Centre of Environmental Research

Waste Management, Circular Economy and Environmental Security

1.F National circular economy monitoring

Environment - Environment for Life
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Contribution of waste flow modeling based on historical data

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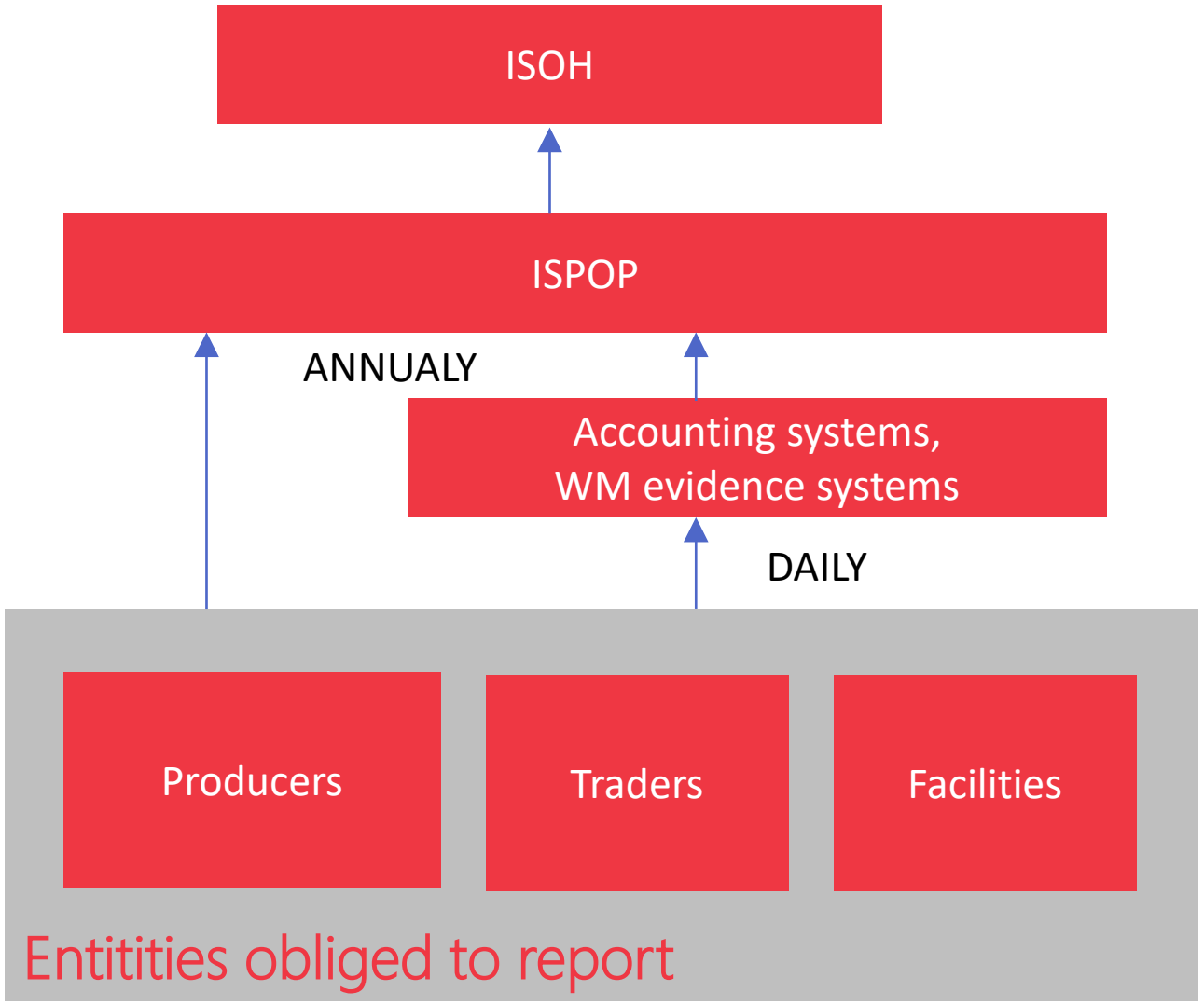
Work Package 1F Introduction

- Effective waste management and circular economy-related data processing and analysing
- Application of advanced mathematical models
- Calculation tools creation
- Contribute to the transition of the sector from linear waste management to circular economy

Reporting system in the CZE

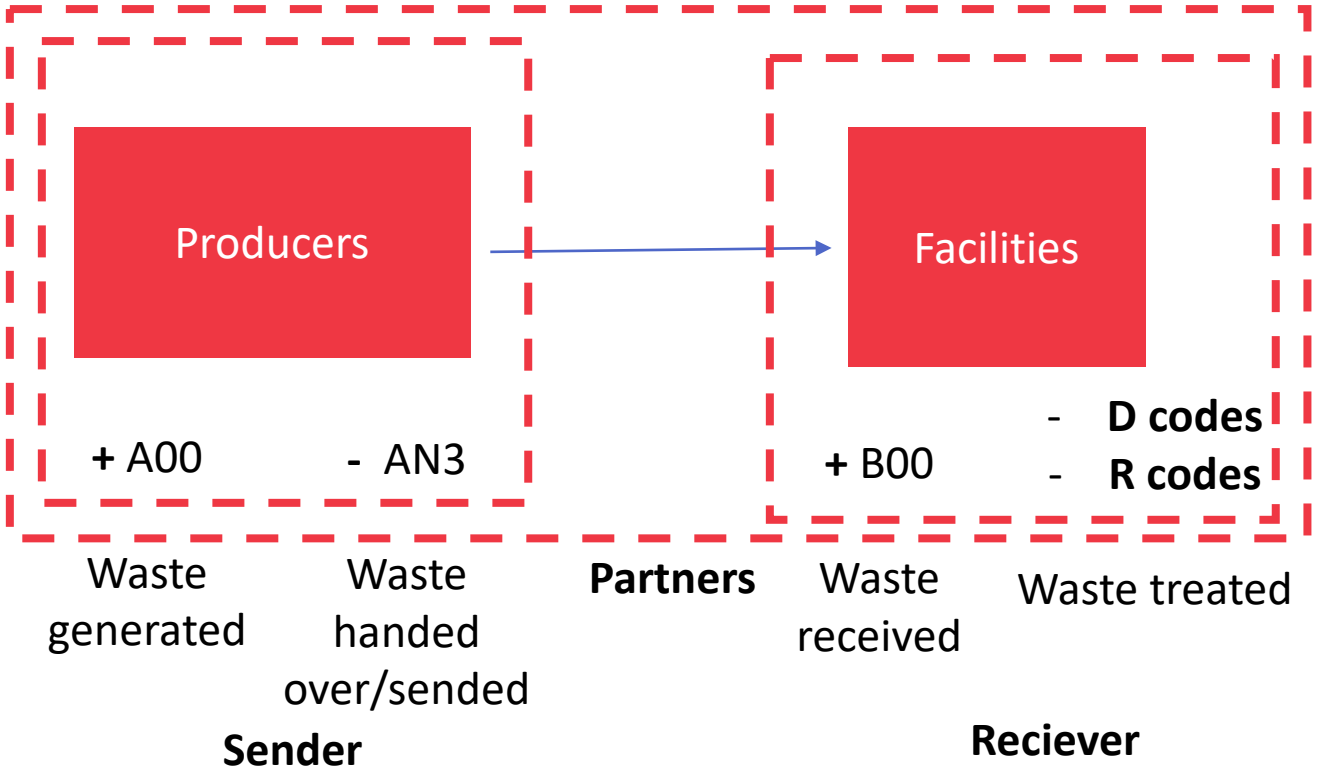
- ISOH (Integrated system of waste management)
- ISPOP (Integrated reporting system for environmental issues)
- Commercial software (daily agenda, accouting)



Reporting waste data in the CZE

- "Double-entry accounting"

