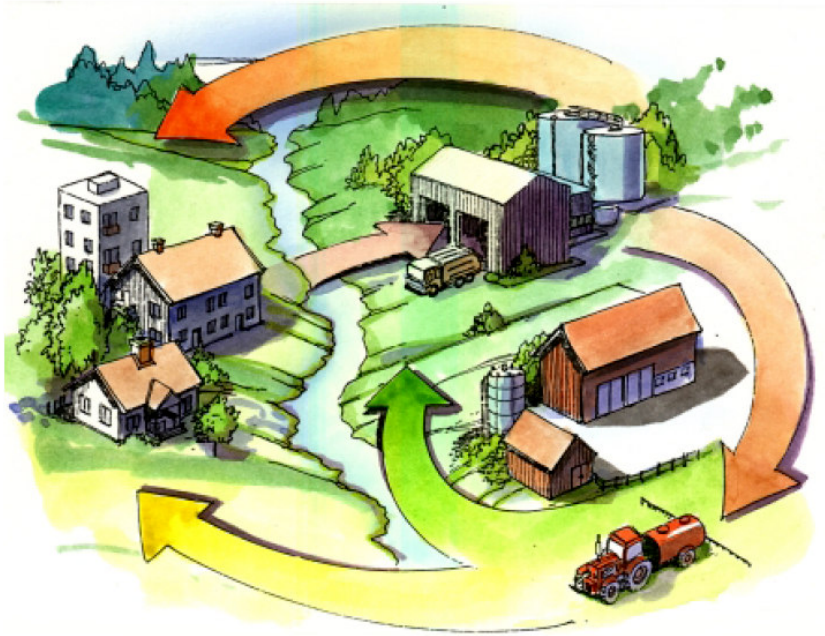
AGROPTI-gas

Demonstration of an optimised production system for biogas from biological waste and agricultural feedstock



A project implemented through financial assistance from funds of EUROPEAN COMMISSION – DG Tren 5th FW Programme

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Main objectives

To demonstrate:

- Co-digestion of source-sorted municipal waste and energy crops in a large scale system
- Biogas from waste and crops as a competitive vehicle fuel
- Recycling of municipal waste as a high-quality organic fertiliser in conventional and organic farming including advantages for farmers to participate in such systems.

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Why combine energy crops and organic waste?

The farmers perspective

- Improvement of soil fertility when e.g. grass/clover are introduced in cereal dominated crop rotation systems
- Improve economic conditions for biogas production by gate fee from waste
- Farmers will have new possibilities as hired contractors for coordinated harvest and ensiling

The municipalities perspective

- Better acceptance of digestate as organic fertiliser when farmers deliver feedstock
- Facilitates municipalities in reaching sustainable targets (e.g. CO_2-reduction, recycling of food waste)

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Work package	
WP 1	Project coordination
WP 2	Procurement process
WP 3	Building
WP 4	Communication and information forum for urban-rural cooperation
WP 5	Socio-economic analysis
WP 6	Dissemination
WP 7	Evaluation of biogas process (biology/technology)
WP 8	Evaluation handling system
WP 9	Final report

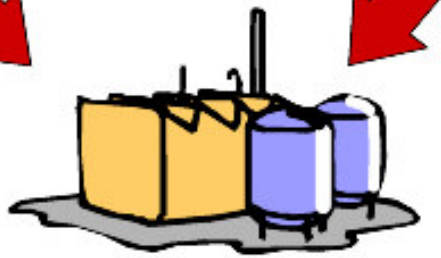
Västerås biogas plant (AGROPTI-gas)

14 000 tonnes source-sorted municipal solid waste

4 000 tonnes grease trap removal sludge

5 000 tonnes ley crop

300 ha



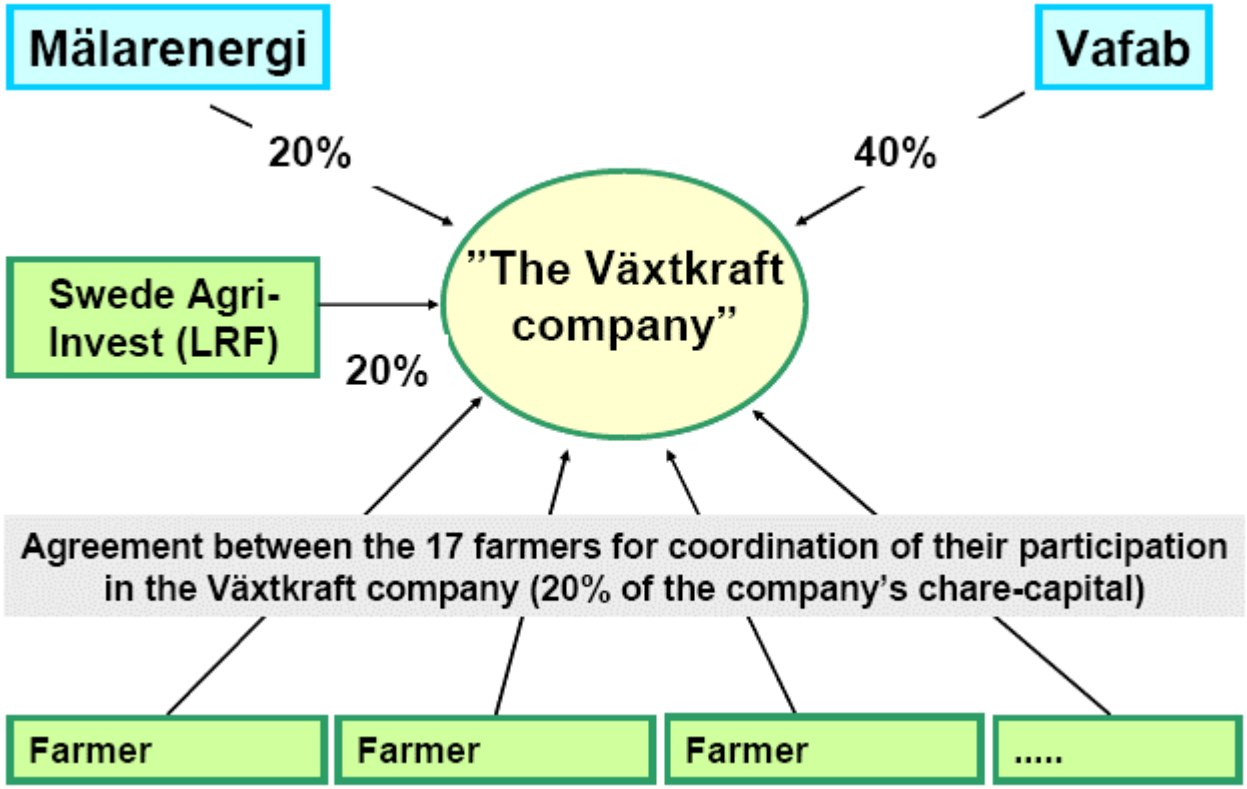
N: 150 tonnes
P: 30 tonnes
K: 100 tonnes

Solid digestate: 6 500 t
Liquid digestate: 15 000 t

Vehicle fuel

15 GWh = 1500 m^3 petrol

23 GWh incl. sewage gas


Mälarenergi
Vafab
20%
40%
Swede Agri-Invest (LRF)
20%
"The Växtkraft company"
Agreement between the 17 farmers for coordination of their participation in the Växtkraft company (20% of the company's chare-capital)
Farmer
Farmer
Farmer
.....

