

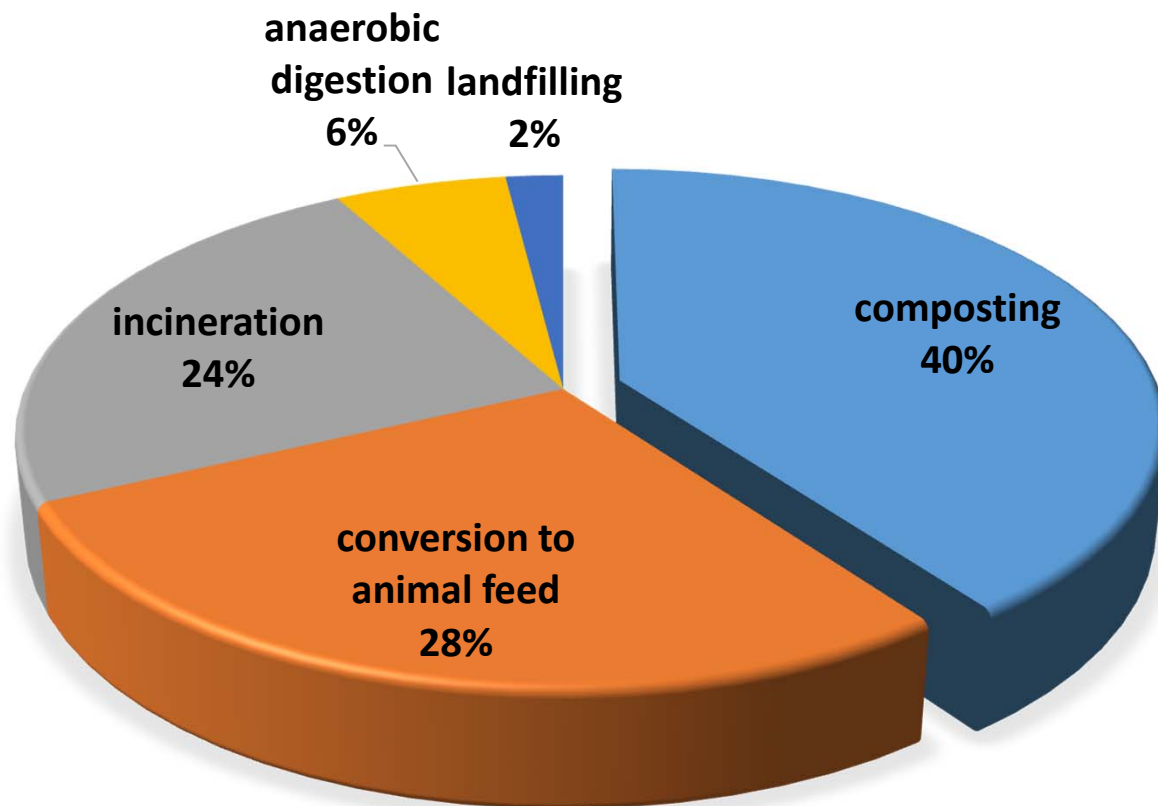
Enabling decentralized pre-composting of organic household waste with a novel high-rate bioreactor



The Urban pre-Composter

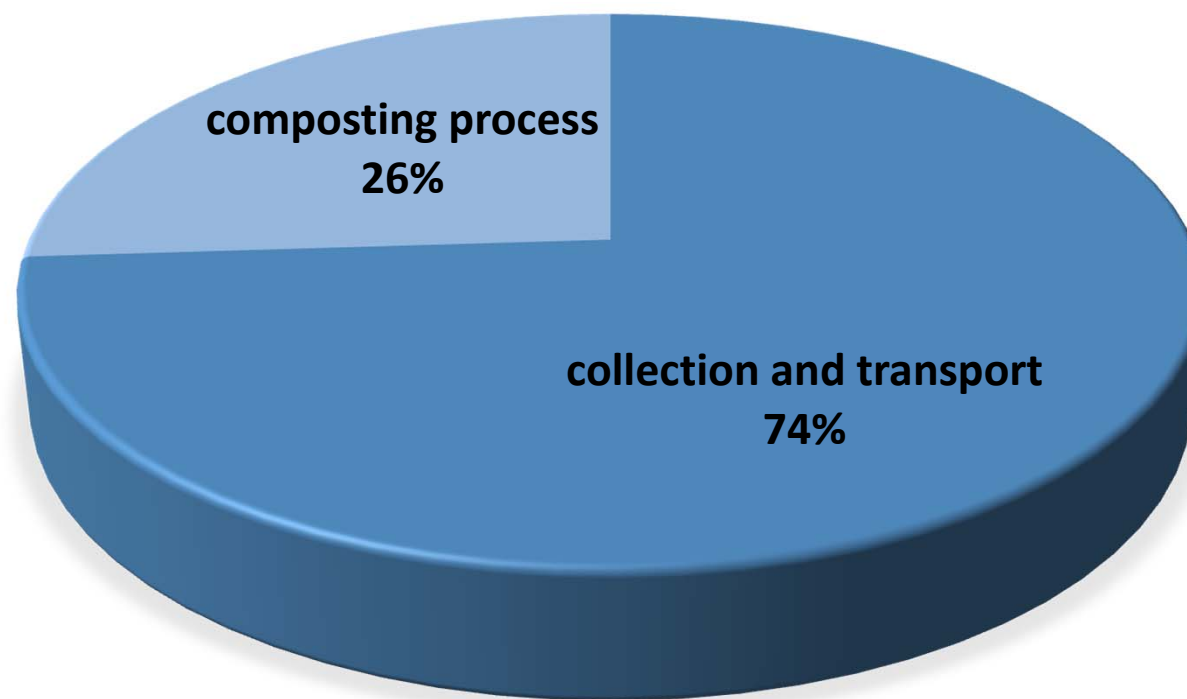
M. Sakarika, R. Baetens, K. Vinck, M. Spiller, K.C. Vrancken, G. Van Barel, E. Du Bois, S.E. Vlaeminck

Fate of organic household waste in Flanders



[Reference period: 2015]

