



ERA-MIN 2

RESEARCH & INNOVATION PROGRAMME
ON RAW MATERIALS
TO FOSTER CIRCULAR ECONOMY

INSTAnT

**Innovative sensor technology for optimised
material recovery from bottom ash treatment**

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(VITO, Belgium)**

**ERA-MIN 2 Final Conference and Final Seminar of Call 2017 projects
18-19th November 2021**



Co-funded by the Horizon 2020 programme
of the European Union



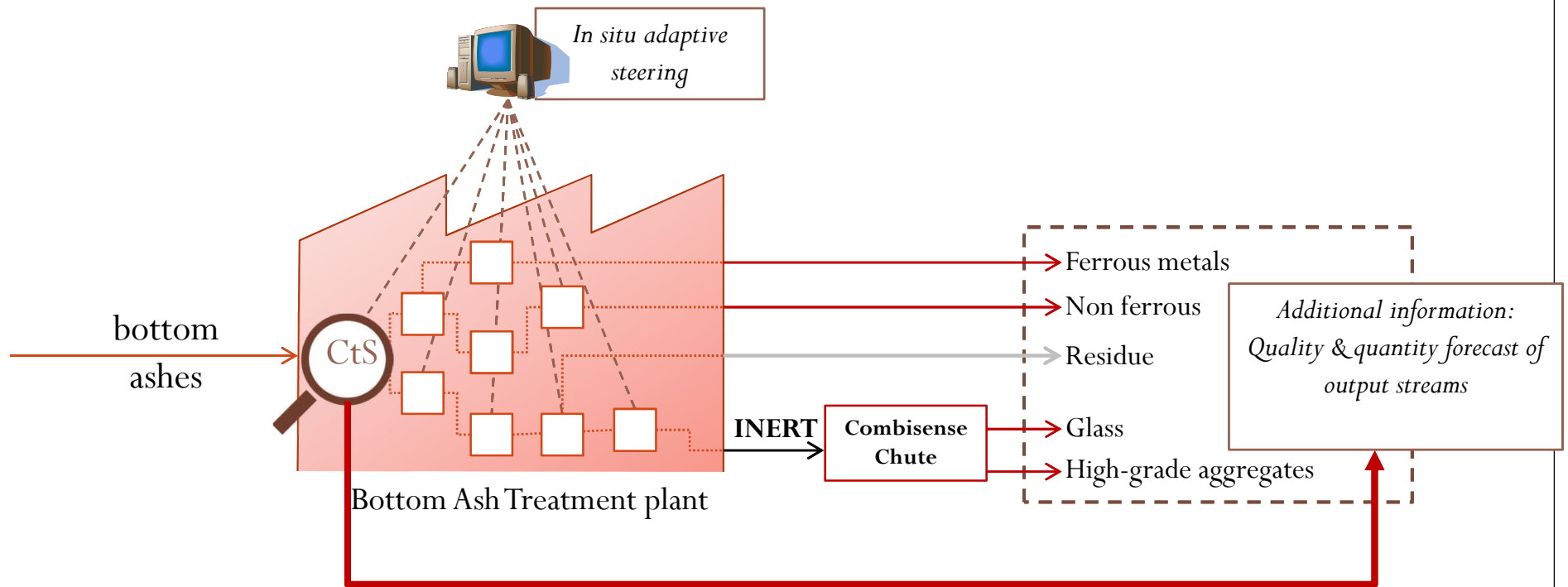


Consortium

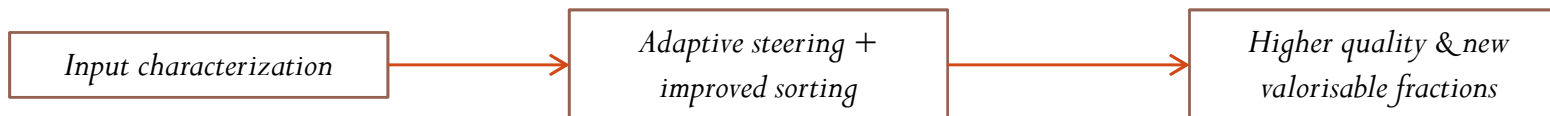
- Topic 4. Recycling of End-of-Life products (4.2 pre-processing, 4.3 recovery and 4.4 increase recycling of through ICT)
- May 1, 2018 – October 31, 2021 (3,5 years) (6M extension Covid-19 e.a.)
- Project consortium
 - VITO, Research Institute, Belgium (Hermesfonds)
 - RWTH Aachen, University, Germany (BMBF)
 - XRE, SME, Belgium (Hermesfonds)
 - SUEZ, Industry, Belgium (Hermesfonds)
 - TOMRA Sorting, Industry, Germany (BMBF)
- TRL 5 > TRL 7
- Project budget 1.14 M€ (871 k€ funding), 98% executed (final reporting)