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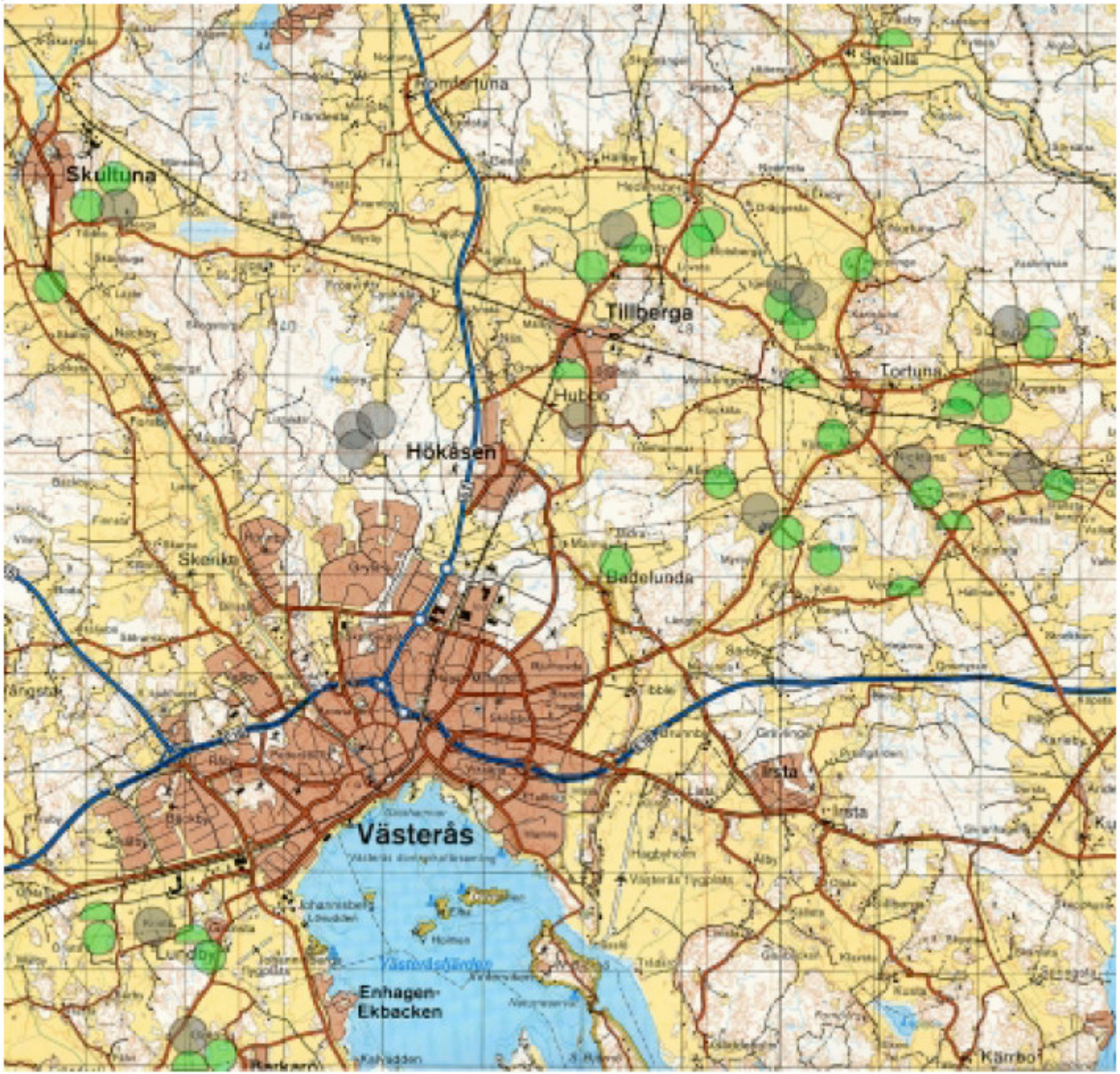

10 ha ley crop

10-20 km to biogas plant

1000 m^3 digestate storages

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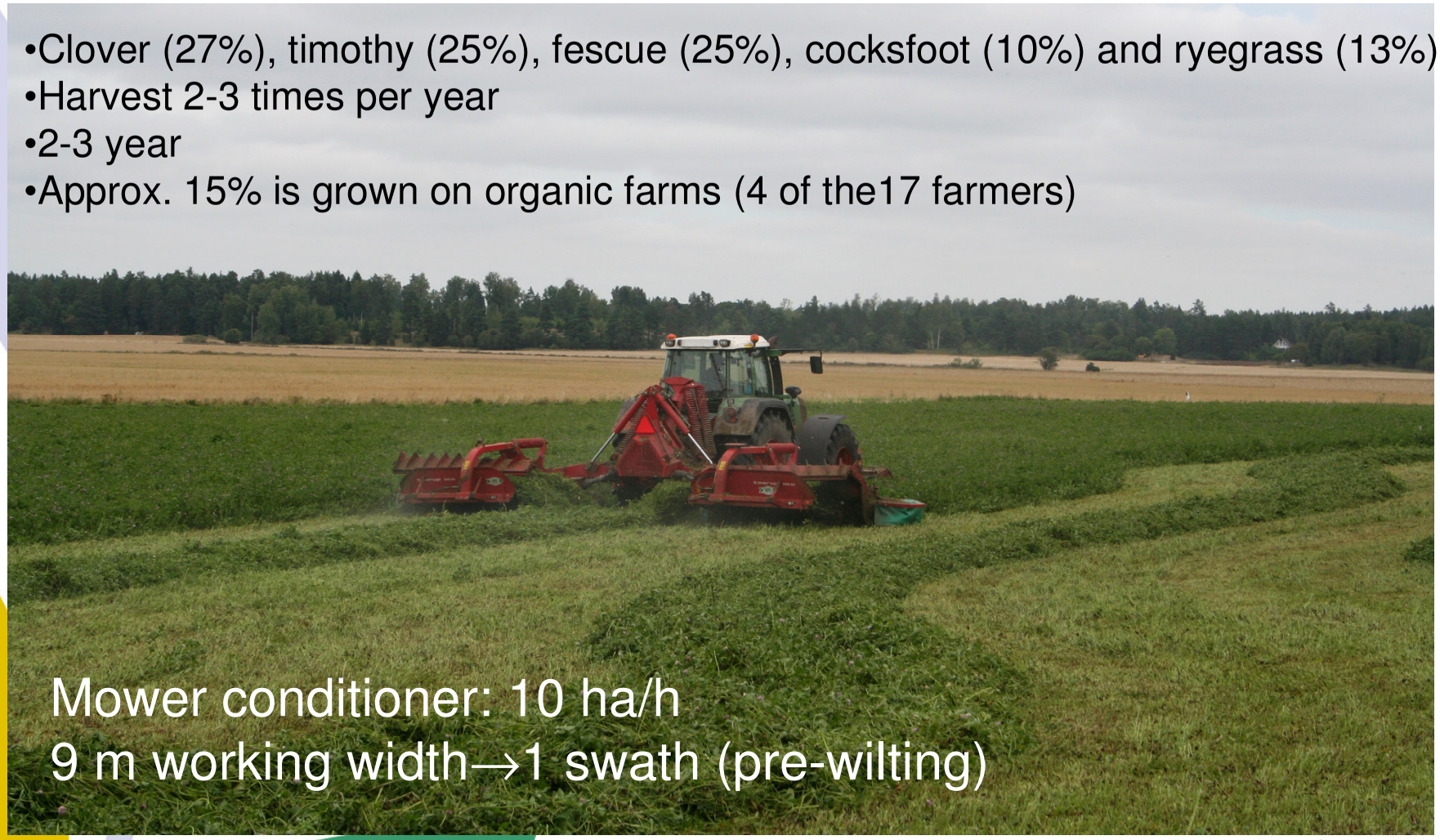
•Clover (27%), timothy (25%), fescue (25%), cocksfoot (10%) and ryegrass (13%)
•Harvest 2-3 times per year
•2-3 year
•Approx. 15% is grown on organic farms (4 of the17 farmers)