- Repeated for specific waste code

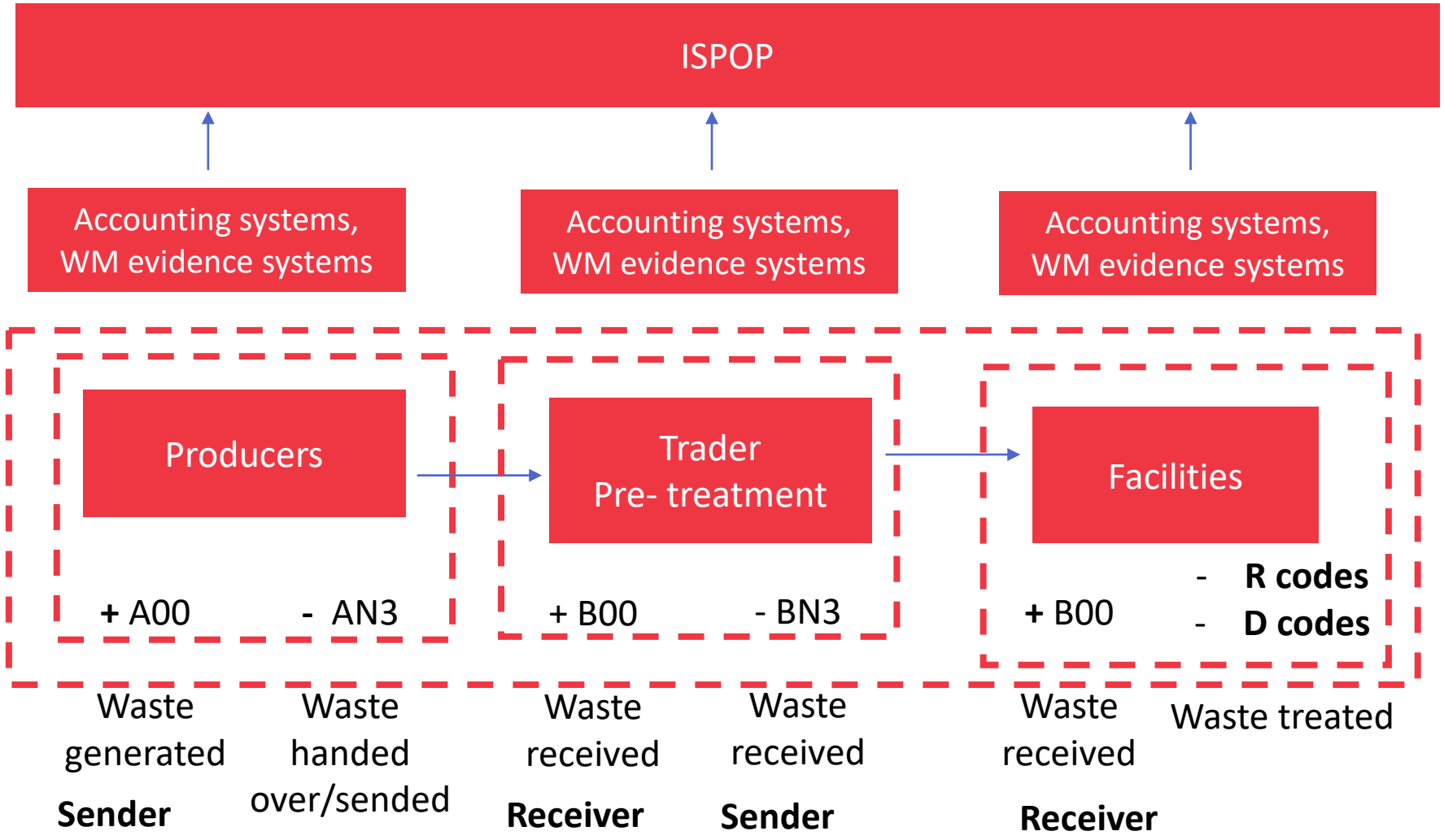


D,R codes according to 2008/98/EC, Annex I and II (R1 Waste to energy, D1 – Landfilling, etc.)

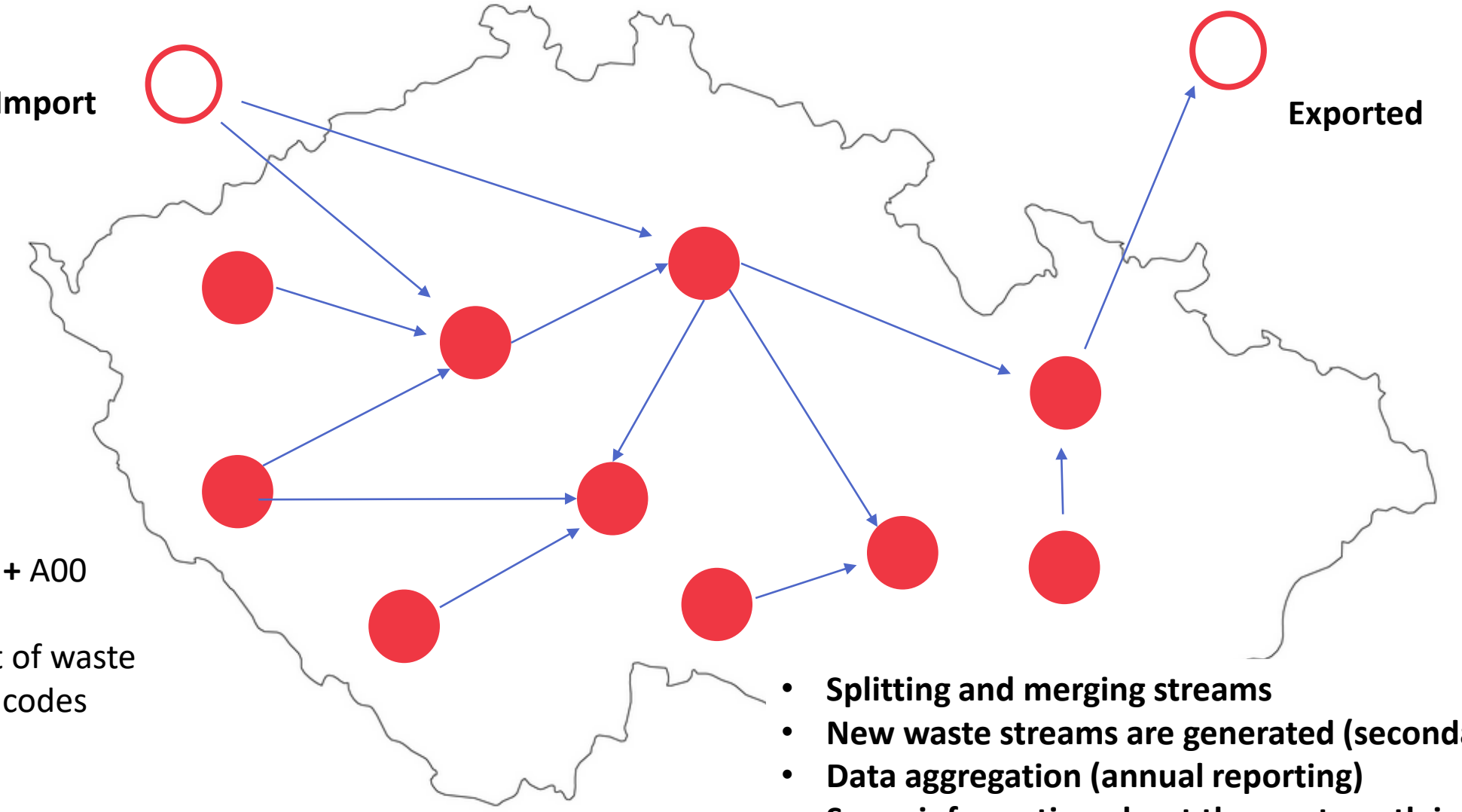
Mass balance could be checked for various boundary systems

