

# Preliminary Results on HCCI Implementation with High Cetane Number Fuel

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# Research Objective

- **A new approach to HCCI study → effect of high cetane number on combustion behavior**
- **Pre study**

# Hydrotreated Vegetable Oil

Property	Unit	EN590	HVO
Density	kg/m <sup>3</sup>	843	779.7
Heating value	MJ/kg	45.99	47.27
Cetane number	IQT	57	95
Viscosity	mm <sup>2</sup> /s	3.208	3.087
Aromatics	wt -%	18.9	0.2
Paraffins	wt -%	29	100
C/H	-	6.52	5.61

# Fuel properties

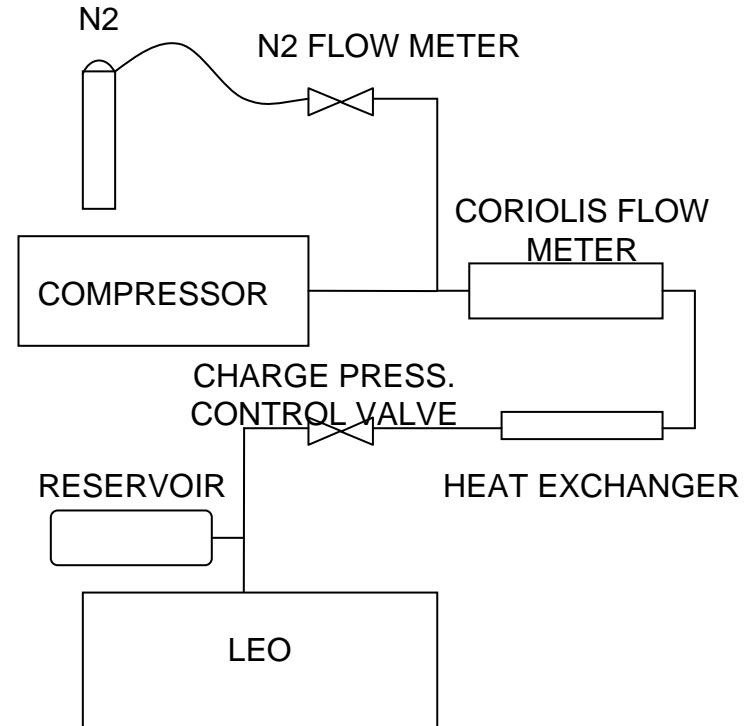
	NExBTL	GTL Diesel	FAME	EN590/05 Summer	PetroDiesel winter MK1
Density @ +15°C (kg/m <sup>3</sup> )	775 - 785	770 – 785	≈ 885	≈ 835	800 - 820
Viscosity @ + 40°C (mm <sup>2</sup> /s)	2.9 – 3.5	3.2 – 4.5	≈ 4.5	≈ 3.5	1.5 - 4
Cetane number	84 – 99	≈ 73 – 81	≈ 51	≈ 53	≈ 51
10% distillation (°C)	260 – 270	≈260	≈ 340	≈ 200	≈ 210
90% distillation (°C)	295 – 300	325 – 330	≈ 355	≈ 350	≈ 275
Cloud point (°C)	-5 to -30	0 to -25	≈ -5	≈ -5	-22 to -36
Heating value (low) (MJ/kg)	≈ 44	≈ 44	≈ 38	≈ 43	≈ 44
Heating value (MJ/l)	≈ 34	≈ 34	≈ 34	≈ 36	≈ 35
Polyaromatic content (wt%)	0	0	0	≈ 4	0
Oxygen content (wt%)	0	0	≈ 11	0	0
Sulfur content (mg/kg)	≈ 0	< 10	< 10	< 10	< 10

