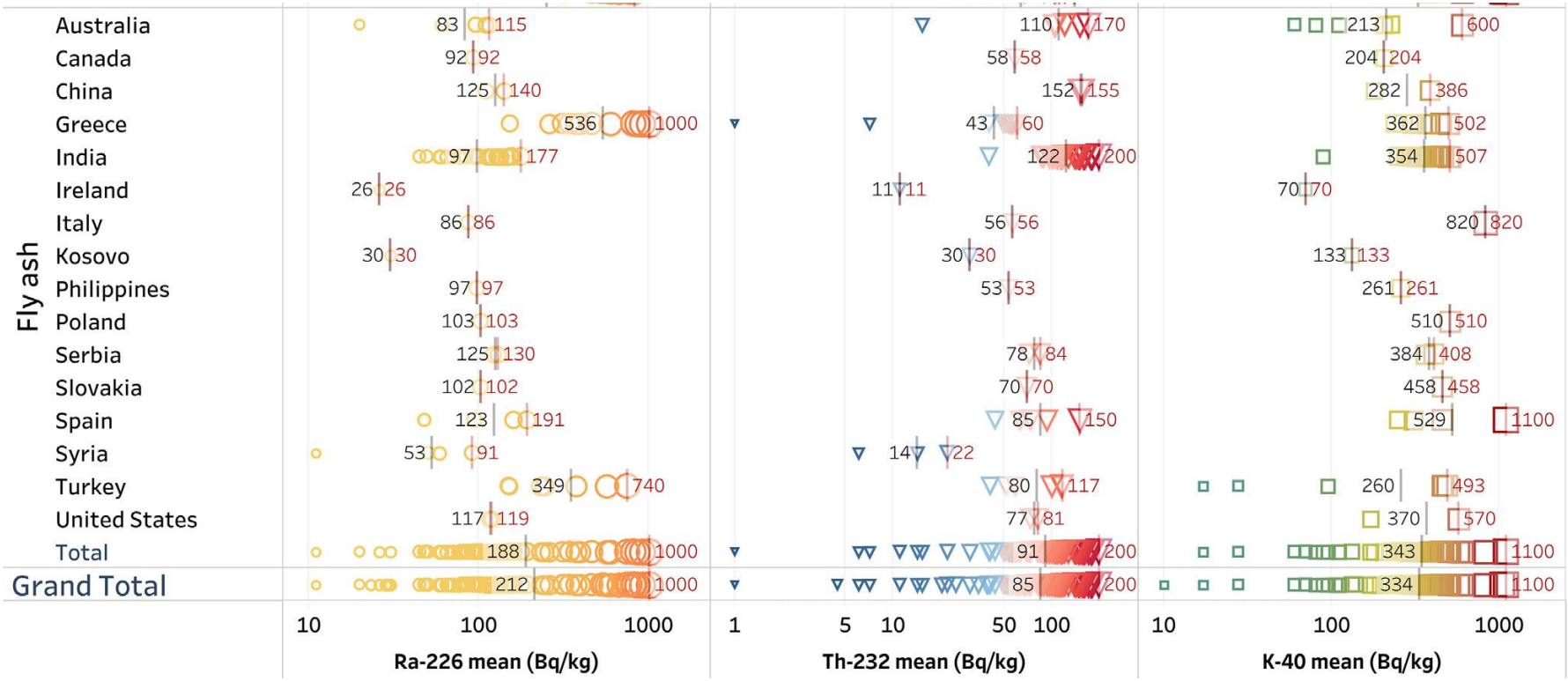
Fly ash from coal, peat and heavy oil fired power plants