Annual reporting through ISPOP

- Aggregated transactions
- Mass balance revisions in ISPOP
- Reporting on a daily/batch basis



Treatment balance - CZE



Recovered amounts (R codes)

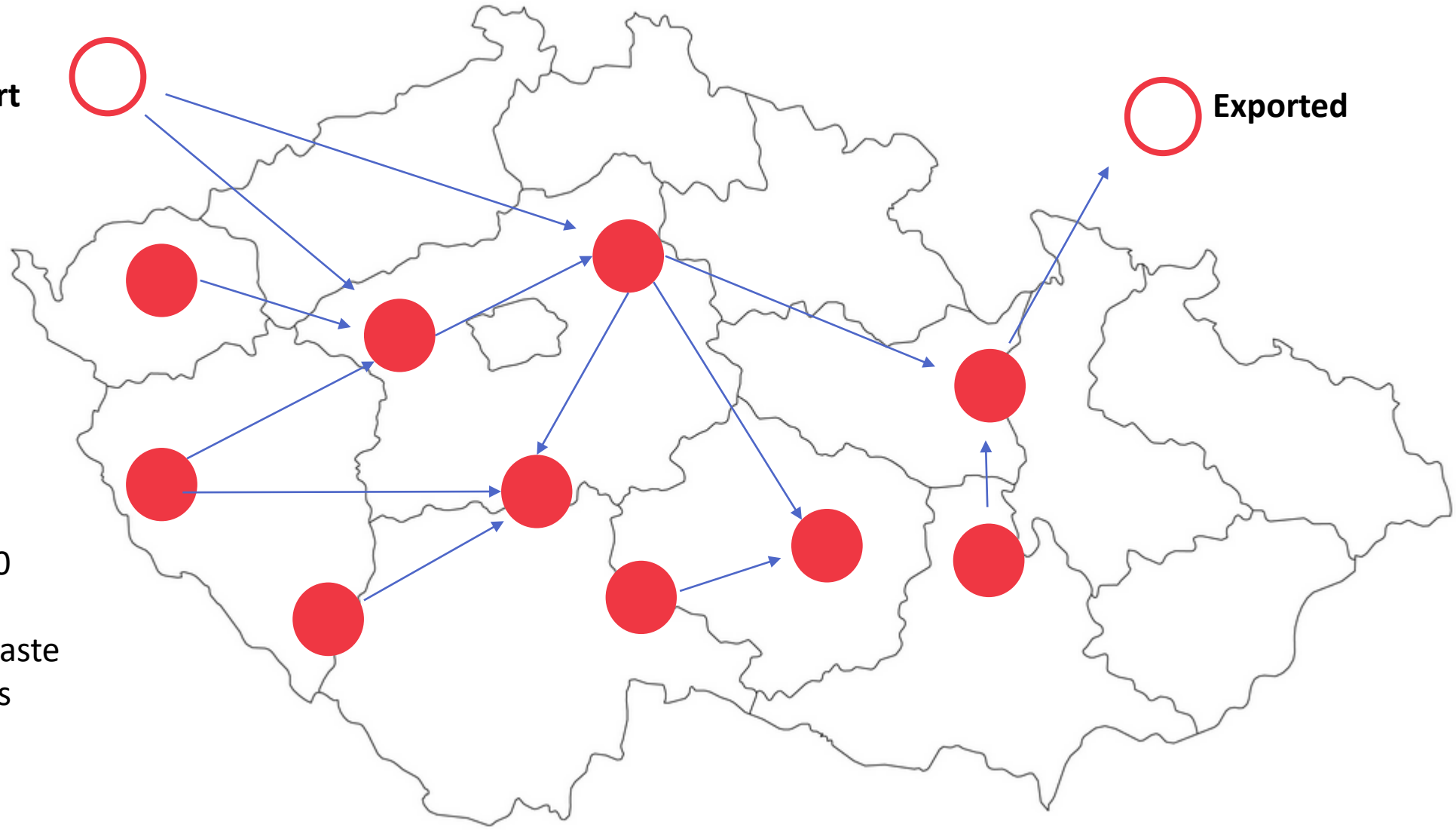
Disposed amounts (D codes)

+ A00

List of waste codes

- **Splitting and merging streams**
- **New waste streams are generated (secondary waste)**
- **Data aggregation (annual reporting)**
- **Some information about the waste path is lost**

Treatment balance – regions, microregions



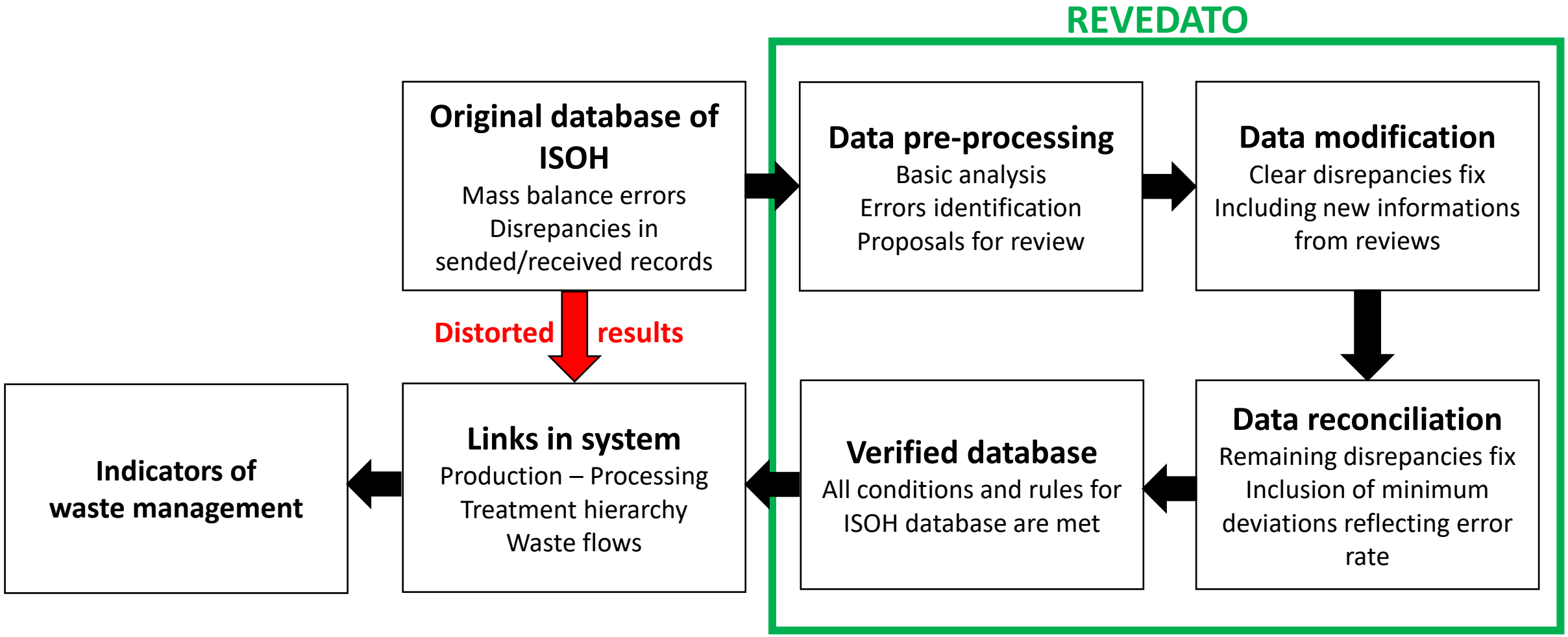
Goal of modelling

- Utilise data to model movement of waste inside the CZE
- Understand the processing chain of specific waste types
- Evaluate current rates of recovery/disposal for specific waste types and regions
- Development of future scenarios
- Necessary input for waste management planning and policies development

