



E85 FFV / Saab BioPower - the Swedish experience

TAC @ Millford Proving Ground – September 10th 2007

GM Powertrain Sweden

Kjell ac Bergström



Saab BioPowered Engines - The Swedish Experience

- Why Renewable Fuels
- Initiatives from European Governments
- Saab BioPower Technology – Today
- Saab BioPower Technology - Future



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The Swedish Experience

- History

- Environmental Concern in the Nordic Countries
- Swedish Vehicle Emission Legislation
- Green Party in coalition with Socialdemocrats
- Green Consumer Organisations
- Company Environmental Policies include company cars



The Swedish Experience

- Fuels History

- Swedish Fuel requirement early for Low Sulphur levels
- Trial Market Tests with Low Blending 10 % around 1975
- BioGas / CNG since late 1980
- E05 since mid 1990 (from Brazil with import tax)
- E85 since late 1990 (produced in Sweden no energy tax)

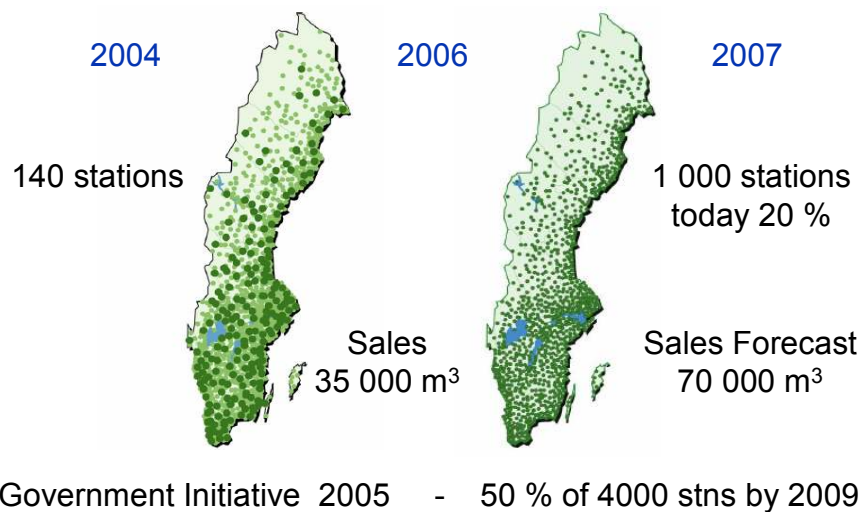


Financial benefits for environmental cars in Sweden

- No tax on renewable fuels – to 2013
- 20% lower tax on company cars – to 2011
- Lower vehicle tax on clean cars
- 10 000 SEK return for private owners
- Free & longer parking in cities
- Exempt from congestion charge - Stockholm
- Clean taxi cars "cut the line" at Arlanda Airport, Stockholm
- Clean cars are demanded in various procurements by state authorities, police etc
- State funding programs and EC funding for fuel production, distribution and investments in vehicles

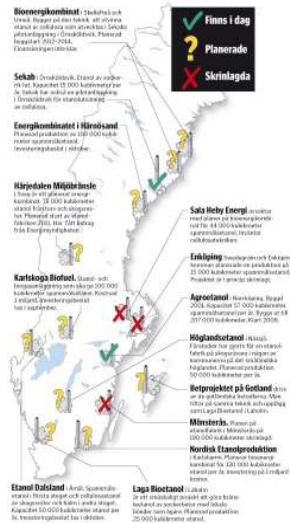


E85 Infrastructure Growth in Sweden



The E85 Production Plans in Sweden

- Ethanol Plants planned
 - 14 with Total capacity @ 730 000 m³
 - 6 based on cellulosic sources
 - 8 based on crops sources
- Tough Financial Situation
 - Very high Price on Wheat
 - Low Market Price on the imported Ethanol
 - Uncertainty about Future Import Customs
 - Awaiting for Process Techn. Break through
- Current Situation
 - 2 plants – up and running @ 75 000 m³
 - 9 plants - plans on hold
 - 3 plants - plans closed – crops based



E85 vs EU target for 2012 of 130 g CO₂ / km

- Industry target was reduced with 5 g CO₂ due to commitment to make cars driveable on E05
- Discussions of how to rate E85 cars vs CO₂ target is ongoing
- Car taxation is being based on CO₂ emissions in UK, Holland, Spain and more countries to follow
- Spain: - CO₂ based vehicle taxation introduced 2007
 - E85 cars taxed @ 30 % of gasoline level
 - Saab 9.5 BioPower = 65 g fossile CO₂/km
- Discussion for the EU5 (2009) and EU6 (2014) emissions requirements on Ethanol content in emissions (NMHC-like)

The E85 Roll out in Europe - Other Markets

- Saab BioPower is marketed cross Europe
 - Strongest E85 markets are besides Sweden now Norway, Finland, Ireland, France, Spain & Germany
- France: Government Initiative 2006 to launch E85
 - Saab, Renault & Peugeot
 - At least One offer per Car Line by 2007

Fuel prices	Sweden		France
	SEK / ltr	USD/gal	€ / ltr
E85	8.00	4.60	0.80
Gasoline 98 RON	11.00	6.25	1.18
Diesel	10.00	5.70	0.96