Mower conditioner: 10 ha/h
9 m working width→1 swath (pre-wilting)

Precision chopping (15 mm) into 40 m^3 containers
11 tonnes/container
1 container ⇔ 1 ha
Capacity of chopper: 7 containers/h

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Loading containers to truck at the side of the field
3 containers/truck (max 40 tonnes)
ca 20-30 min for loading truck with 3 containers

2 trucks used for transport to biogas plant
4-5 containers/h
ca 20 min for transport to biogas plant

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Ensiling on 7000 m² storage place at biogas plant
Packing machine (self-propelled) 100 tonnes/h
Bag silos: diameter 3.5 m, length 90 m

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1st harvest: 3200 tonnes (340 ha) 7 active days
2nd harvest 2800 tonnes (300 ha) 6 active days
Total capacity ca 50 ha/d (10-16 h)

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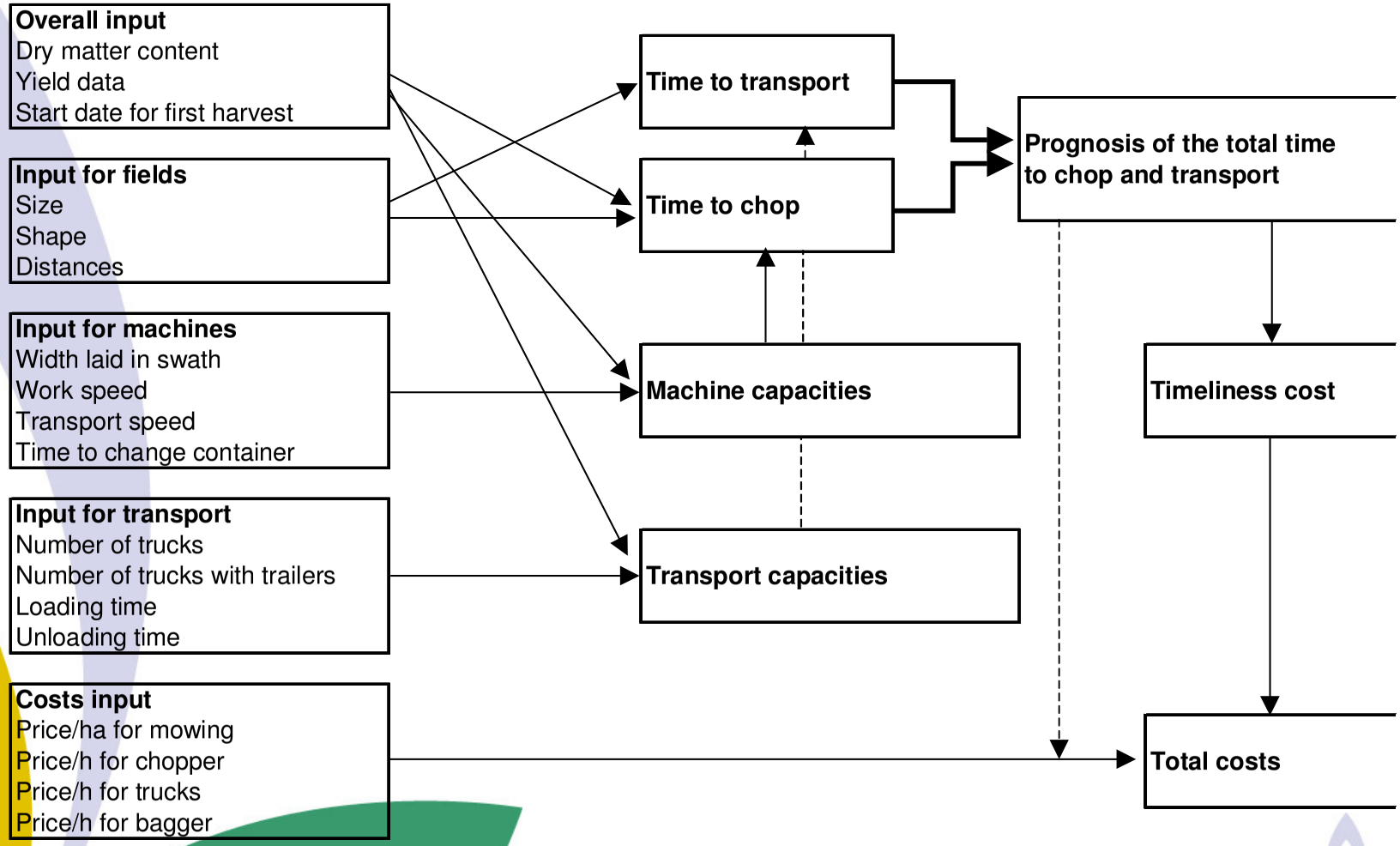
Model for energy crop handling



The AGROPTI-gas project includes:

- Biogas plant for treating organic waste and agricultural crops
- Plant for up-grading the biogas to vehicle quality and filling stations
- Pipelines for transportation of raw and purified biogas
- Storage for ensilage and system for harvesting and handling ley crop
- Storages and handling system for digestion residuals

