

Biogas vision

**To replace 20% of petrol and diesel in
Europé with the best fuel on market today**

Lars Rahm



Only 3 ways to reduce oil dependency and fossil CO₂ from transportation!

- Curb the uncontrolled growth of transport
- Increase energy efficiency
- Increase the use of biofuels



Why biogas as a vehicle fuel?

- Biogas is renewable, solving waste problems and makes it to a resource of energie and fertilizer.
- It replace fossil fuels and in the same time takes care of existing methan losses (reduce greenhouse gases addition up to -180 %)
- Less polluting emissions (particles, NOx) Can be localy produced and distributed in a gas grid.
- No other biofuel has an equal flexibility concerning the choice of biomass feedstock.
- Less expensive than petrol, diesel and ethanol in Sweden (in petrol equivalentents)



Biogas production

Biogas is formed when organic materia is decomposed by methane-producing bacteria in an anaerobe environment.

The biogas is typically composed of 55 – 70 % methane, 30 – 45 % carbon dioxide and small amounts of hydrogen sulphide and ammonia



Cleaning and upgrading

Cleaning: Removal of solid particles, water and corrosive species.

Upgrading: Removal of carbon dioxide to obtain a higher heating value.

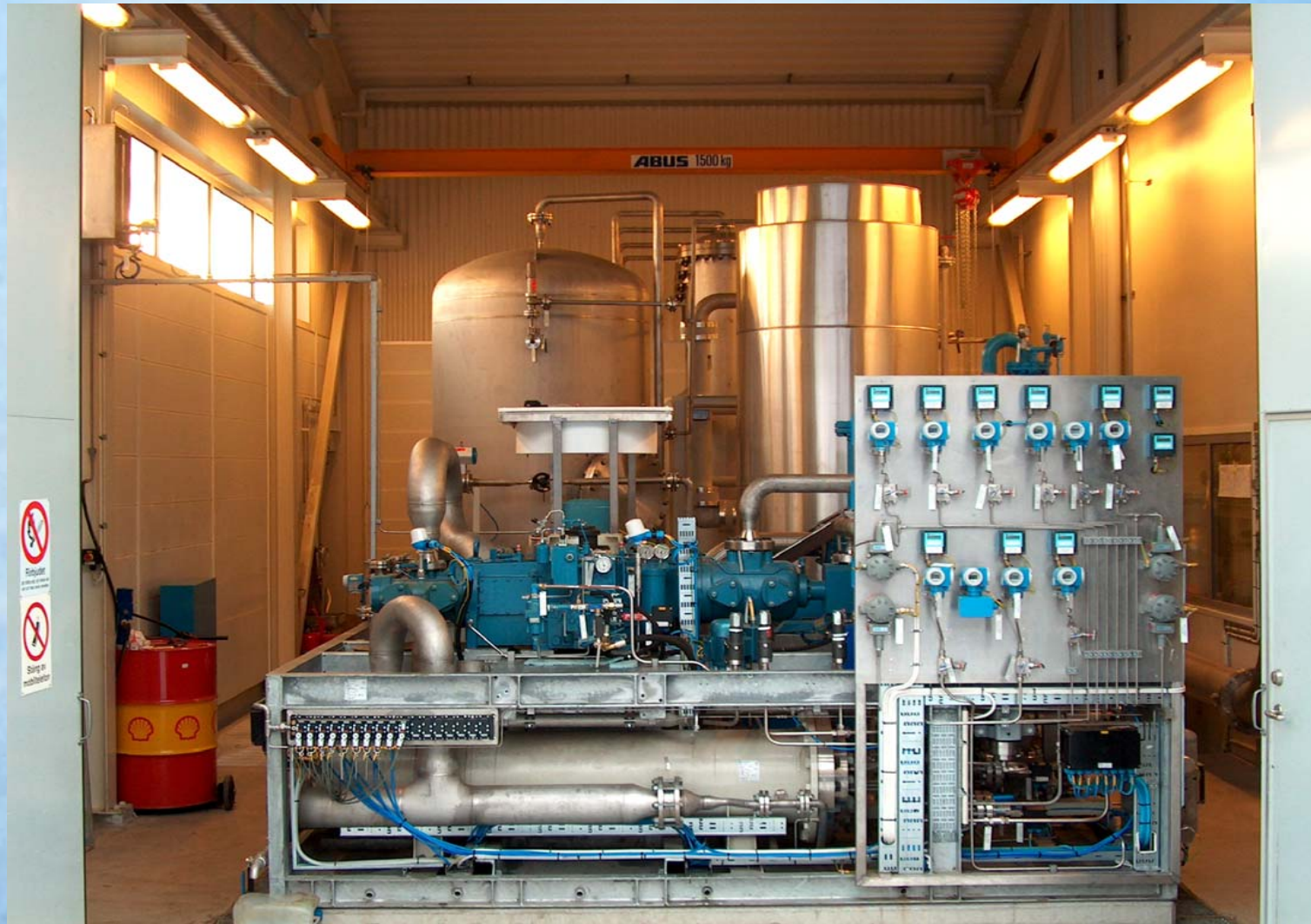
Standard A fuel: 97 ± 1 % methane

Standard B fuel: 97 ± 2 % methane



Bromma Biogas plant



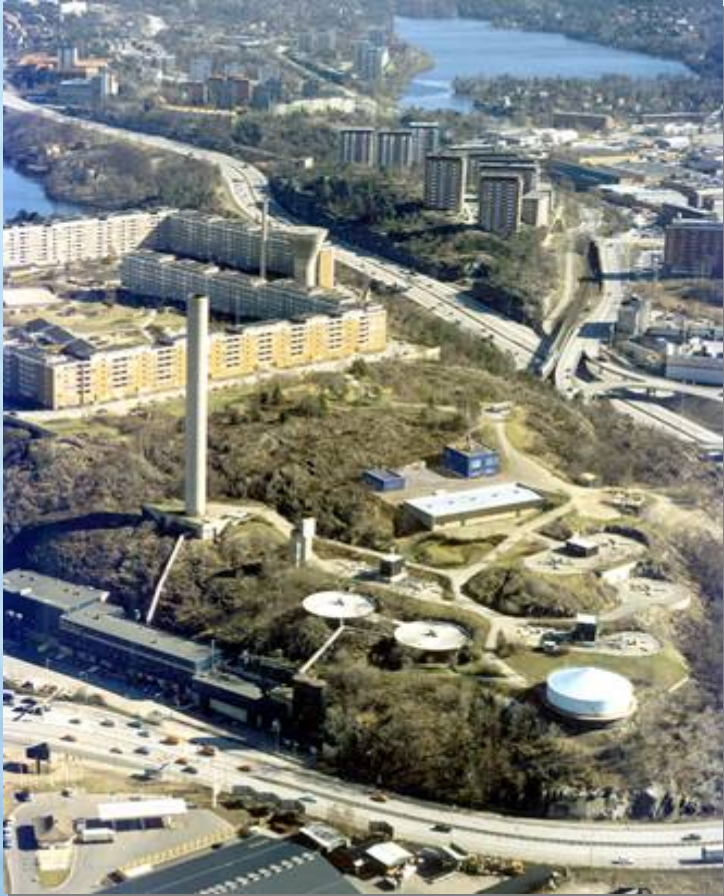








Henriksdal Sewage Treatment plant



Henriksdal Biogas plant



Investment

Total 22 410 milj. yen

Grants 4 482 milj. yen

Income

5 976 milj. yen /year

(20 years contract)

Running cost

2 988 milj. yen /year

(45 yen/ Nm³)

SÖDERHALLEN - BIOGASPROJEKT - INGÅENDE DELPROJEKT

③ GASLEDNING - STRÄCKNING



Stockholm Public Transport Co. (SL)

- Provision of public transport in the Stockholm region
- Planning, Procurement and Follow-up
- Infrastructure issues.
- Metro, Buses (2 000), Commuter trains, high speed trams.
- 685.000 passengers / day
- 2,5 million boardings / day,
- Owned by the Stockholm County Council



Targets for SL renewables

Trains

- SL should only use electricity from renewable sources (wind, hydro, biomass)



