Hyper-accumulation and detoxification of heavy metals by conditioned plants and bacteria.

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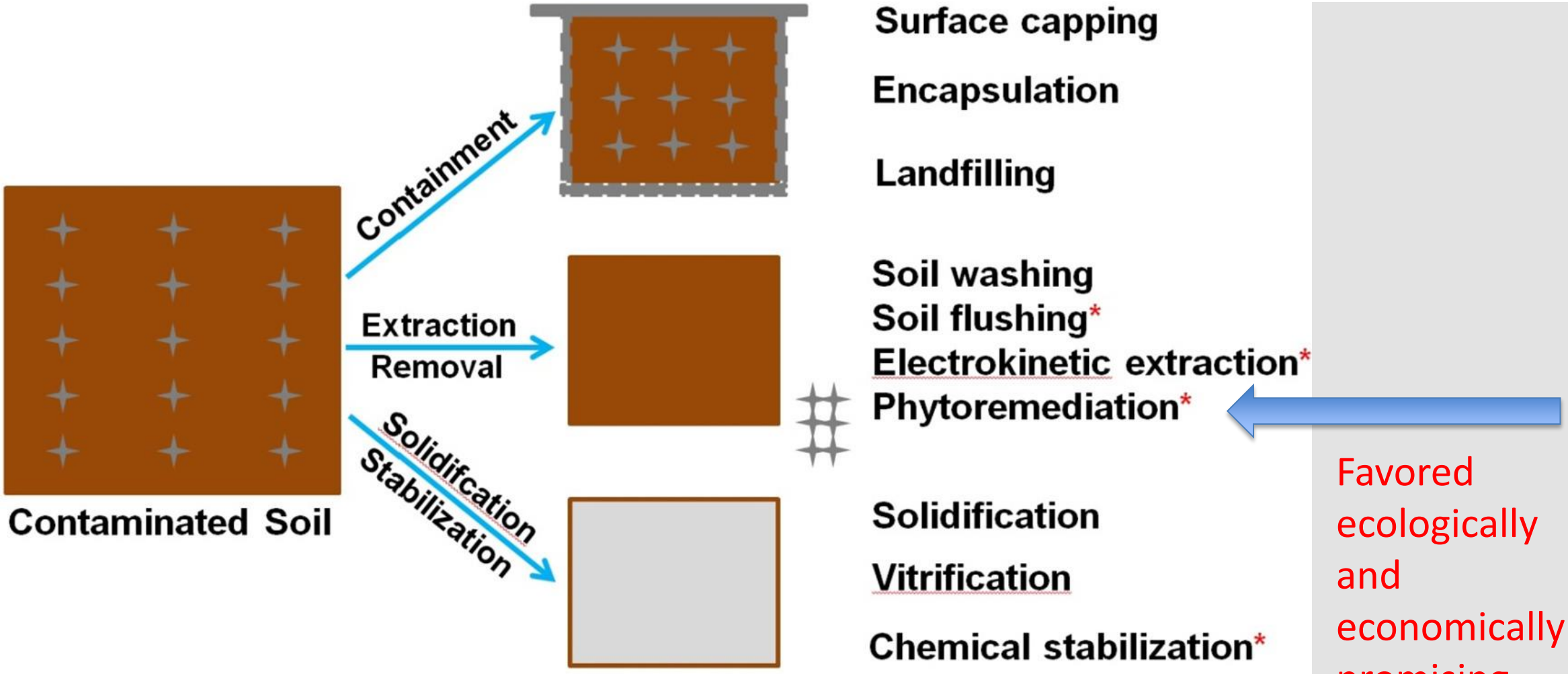
ZENIT Successful R&I in Europe 2019,
10th European Networking Event, 14th /15th February 2019, Düsseldorf

Environmental societal challenges

- **Soil heavy metals contamination is an alarming environmental fact and a threat to food security.**
- **Soil cleanup is a great challenge in most countries.**
- **Hyperaccumulator plants provide an opportunity to remediate heavy metals.**
- **Phytoremediation is a promising soil remediation approaches.**
- **More research is required to test new hyperaccumulators for soil cleanup.**



Favored ecologically and economically promising approach!