Source-sorted municipal solid waste

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Ley crop grass/clover

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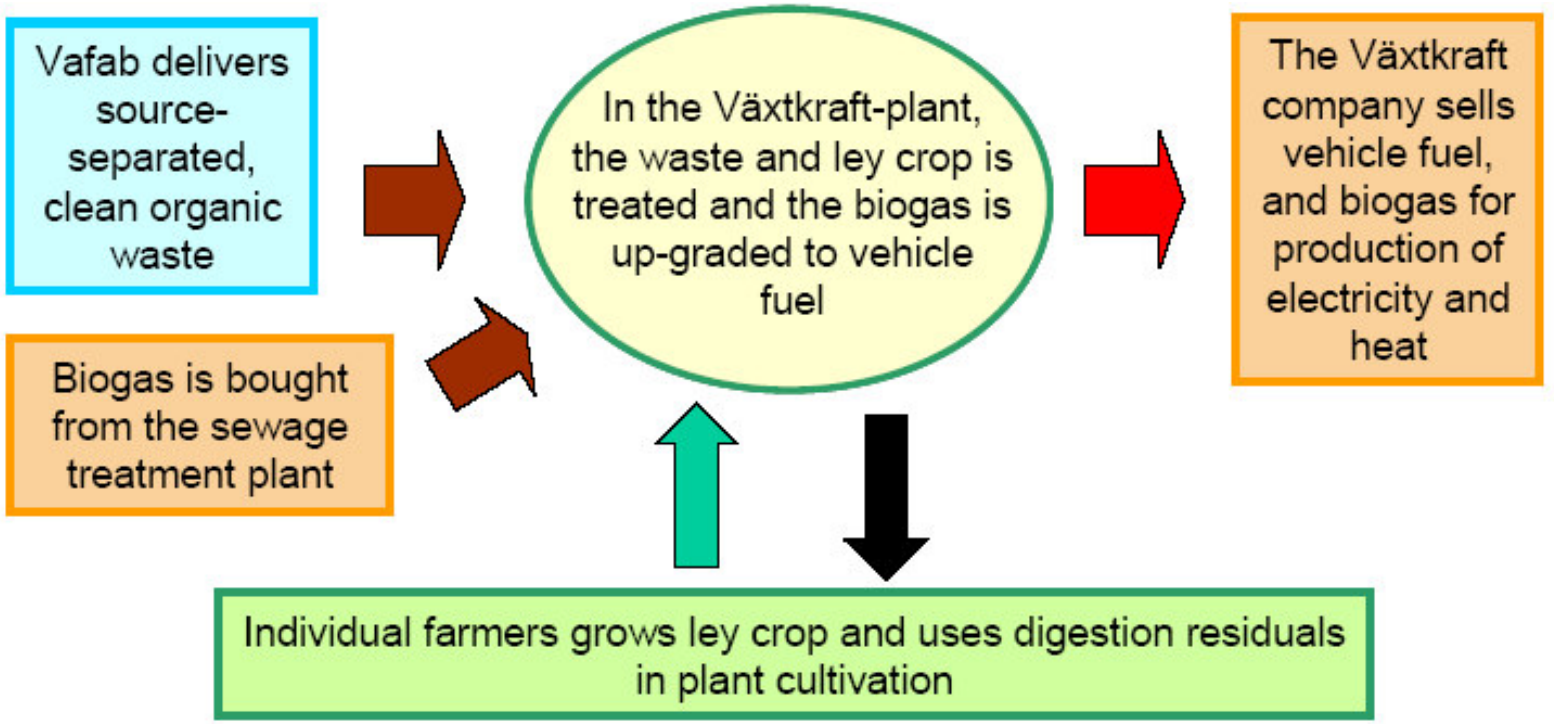
Vafab delivers source-separated, clean organic waste
Biogas is bought from the sewage treatment plant
In the Växtkraft-plant, the waste and ley crop is treated and the biogas is up-graded to vehicle fuel
The Växtkraft company sells vehicle fuel, and biogas for production of electricity and heat
Individual farmers grows ley crop and uses digestion residuals in plant cultivation

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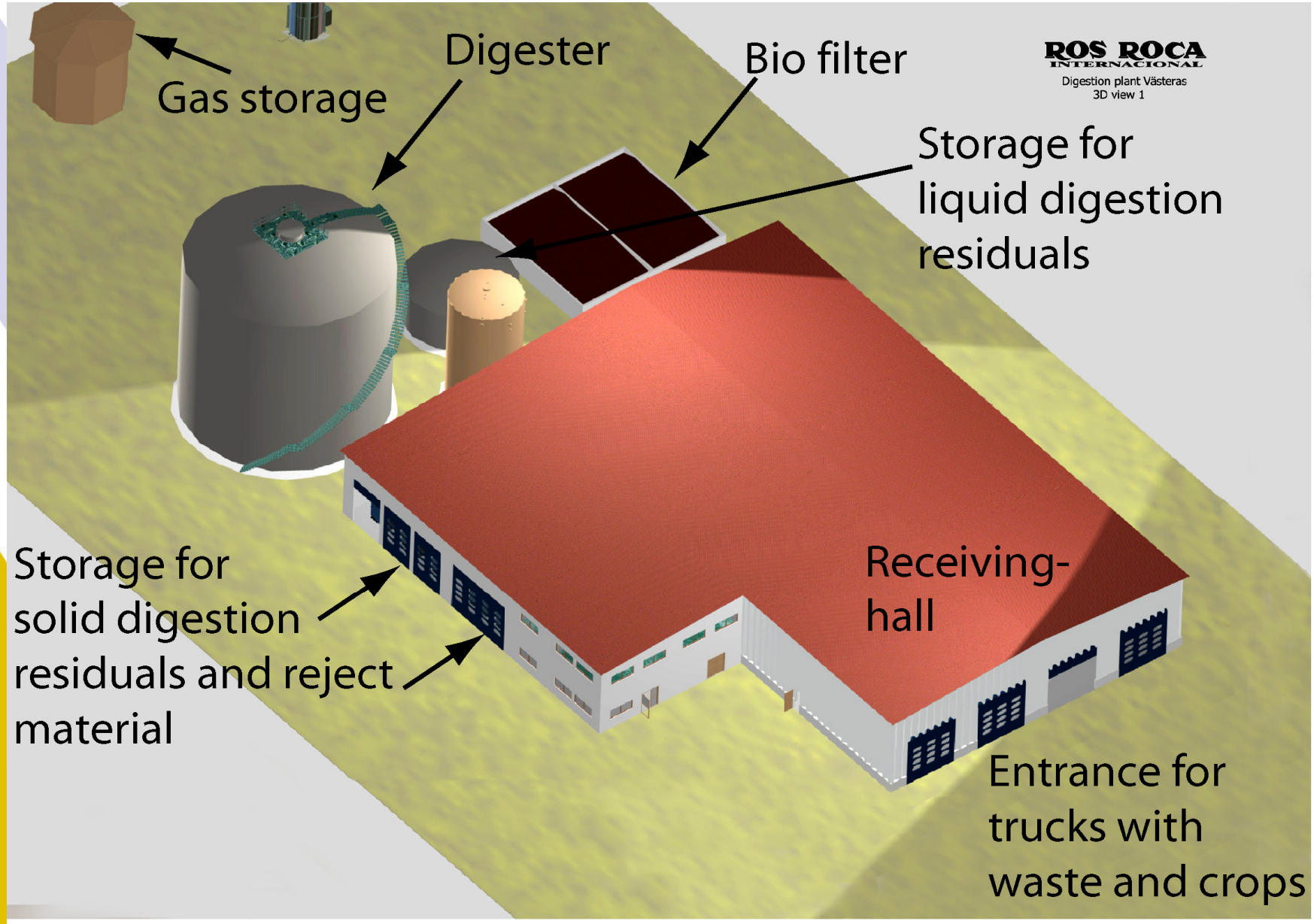
Gas storage
Digester
Bio filter
ROS ROCA INTERNACIONAL
Digestion plant Västeras
3D view 1
Storage for liquid digestion residuals
Storage for solid digestion residuals and reject material
Receiving-hall
Entrance for trucks with waste and crops