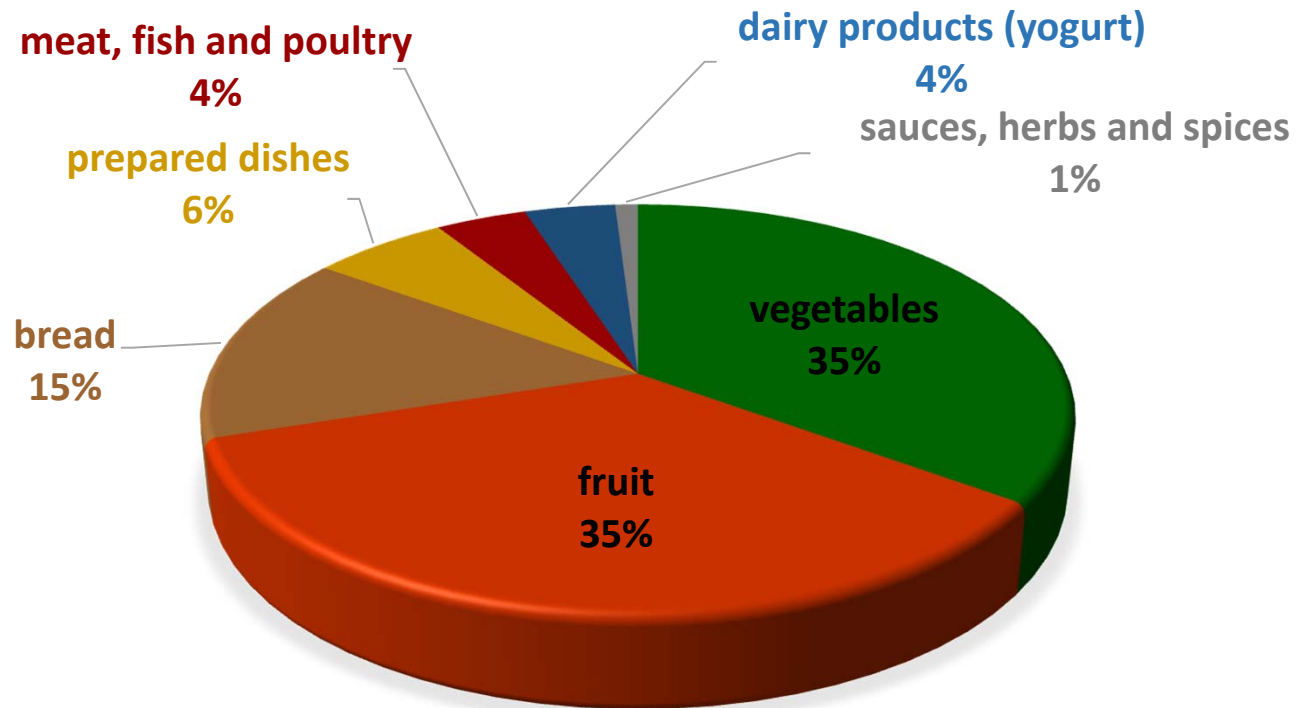
Cost breakdown composting



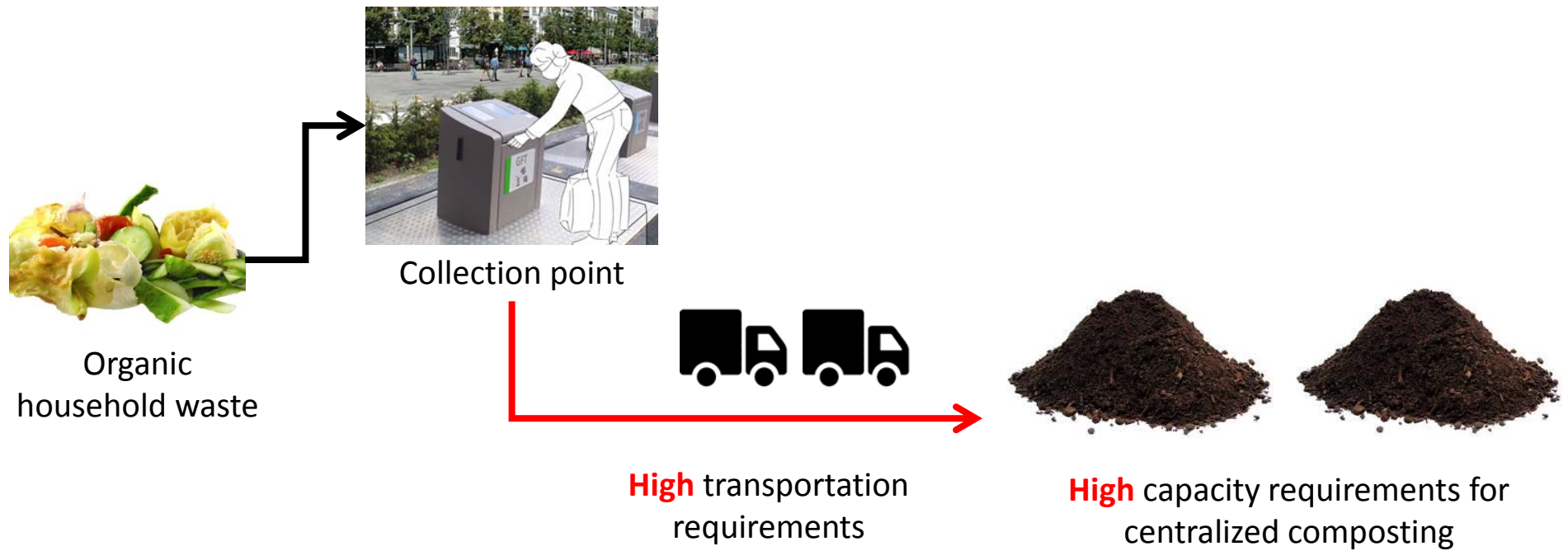
[Reference period: 2009]

Urban household organic waste composition

- Household organic waste: vegetables, green, fruit (VGF)
- **Urban household organic waste: mainly kitchen waste**
- Composition of waste disposed in the collection points of the Flanders:



Conventional organic waste flow



Mobility problems (traffic)