## ■ LEO engine

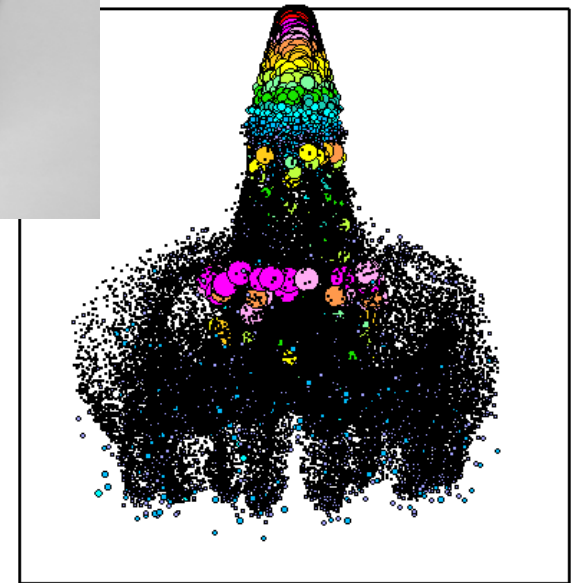
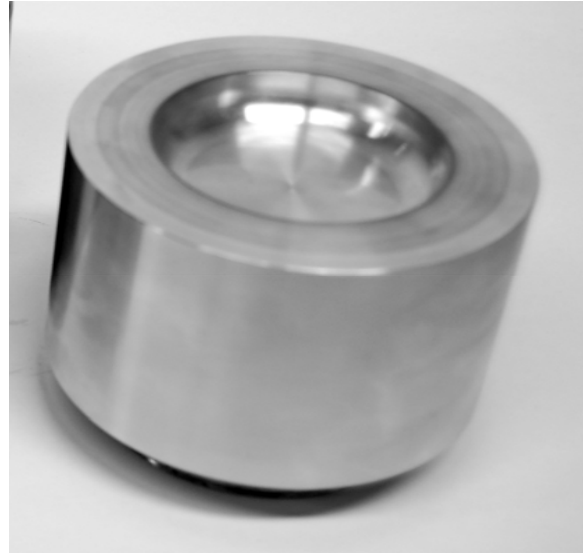
<b>Bore</b>	<b>111</b>	<b>mm</b>
<b>Stroke</b>	<b>145</b>	<b>mm</b>
<b>Displacement</b>	<b>1.4</b>	<b>Litres</b>
<b>Compression ratio</b>	<b>17</b>	<b>-</b>
<b>Speed</b>	<b>1400</b>	<b>r.p.m.</b>



- **Nitrogen was used to simulate EGR**



- **Piston combustion chamber was designed based on CFD simulation**



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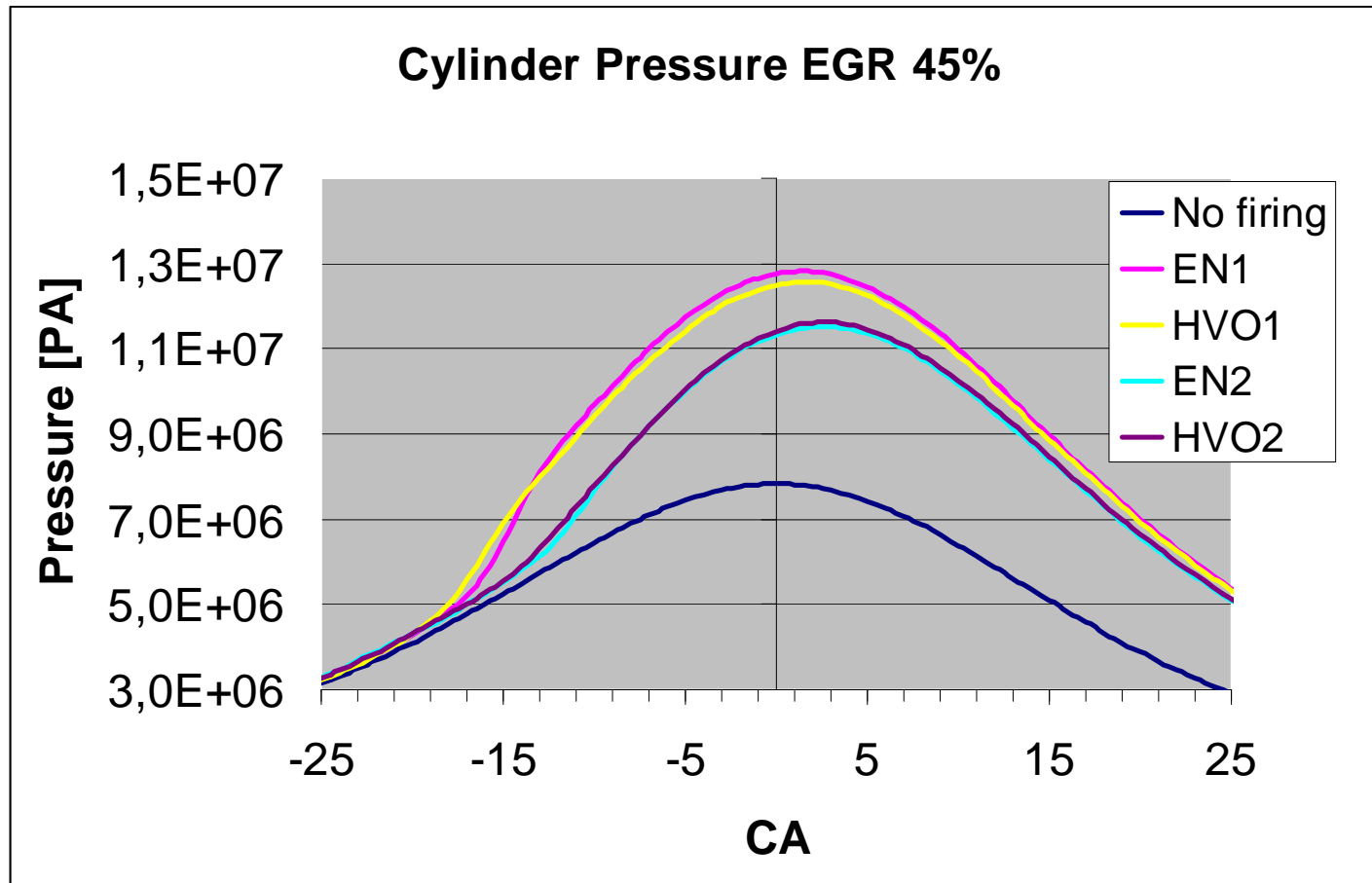
# Test Matrix