Ethanol E85 as an Engine Fuel - PROs & CONs

PROs :

- High Concentration Blends like E85 or E100
 - best use of the fuels advantageous properties
- High E85 Octane Number - RON 105 $((R + M)/2 = 96)$
- High Heat of Vaporization Value - 2.8 times vs Gasoline
 - Gives Charge Cooling effect of 2.4 times vs Gasoline
 - Allows increased Compression Ratios and Spark Advance



CONs :

- Lower Calorific Value
- Low Vapor Pressure
- Liquid Ethanol is chemically aggressive

Saab BioPower Today – Customer Response



Improved Customer Response

- More Responsible towards Social Consciousness & Global Issues
- More Responsiveness towards the Driver

Higher Specific Performance

- Saab 9-5 2.3t 185 hp / 280 Nm Gasoline
=> Replaced by Downsized Engine
Saab 9-5 2.0t 180 hp / 280 Nm BioPower (150/240 Gasoline)
- Saab 9-5 2.3t 210 hp / 310 Nm BioPower (185/280 Gasoline)
- Saab 9-3 1.8t 175 hp / 265 Nm BioPower (150/240 Gasoline)
- Saab 9-3 2.0t 200 hp / 300 Nm BioPower (175/265 Gasoline)

Simple to use

- Full fuel flexibility & seamless transition

Shorter Driving Range

BioPower Saab

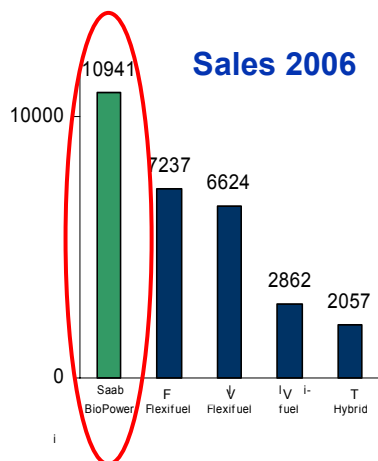


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Saab 9-5 BioPower #1 Environmental Car in Sweden



- Exceptionally strong reception of Saab 9-5 BioPower in Sweden
- BioPower represents ~85% of 9-5 sales - with only one variant 2.0t BioPower
- **The leading environmental car**
- Sales in 2006 of environmental cars - Up 256% vs. 2005. Equal to a 17% MS



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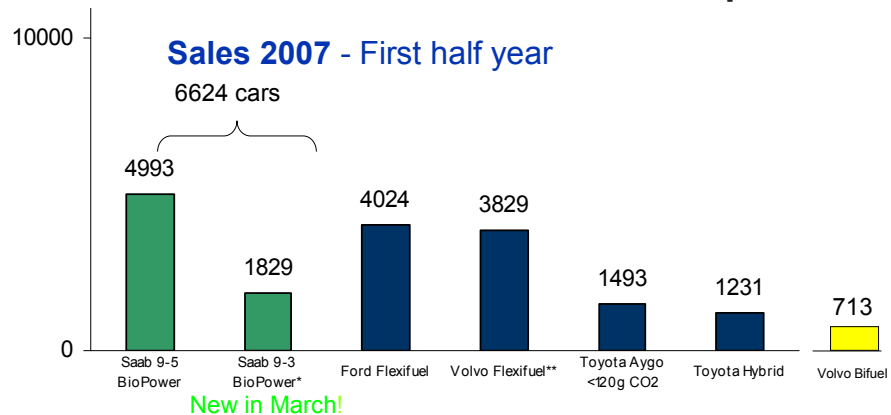
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The Swedish market has made its choice: **BioEthanol**



Saab BioPower is the clear leader among **environmental cars!**



Saab BioPower Technology – Future Potentials

High Potential combined with Turbocharging

- Next Generation Optimized for Ethanol
- Still driveable on Gasoline

Increased Compression Ratio

- Increased Efficiency
- Reduced Fuel Consumption

Increased Powertrain Bandwidth

- Rightsizing – Right Engine Size for the Application

Direct Injection Engines (SIDI)

- Further Increased Efficiency
- Further Reduced Fuel Consumption
- Securing Cold Starts without extra starting aids



BioPower Saab

Saab BioPower Technology – Future Potentials

Alcohol Engines

- Increased Peak Pressure
- Further increased Compression ratios
- Increased Thermal Efficiencies



Plug-In Hybrid combined with BioPower

- Offers best Potential for the future
- Increases Driving Range
- Further Potential for Rightsizing



Saab
BioPower



BioPower Technology - Today & In the Future Summary



- Renewable Fuels – because it is needed
- Renewable Fuel today – 1st gen BioEthanol E85
- BioPower
 - Responsible & Responsive to Customer Needs
 - Can be combined with Future Technologies

Saab
BioPower





Welcome On Board



Saab BioPower Powertrain technology

Today's Engines

Diesel Engines:

- + Efficiency
- Exhaust Emissions

Otto Engines:

- + Exhaust Emissions
- Efficiency

Future Saab BioPower

Engines

SIDI Turbo Engines:

Highly Charged, combined with Alternative Fuels

- + Efficiency
- + Exhaust Emissions

and with Hybrids

- + Range