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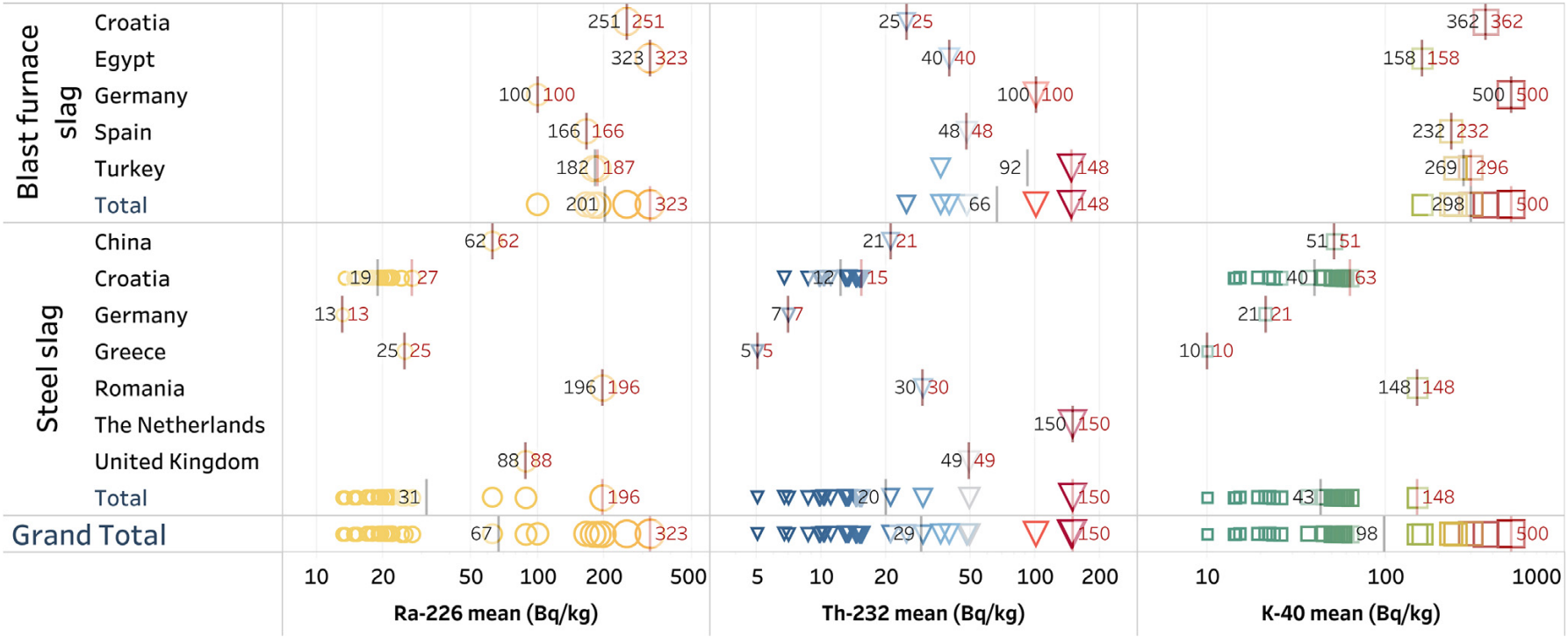
By-products from ferrous industry