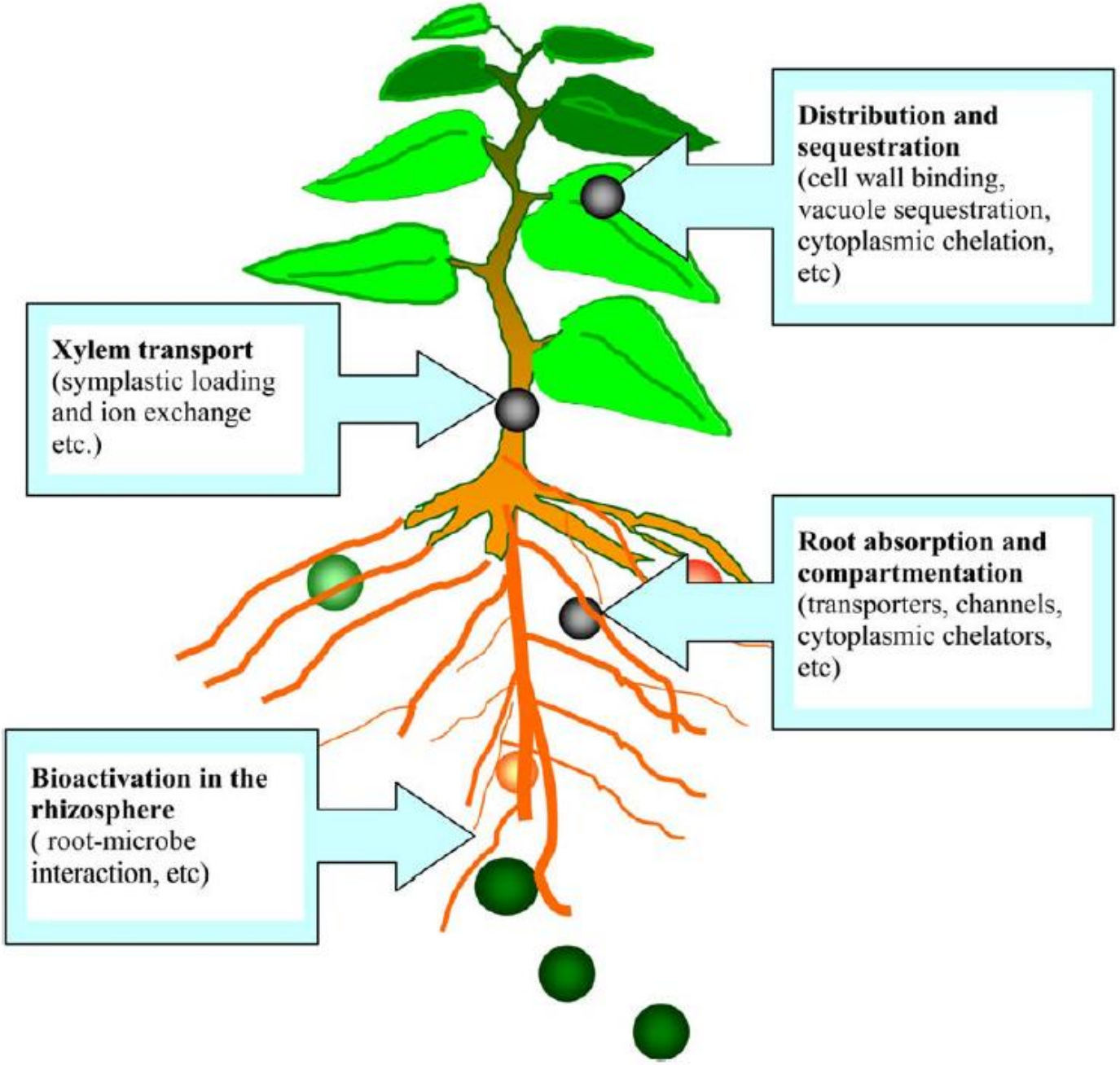
Remediation techniques for heavy metal-contaminated soils

* Under development

Xiaoming Wan et al., 2016

Hypertolerance and hyperaccumulation

- **Heavy metals are categorized as essential and non-essential.**
- **Essential heavy metals are: Copper (Cu), zinc (Zn), manganese (Mn), nickel (Ni), and iron (Fe).**
- **Non-essential heavy metals are: Cadmium (Cd), mercury (Hg), and lead (Pb).**
- **Plants exposed to heavy metals stress respond by altering cellular mechanisms and gene expression.**
- **Many plant species (> 400) have evolved resistance to high heavy metal concentrations, i.e. *Arabidosis halleri*.**