Air pollution

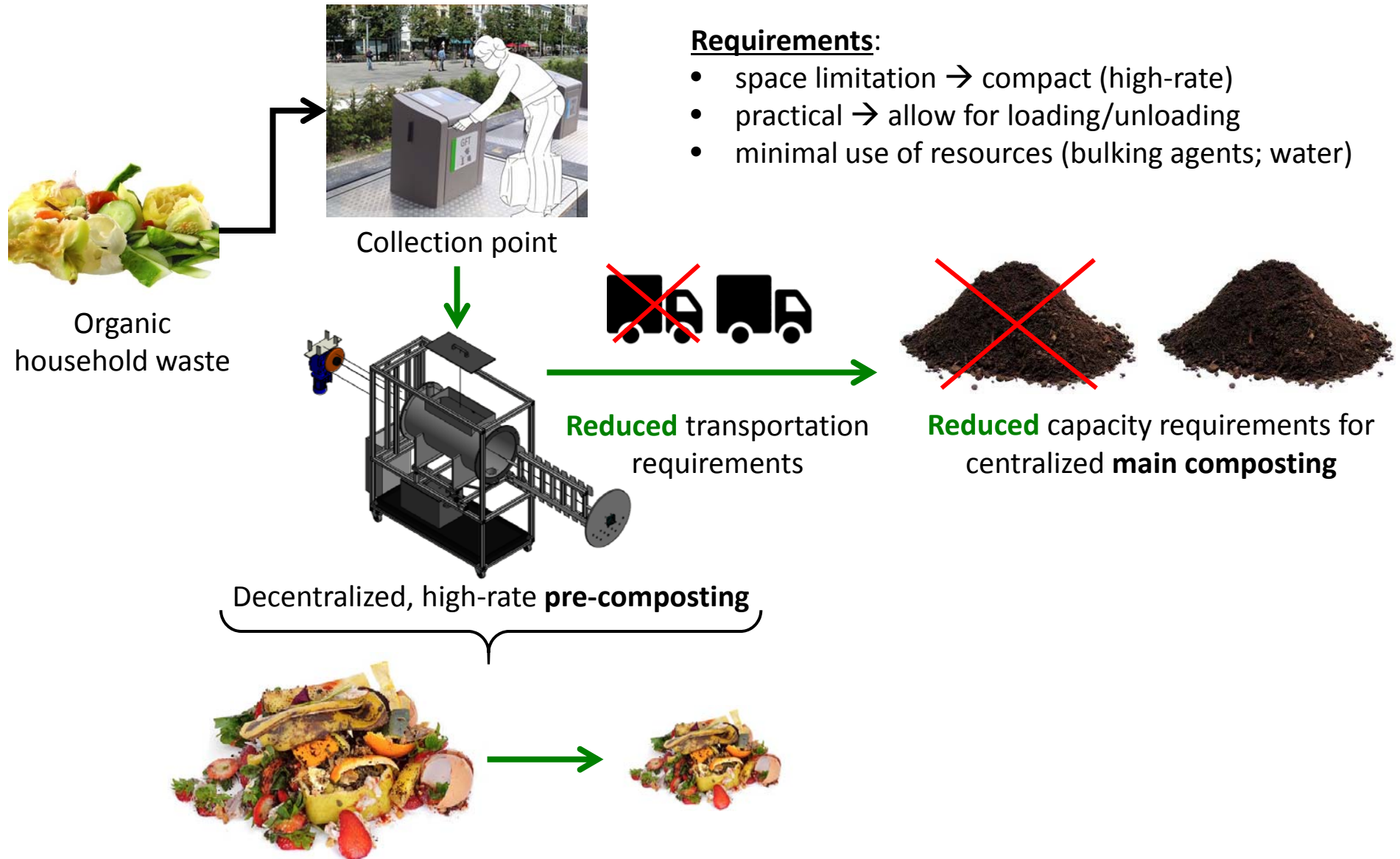


Odor



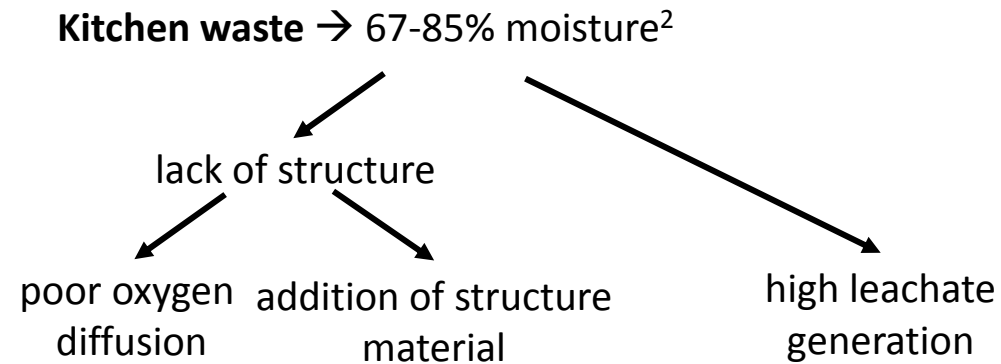
Noise

Novel organic waste flow with the Urban pre-Composter



Goal: max. mass and volume **reduction** in 2 weeks

Challenges in composting kitchen waste



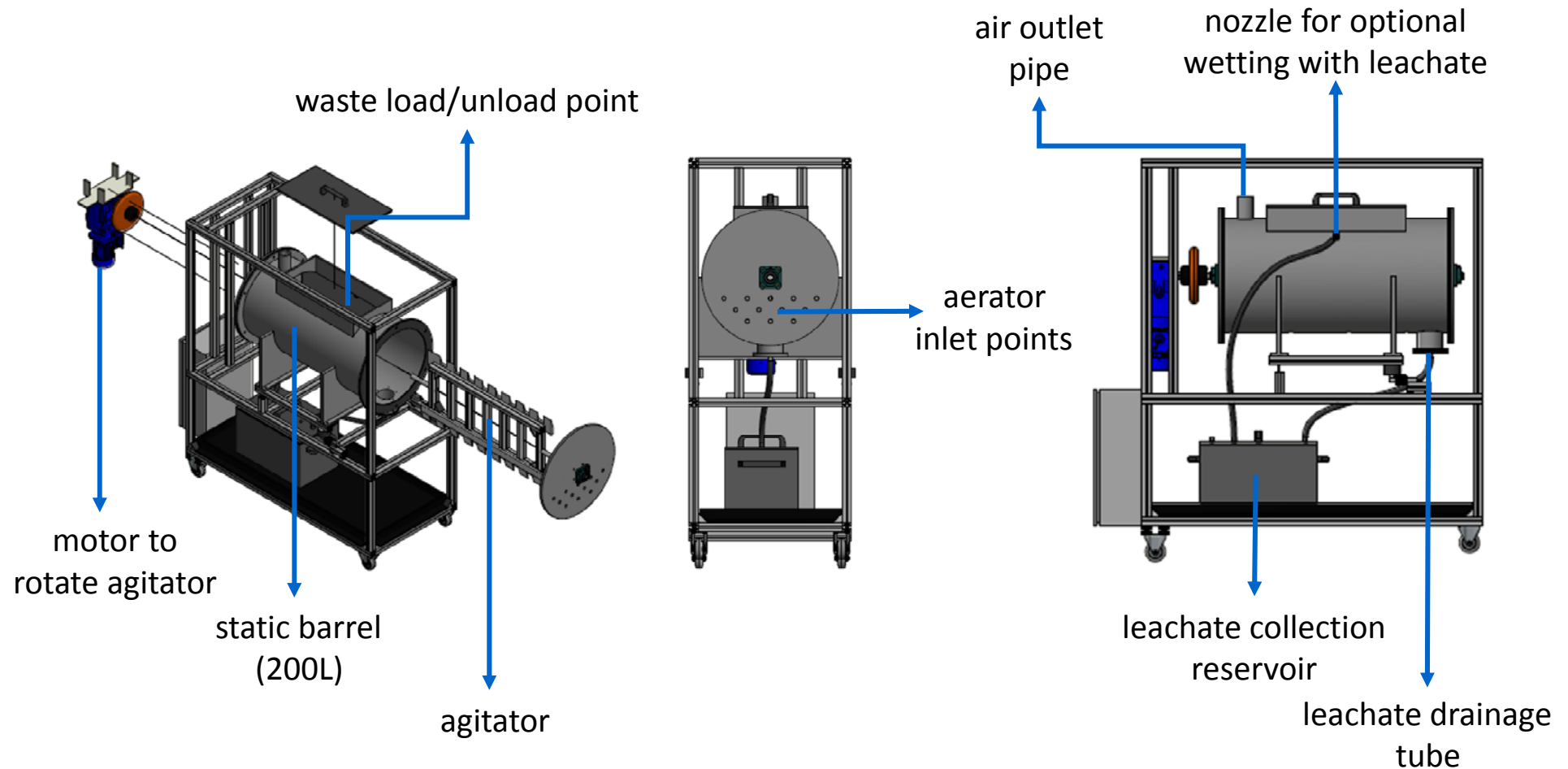
²(Nair et al. 2006); (Yang et al. 2013)
[picture from: www.thebulletingredients.com]

Research objectives

1. **Develop a prototype Urban pre-composter and validate achievable mass and volume reduction of kitchen waste**