⇒Fixing procedures = Less error rate => better estimates and plans for future

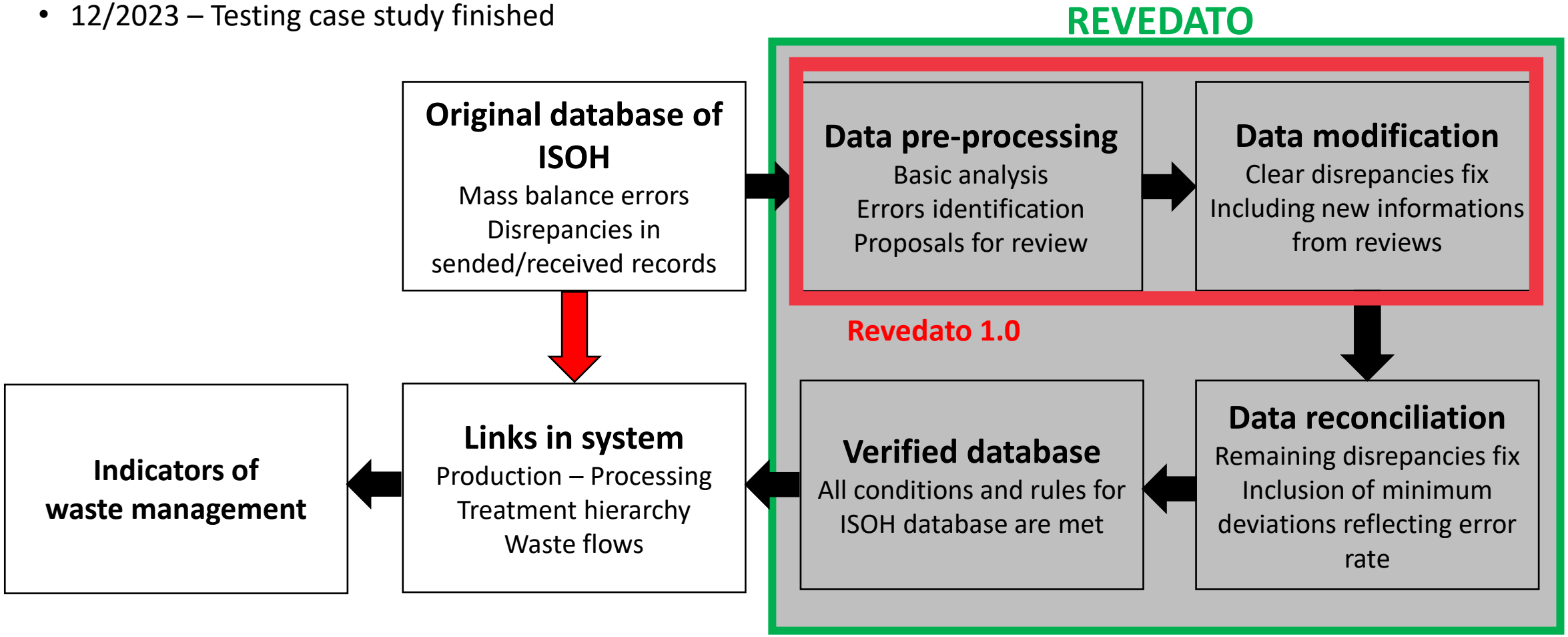
⇒Information about data credibility => big error leads to necessity of various scenarios

REVEDATO: Structure of proposed system



REVEDATO – Milestones WP1F

- 3/2023 – SW application finished (Revedato 1.0)
- 12/2023 – Testing case study finished



Preliminary results for specific waste streams

Waste code: **190805**
Sludge from wastewater treatment

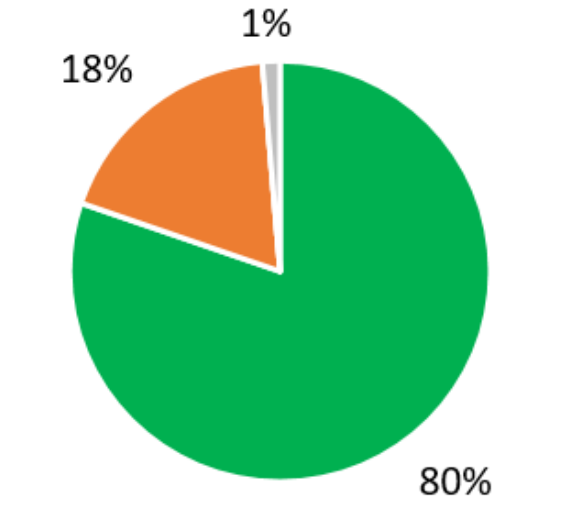
In cooperation with **WP 1.C**

Sludge management codes

			Amount of waste [kt]
Generation: plus sign in mass balance			
Production	A00, BN30, XN60	**A = Own waste**	766
Unload from storage	C00	**B = Somebody else's waste**	175
Import from foreign countries	BN6, BN16	**C = Waste from own storage**	0
Other	BN40, XN50	**X = Any of A/B/C**	13
Transport: Receiving waste	B00		1065
Treatment: minus sign in mass balance			
Material recovery	XR2, XR3, XR4, XR5, XR6, XR7, XR8, XR9, XR10, XR11, XR12 XN1, XN8, XN11, XN12, XN13, XN15		724
Energy recovery	XR1		10
Incineration	XD10		3
Landfilling	XD1, XD5, XD12		2
Other placement	XD3, XD4		0
Export to foreign countries	XN7, XN17		0
Waste stowing	XN5, XD15, XR13		205
Other	XD2, XD8, XD9, XD13, XD14, XN9, XN14, XN18, XN53, XN63		27
Transport: Sending waste	XN2, XN3, XN10		1048