FUEL	EGR [%]	SOI [BTDC]	Abbreviation
EN590	45	25	EN1
EN590	45	35	EN2
EN590	55	25	EN3
EN590	55	35	EN4
EN590	65	25	EN5
EN590	65	35	EN5
HVO	45	25	HVO1
HVO	45	35	HVO2
HVO	55	25	HVO3
HVO	55	35	HVO4
HVO	65	25	HVO5
HVO	65	35	HVO6

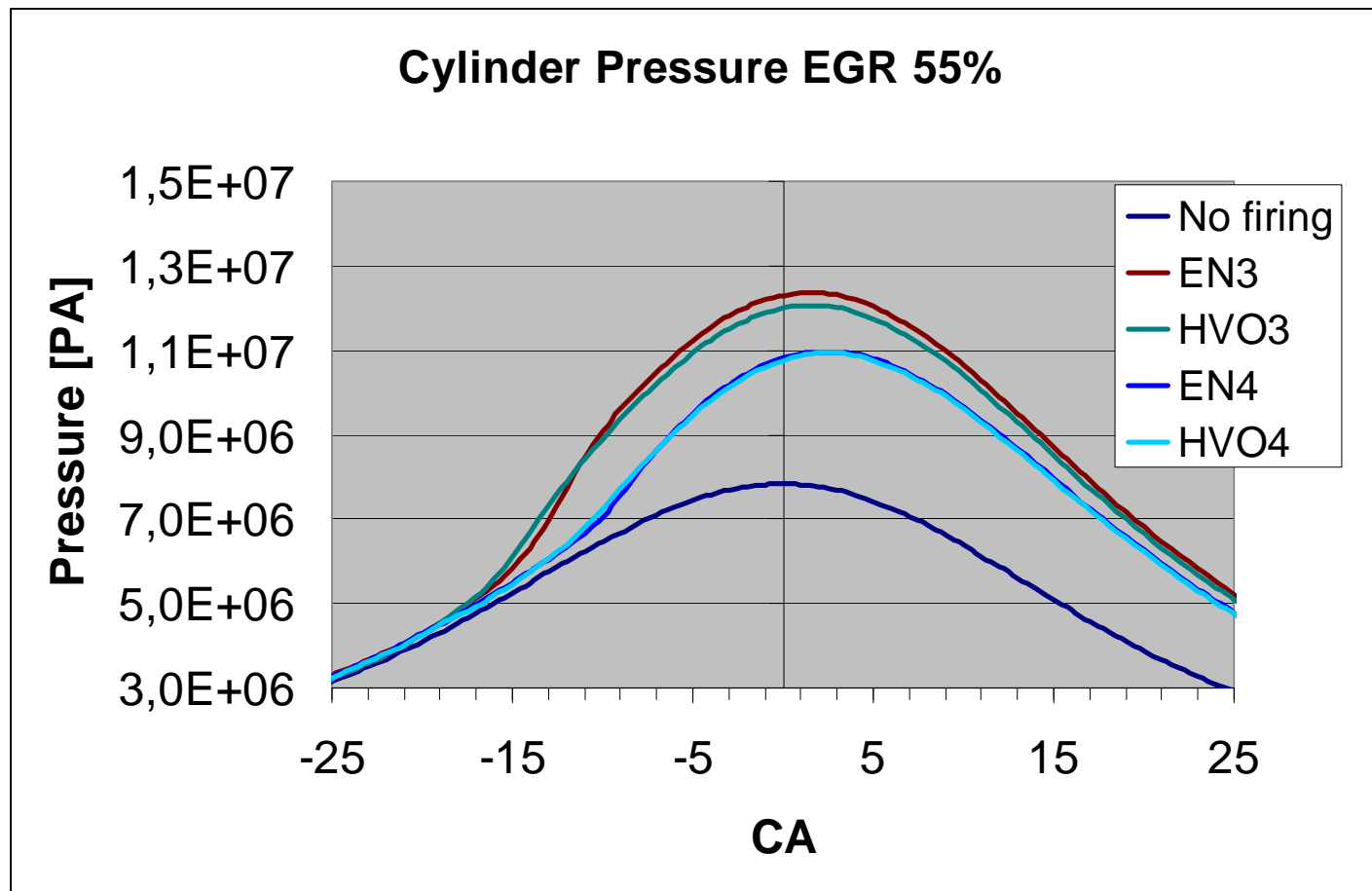
Parameter	Value	Unit
Charge pressure	0,8	bar
Charge temperature	340	K
Injection pressure	1000	bar
Injection duration	800	μs