Project Concept



The INSTAnT innovation:



INSTAnT Objectives & Impact

- Objective: Close the material cycle of resources present in bottom ashes (BA) by using smart recycling technologies:
 - an innovative **sensor-based characterization technology** for **BA** allowing for a fast identification of different material fractions which can be used for adaptive steering of the processing plant and for quality control
 - a novel **sensor-based glass separation technology** focused on **BA**
- Impact
 - Increased valorization potential of mineral fractions
 - Improved recovery of metals
 - Optimized recovery for high-grade valorisation





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Characterize-to-Sort

vito

RawMaterials

EIT RawMaterials is supported by the EIT, a body of the European Union.

<https://vimeo.com/545185006>



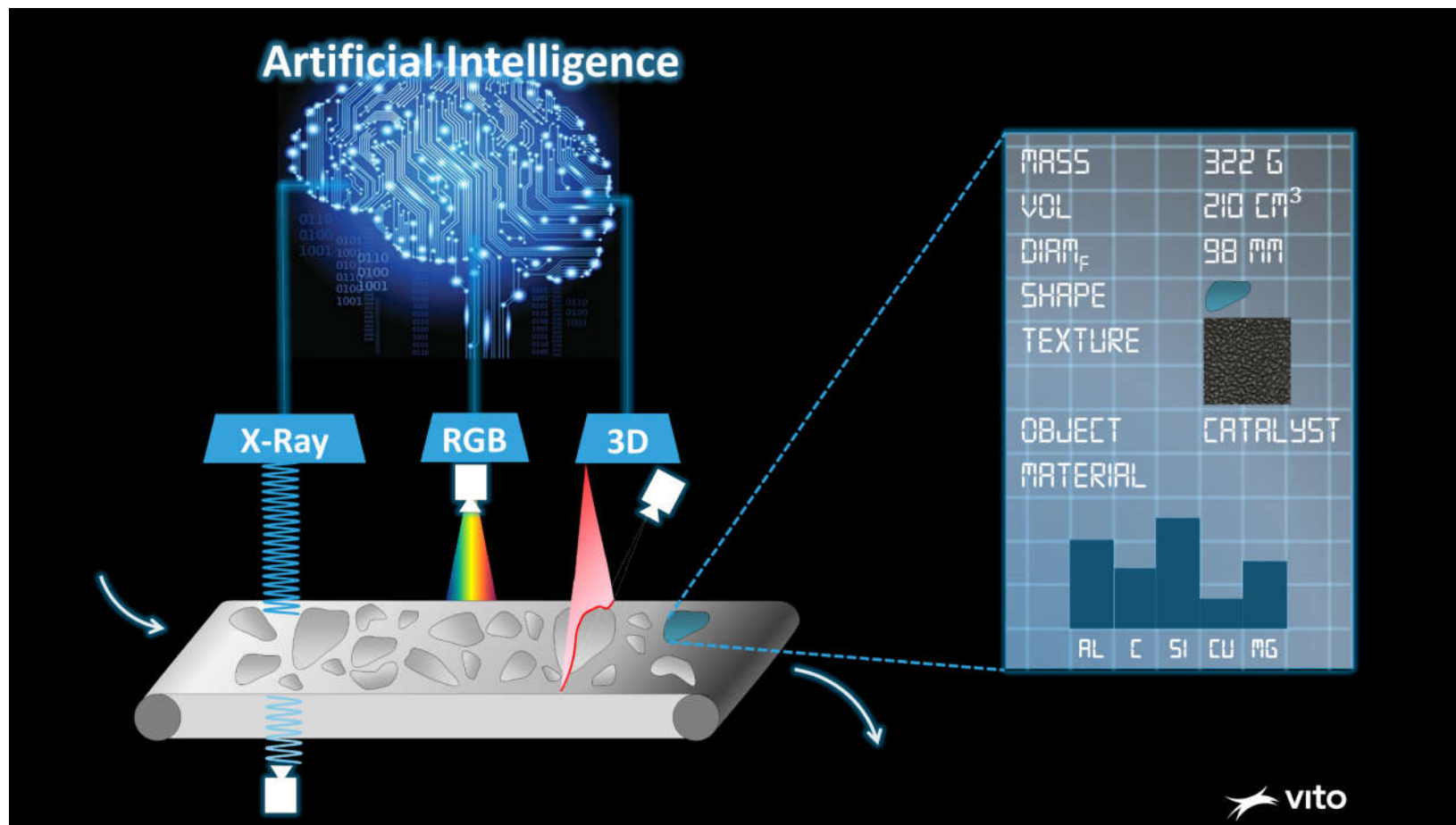
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Characterize-to-Sort technology