Management, country

Generation

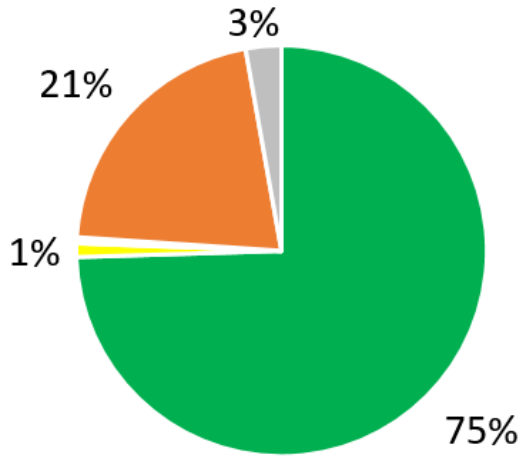


- Production
- Unload from storage
- Import from foreign countries
- Other

≠

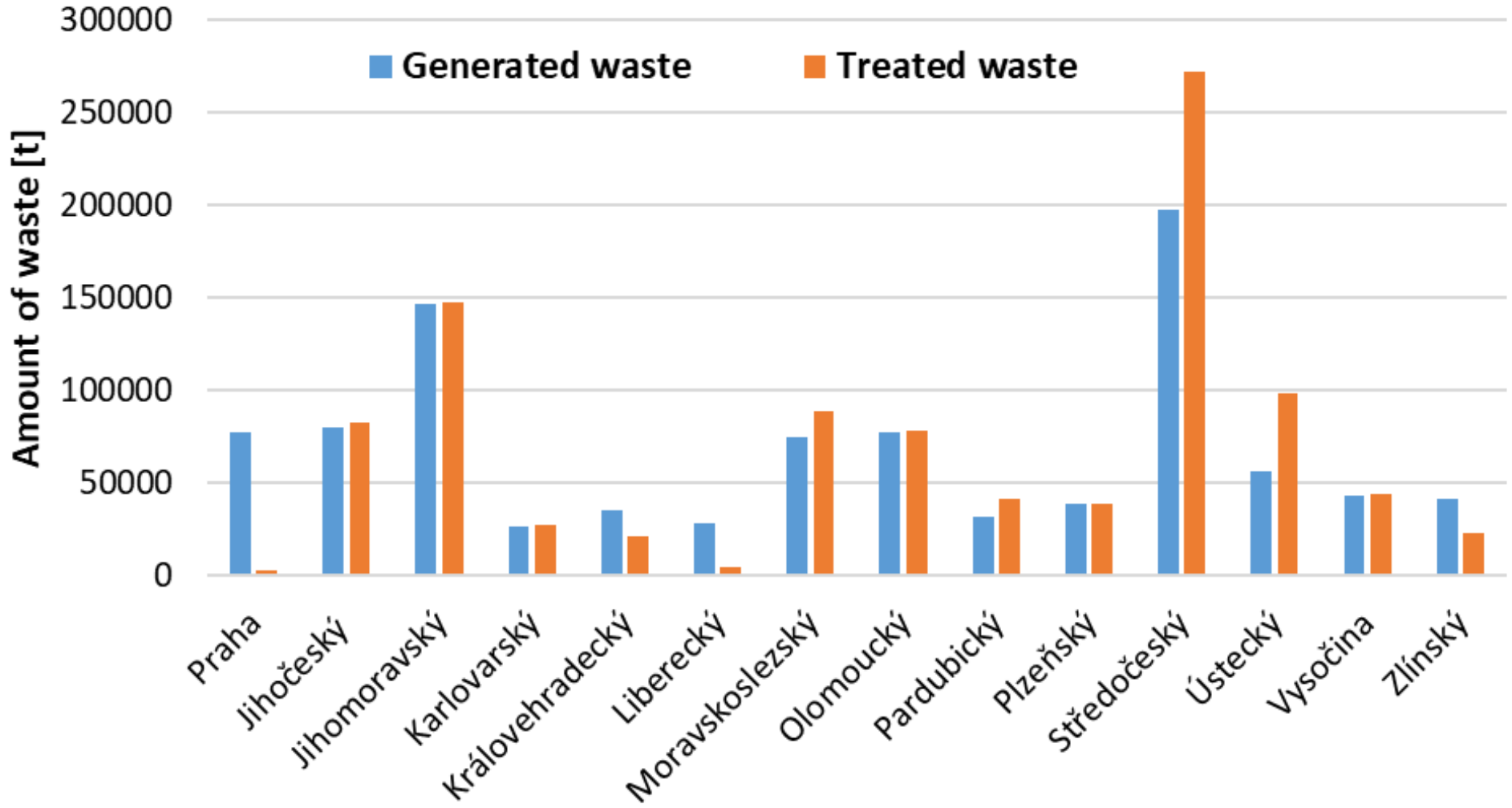
954 kt vs 971 kt

Treatment



- Material recovery
- Energy recovery
- Incineration
- Landfilling
- Other placement
- Export to foreign countries
- Waste stowing
- Other

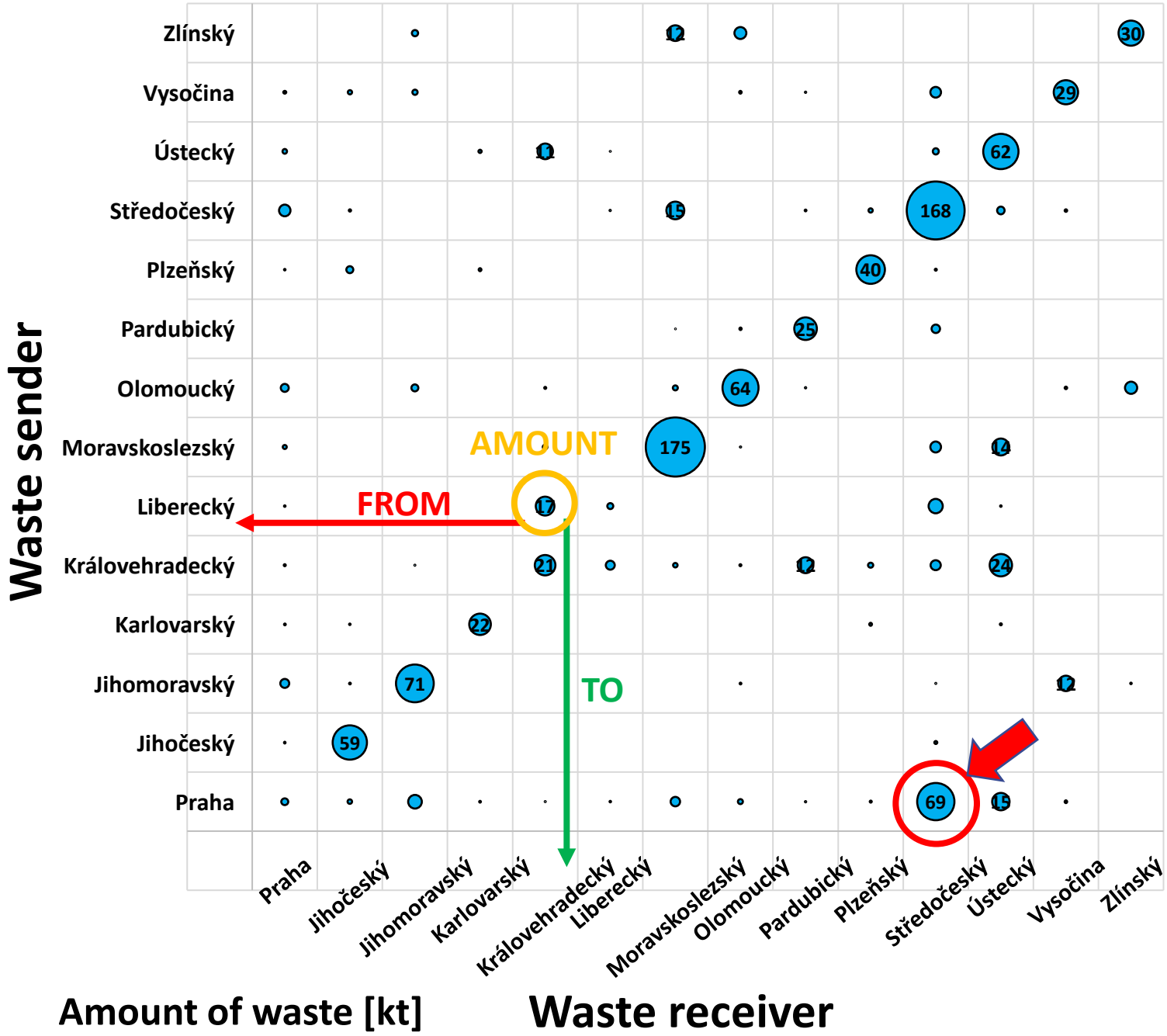
Management, regions



=> Waste transportation between regions

Transportation between regions

- **Diagonal predominate**
  - Most of generated waste stays in the region of origin
- **Capital city Prague**
  - Transport to adjacent region