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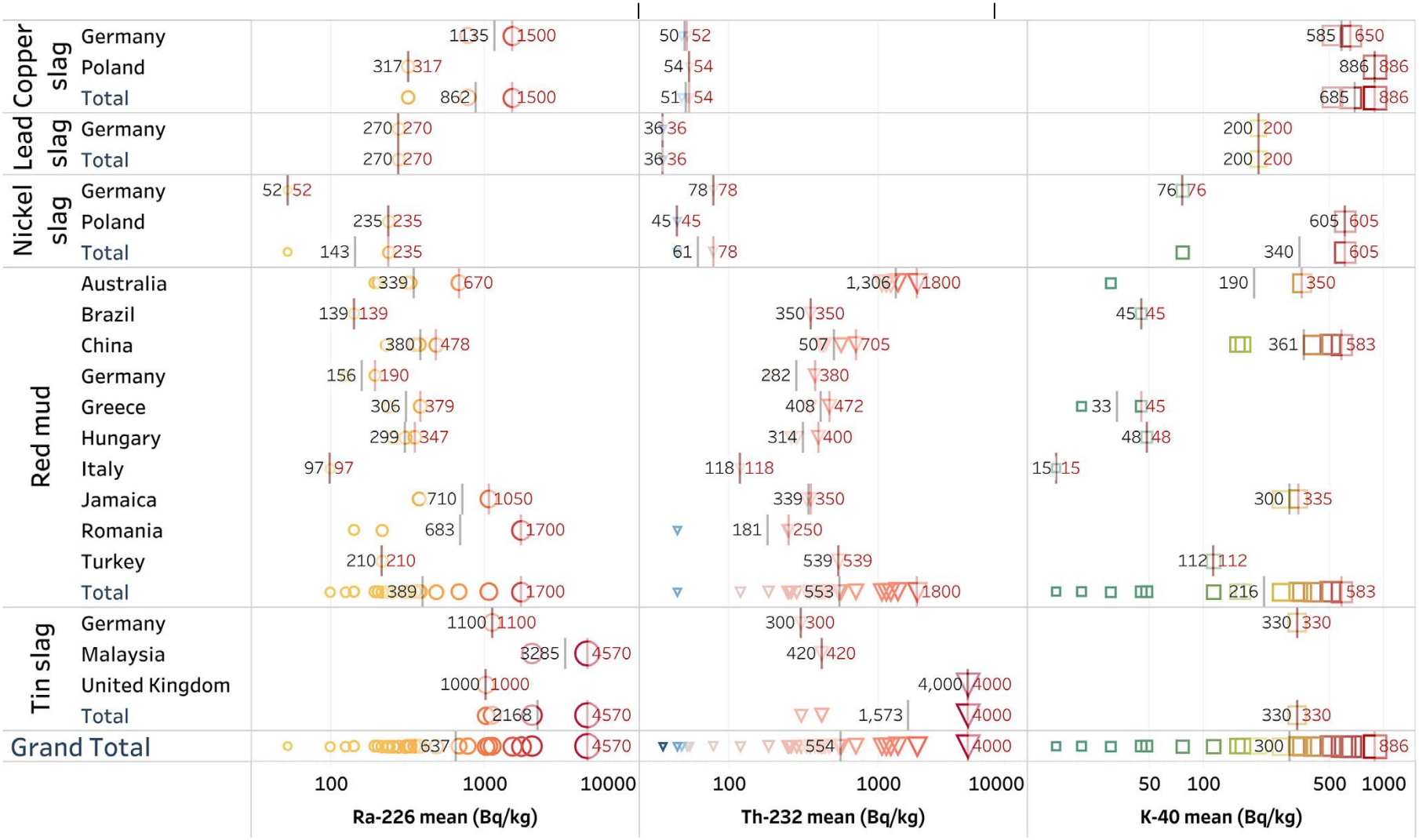
By-products from non-ferrous industry



NORM4Building database (www.norm4building.org)

W. Schroeyers et al. Construction and building materials, 2017, Accepted paper

NORM4BUILDING

cost

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Discussion: evaluating datamining approach

- Strength:
  - **Hundreds of publications** can be **processed monthly**
  - Finds data **accurately**
  - Allows **continuous (automated) search** for new data: useful for keeping inventory up to date
  - Can run again on collected data using **different key-words**

- Limitations
  - Reliability of the data is strongly dependent of the **reliability of the published results:**
  - Validation is a **labour intensive step**
  - Data from **graphical images** (eg.: histograms) is currently not collected
  - Licence for datamining software is **expensive**
  - **Industrially relevant?**
    - **There is a need** to filter out publications according to date, insert **more data from national surveys**

W. Schroeyers et al. Construction and building materials, 2017, Accepted paper

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I-index calculations

$$I - index = \frac{Ac_{226Ra}}{300\ B\ q/k\ g} + \frac{Ac_{232Th}}{200\ B\ q/k\ g} + \frac{Ac_{40K}}{3000\ B\ q/k\ g}$$

Euratom-BSS, 2013

- First screening to verify if I-index < 1 to assess which materials need further investigation
- **Only used for building materials** (or for their constituents if the constituents are also building materials)
- Values used in calculations:
  - Cement: I-index 0,38 (*)
  - Soil/aggregates: I-index 0,45 (*)