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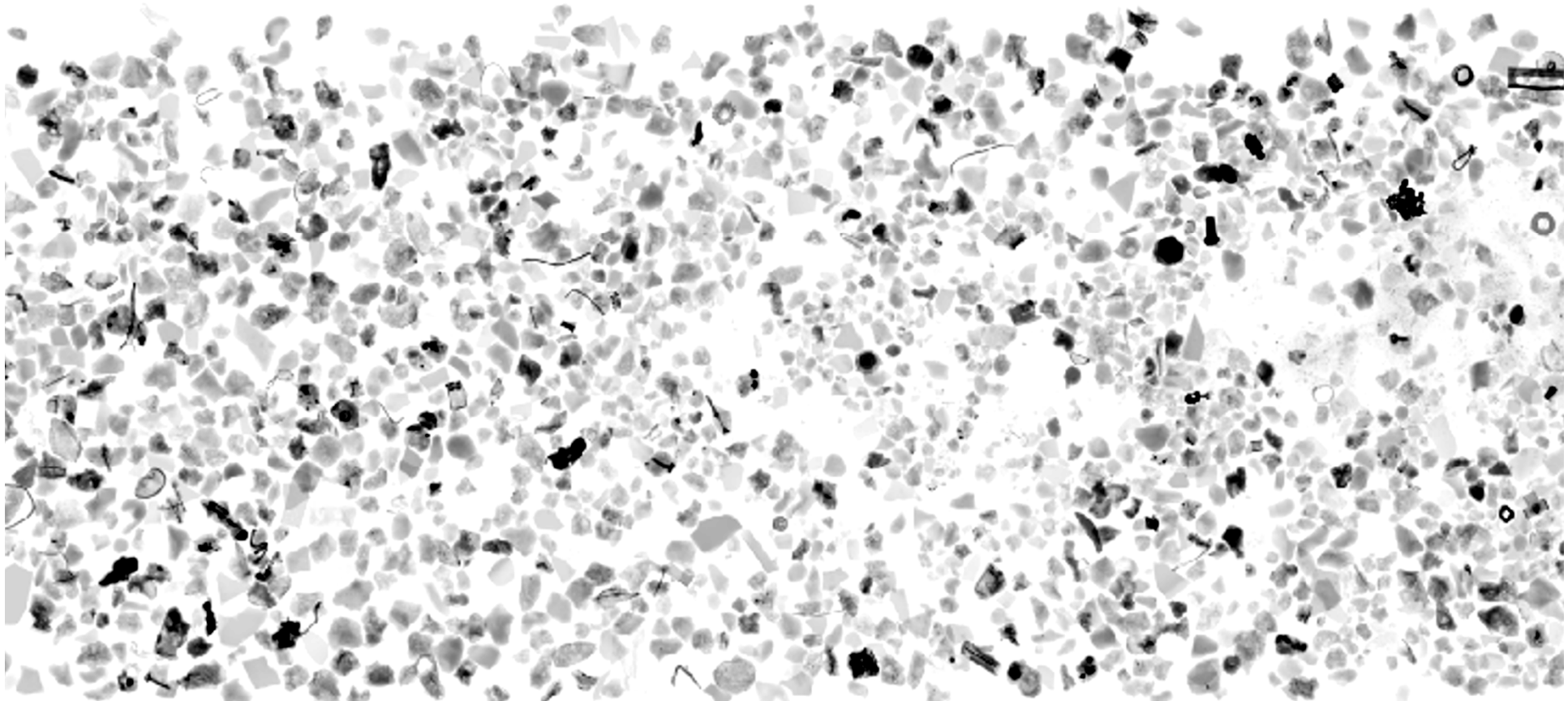