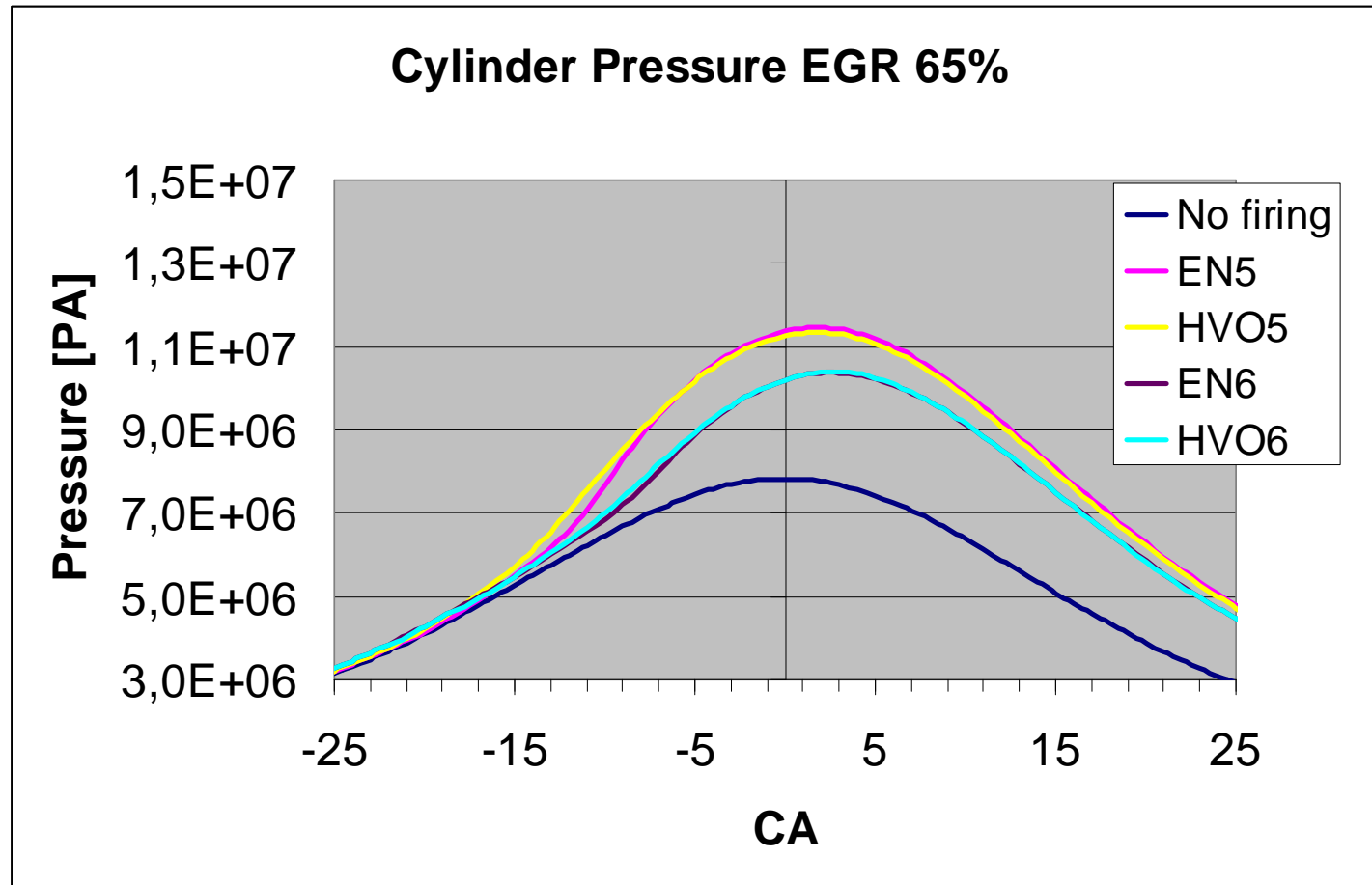
# Results - Cylinder pressures



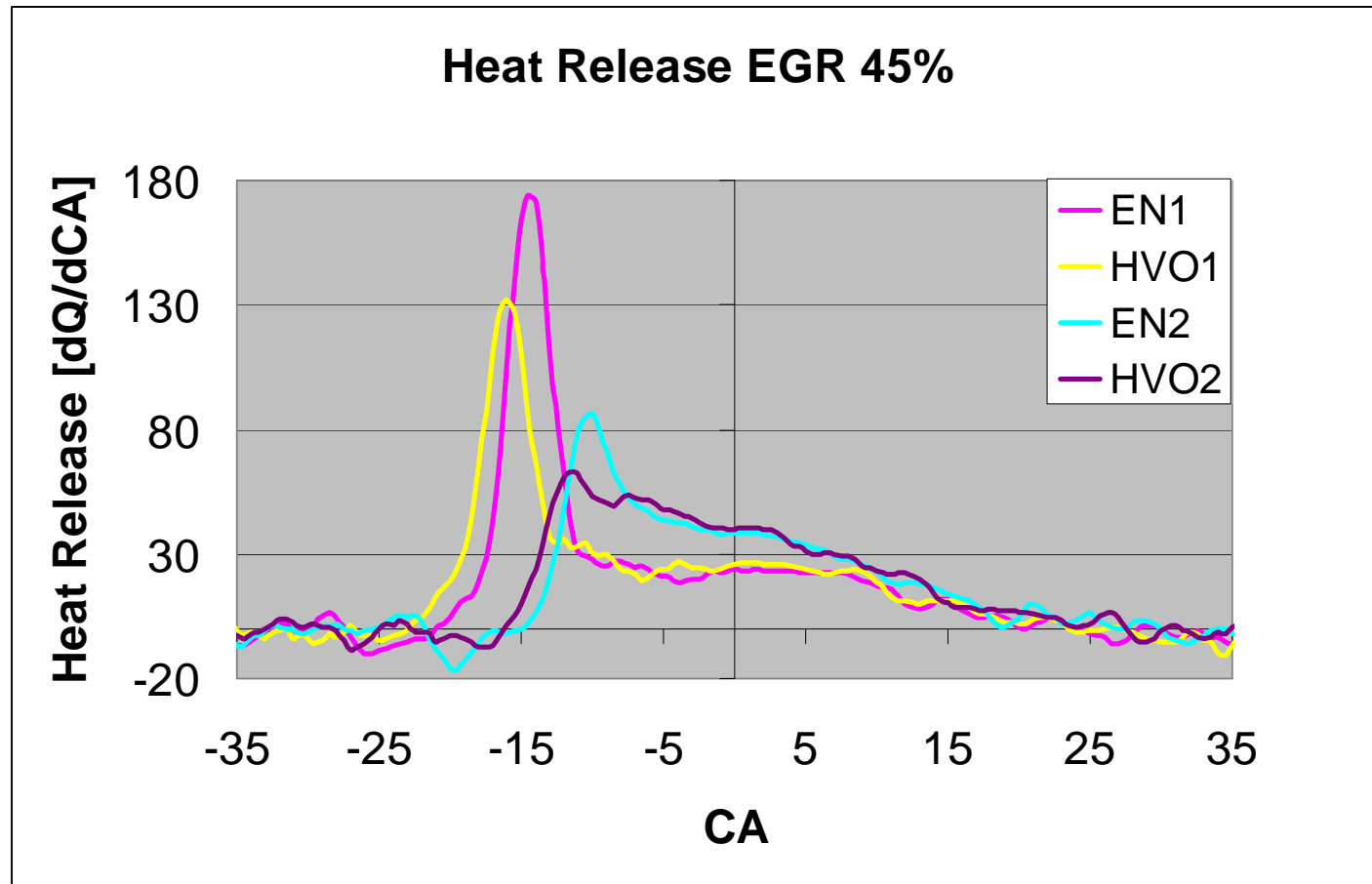
# Results - Cylinder pressures



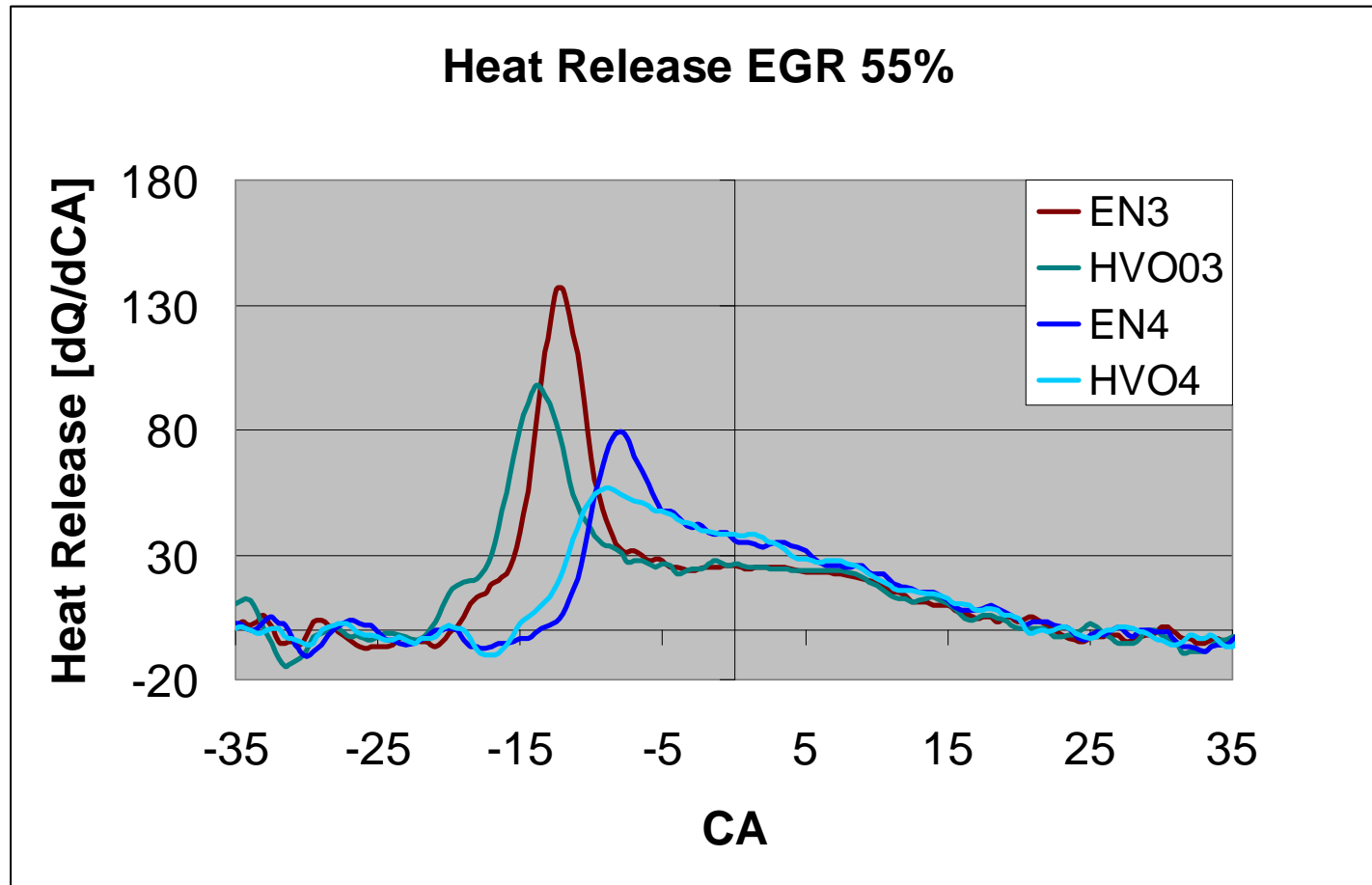