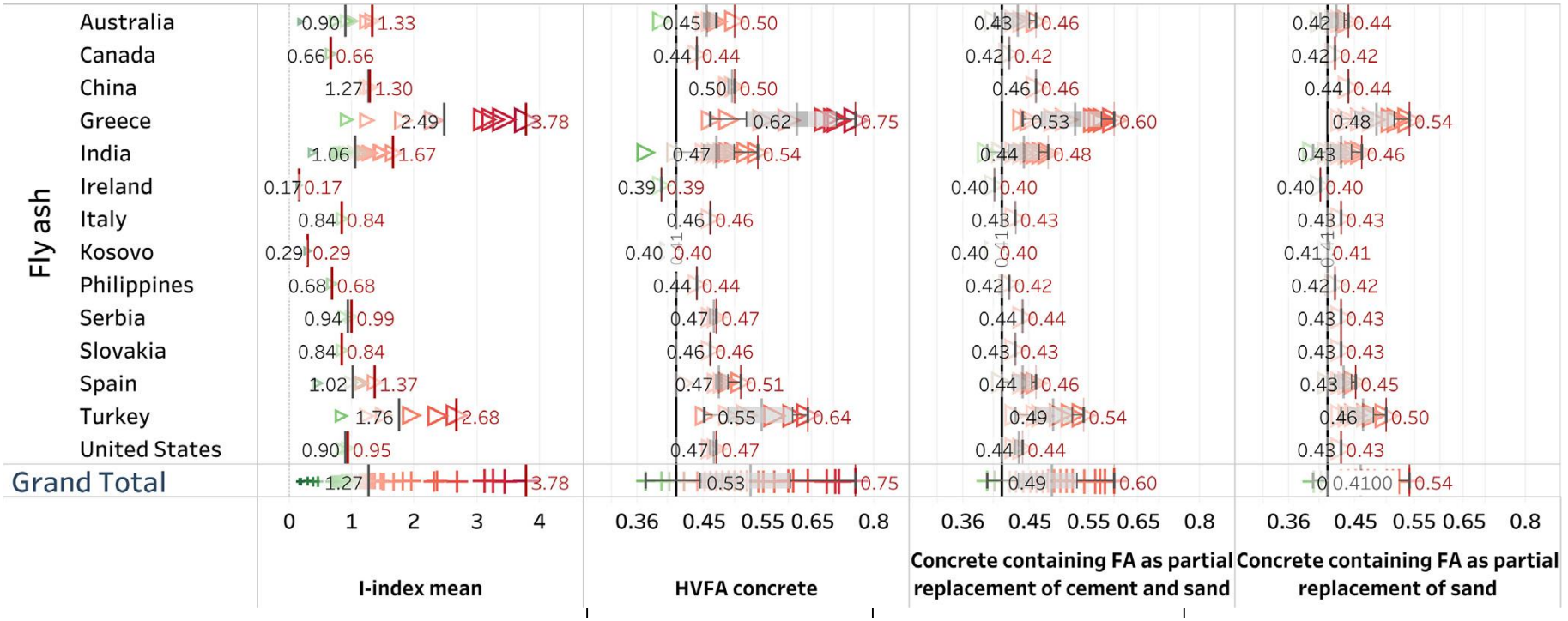
*R. Trevisi et al. J. Environ. Radioact. 105 (2012) 11–20.

Scenarios for evaluation use of by-products

Scenario ID	Construction Material	Composition (kg/m^3)			
		Cement	By-product	Aggregates	Water
1	Reference concrete	400		1850	150
2	High volume fly ash (HVFA) concrete	160	220 (fly ash (FA))	1700	140
3	Concrete with FA as partial replacement of cement and sand'	320	130 (FA)	1750	150
4	Concrete with FA as partial replacement of sand	360	90 (FA)	1800	150
5	Concrete with slag as partial replacement of cement and aggregates'	80	720 (slag)	1850	150
6	Concrete with slag as partial replacement of cement	80	320 (slag)	1850	150
7	Concrete with slag as partial replacement of aggregates'	400	400 (slag)	1450	150
8	Alkali activated concrete containing red mud as partial replacement of cement and aggregates		1800 (red mud)	450	150

W. Schroeyers et al. Construction and building materials, 2017, Accepted paper

I-index concretes containing fly ash



NORM4Building database (www.norm4building.org)