Buses

- 25 % renewables 2006
- 50 % 2011
- 100 % 2025

How to get there

One of Europe's largest Biogas
Bus Fleets to be built up

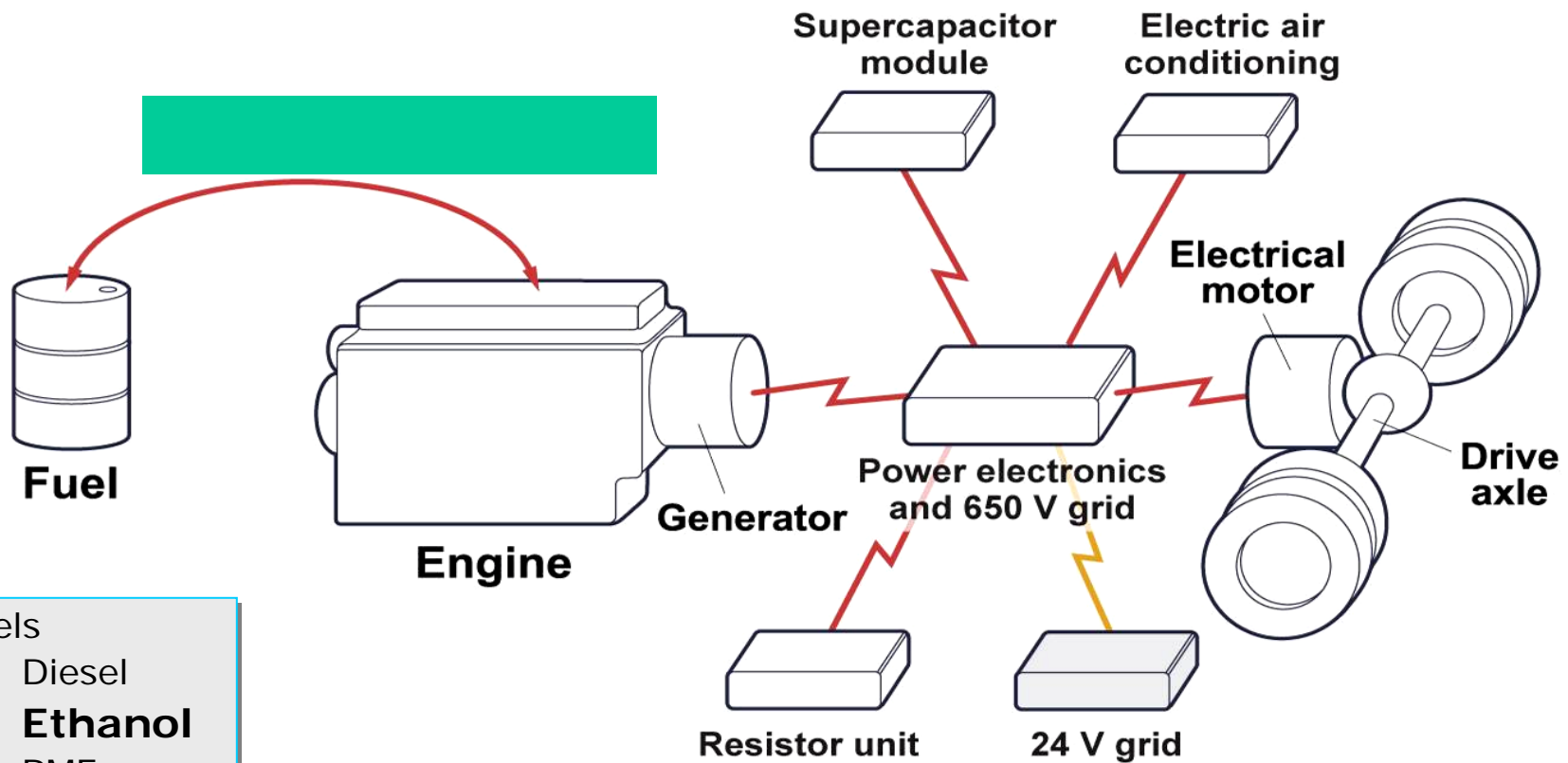
51 buses in 2006

Approximately 120 - 130 buses
in 2009

Long term co-operation with Stockholm
Water Cmp's waste plants

New contract signed with Käppala waste
water treatment plant

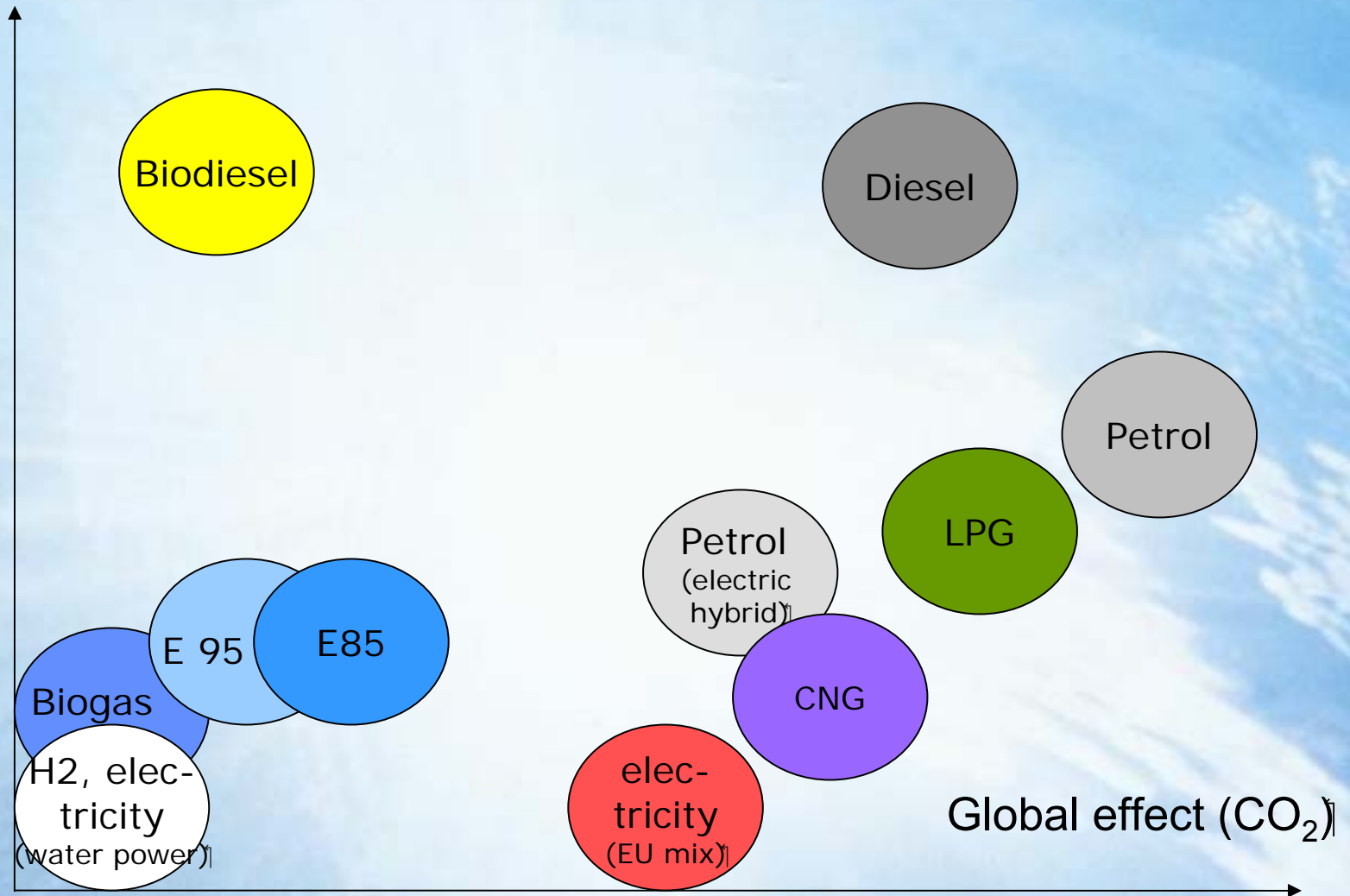




- Fuels
- Diesel
 - Ethanol**
 - RME
 - Gas
 - ...

Robust components and subsystems

Local Emissions (PM, NOx)



Net gain in Stockholm with ethanol and biogas buses (status December 2006)



- 380 ethanol and 51 biogas buses (2006):
