

RFID JOURNAL LIVE!

MAY 9-11, 2023 | ORLANDO, FLORIDA

Waste Collection 4.0

- Kåre Edvardsen
- Director Waste Collection – Halden Municipality

- Waste Collection yesterday – today – tomorrow
- Reasoning, Benefits and results



Halden municipality

- Approximately 31.000 inhabitants
- 30 largest municipality in Norway
- 13.000 house holds
- 26.000 waste bins with UHF RFID tag
- 300 large containers with level measurement sensors.



Waste collection in Norway 1950

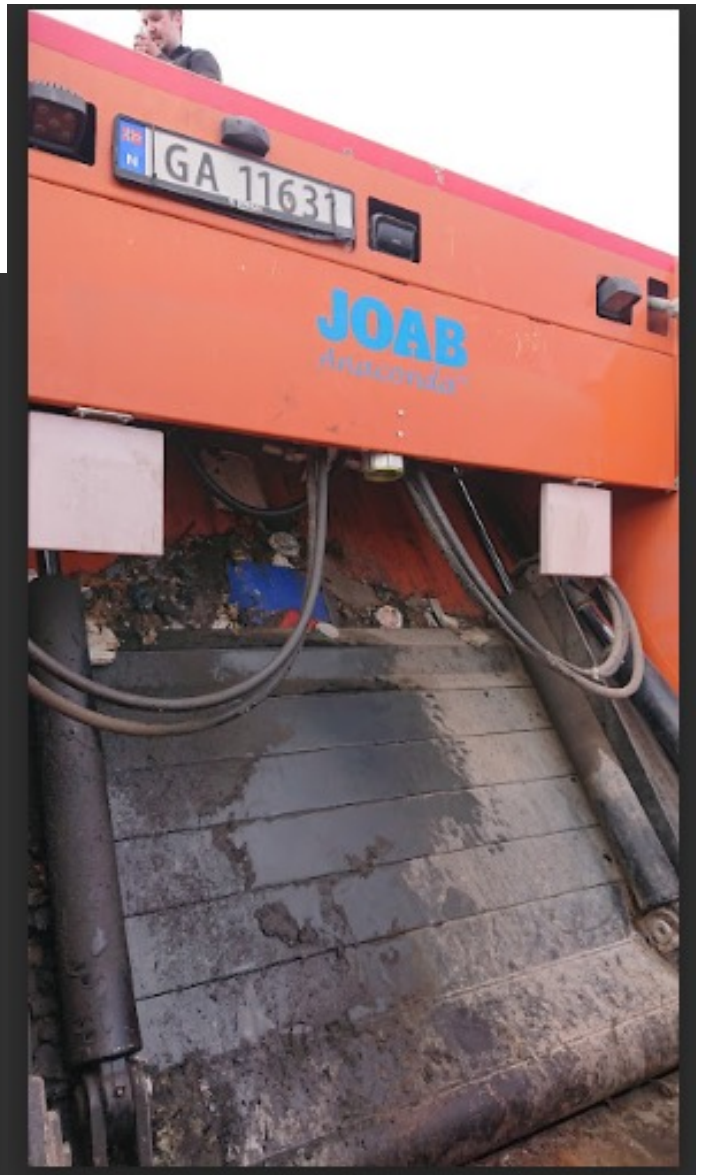


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Waste collection 2022->



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Challenges – identified and solved

- Transition from into data capture from waste collection
- Leverage sensor data to monitor circular performance
- Leverage sensor data to meet legislation to come.

2016 - challenges identified

- Bad data
 - Do we actually have control?
 - Does every household with waste bins pay fee?
 - Does every household that pays fee have waste bins?
 - Do we pay for more emptied bins than actually emptied?
 - Do we empty bins twice when complaints are received?

15.05.2023

2016 - challenges identified

- Bad data
 - Do we actually have control?
 - Does every household with waste bins pay fee?
 - Does every household that pays fee have waste bins?
 - Do we pay for more emptied bins than actually emptied?
 - Do we empty bins twice when complaints are received?