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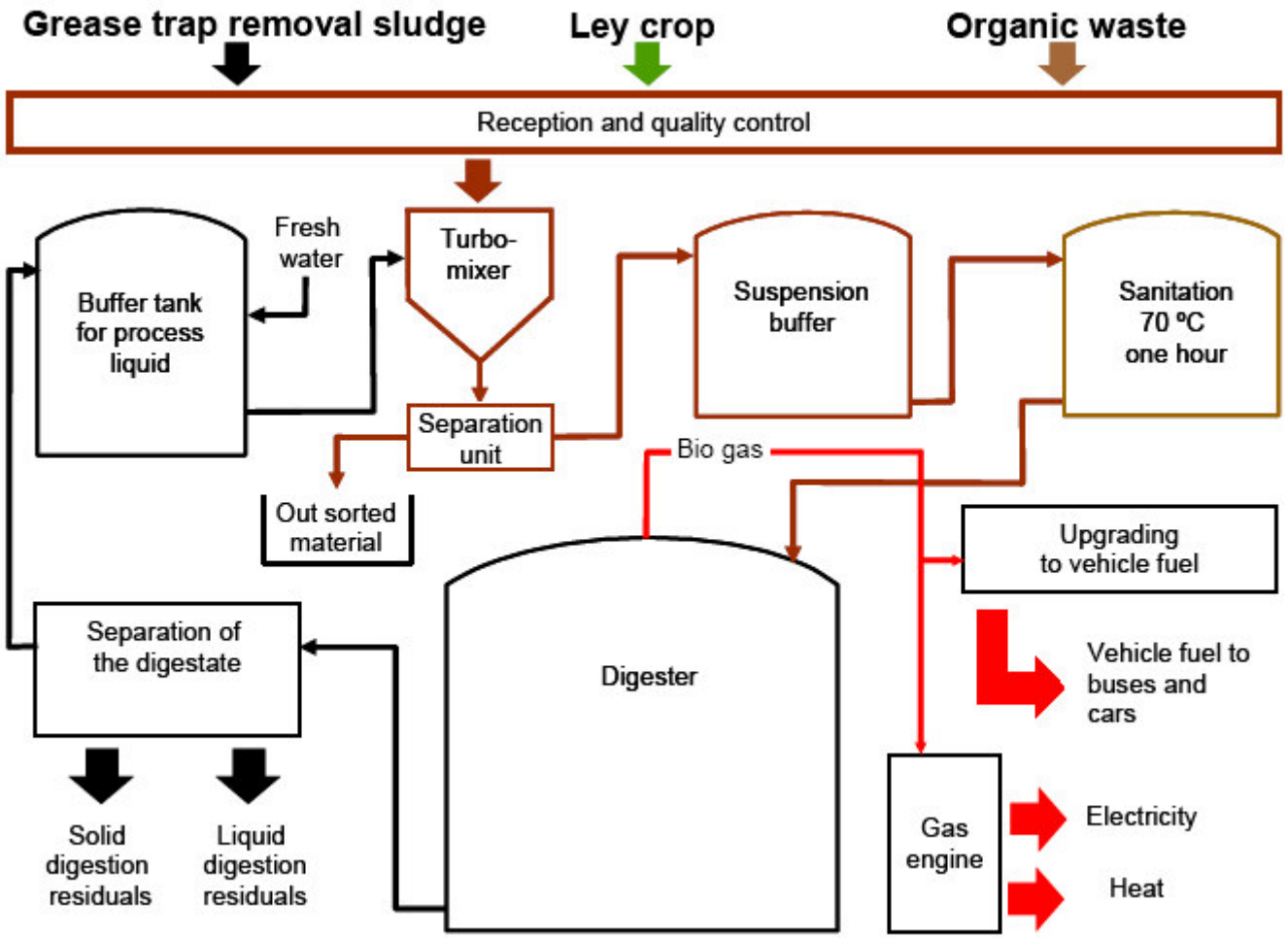
Grease trap removal sludge
Ley crop
Organic waste
Reception and quality control
Fresh water
Turbo-mixer
Buffer tank for process liquid
Suspension buffer
Sanitation 70 ºC one hour
Separation unit
Out sorted material
Bio gas
Upgrading to vehicle fuel
Separation of the digestate
Digester
Vehicle fuel to buses and cars
Solid digestion residuals
Liquid digestion residuals
Gas engine
Electricity
Heat

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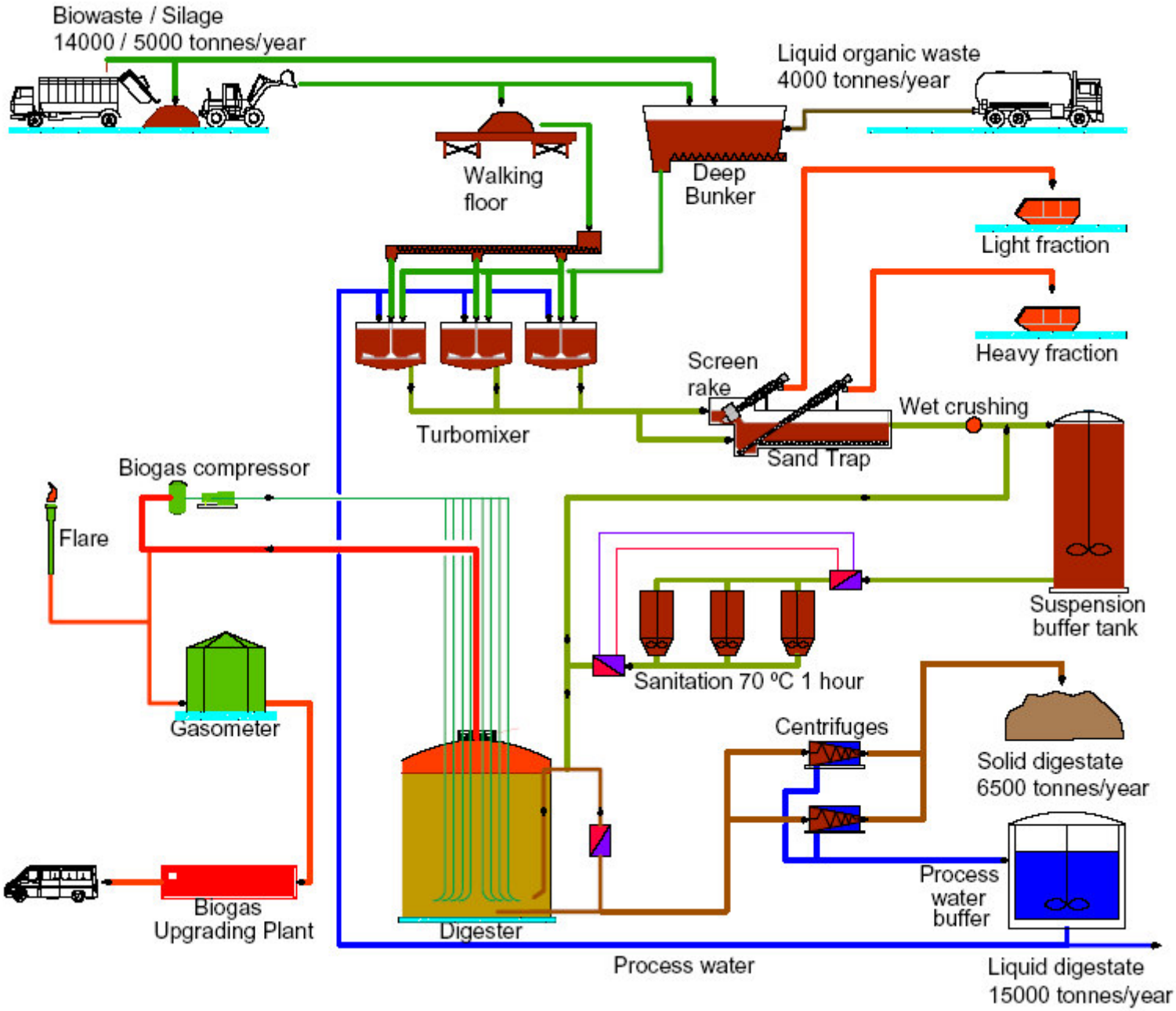
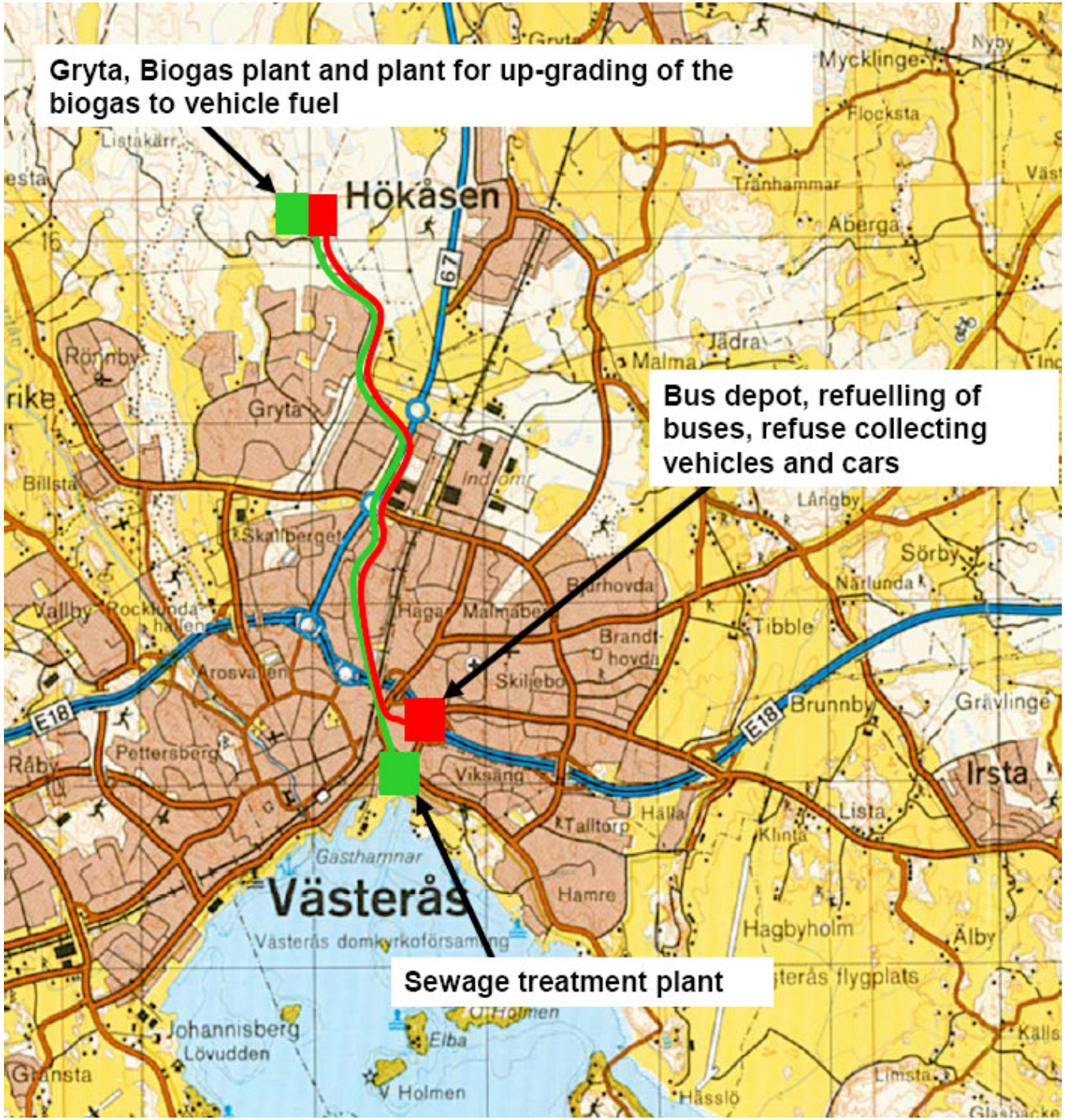