2. Extrapolate to efficiency gains in the overall kitchen waste treatment (pre-composting + main composting)
3. Characterize final compost quality

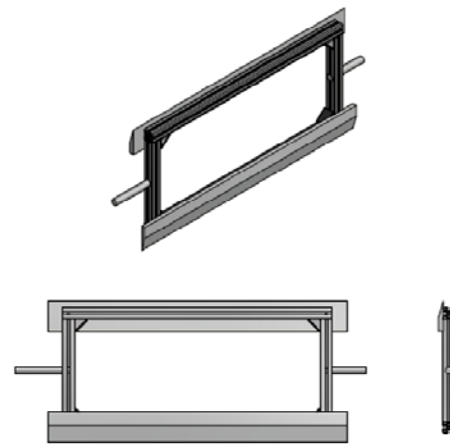
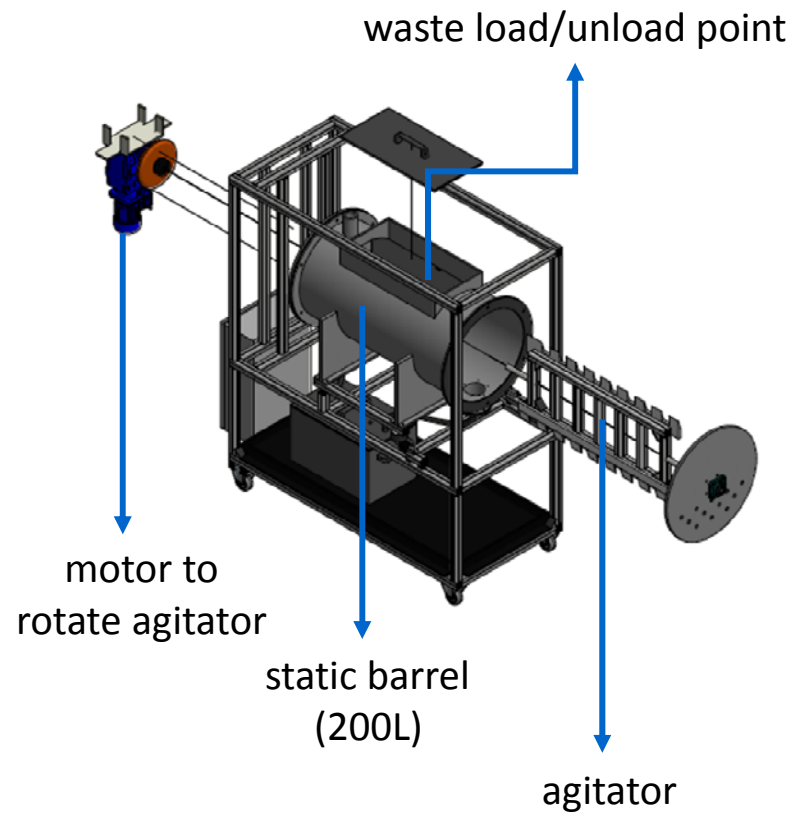


Reactor design

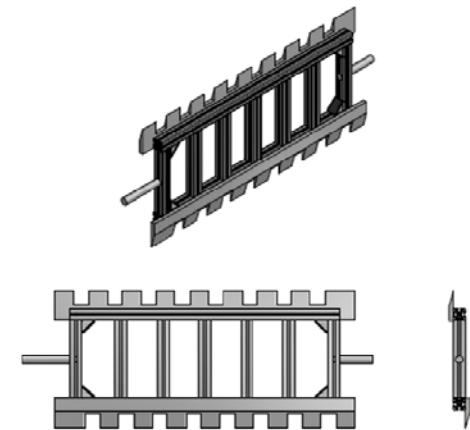


- Continuous loading drum bioreactor with forced aeration and internal agitation
- Capacity: kitchen waste from 44 persons (4.5 L/person)