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X-ray TRANSMISION



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Voettekst invulling

9





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Atomic number



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Voettekst invulling

10

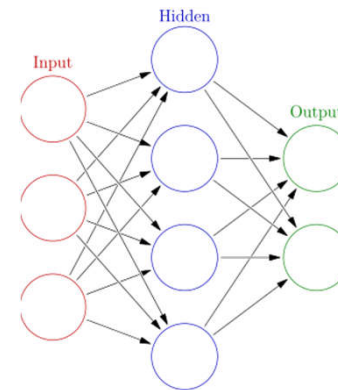




Model training



	m	v	Z	...



label
Aluminium
Copper
Slag
Ceramic
Aluminium



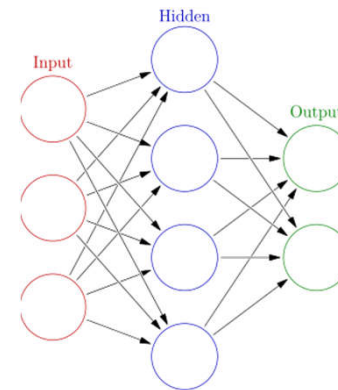


Model prediction

Learning fractions are crucial!



	m	v	Z	...



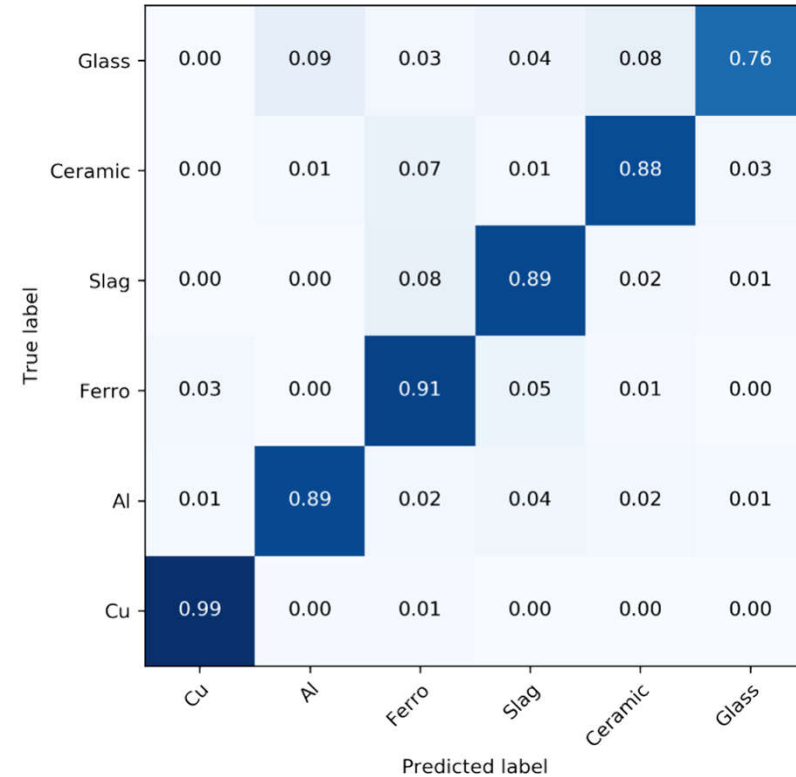
label





Final Results CtS

- Classification model results
 - Overall good accuracy (~90%)
 - Glass lower accuracy:
 - Mainly confused with Al & Ceramic
 - Due to
 - Similar chemistry (Al/Si) & structure
 - Impure learning fractions (overlap)