# Results - Cylinder pressures



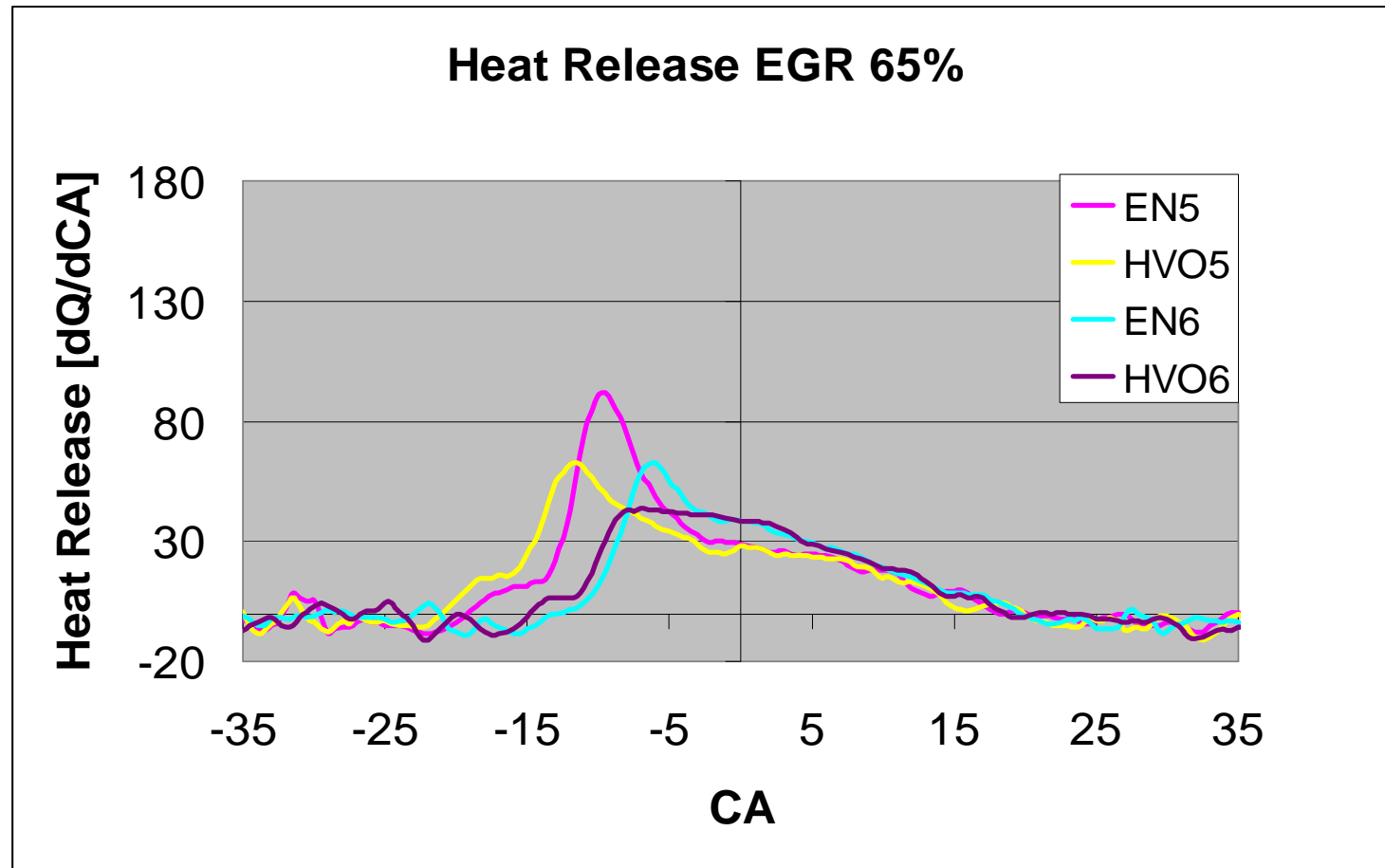
# Results - Heat Release



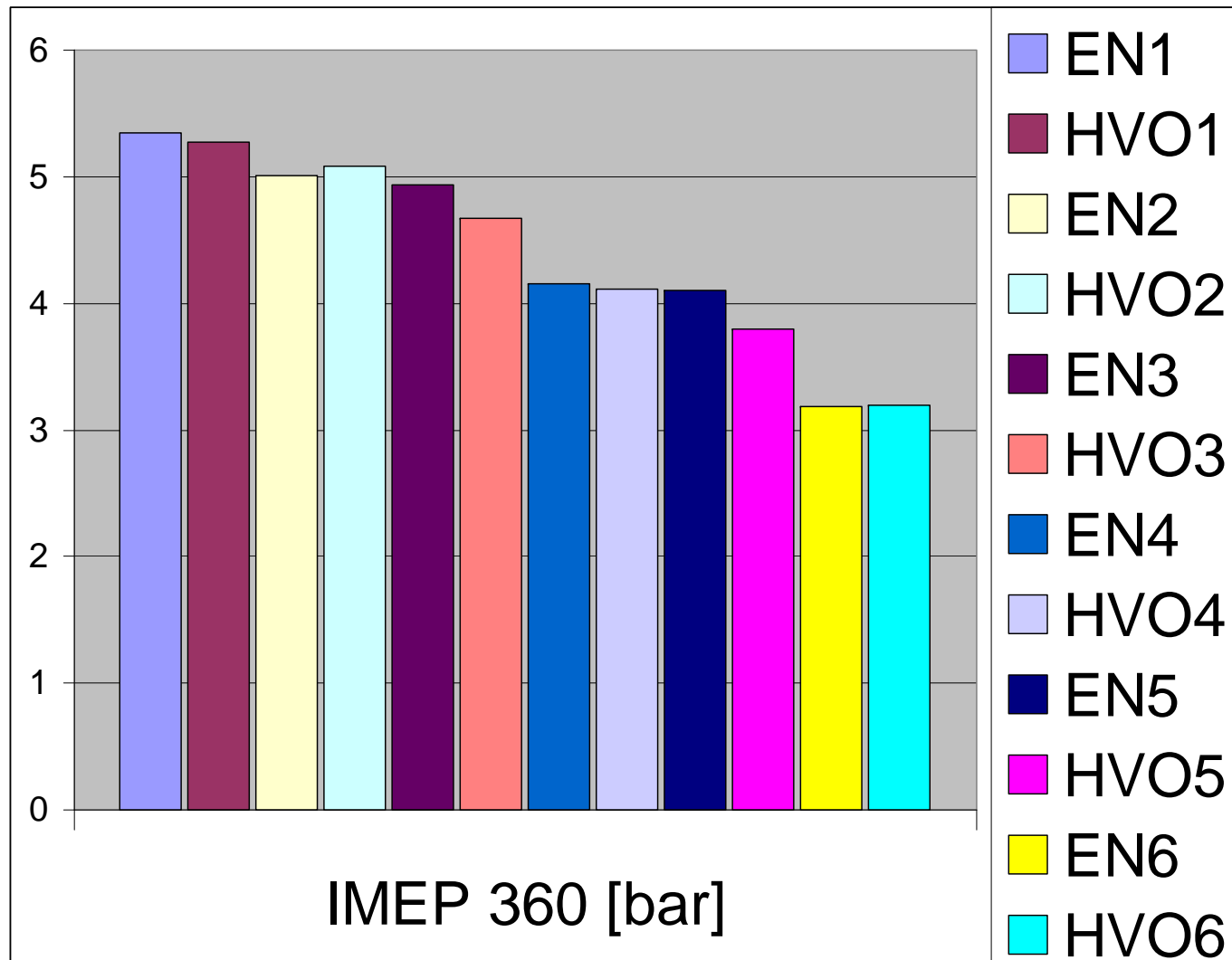