CEVOOH

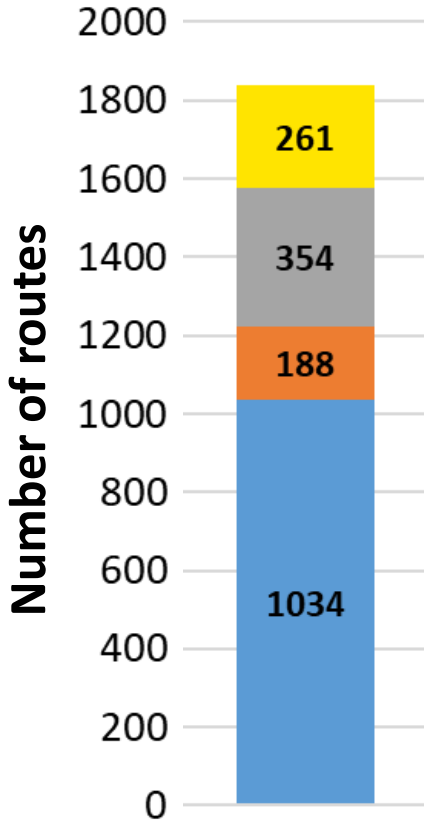
Analysis of mass balances

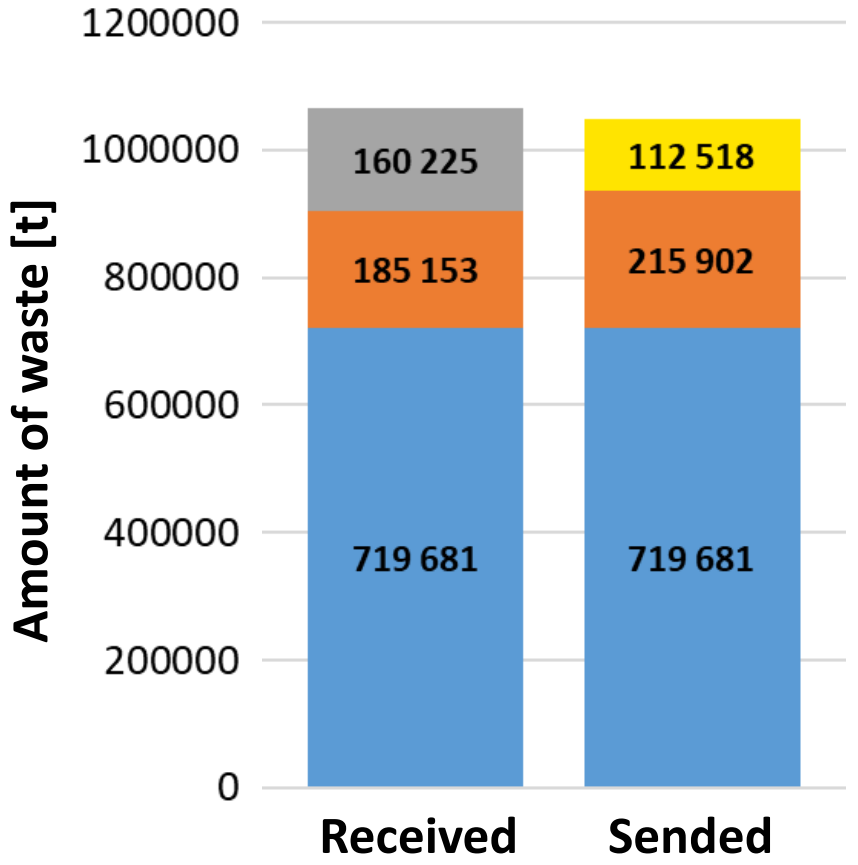
- Difference between production and processing in whole system: **17 kt / 2 %**
  - More treated waste than produced => treating waste with no origin
- Cumulative mass balance error in municipalities: **0 kt / 0 %**
  - Production + received waste = Processing + sended waste
- Cumulative mass balance error in storing waste: **0.1 kt / 0 %**
  - Difference between stored waste in previous year and waste in storage in analyzed year
- Cumulative mass balance error in waste pre-processing: **144 kt / 15 %**
  - Duty to report waste generation with code **BN40**
  - Could be reported to another waste catalogue number
- Cumulative mass balance error in transport: **234 kt / 25 %**
- Cumulative mass balance error in own transport: **34 kt / 4 %**

46 %

Waste transit: Discrepancy (original data)

1. **Correct reports**
   - Paired records with same amount
2. **Reports with different amount**
   - Paired records with different amount
3. **Missing sending record**
   - No record match, only received is in database
4. **Missing receiving record**
   - No record match, only sended is in database



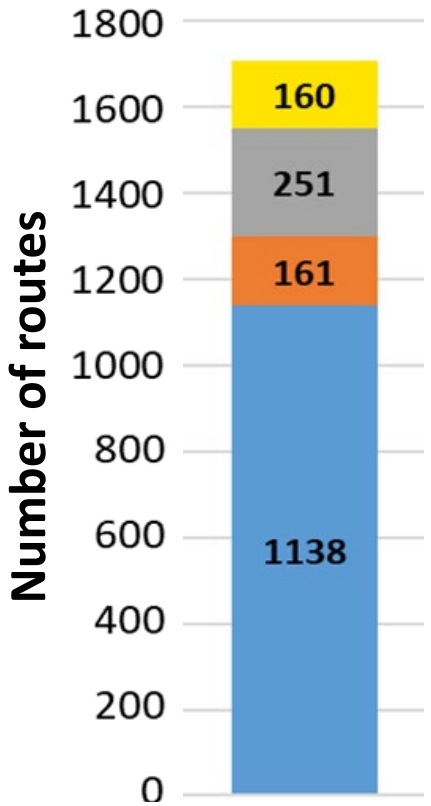


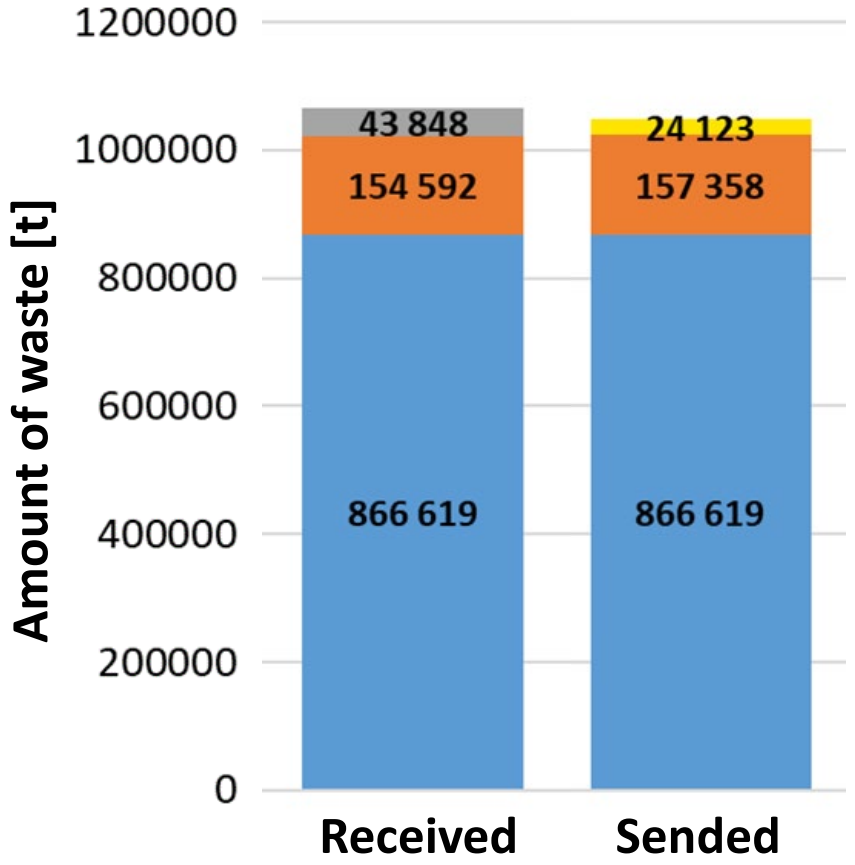
33 % with errors

CEVOOH

Waste transit: Discrepancy after pre-processing

1. **Correct reports**
   - Paired records with same amount
2. **Reports with different amount**
   - Paired records with different amount
3. **Missing sending record**
   - No record match, only received is in database
4. **Missing receiving record**
   - No record match, only sended is in database