- Reduce diesel use with 16 million litres of diesel/year
- Reduce fossil CO₂ by approx. 41 000 tonnes/year
- Reduce particulates by approx. 4 tonnes/year (Approx 5 % of PM in Stockholm)



Waste Collection in Stockholm

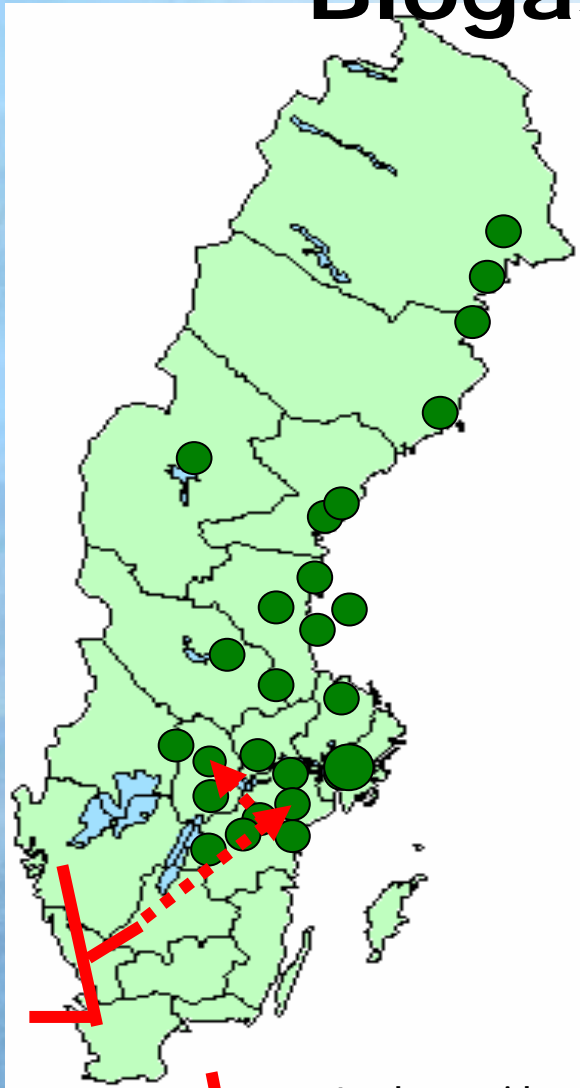
- 227 000 ton waste from the households each year
- Operation through entrepreneurs
- Demand for clean fuels when procuring the service
- 85 waste trucks in total
- 32 of these are biogas
- 9 of these in TRENDSETTER

Source: *Eva Sunnerstedt,*
City of Stockholm,
eva.sunnerstedt@miljo.stockholm.se



Biogas production in Sweden

Total production today is 1.3 TWh, at 233 plants



= natural gas grid
in Sweden.