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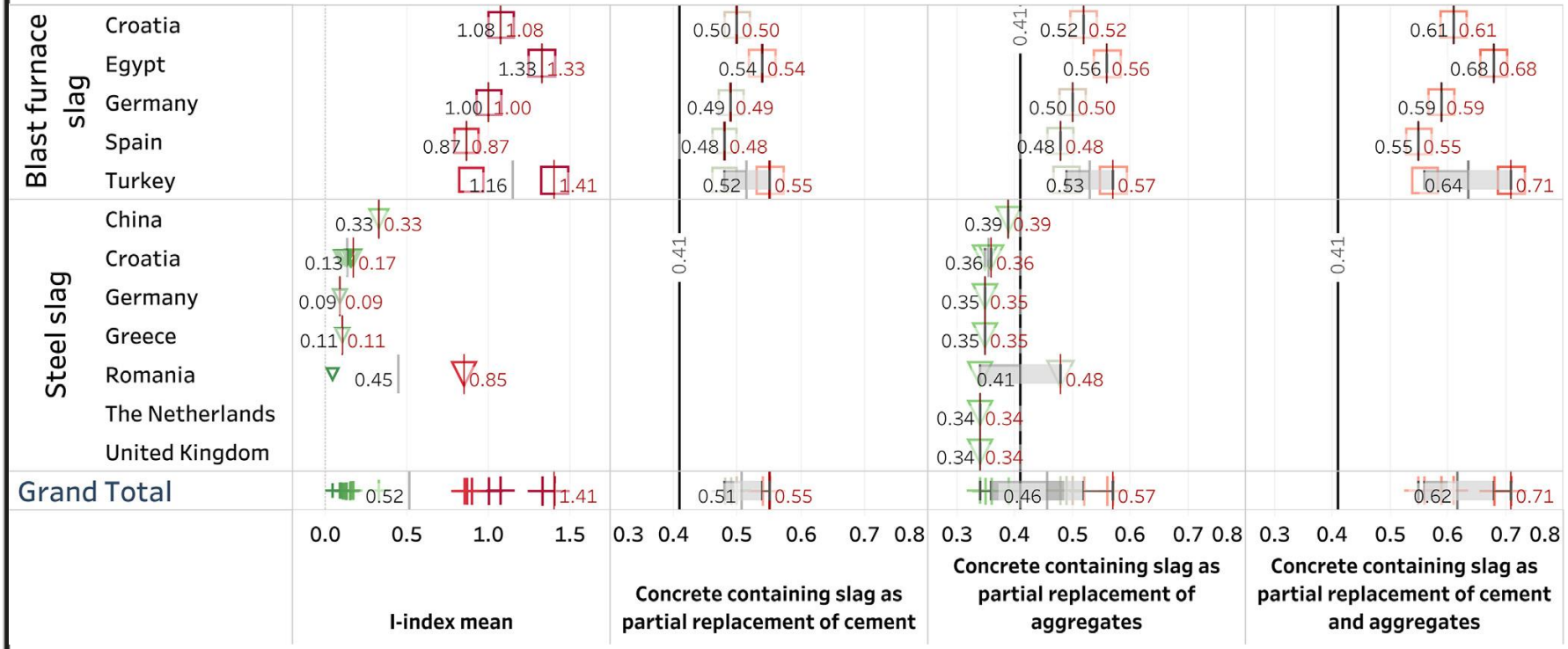
I-index concretes containing blast furnace slag