33 % => 19 %

Almost 50 % fixed

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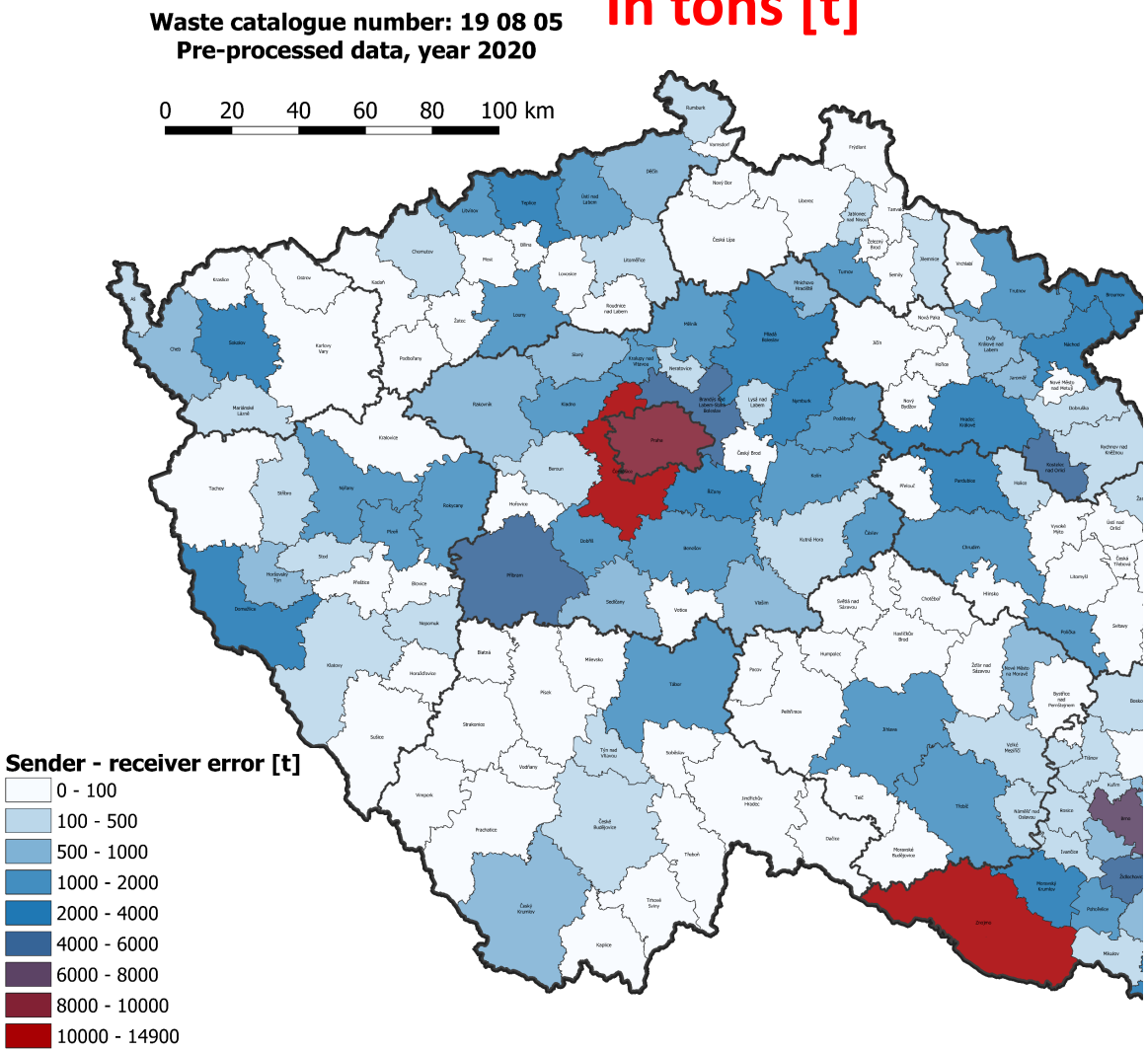
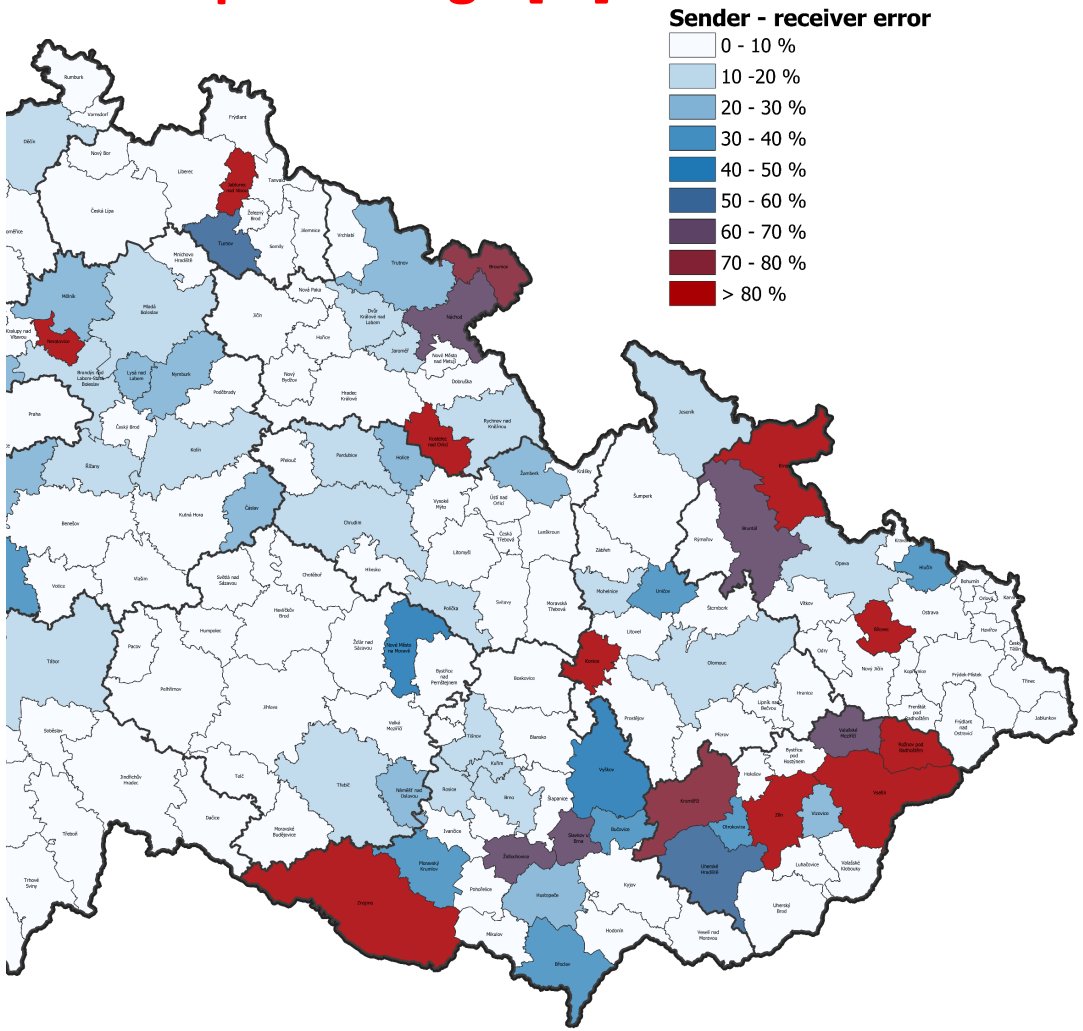
Discrepancy sender – receiver in maps