Agitator design




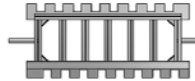
Design 1: straight scraper with internal void (Runs 1 and 2)



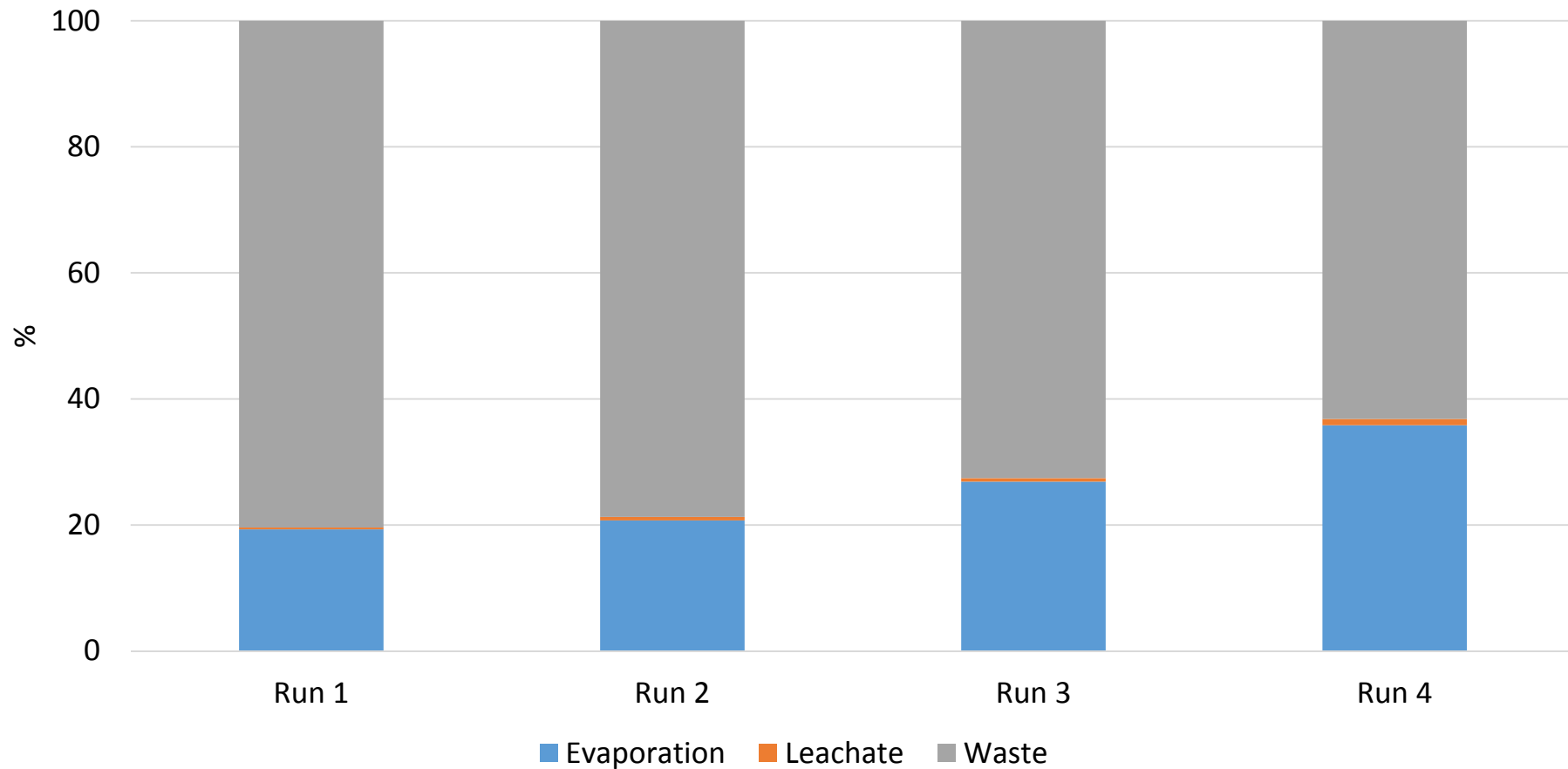
Design 2: battlemented scraper with internal bars (Runs 3 and 4)

Urban pre-composter performance



	■ Run 1	■ Run 2	■ Run 3	■ Run 4
Kitchen waste	Formulated			Real
Sawdust	No	Yes		No
Agitator design				