● = biogas-
production
in water plants.

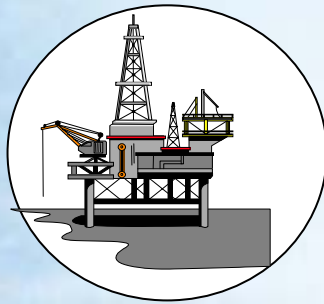
	Plants	% of prod [GWh]
Sewage treatment plants	139	43
Co-digestion plants	13	13
Landfills	70	36
Industry water	4	7
Farm plants	7	4
Upgrading plants (cleaning)	30	

Source: Swedish Energy Agency

"Vehicle gas" = natural gas (CNG) and biogas (CBG)

Not renewable

renewable



Sewage



Waste



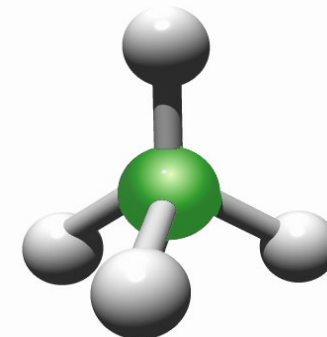
Grain



Natural gas

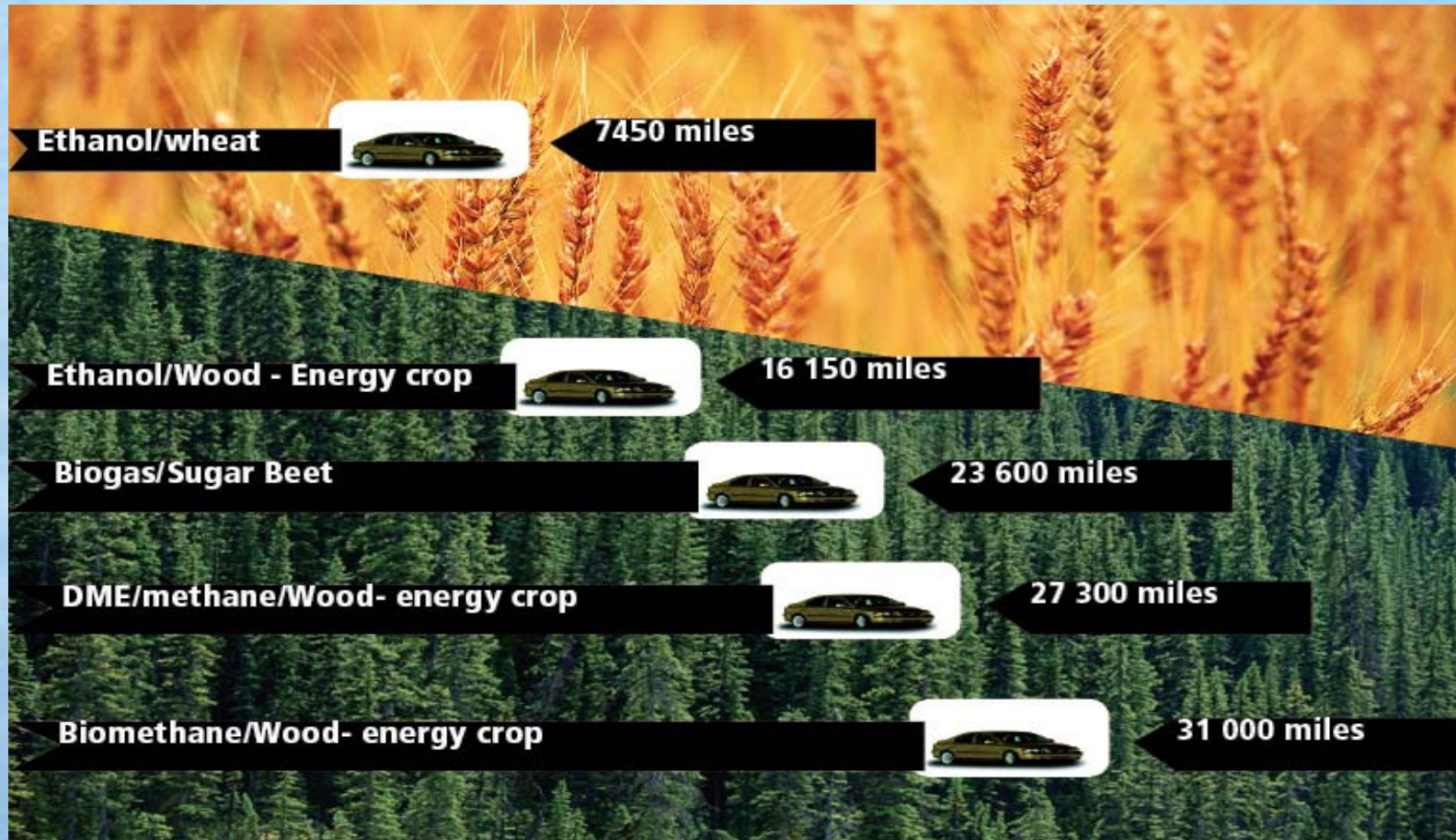
Biogas

Vehicle gas



CH₄

How many miles can a car be driven on biomass from one hectare of land?