X. Yang et al. (2005)

Cloning strategy of hyperaccumulating genes

Arabidospsis halleri

HMA2, HMA3, HMA4	Zn^{2+}, Cd^{2+}	
HMA5, HMA6, HMA7, HMA8	Cu^{+}	
Cpx-type heavy metal ATPases	Cu^{+}, Zn^{2+}, Cd^{2+}, Pb^{2+}	

Gene isolation, characterization, cloning in *E.coli*

Transfer of genes into *Agrobacterium tumefaciens*

Gene optimization

e.g. CRISPR/Cas

Transformation of recipient plant of **high biomass** to become the **phytoremediator** of choice

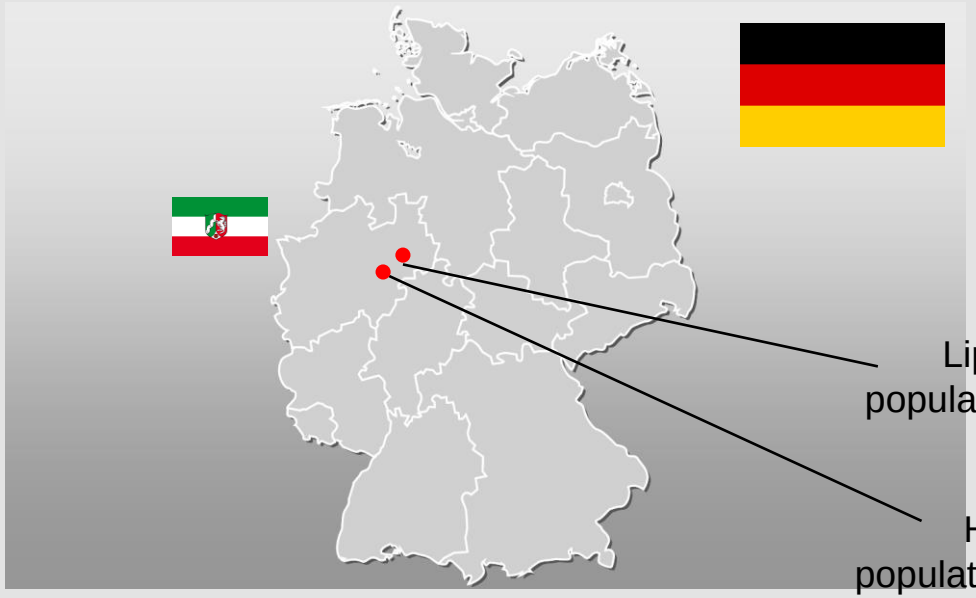
Properties of plants selected for phytoremediation

- rapid growth rates,
- high biomass production,
- hyperaccumulator of heavy metal,
- translocate metal from root to shoot,
- tolerate the toxic effects of heavy metal,
- resistant to pathogens and pests,
- well adopted to prevailing climatic conditions,
- easy to cultivate and harvest, and
- no attraction to herbivores to avoid its entry into food chain.

Scientific & Technological Expertise

- **iGEM participation in 2018**
- **Excellent, newly established laboratories**
- **Devoted Bachelor- and Master students; Ph.D. possible**
- **On-going university collaborations**
- **Molecular biology methods established**
- **Access to green houses**
- **But: No previous Horizon2020 consortia experiences**

Hamm & Lippstadt In Germany and North Rhine-Westphalia



Lippstadt
population: 67 233

Hamm
population: 179 397

North Rhine-Westphalia
34 880 km²
population: 17 865 561

Collaborations sought / Potential Partners

- To establish consortia for Horizon2020 (and Horizon Europe?) calls including:
- Academic, institutional and industrial partners to identify and to co-develop hyper-accumulating plants and potentially organisms.
- Connecting economic and environmental gains - the circular economy
- CE-SC5-01-2018: Methods to remove hazardous substances and contaminants from secondary raw materials CLOSED
- H2020-SC5-2018-2019-2020 OPEN
- Call - Greening the economy in line with the Sustainable Development Goals (SDGs).