

Experiences from four years of operation with the biogas train Y1G 1334 “Amanda”

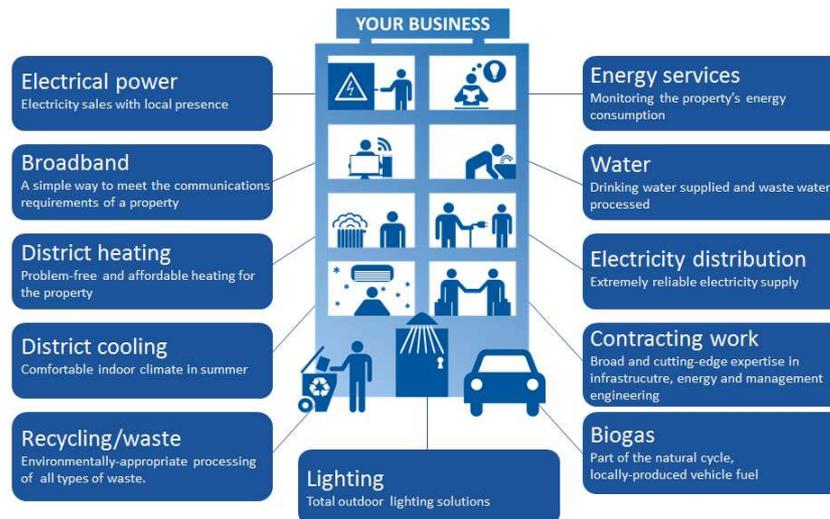
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The Tekniska verken group

- Tekniska verken was founded 1902
- Today a multi utility company
- 100 % owned by the City of Linköping since 1921
- The city's goal: CO₂ neutral by 2025



Financial key figures 2016

- Clients: ≈ 260 000
- Employees: 850
- Sales: M € 505
- Profit*: M € 70
- Net investments: M € 63
- * after net interest income/expense

Tekniska verken i Linköping AB and Svensk Biogas

100 % renewable vehicle fuel produced using organic material

**Local production of biogas at Tekniska verken
2016 \approx 120 GWh**

- Co-digestion \approx 100 GWh
- WWTP \approx 20 GWh

**Operates its own filling stations for CBG
(Svensk Biogas)**

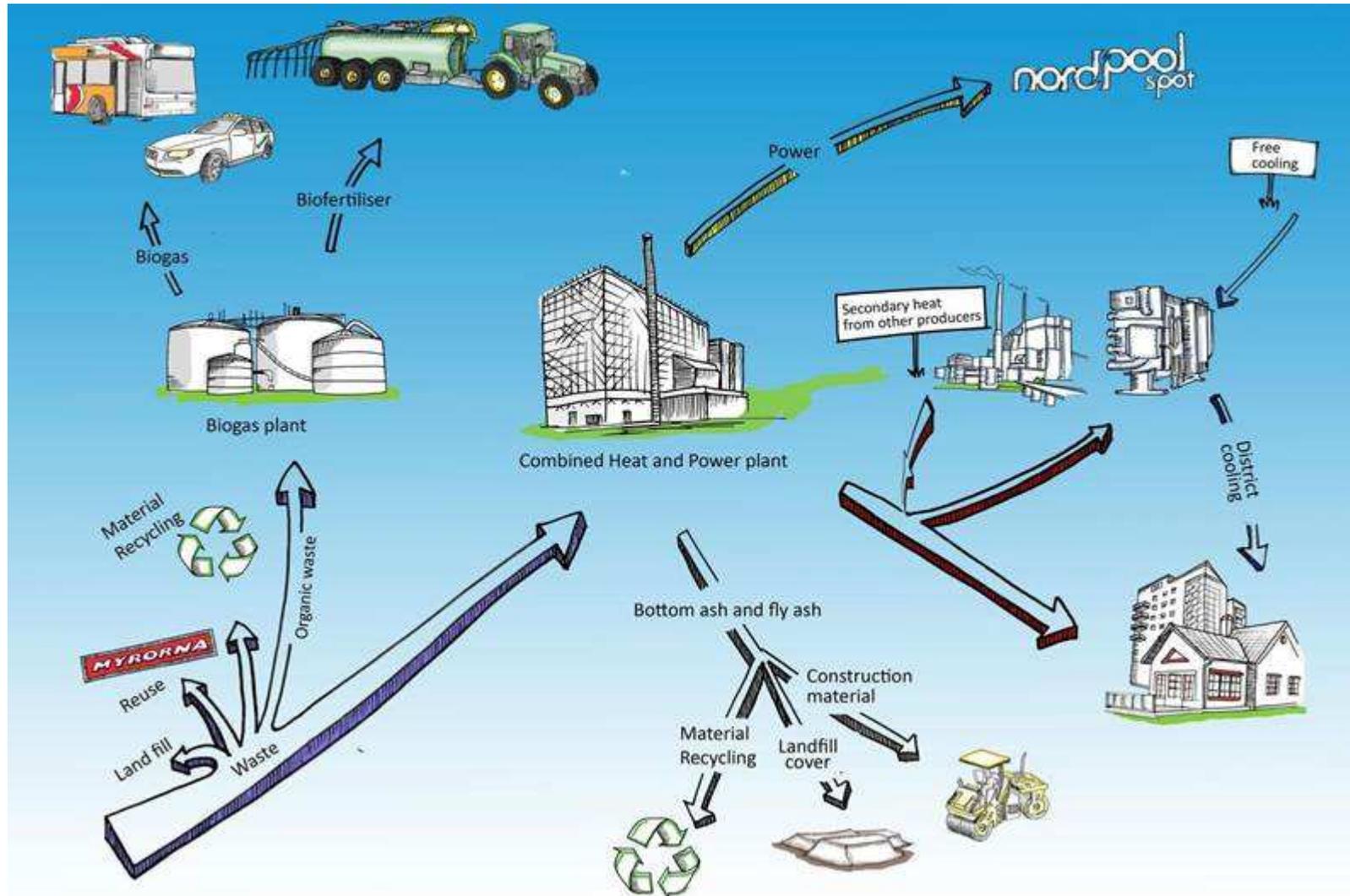
- 11 filling stations and 4 bus depots
- >180 busses in four cities, 25 garbage trucks
- >3 000 cars (public and private)