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2016 – some facts discovered

- Bad data
 - Do we actually have control?
 - Does every household with waste bins pay fee?
 - Fact: 700 did not
 - Does every household that pays fee have waste bins?
 - Do we pay for more emptied bins than actually emptied?
 - Fact: 1500 more than there was actual subscriptions.
 - Do we empty bins twice when complaints are received?
 - Fact: we think so

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2017 -> preparing for data collection

- **Choosing the data collection infrastructure**
 - RFID: yes

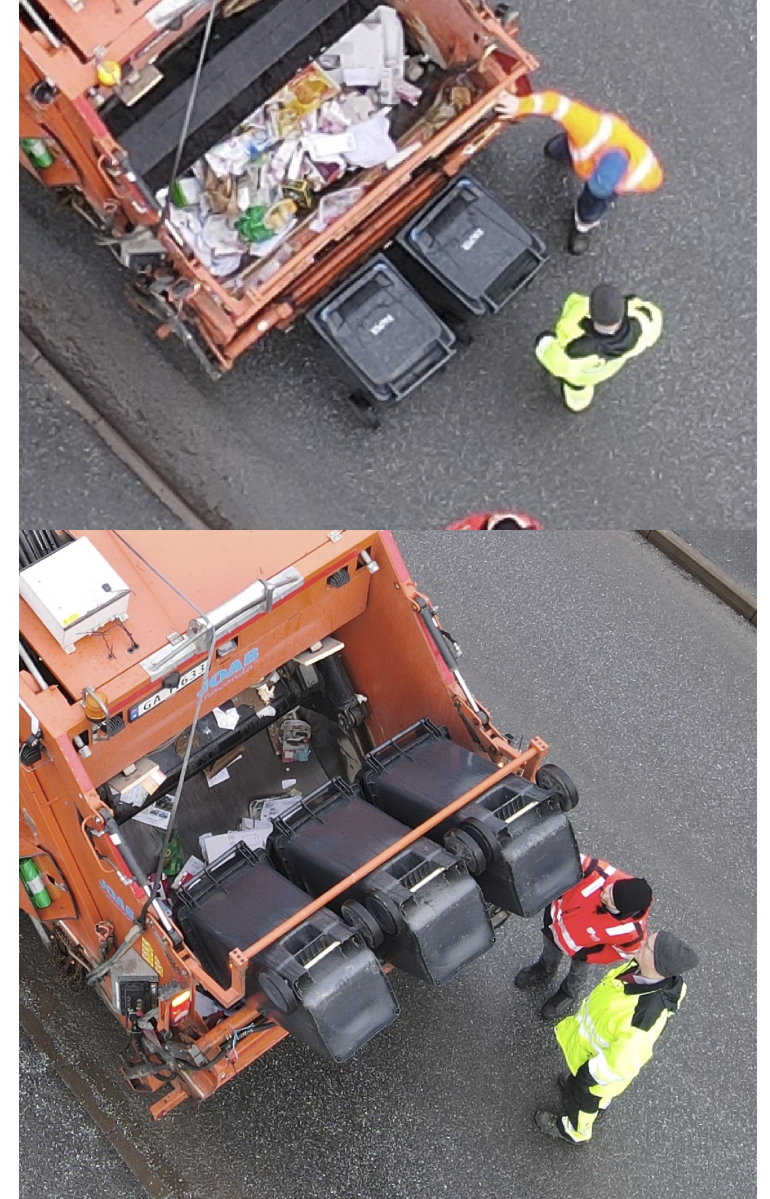
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LF or UHF

- Most waste collection happens without RFID
- If RFID: LF is in use
- Typically municipalities are happy with 95% read rate
- Typically waste trucks are out of service at least once per year.
- What about UHF?

UHF?

- A bachelor assignment incl. tests
 - 99-100% read rate to be expected
 - Significantly less complicated maintenance due to distance to harsh environment.
 - Significantly lower tag cost and can be placed less exposed