Source:

Pål Börjesson, Lund University


Energy efficiency

A football area can provide



One car (one year or 15000 km) with biomethane from energy grass crops

Six cars (one year or 15000 km) with biomethane from sugar beets

 Corn - Etanol:
→ **2,25 kWh/kg**

 Corn - Biogas:
→ **3,12 kWh/kg**

 Corn – Etanol o Biogas:
→ **2,90 kWh/kg**

Costs for production (incl upgrading) of biomethane

Process	yen/ kWh	yen l petrol eq.
Sewage treatment	5,6	49,8
Slaughter house waste	7,5	64,8
Energy Crop Gas	8,1	71,4

The price on petrol is about 20 % higher (215 yen/ lit)
compare to biogas (179 yen petrol eq.) in Sweden

Source: Svensk Biogas
Refers to production in Sweden

Biomethane as vehicle fuel in Sweden 2006

~ 13 500 gas vehicles (NGVs)

~ 100 fueling stations for CBG/CNG

CBG/CNG = Compressed Biogas/ Compressed Natural Gas

~ 23.7 mill.Nm³ biomethane (CBG)

~ 20.2 mill.Nm³ natural gas (CNG)



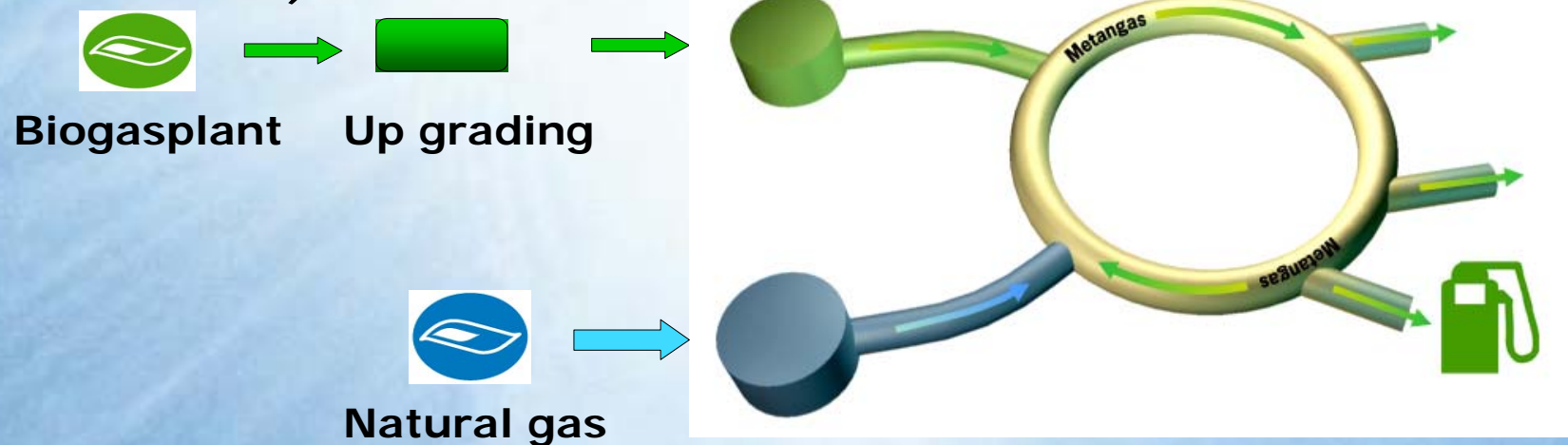
First Biogas train in the world



Name : AMANDA
20 juni i Linköping 2005

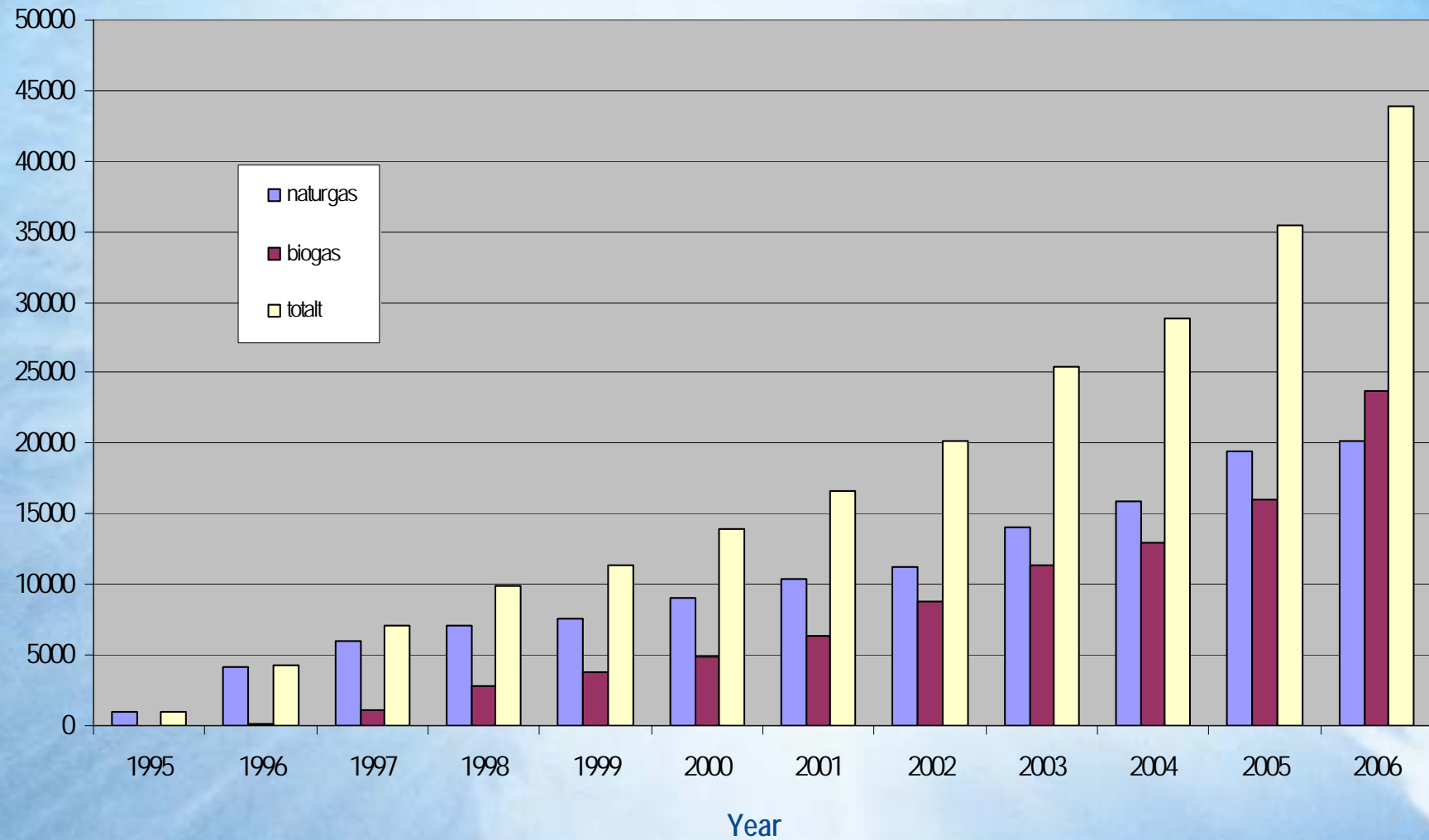
CO-operation Biogas (metan) – Natural gas (metan) - Hydrogen