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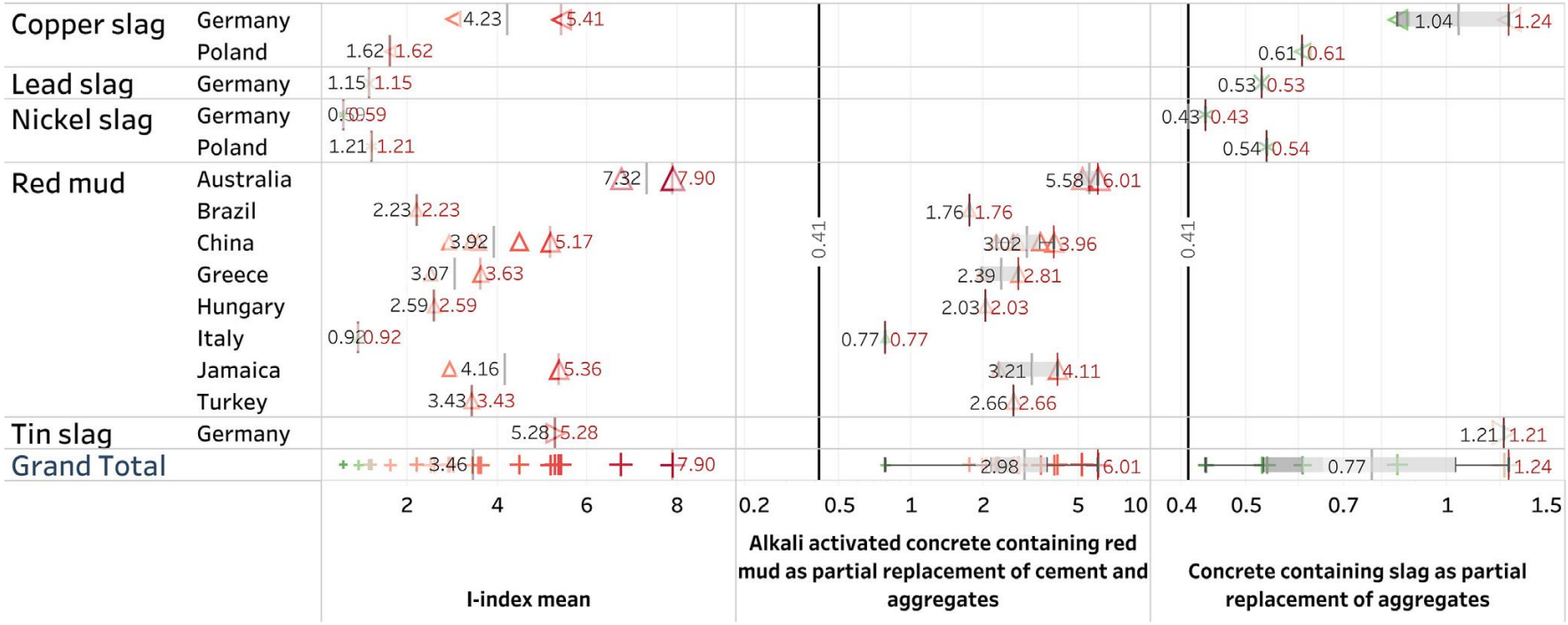
I-index concrete containing non-ferrous slag and red mud as replacement aggregates



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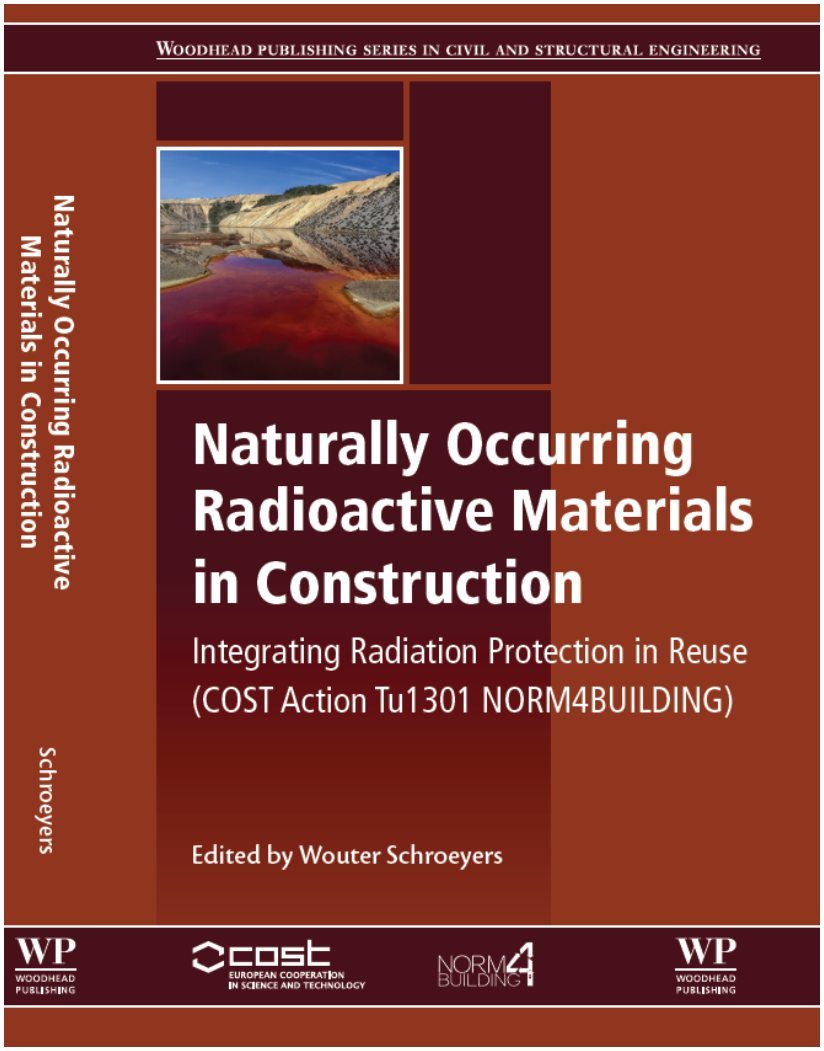
"NORM4Building, the book": detailled assessement of impact of use of NORM in construction