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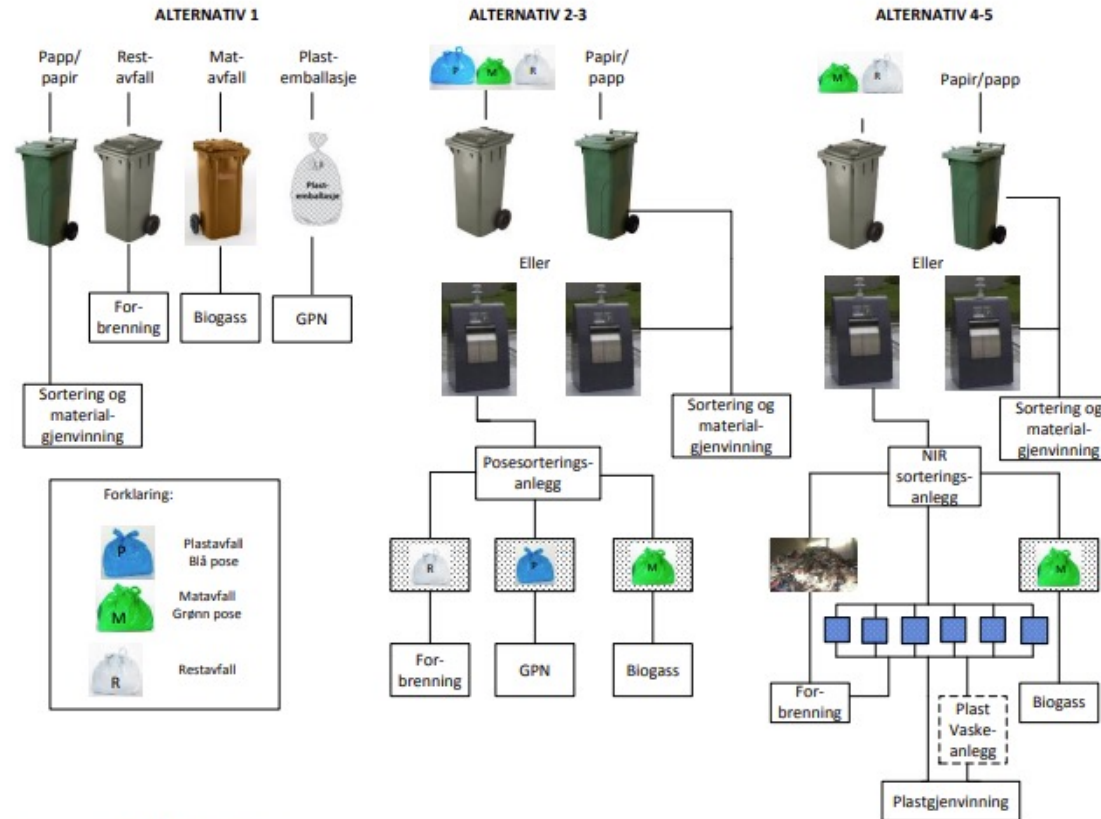
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2017 -> preparing for data collection

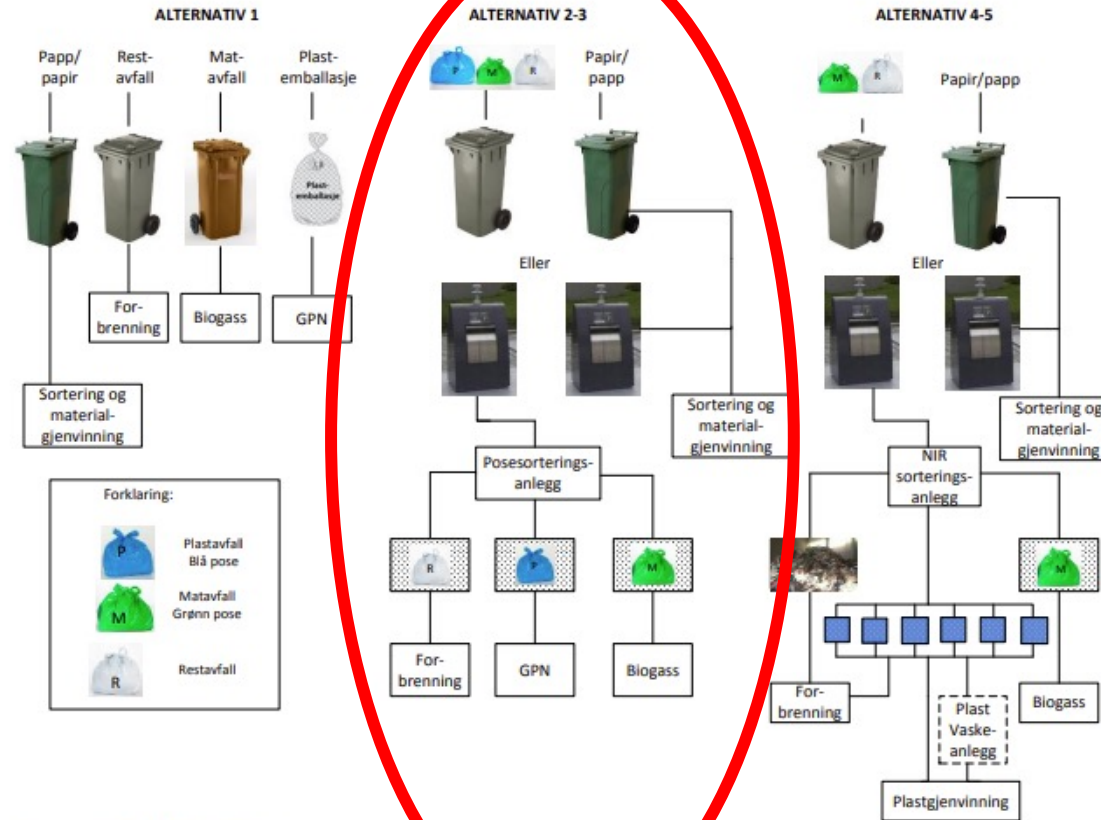
- Choosing the data collection infrastructure
 - RFID: yes
 - UHF: yes
- **Choosing the collection concept**

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Ways to collect waste



Ways to collect waste



2018 -> implementing

- UHF chosen
- GS1 GRAI codes
- GS1 QR code
 - Now Digital Link for future services
- All waste bins replaced with tagged bins



2018 -> implementing

- UHF chosen
- All waste bins replaced with tagged bins
- Trucks equipped with UHF+4G+GPS.
 - Prepared for camera.