- Biogas can be distributed into the natural gas grid
- Gives possibilities to continuous production, avoiding flaring
- Gas grid can be used as a backup storage
- New customers can be reached
- Hydrogen can also be provided to the grid, up to 10 % (Reducing emission and fuel consumption – project in Malmö)

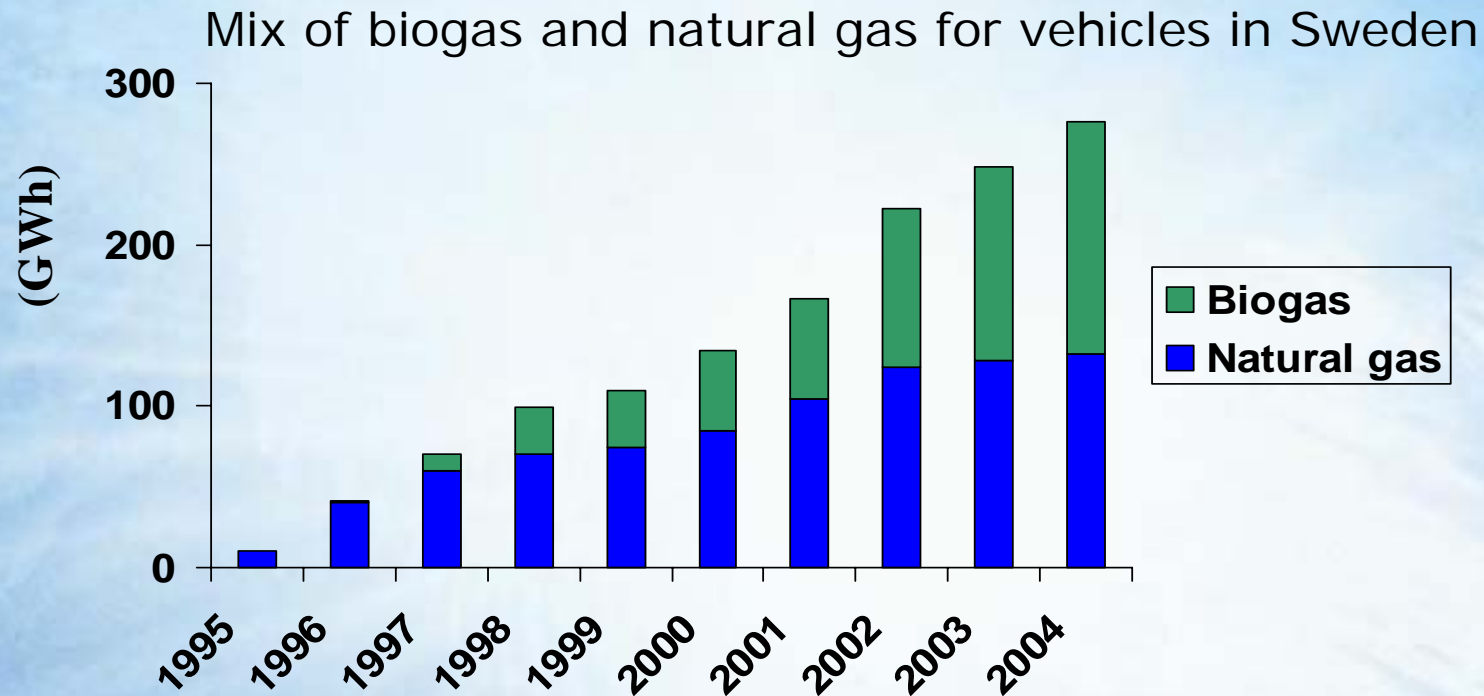


Methane sold as vehicle fuel in Sweden

Volume
in kNm³



Biogas and natural gas co-operation



- 45 % biogas and 55 % CNG reduce CO₂ with 55 %

SWEDEN

1999

Gas filling stations

2005



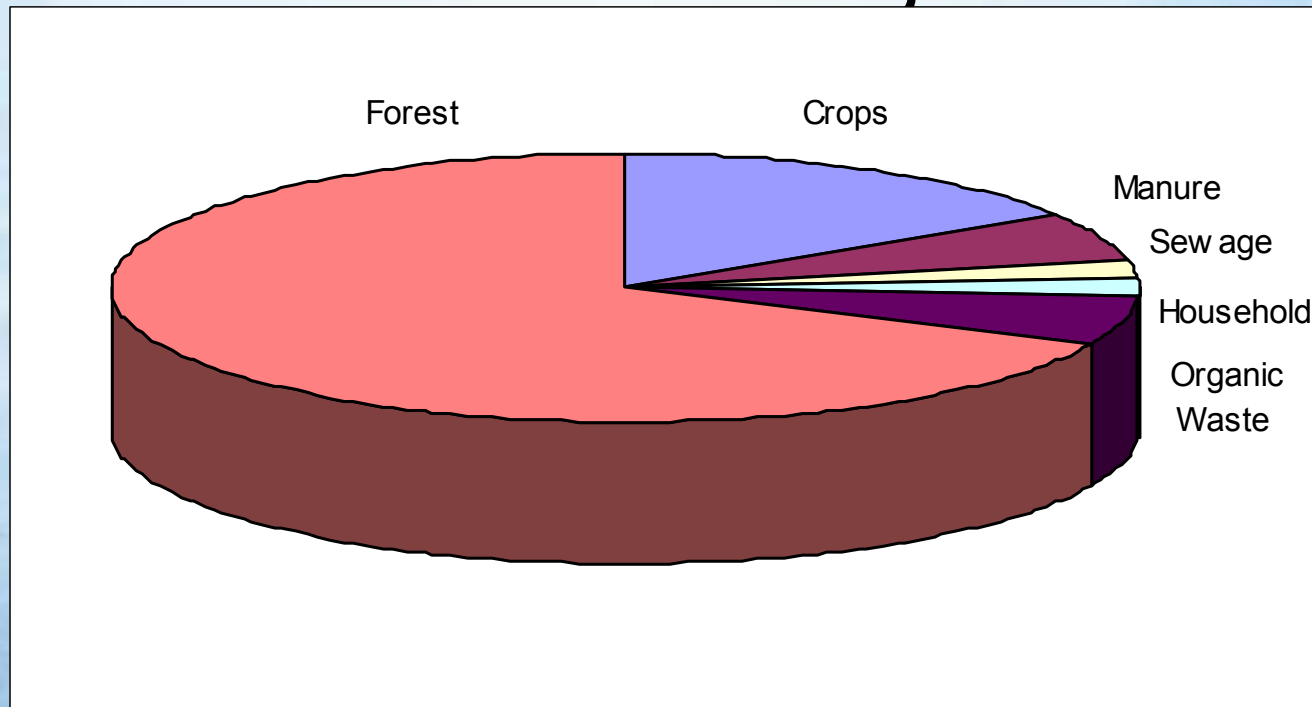
Red = stations under construction 2005

E = filling stations (European highways) under construction 2005

Sweden

biogas potential year 2050

45 TWh/ 4 635 Milj Nm³



New Cooperation California-Sweden & Biogas Cities



- Agreement between Swedish Environmental Minister Lena Sommestad and Cabinet Secretary to Governor Arnold Schwarzenegger Mr Terry Tamminen
- Starting a Task Force
- Look at the possibility of developing a transport system based on biogas in California