Biowaste / Silage
14000 / 5000 tonnes/year
Liquid organic waste
4000 tonnes/year
Walking
floor
Deep
Bunker
Light fraction
Heavy fraction
Screen
rake
Wet crushing
Turbomixer
Sand Trap
Biogas compressor
Flare
Suspension
buffer tank
Sanitation 70 ºC 1 hour
Gasometer
Centrifuges
Solid digestate
6500 tonnes/year
Biogas
Upgrading Plant
Digester
Process
water
buffer
Process water
Liquid digestate
15000 tonnes/year


Gryta, Biogas plant and plant for up-grading of the biogas to vehicle fuel
Hökåsen
Bus depot, refuelling of buses, refuse collecting vehicles and cars
Sewage treatment plant
Västerås
Irsta
Gryta
Malma
Jädra
Tränhammar
Aberga
Flocksta
Mycklinge
Nyby
Rönnby
Billsta
Skälberget
Vallby
Haga
Malmabergen
Brandthovda
Tibble
Sörby
Närlunda
Brunnby
Grävlinge
Lista
Hälla
Tallåsen
Hamre
Hagbyholm
Älby
Pettersberg
Råby
Viksäng
Arosvallen
Skiljebo
Gästhamnar
Johannisberg
Lövudden
Elba
V Holmen
Hässlö
Limsta
Källs
Glasbacke
E18
67