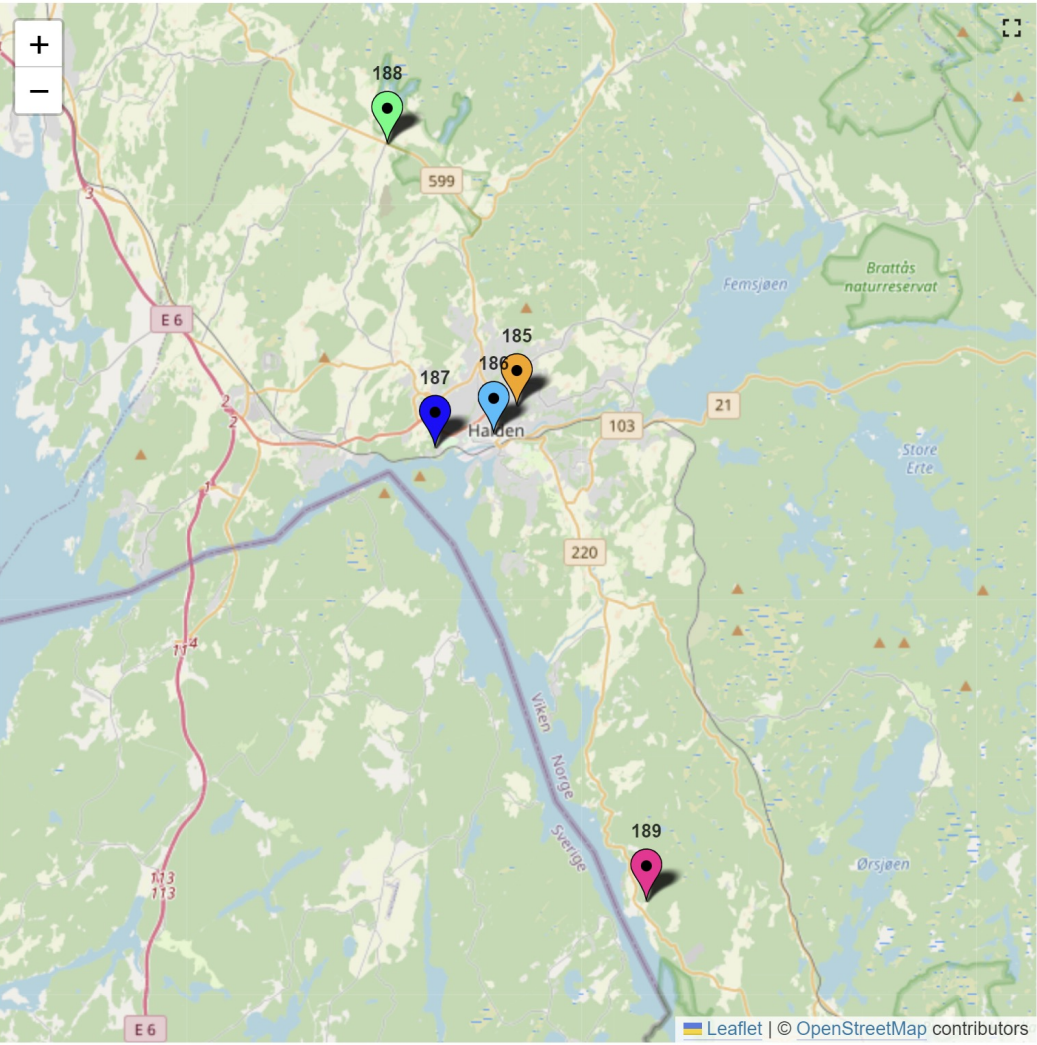


Technology

- RFID box for truck
 - GPS
 - RFID (UHF)
 - BLE
 - 4G
 - Option to connect external camera
- RFID tag
 - EPC class 1 Gen2
 - GS1 GRAI inni
 - Residual and paper waste have their own asset types coded in the tag
 - QR: GS1 Digital Link
 - Services