# Results - Heat Release



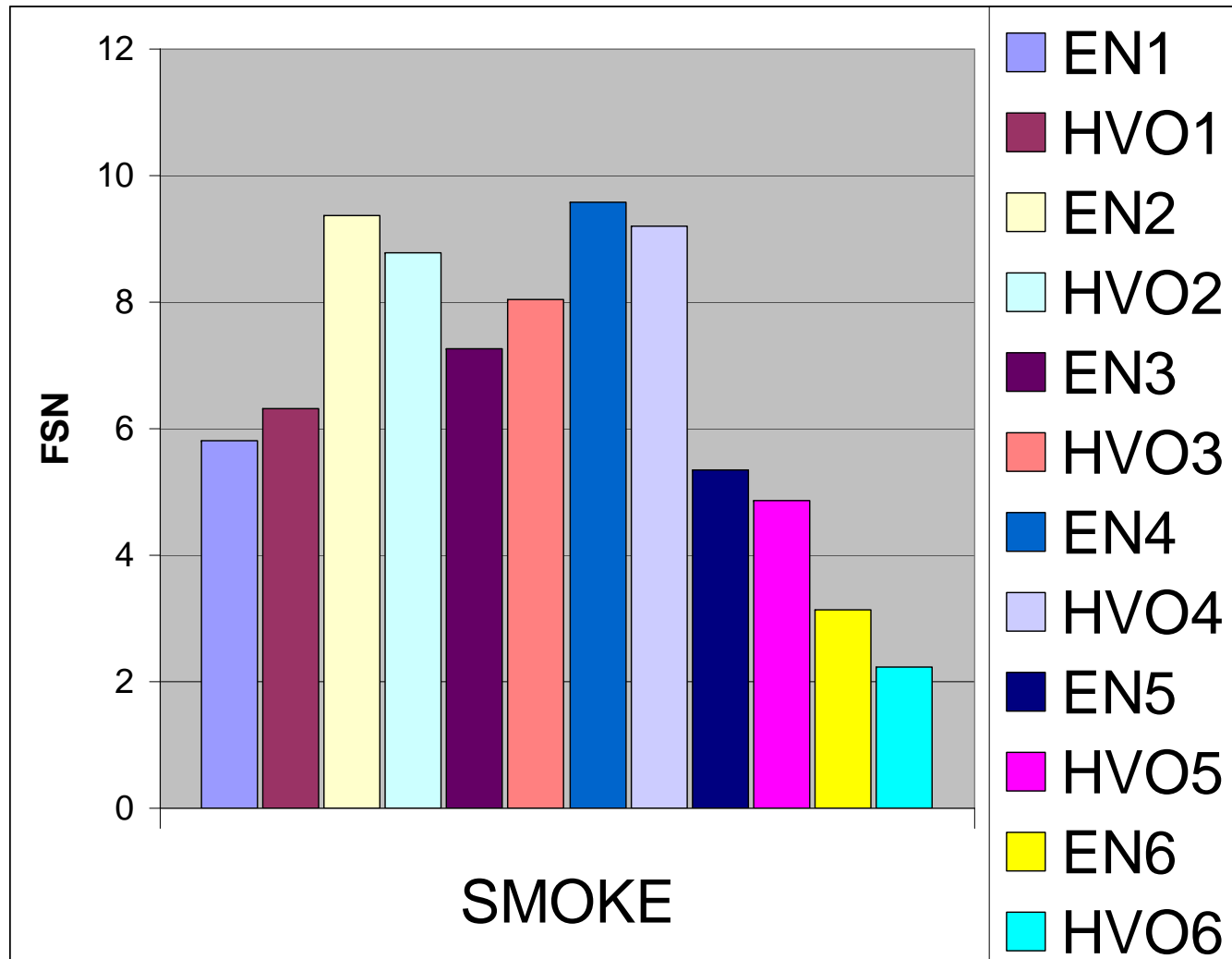
# Results - Heat Release



# Results - IMEP



# Results - Smoke





# Conclusions

- **The HVO fuel ignites earlier but the maximum heat release rates are lower than with EN590 fuel**
- **Differences on IMEP between two fuels are small**
- **This might give more tolerance of ignition instabilities on HCCI combustion, since the risk of too steep and high pressure rise seems to lower with HVO than EN590**
- **Plenty of research work still ahead.**