- Mr Tamminen and Mr Kawamura (Agriculture Minister in CA) will come to Sweden in May/June



Government incentives to promote clean vehicles

- 40% reduction of income tax for use of company NGVs
- Government procurement policy - 75 % clean cars
- Municipal/regional procurement policies – up to 100 %
- Subsidies (Climate program - LIP/KLIMP) for vehicles purchased by municipalities.
- State subsidy (166 000 Yen) when a clean vehicle is purchased privately.
- Free parking benefits in many cities
- Clean cars exempted from Stockholm congestion tax

Governmental incentives to promote biomethane

- National (LIP/KLIMP) grants, usually 30 % of investments in biogas production and upgrading facilities.
- Approx 2 822 million Yen towards (30% of investment) establishing new filling-station, 2006-2007.
- Low tax on natural gas, no tax on biomethane, means substantial fuel cost savings

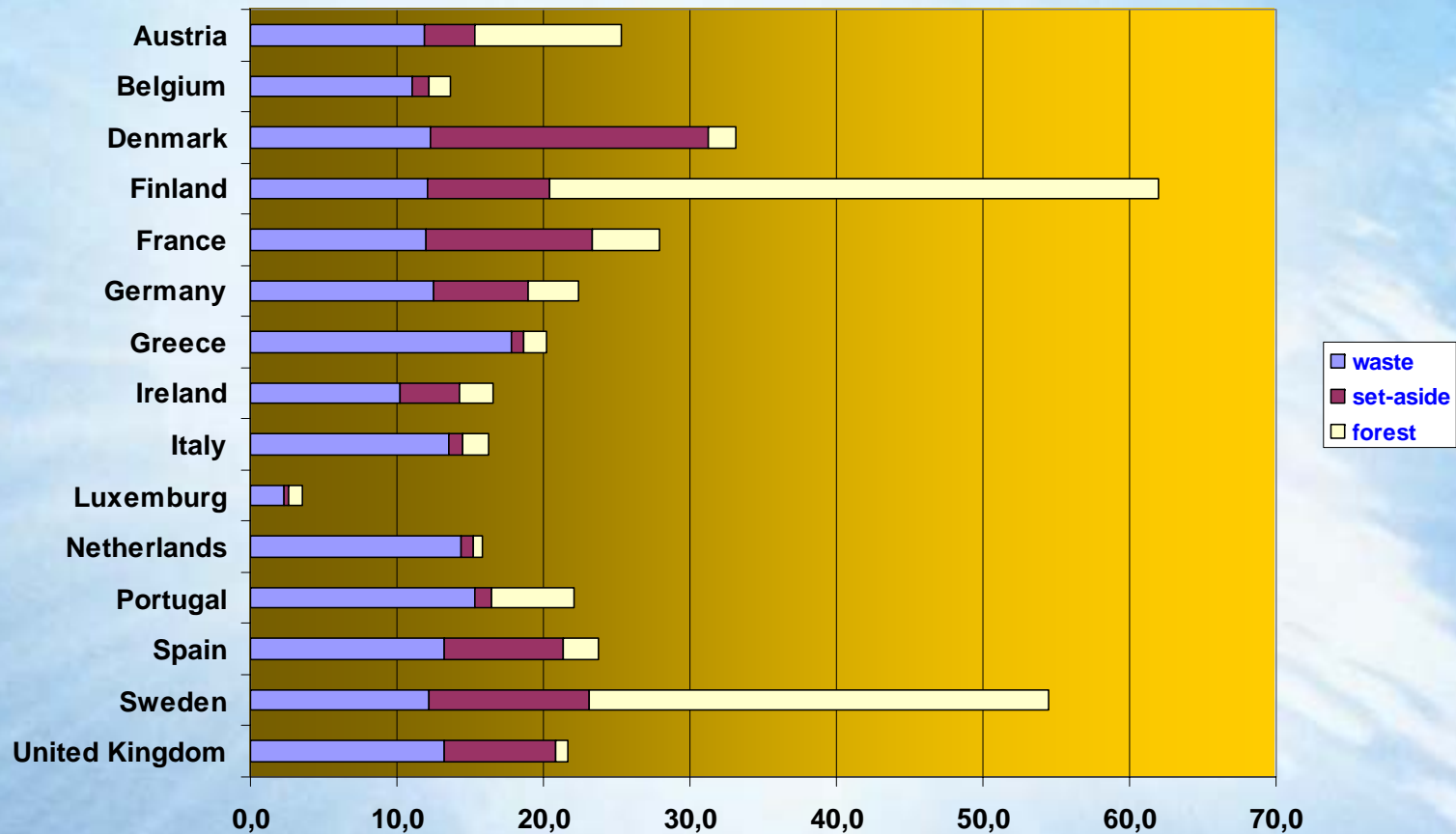
Biomethane potential in Europe



- Cities - sewage, household waste, food industry, waste, landfills
- Agriculture – manure, agriculture waste, energy crops
- Forest - (gasification) Wood, wood rests, energy forests