System in place



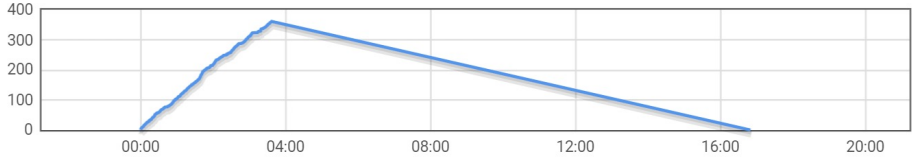
BIL 185 - 11633

PAPIR

0 beholdere

VPN

Bil



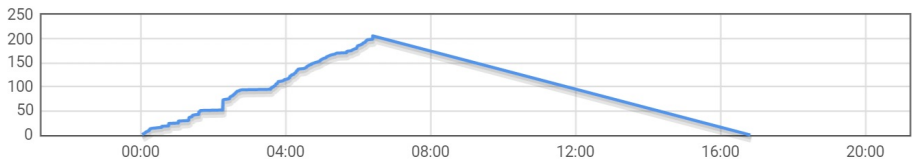
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RESTAVFALL (SENTRUM)

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VPN

Bil



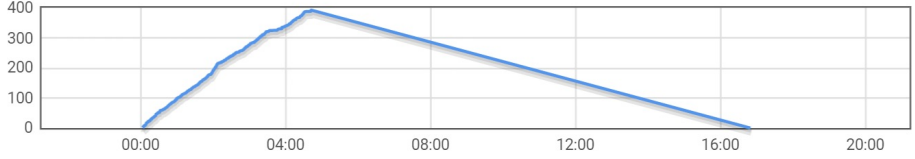
BIL 186 - 12021

RESTAVFALL (UTKANT)

0 beholdere

VPN

Bil



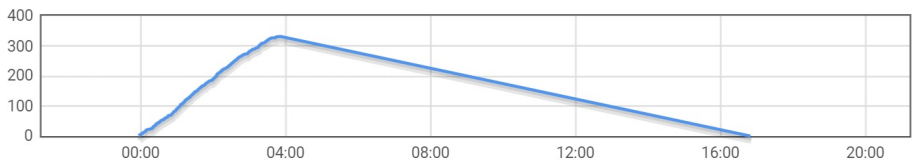
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RESTAVFALL (SENTRUM)

0 beholdere

VPN

Bil



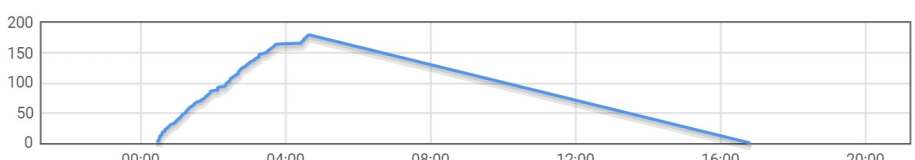
BIL 189 - 12020

PAPIR (AREMARK/UTKANT)