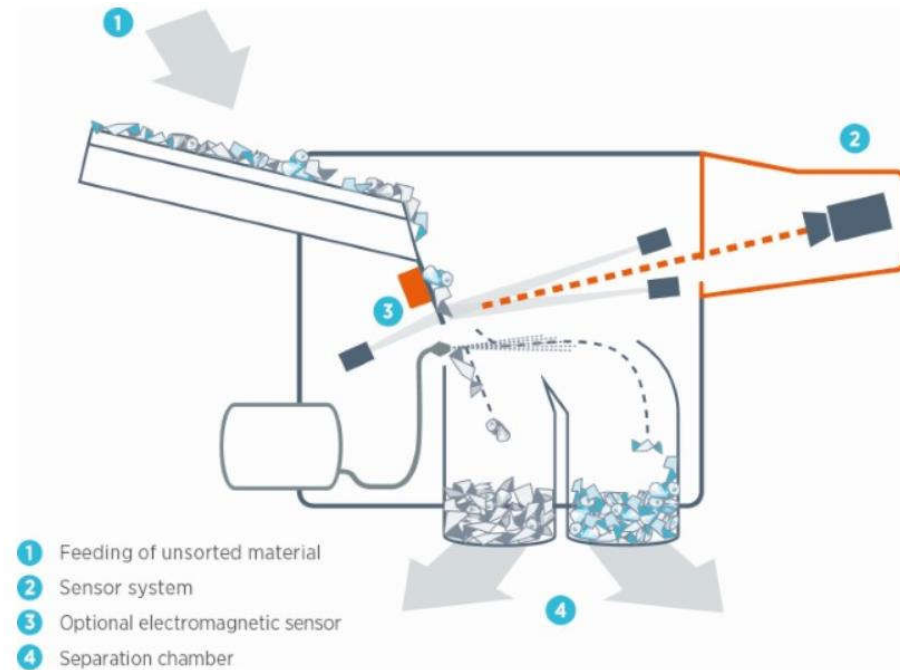


1 H Hydrogen 1.008	2 He Helium 4.003																
3 Li Lithium 6.941	4 Be Beryllium 9.012	5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180										
11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948										
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.887	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 68.722	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.798
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294





Final Results glass separation



Combisense Chute principle



Glass

- Purity increase from 10% to 82%
- Recovery 94%
- Minerals (slag)
 - Purity from 86 % to > 99%
 - Meeting criteria for high-quality concrete application





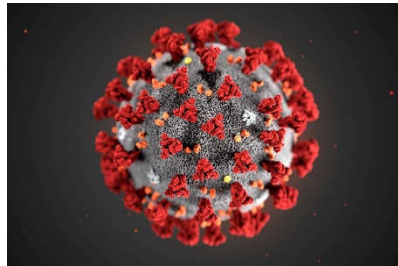
Lessons learned

- A bottom ash classification model was developed (based on DE-XRT & 3DLT images) for 6 classes: Slag, Glass, Ceramic, Ferrous, Aluminium, Copper with overall accuracy 90%
- Glass separation improved mineral fraction for high-quality applications

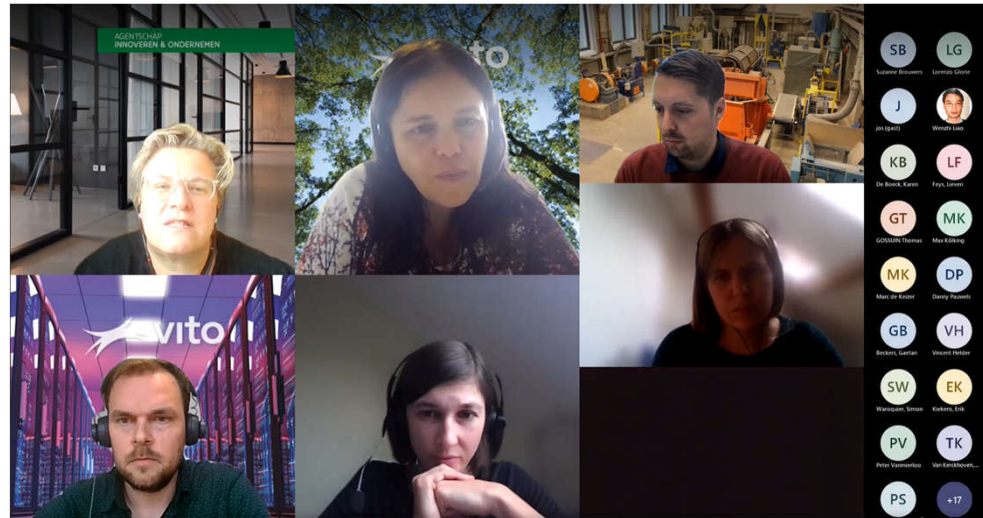
BUT

- **Preparation of representative learning fractions crucial** for quality control and process steering
 - high purity, avoid overlap, long term representativeness
- Further cleaning steps needed for high purity glass (economics?)





Dissemination



- Online Demo-event 26 October 2021 (46 participants)
- Sensor Based Sorting Conference 2022 (13-14 April, Aachen, Germany)
- Looking for other opportunities to disseminate & collaborate





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- Questions?
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