1. Objectives
2. Introduction
3. Basic aspects of natural radioactivity
4. **Legislative aspects**
5. **Measurement of NORM**
6. From raw materials to NORM by-products
7. From NORM by-products to building materials
8. **Leaching** assessment
9. **Nontechnical** aspects
10. General conclusion and the way forward

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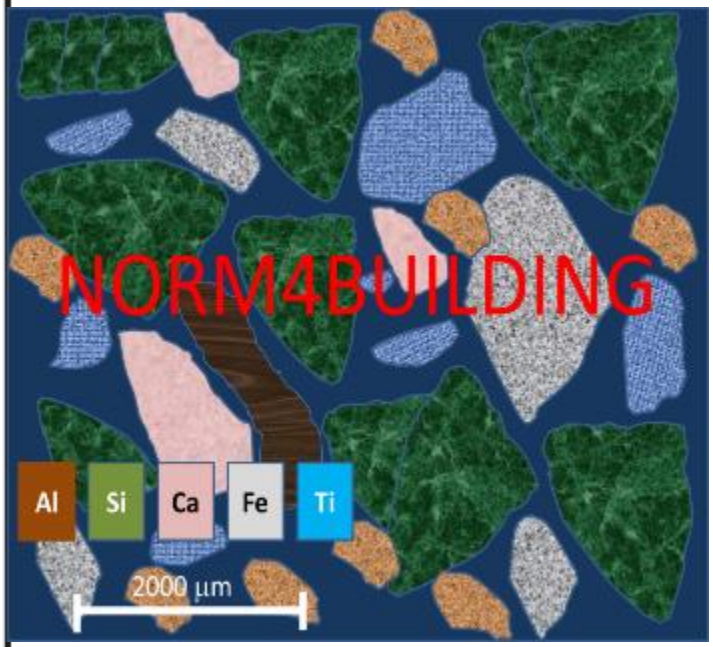
NORM4Building "special issues"



- Previous special issue:
  - **Journal of Environmental Radioactivity**
  - 'Natural radioactivity in construction'
  - Volume 168, March 2017
- Upcoming special issue
  - **Journal: Construction and building materials**
  - Expected publication March 2018

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Conclusion - outlook

- Building expanded **database** for screening: identify materials of concern from radiological perspective

- **Realistic models** for assessing impact in stead of too conservative scenarios: taking **adequate measures**

- Outlook:
  - To make the database **industrially relevant**, option is to apply the datamining tool on **national surveys** (and update it when a new survey is uploaded)

  - New database based on individual entries, including the date of measurement/study as relevant parameter