0 beholdere

VPN

Bil



Beholdere

Abonnementer

Ruter

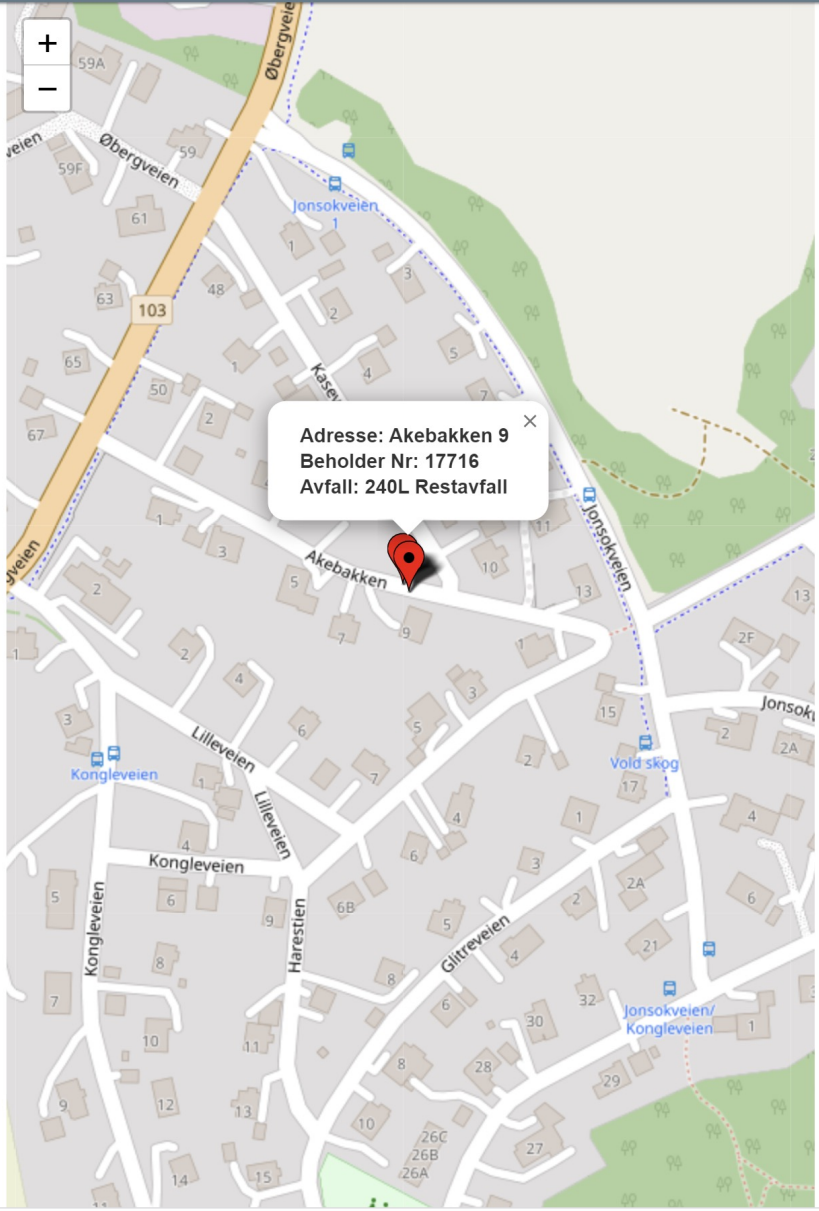
Dato: 8.5.2023
Uke: 19 - 0

Avtaler		
Avtale NR	Adresse ↑	Avtaletype
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10518	Akebakken 2	Privat
18047	AKEBAKKEN 3	Privat
10375	Akebakken 4	Privat
10372	Akebakken 5	Privat
10514	Akebakken 6	Privat
10376	Akebakken 7	Privat
10381	Akebakken 9	Privat
7792	Alfheimveien 1	Privat
8025	Alfheimveien 1 A	Privat
7886	Alfheimveien 10	Privat
7897	Alfheimveien 11	Privat
7916	Alfheimveien 13	Privat

1 – 30 of 8547

Beholdere					
Beholder NR ↑	Avfall	Rute	Forrige tømming	Bil	
17716	Restavfall	O - Onsdag	19.4.2023, 01:27:14	187 - 11631	
31286	Papir	O - Onsdag	3.5.2023, 03:18:07	185 - 11633	

Beholder historikk		
Tømminger	Lengdegrad	Breddegrad
19.4.2023, 01:27:14	11.431319	59.110886
4.4.2023, 01:10:41	11.431378	59.11089
22.3.2023, 02:26:09	11.431311	59.110927
8.3.2023, 02:29:56	11.43134	59.110882
25.1.2023, 01:31:26	11.431422	59.110858
14.12.2022, 02:30:50		



Challenges – identified and solved

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- **Leverage sensor data to monitor circular performance**
- Leverage sensor data to meet legislation to come.