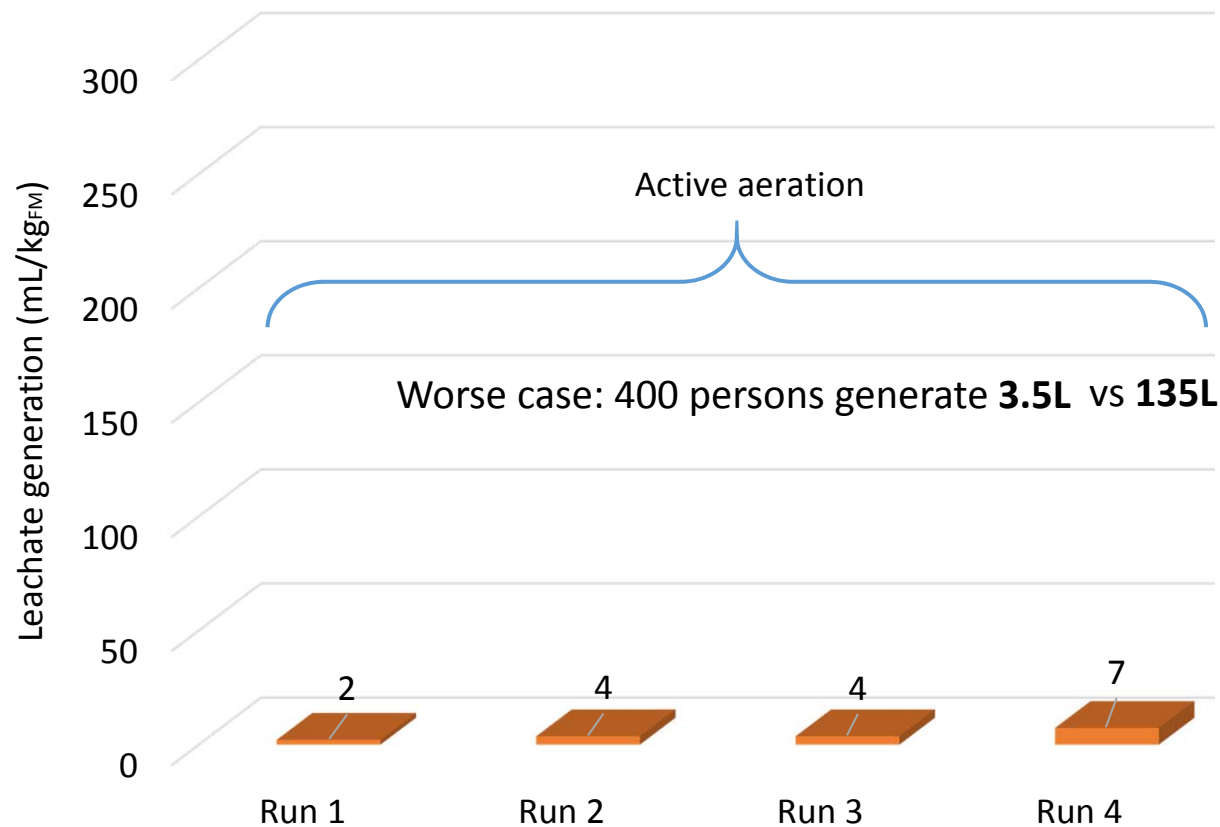
Water balance



- Minor water removal from leaching
- Moisture content 56-75% → above 55%, so no need for moistening³

³(Nair et al., 2006)

Leachate generation



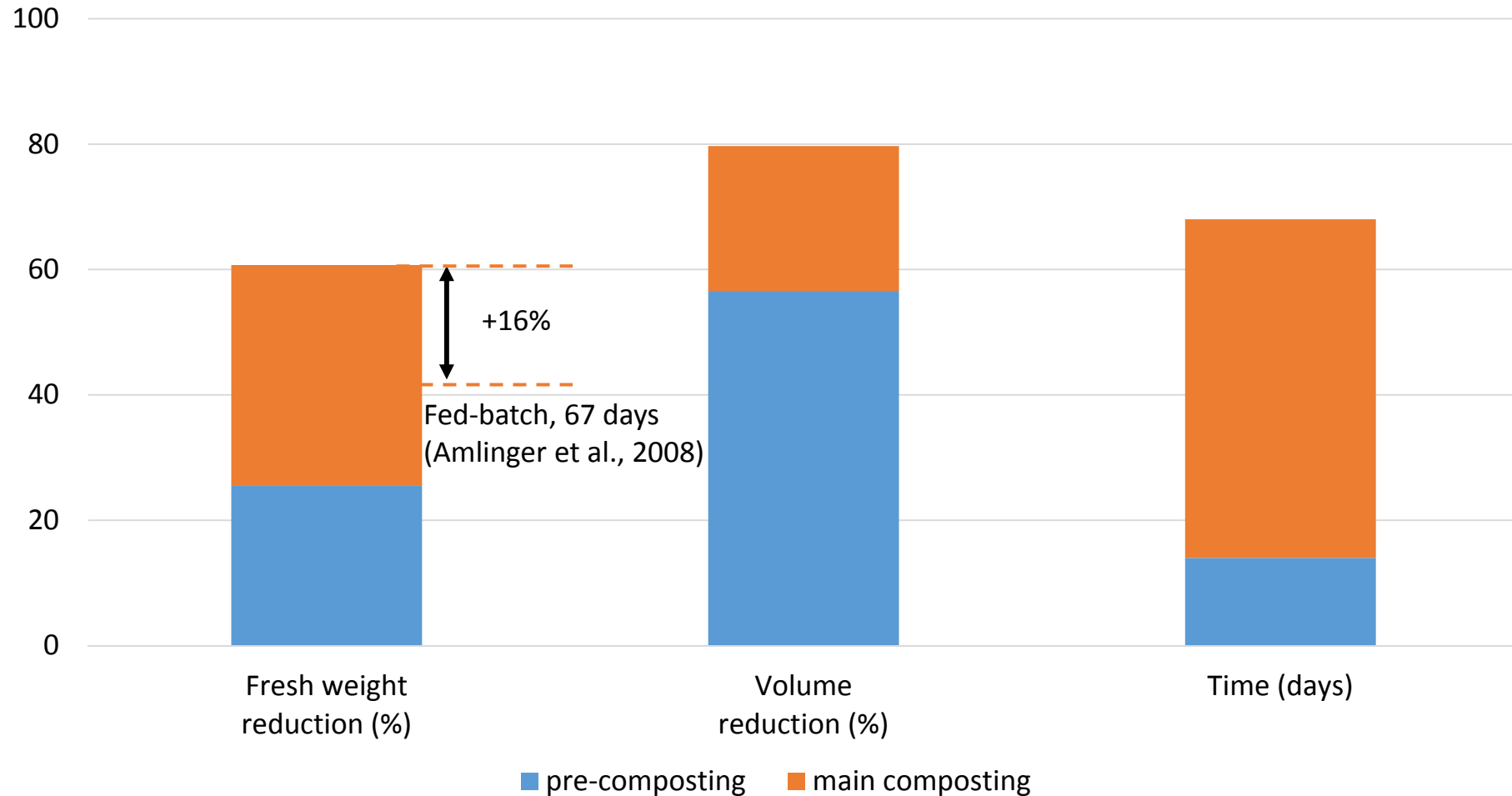
- Low amounts of leachate
- Can be added to compost (negligible moisture content increase 0.8-1.1%) → no separate collection
- Upscaling: trade-off between energy use (aeration; evaporation) and leachate production

Research objectives

1. Develop a prototype Urban pre-Composter and validate achievable mass and volume reduction of kitchen waste
- 2. Extrapolate to efficiency gains in the overall kitchen waste treatment (pre-composting + main composting)**
3. Characterize final compost quality



Overall treatment: pre-composting + main composting



- High-rate conversions during pre-composting
- 42% and 71% of overall mass and volume reduction potential achieved in 21% of the time

Research objectives

1. Develop a prototype Urban pre-Composter, and validate achievable mass and volume reduction of kitchen waste
2. Extrapolate to efficiency gains in the overall kitchen waste treatment (pre-composting + main composting)
- 3. Characterize final compost quality**