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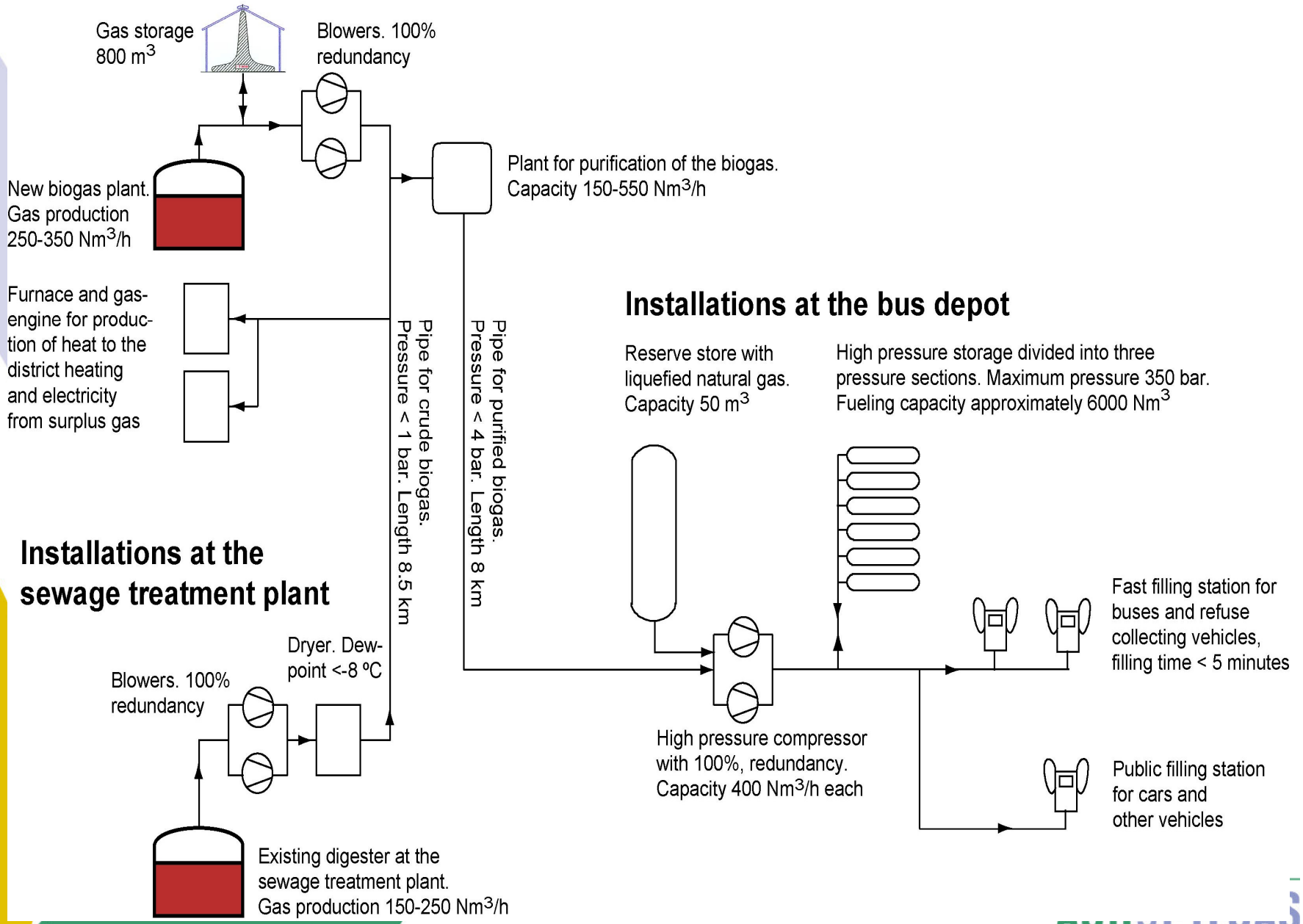
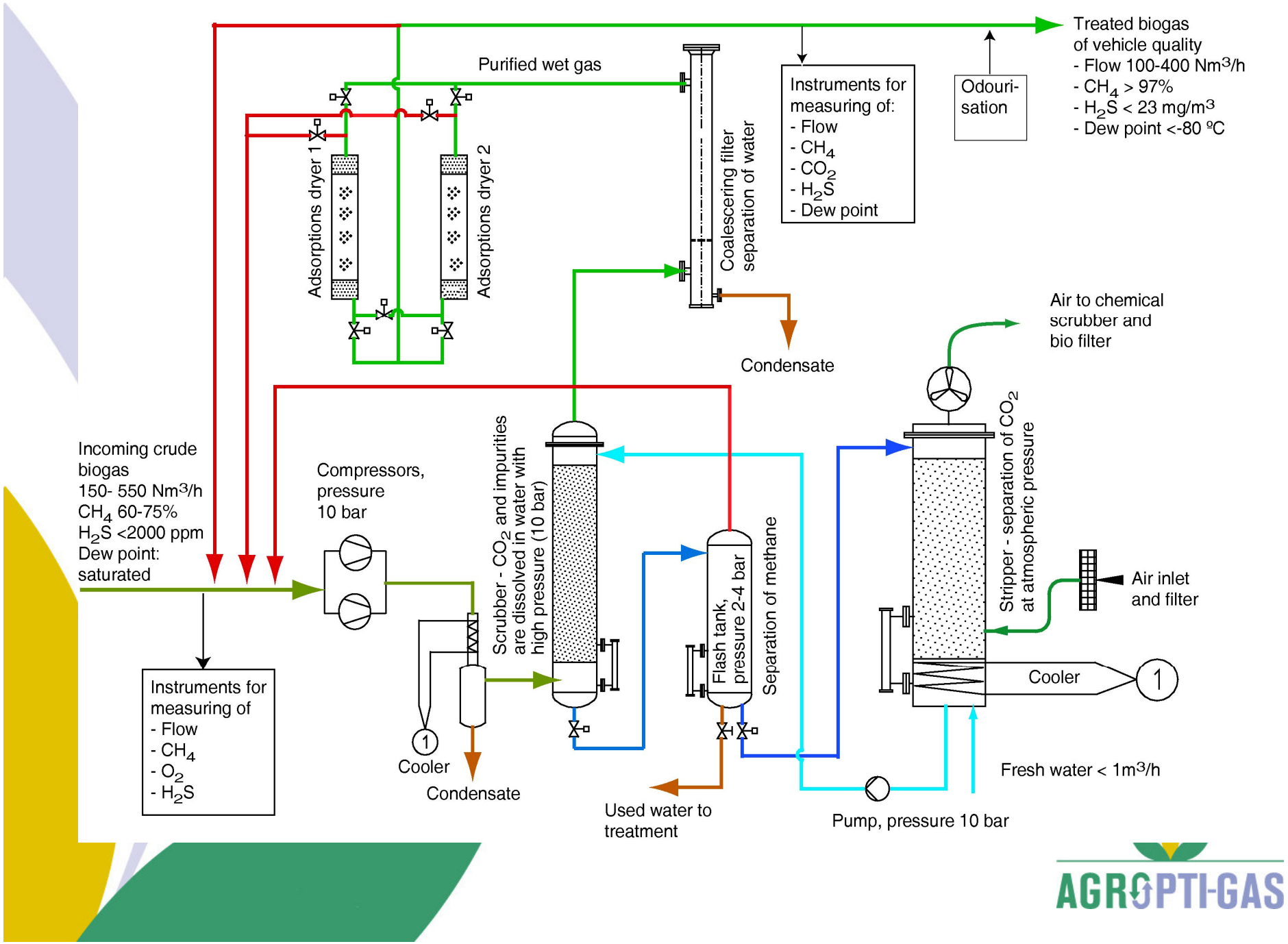
Installations at Gryta waste treatment plant




Treated biogas
of vehicle quality
- Flow 100-400 Nm3/h
- CH4 > 97%
- H2S < 23 mg/m3
- Dew point <-80 ºC
Purified wet gas
Instruments for
measuring of:
- Flow
- CH4
- CO2
- H2S
- Dew point
Odouri-
sation
Adsorptions dryer 1
Adsorptions dryer 2
Coalescering filter
separation of water
Condensate
Air to chemical
scrubber and
bio filter
Incoming crude
biogas
150- 550 Nm3/h
CH4 60-75%
H2S <2000 ppm
Dew point:
saturated
Compressors,
pressure
10 bar
Scrubber - CO2 and impurities
are dissolved in water with
high pressure (10 bar)
Flash tank,
pressure 2-4 bar
Separation of methane
Stripper - separation of CO2
at atmospheric pressure
Air inlet
and filter
Cooler
1
Instruments for
measuring of
- Flow
- CH4
- O2
- H2S
Cooler
1
Condensate
Used water to
treatment
Fresh water < 1m3/h
Pump, pressure 10 bar

Digestion residuals

- Digestion residuals are obtained in one liquid and one solid phase
- Are accepted for the usage in organic farming and conventional farming
- Are stored close to the fields
- The Växtkraft company transports the digestion residuals to the storage facilities
- The farmers get digestion residuals in proportion to the acreage of ley crop
- The digestion residuals potential is utilized by using modern spreading technique
- It is up to the farmer how the digestion residuals are used

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WP8. Hanteringssystem

- Utvärdera/dokumentera kapacitet och resursbehov i hanteringskedjan
- Identifiera “flaskhalsar” i olika delar av hanteringssystemet (fokus på vallgröda och biogödsel)

– Samla data på utrustning, maskiner, geografisk data för enkel modell
– Undersöka möjligheten att använda GIS-verktyg för beskrivning
– Jämföra/verifiera framtagna bedömningar på flaskhalsar genom intervjuer