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Plukkanalyse november 2021

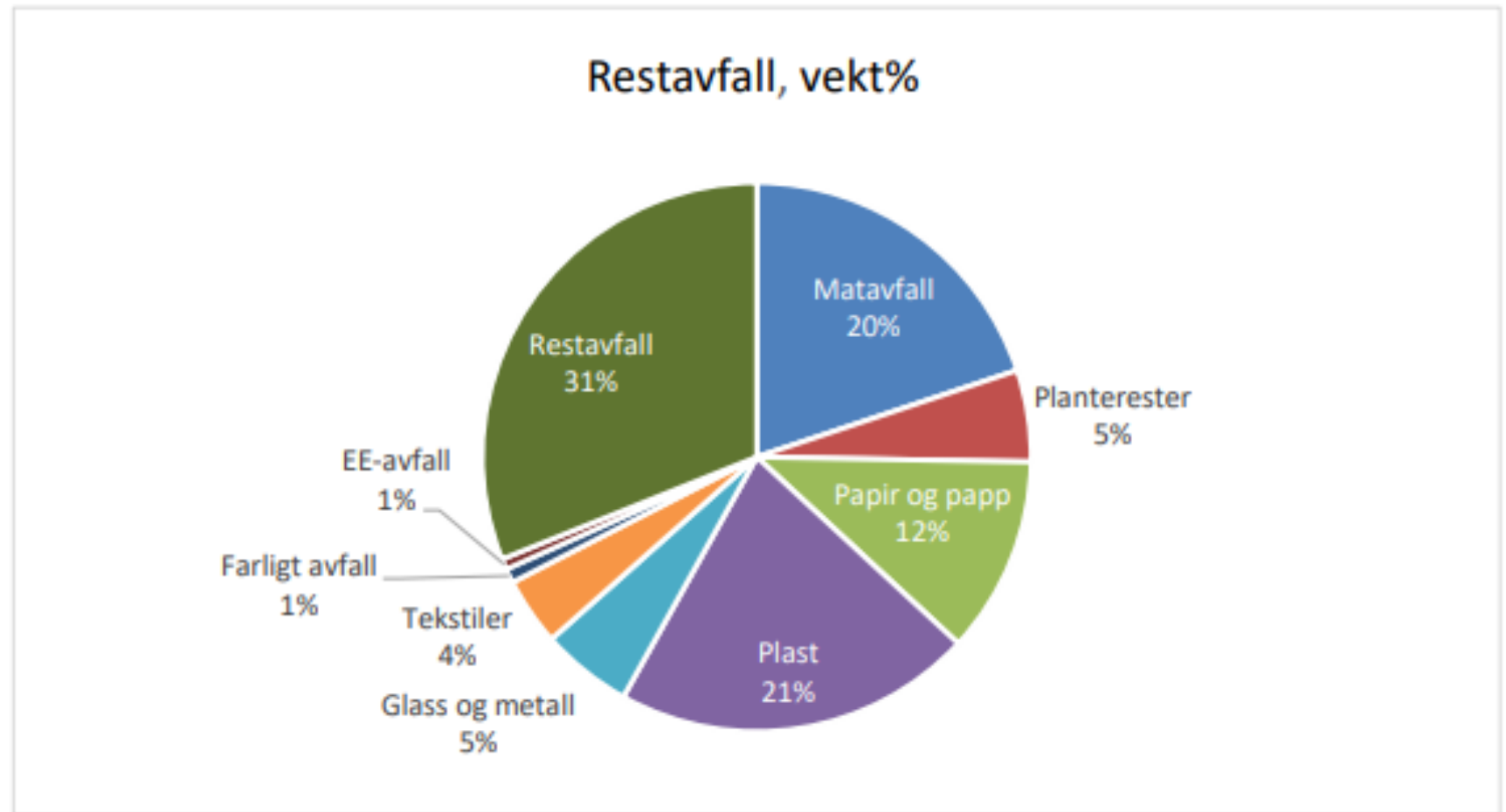
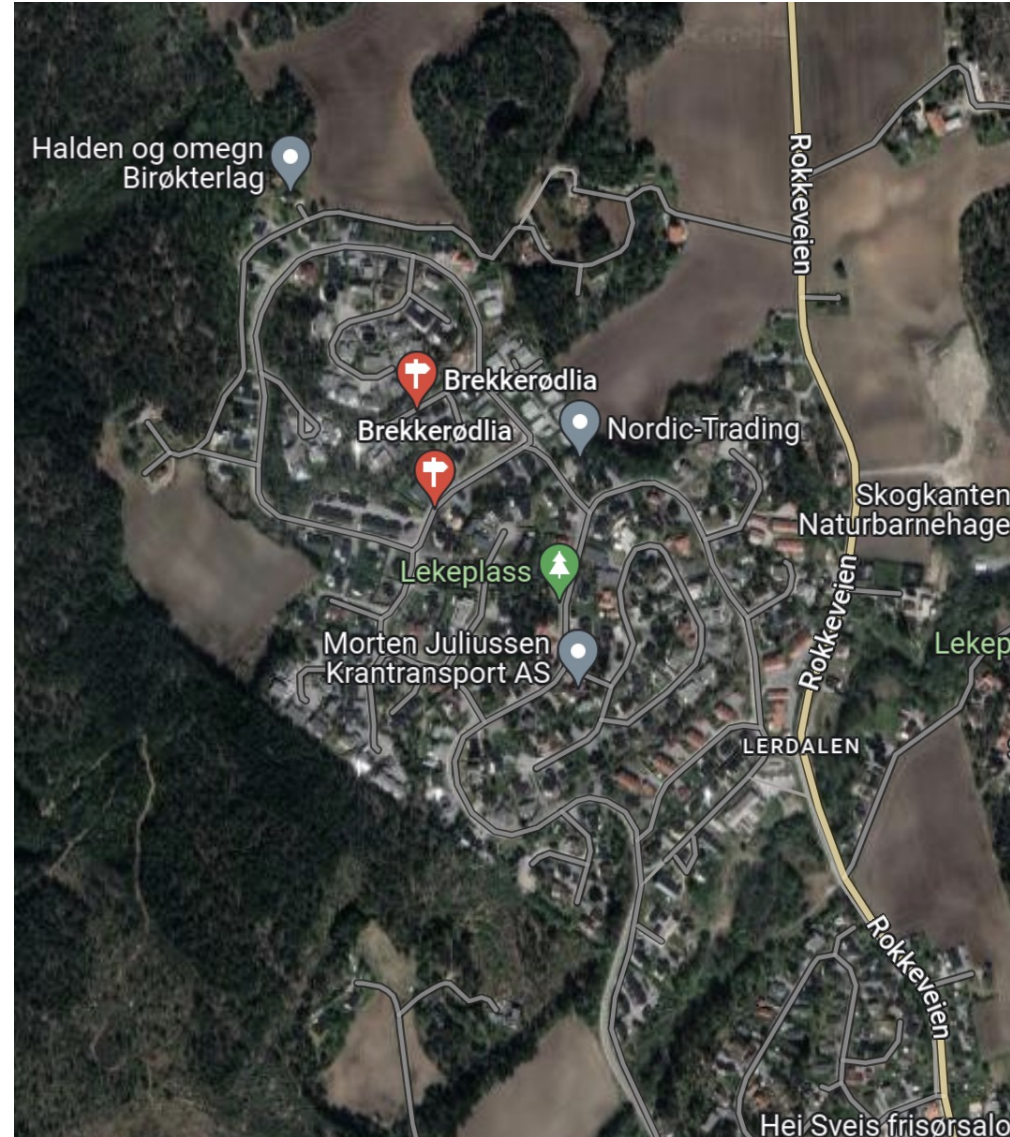