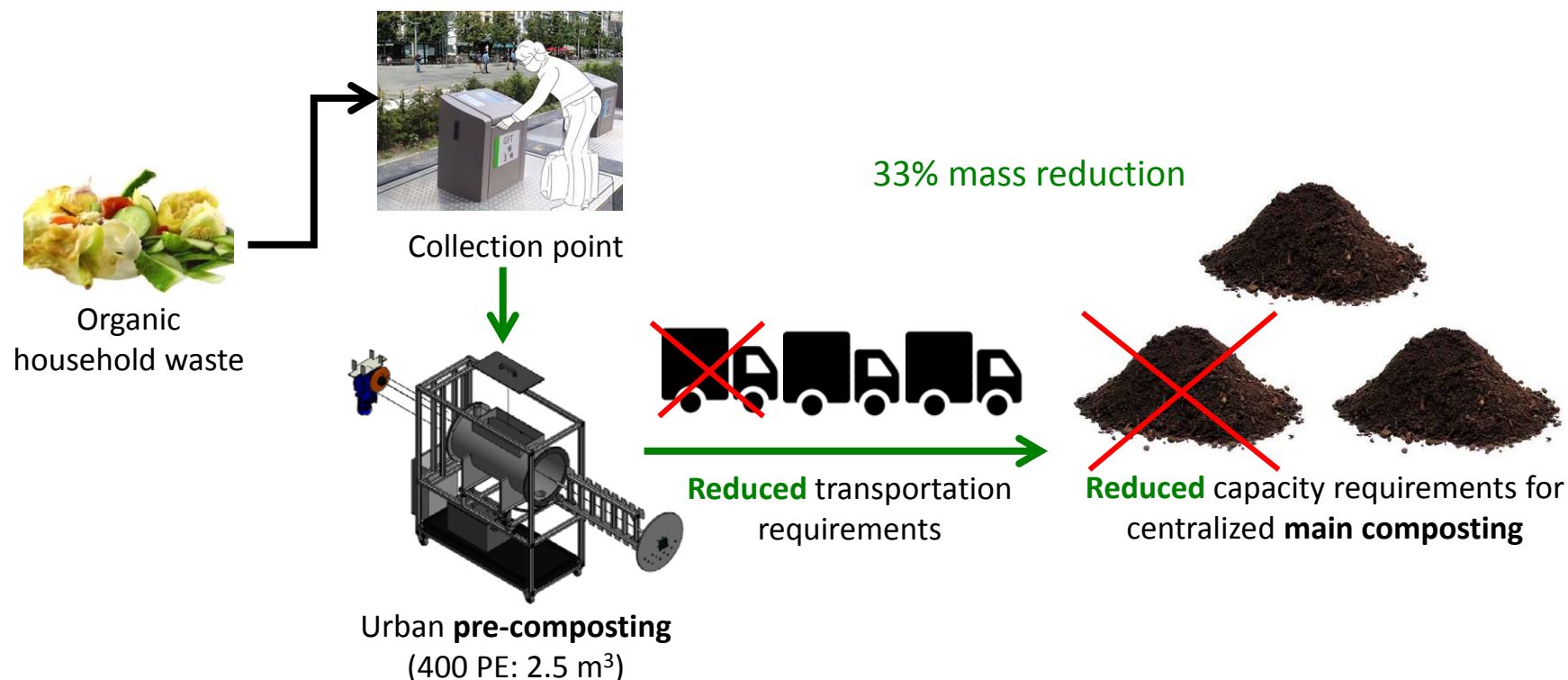
Compost quality

Parameter	Unit	Produced compost	VGF compost composition ⁴	Requirements for solid organic fertilizers ⁵
Total solids (TS)	%g _{TS} /g _{product}	26.8	70	>40
C/N	-	11.8	12	<15
N	%g _N /g _{product}	0.85	1.2	2.5
P	%g _P /g _{product}	0.13	0.13	0.44
K	%g _K /g _{product}	0.07	0.42	0.83
N/P/K	-	1/0.15/0.08	1/0.11/0.35	1/0.18/0.33

- Final moisture removal is needed
- C/N ratio indicates near mature compost after 68 days
- Good N/P ratio

⁴VLACO; ⁵(European Commission, 2016)