H2020-MSCA-IF-2015

By-BM

MARIE CURIE ACTIONS

Natural radioactivity database

MSCA project:
Zoltan Sas

The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 701932

Queen's University Belfast

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MARIE CURIE ACTIONS

H2020-MSCA-IF-2015 By-BM

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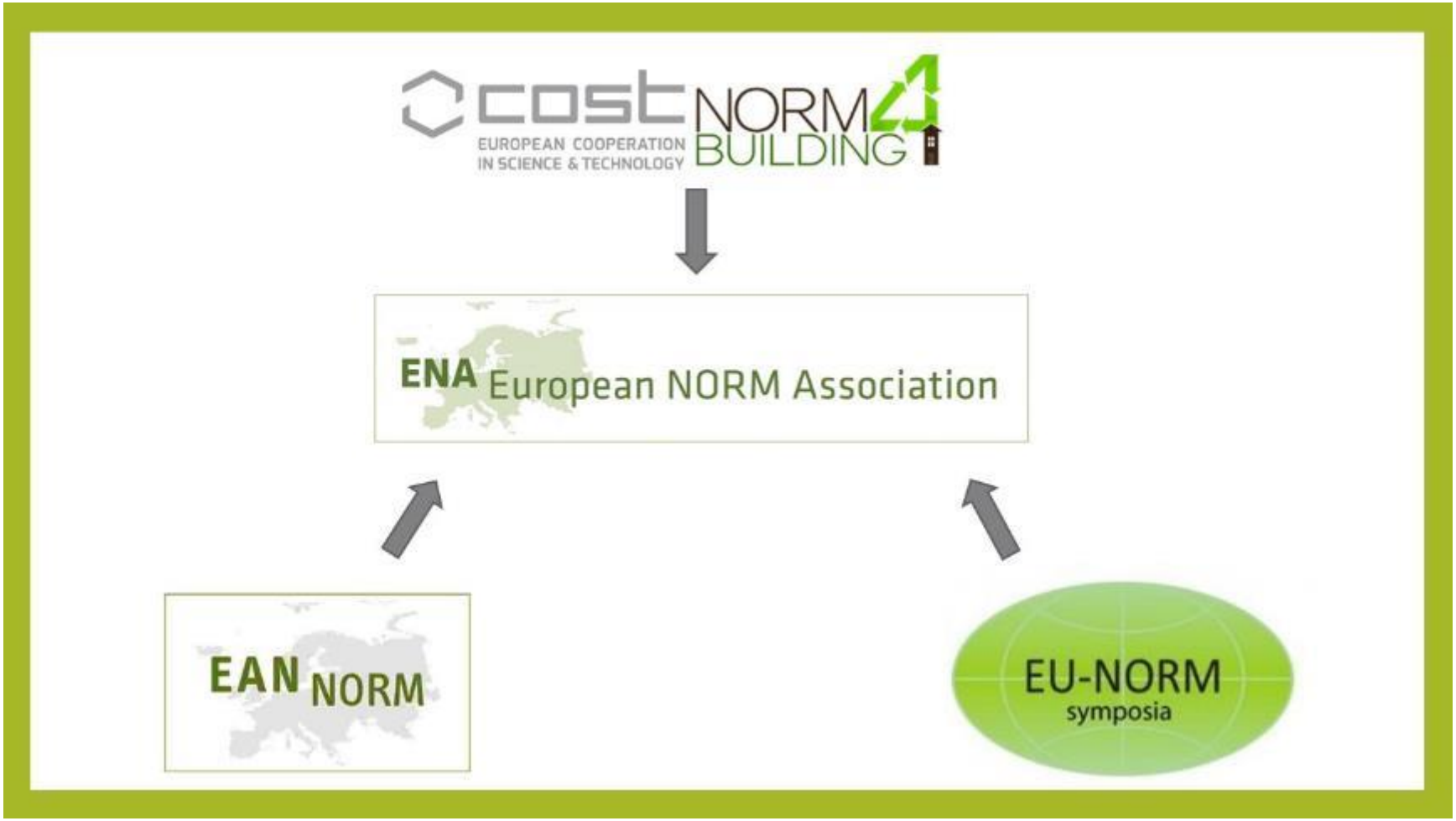
Towards a “European NORM Association”



ENA European NORM Association

http://ean-norm.eu/

The 1st ENA Workshop

Katowice, Upper Silesia, POLAND

19-23 November 2018

Main topics:

1. **NORM and environment** – challenges due to the release of formation/process water
2. **NORM in building materials** –practical approaches to control radioactivity
3. **NORM in the industry** - look beyond oil and gas, phosphorite and red mud.

GIG

Silesian Centre for Environmental Radioactivity,
Central Mining Institute (GIG), Plac Gwarków 1, Katowice, Poland

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http://ean-norm.eu/

The 1st ENA Workshop

Katowice, Upper Silesia, POLAND

- 19th Nov 2018: **Training** courses on:
  - 1. Application of **gamma spectrometry for NORM measurements**
  - 2. Application of **LSC for NORM measurement**
  - 3. **Inventory of NORM and existing regulatory context**
- 20th Nov - 22nd Nov 2018: Scientific sessions and discussions

- 23rd Nov 2018: “Speaker’s Corner”
  - **Member States** sharing experience in implementing the **European BSS**

The 1st ENA Workshop

See you 19-23 November, 2018 !

ENA European NORM Association