20-years anniversary during 2017



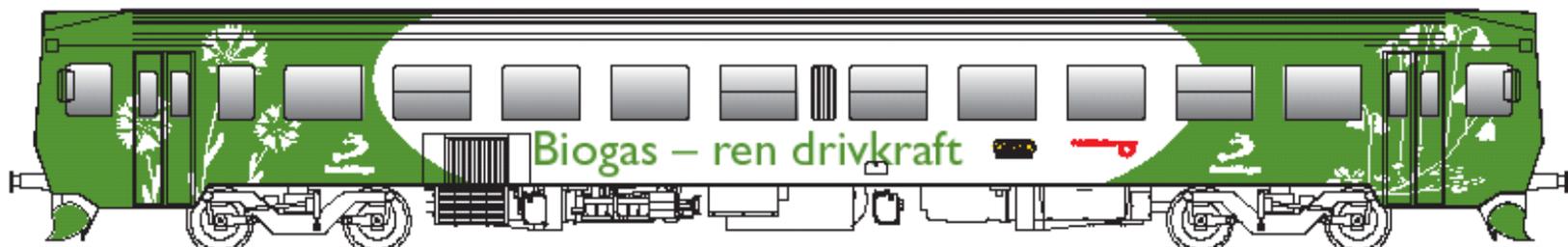
WASTE TO ENERGY



PILOT PROJECT BIOGAS TRAIN

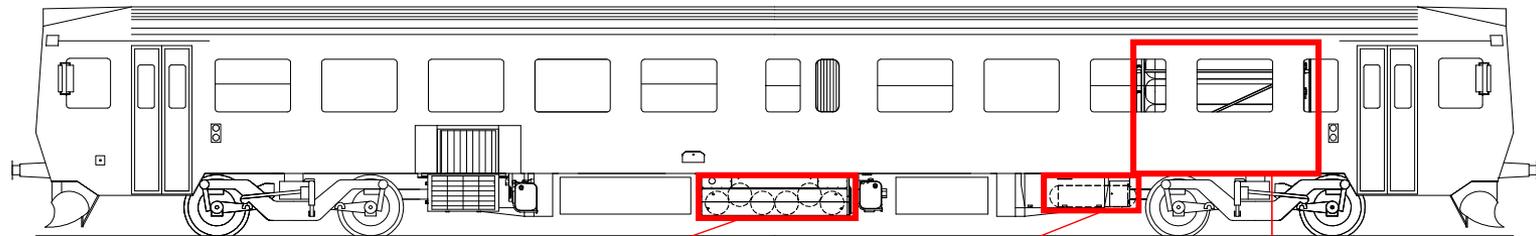


- Old railcar class Y1 (build -81 by Fiat, Italy) bought in February 2005
- Rebuilt by EuroMaint Rail (Åmål, Sweden)
- Two new Volvo gas engines (210 kW each)
- New fuel system with twelve gas cylinders
- Operating range over 600 km
- Internal “face lift”
- Total project cost approx 700 000 €,
- Pure conversion to biogas 230 000 € plus design and approval 120 000 €



GAS FUEL SYSTEM ON BOARD "AMANDA"