Image recognition – more data

- Organic waste collection
 - Green bags with organic waste, thrown together with residual waste
 - All residual, Plastic and organic waste is sorted at a sorting facility
- Circular economy
 - Higher requirements for degree of sorting
 - Re-use and the recycling of municipal waste shall be increased.
 - 2035 goal is – 65%
- How to improve the use of green bags in Halden municipality?
-

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Image recognition - Pilot

- Master thesis
- Using image recognition to detect green bags for organic waste
- The developed machine learning model can be applied to other objects
- One of the tested models gave a 97%^{15.05.2023} accuracy





Implementation - why

- With data:
 - Trends can be captured. Even if they are local.
 - Local degree of recycling can be improved via information campaigns



Utilization of UHF RFID and Image recognition

- Link a specific waste bin to a household
 - Better equipment control
 - Level of service
- Use image recognition together with RFID
 - Are the inhabitants using green bags?
 - Targeted campaigns to improve sorting og waste.
- Use as a basis for invoicing

Challenges – identified and solved

- Transition from into data capture from waste collection
- Leverage sensor data to monitor circular performance
- **Leverage sensor data to meet legislation to come.**

Halden municipality

New rules national and European:

- Need to increase rate of recycling.
- Need to differentiate cost for household according to amount of waste.

§ 10a-4. *Plikter for kommunen*

Kommunen skal sørge for

- a. at matavfall fra husholdninger utsorteres ved kildesortering, og at minst følgende andel av total mengde matavfall som samles inn fra husholdninger per år utsorteres ved kildesortering: 55 prosent fra og med 2025, 60 prosent fra og med 2030 og 70 prosent fra og med 2035,
- b. at park- og hageavfall fra husholdninger utsorteres ved kildesortering,
- c. at plastavfall fra husholdninger som kan materialgjenvinnes utsorteres ved kildesortering, og at minst følgende andel av total mengde plastavfall som kan materialgjenvinnes som samles inn fra husholdninger per år utsorteres ved kildesortering: 50 prosent fra og med 2028, 60 prosent fra og med 2030 og 70 prosent fra og med 2035. Kildesortering av plastavfall kan erstattes av annen sortering dersom metoden gir minst like høy utsorteringsandel som ved kildesortering.
- d. at utsortert matavfall, park- og hageavfall og plastavfall fra husholdningene leveres til materialgjenvinning.

Plikten i første ledd bokstav d gjelder ikke utsortert matavfall og park- og hageavfall som gjenvinnes ved kompostering ved kilden.

Miljødirektoratet kan gi nærmere retningslinjer om plastavfall som kan materialgjenvinnes jf. første ledd bokstav c.

0 Tilføyd ved [forskrift 7 juni 2022 nr. 971](#) (i kraft 1 jan 2023).

Result

- Need to know the amount of waste per bin



Technology

- RFID box for truck
 - GPS
 - RFID (UHF)
 - 4G
 - **BLE**
 - Option to connect external camera
- RFID tag
 - EPC class 1 Gen2
 - GS1 GRAI inni
 - Residual and paper waste have their own asset types coded in the tag
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In progress

- **Pilot today:**

- BLE sensor with TOF distance measurement.

- **Fill level is transmitted via reader unit on arrival**

- 0,1Hz to conserve battery

- **To be concluded:**

- privacy



Challenges – we have discussed

- Transition into data based economics
- Leverage sensor data to monitor circular performance
- Leverage sensor data to meet legislation to come.

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- Transition into data based economics
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-
- Numbers:



THANK YOU

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