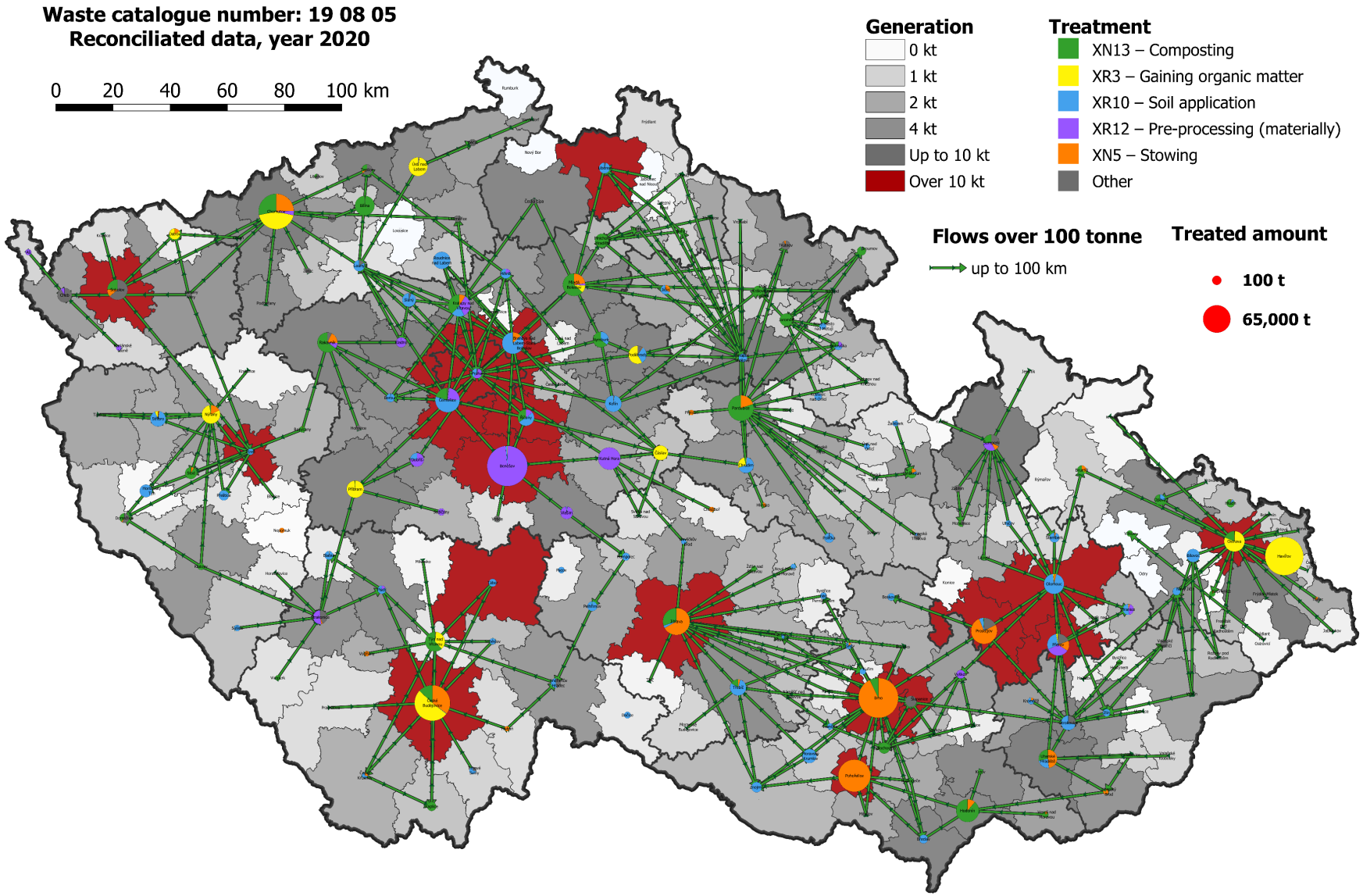
In tons [t]



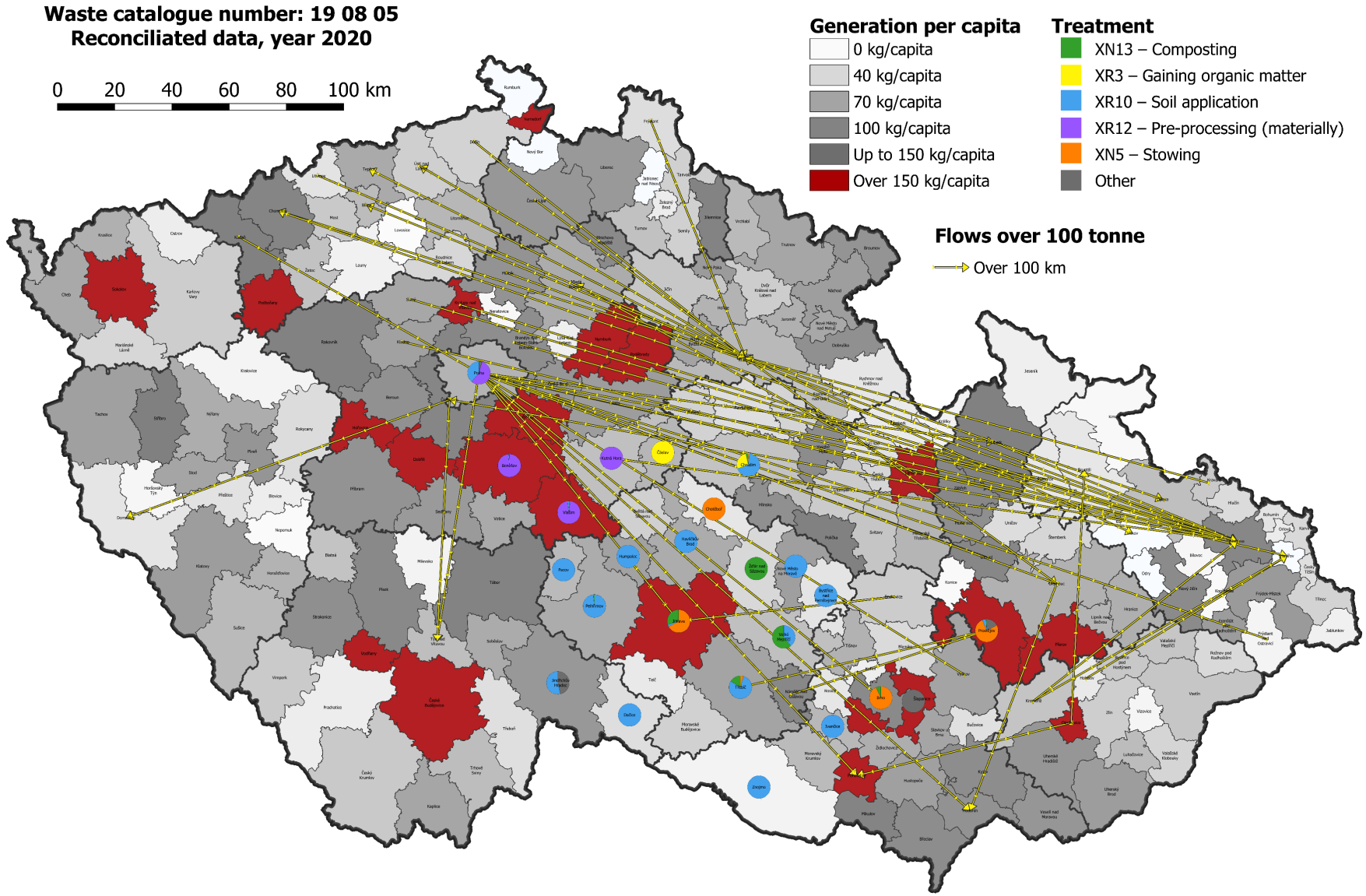
In percentage [%]



Transport and treatment (1)



Transport and treatment (2)



Conclusions

- A computational tool for modelling waste flows based on historical data has been proposed.
- A first stage of the tool, which checks the mass balances of transactions between senders and receivers has been implemented
- The tool has been tested for specific waste stream – sludge from waste water treatment.