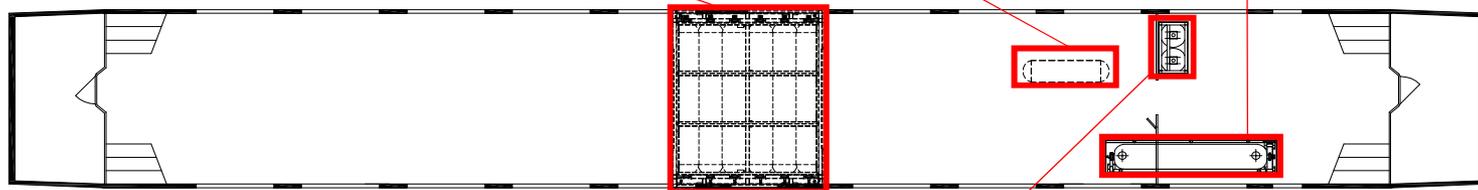
**Twelve high pressure cylinders, six under and six inside the train.
Total volume 2512 litres.**



6 pc. cylinders á 230 litre. 1 pc. dumpcyl. á 25 litre 4 pc Gas cylinders á 230 litre.

A-ände

B-ände



2 pc. gascylinders á 106 litre.

Maximum operation pressure 260 bar(g)



FACE LIFT

- New colors inside
- New lighting
- Improved ventilation
- Sockets for computers
- Vending machine
- TV-screen

Experiences from four years with "Amanda"

The train has been in normal operation during the period 19 April 2006 – 14 June 2010 under all weather conditions.

During these years it has been travelling over 154 000 km, or almost four times around the Globe.

Some special events has been carried out, e.g. a trip with the Swedish King and Queen in April 2008.

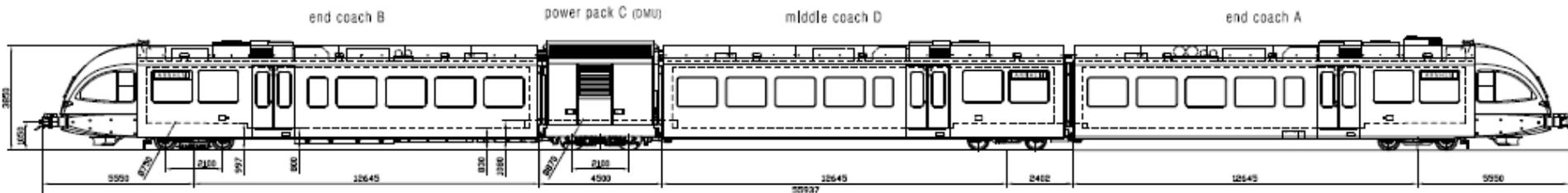
Maintenance costs are equal to diesel driven trains of the same type.

Lower noise level, less vibrations and significant lower emissions compared to diesel powered trains.



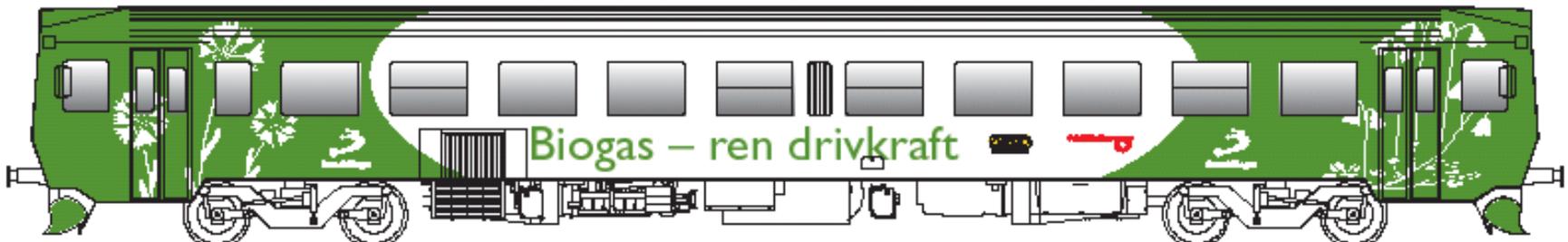
A POSSIBLE NEW BIOGAS TRAIN

- Stadler GTW CGN
- Gas/electric traction
- Hybrid biogas-el
- 119 seats
- Max speed 140 km/h



CONCLUSIONS

- Environmentally friendly trains on non electrified lines.
- Significant lower emissions, no new CO₂.
- Local/regional fuel production based on waste or crops.
- New gas train ~10 % higher investment cost compared to similar diesel train.
- Refuelling station more costly than a diesel pump. Therefor important with a long term commitment.
- The same cost for maintenance compared to diesel trains.
- Operational costs depends on the price of diesel and gas.
- Positive for the train operator to be environmentally friendly.
- Biogas – Clean/pure power.



Thank you for your attention!