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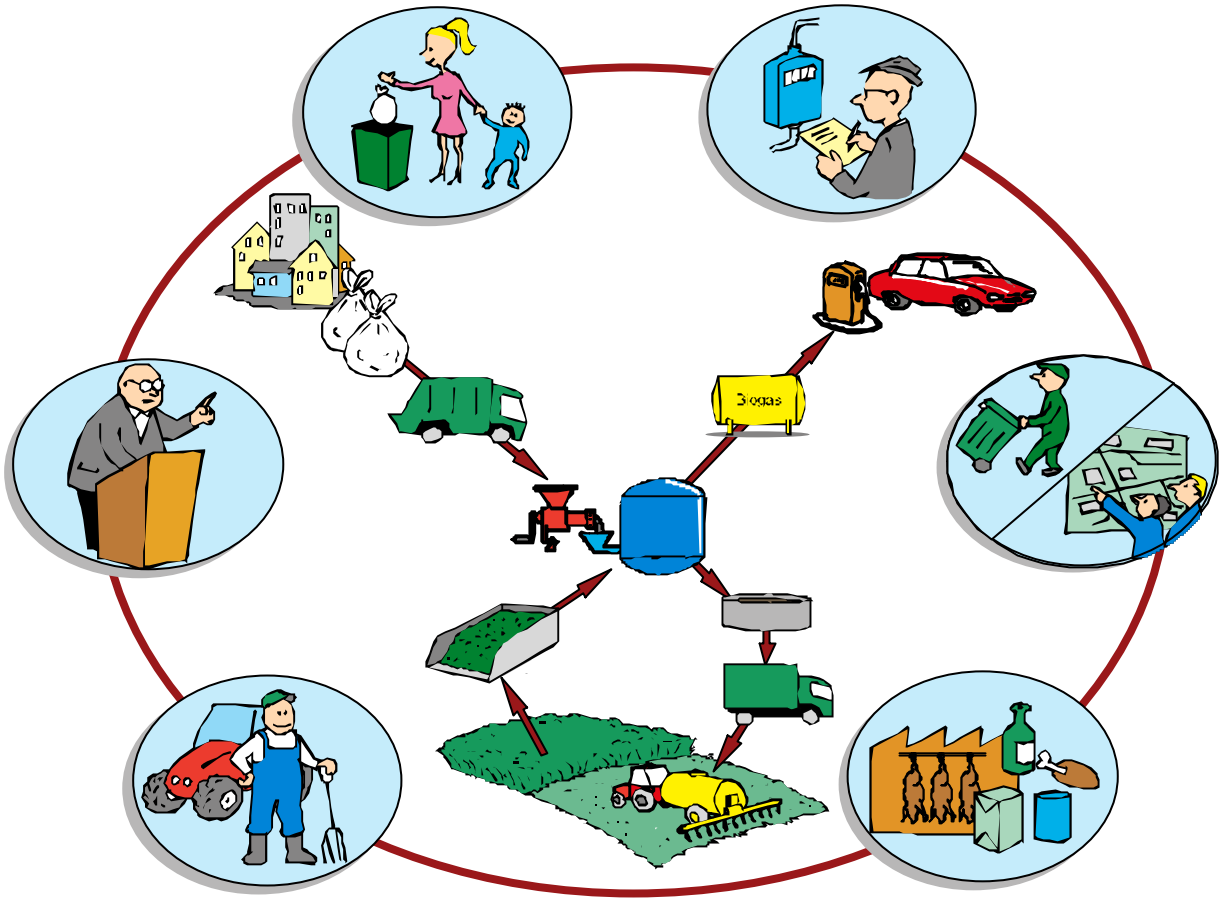

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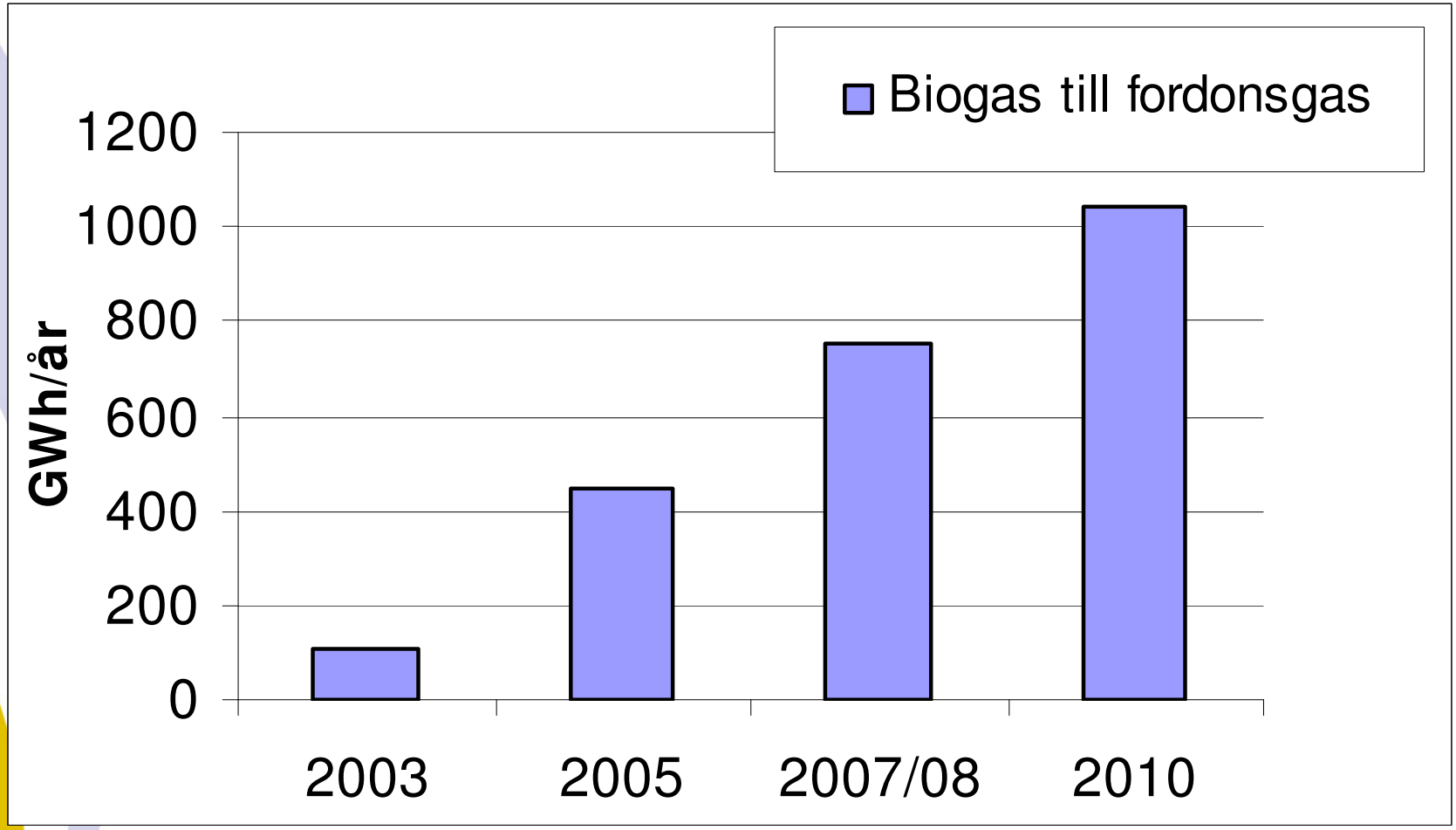
Biogas till fordonsgas
GWh/år
1200
1000
800
600
400
200
0
2003
2005
2007/08
2010

Model for energy crop handling

- Transport system design
- Distance from field to storage
- Dry matter content
- Dry matter yield

- Harvest time and costs
- Timeliness – comparing the value at the time of harvest to the value at optimal harvest time

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