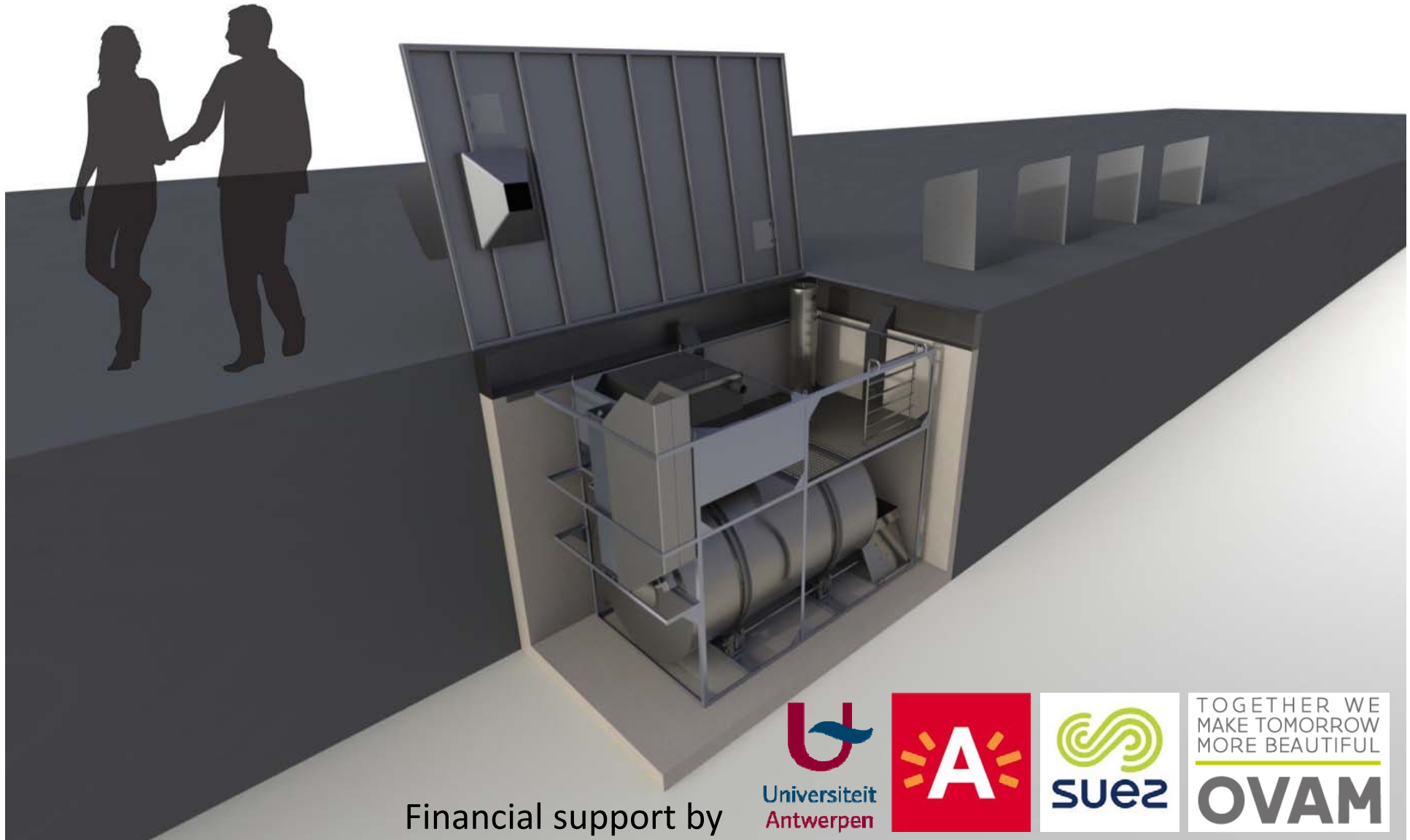
Conclusions



- Successfully **demonstration of the effectiveness and feasibility of urban pre-composting** at semi-technical scale (200L)
- No bulking agent addition, no need for separate leachate collection → **no additional cost for logistics and management**
- **42% and 71%** of the overall mass and volume **reduction potential achieved in 14 days**
- The **urban pre-composter lowers overall costs of organic waste management**

Thank you for your attention!

Myrsini.Sakarika@UAntwerpen.be – Siegfried.Vlaeminck@UAntwerpen.be



Financial support by



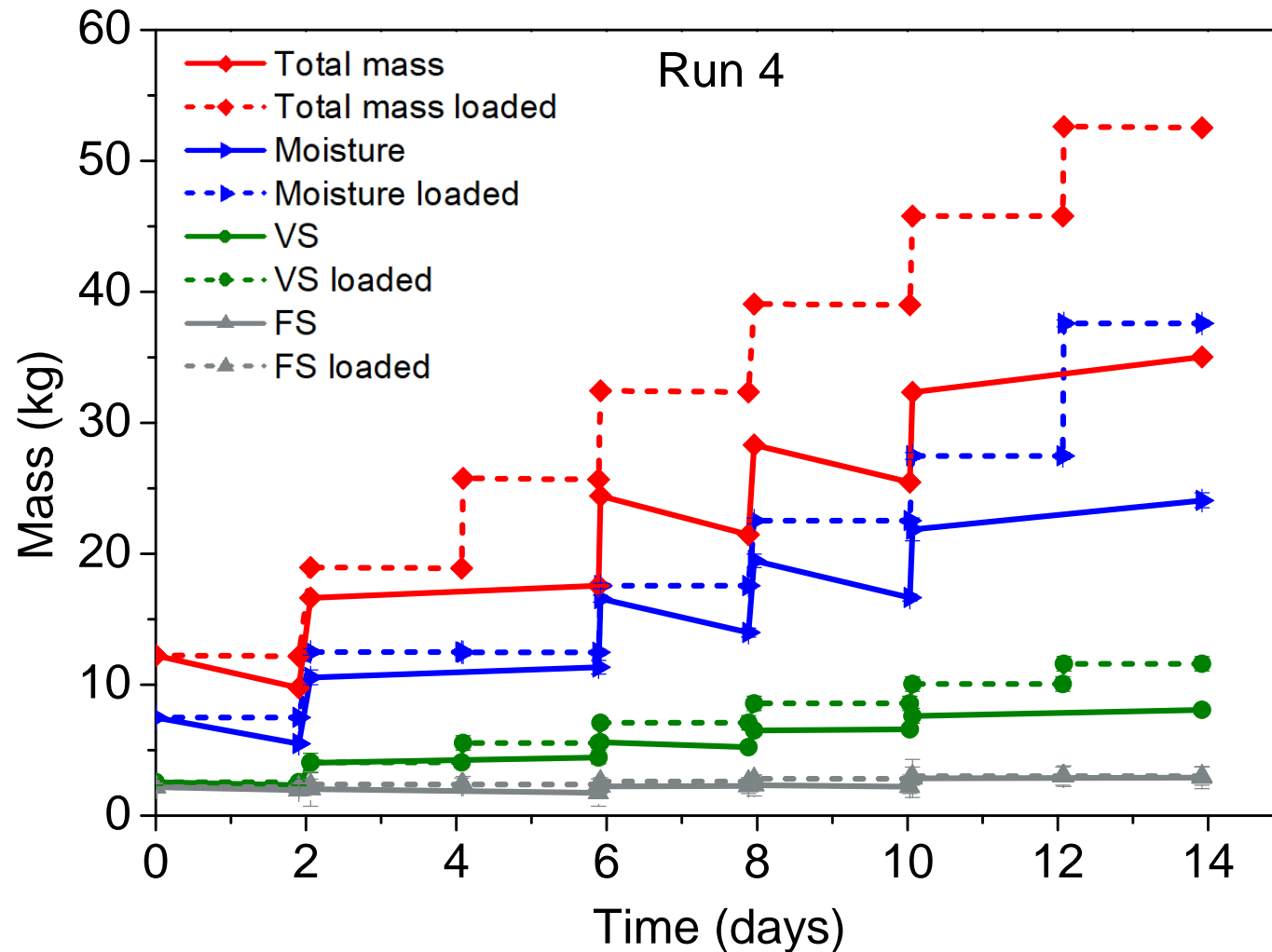
Back-up slides

Neighborhood level waste collection



Sorting streets for 400 persons (250 families)

Composting of real kitchen waste



Mimicking of realistic feeding (fed-batch) → not full reduction potential (compared to batch process)