Biogas potentials as % of all vehicle fuel

(conventional organic waste, use of currently set-aside land, assumed 8 % of annual forest growth)



Distribution through natural gas grid in Europa



- 1 400 000 km pipes in 32 countries
- 2 000 gas filling stations
- 550 000 gas vehicles
- Potential from Waste to biogas enough to 30-50 milj. cars or 1-2 milj. buses

Gas vehicles



Citroën C3*



Citroën Berlingo*



Ford C-MAX*



Fiat Punto



Fiat Dobló*



Fiat Multipla*



Fiat Panda*



Mercedes E 200 NGT*



Opel Combo



Opel Zafira



Peugeot Partner*



Renault Kangoo*



VW Touran



VW Caddy



Volvo S60



Volvo V70



VW Golf Variant
finns som beg.



Mercedes B-klass

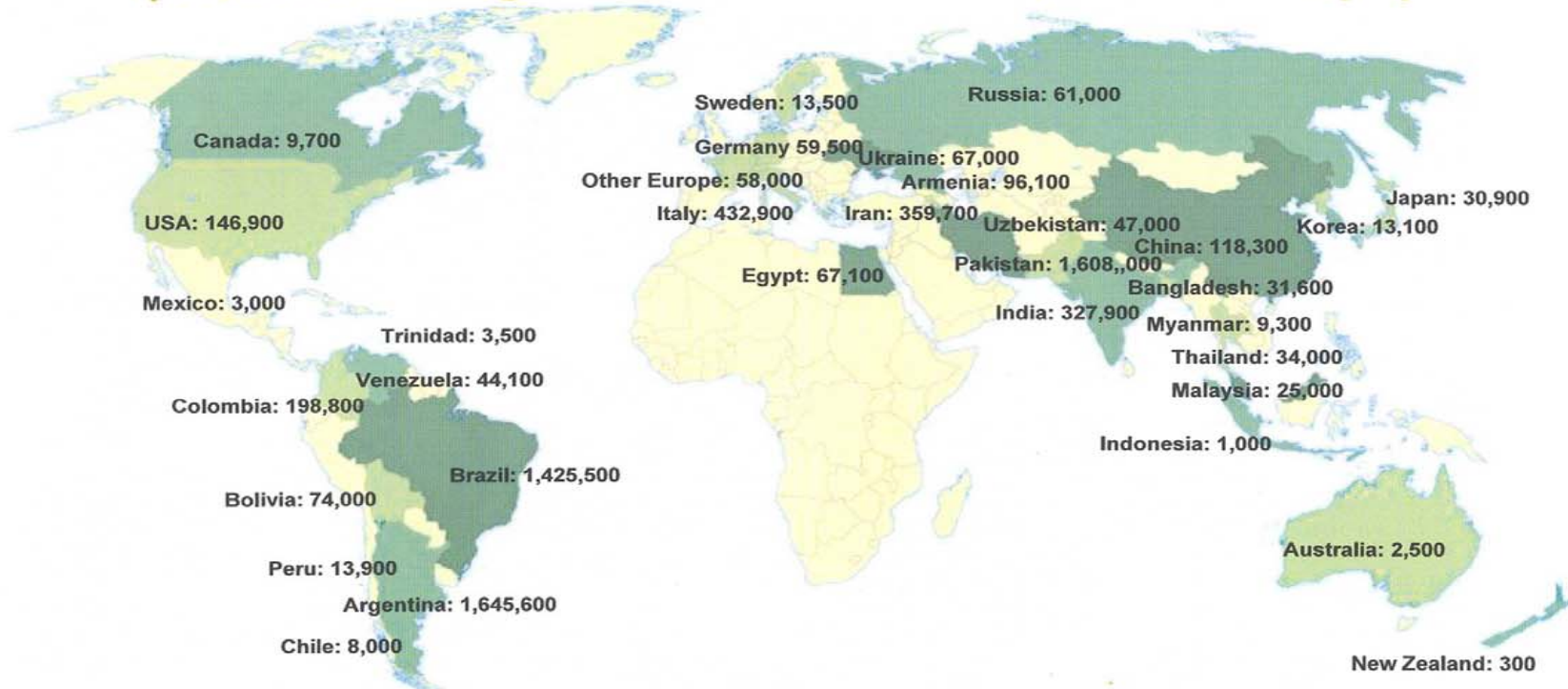


Skoda Octavia

* genom Miljöbilscenter



7.1 MILLION NGVs WORLDWIDE (11,800 fuelling stations –whereof 2,600 in Europe)



Source: The GVR, Sept 2007

170,300 buses, 132,300 trucks, and 6,751,200 LD vehicles
now running on natural gas and biomethane, using 22 billion
Nm³ of methane annually (18.9 Mtoe)



Proposed EU support

- EU Commission planning to start using NGVs or hybrid cars
- NGV Technology Platform proposed
- New directive setting European targets for use of natural gas in road transports proposed
- The European Parliament via the Morgan report in December 2006 highlighted that gaseous biofuels (like biomethane) must not be seen only as a fuel for heat and power generation, but also as a biofuel option in the road transportation sector.



Directives and long-term targets of the EU

Biofuel is to replace petrol and diesel with

2 %	2005
5,75 %	2010

The long-term target for 2020

- 10 % natural gas
- 8 % biofuels
- 5 % hydrogen

ARIGATO GOZAIMASHITA

ありがとうございました

Thank you for your attention!

Lars Rahm
Lars.rahm@stockholmvatten.se

www.sgc.se

www.fordonsgas.se

www.grida.no/climate/ipcc_tar/wg1/134.htm#tab42