

# A model investigation of fuel and operating regime impact on HCCI engine performance

Bissoli, M., Frassoldati, A., Cuoci, A., Ranzi, E., Faravelli, T.\*

Department of Chemistry, Materials and Chemical Engineering "G. Natta", Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

## Appendix A. Sensitivity of operability limits to wall temperature, engine speeds and boost pressure.

### 1.1 Sensitivity to wall temperature

Figure A1 and Figure A2 show the effect of decreasing the wall temperature from 450 K to 430 K on different parameters on ethanol operability maps. First, Figure A1 shows that effects on the operability limits are negligible. Similarly, by comparing with Figure A2 with Figure 15, Figure 18 and Figure 23, it is possible to observe that wall temperature has a limited impact on the prediction of ignition timing, load and exhaust emissions. These findings confirm that model results support the adoption of 450 K as wall temperature.

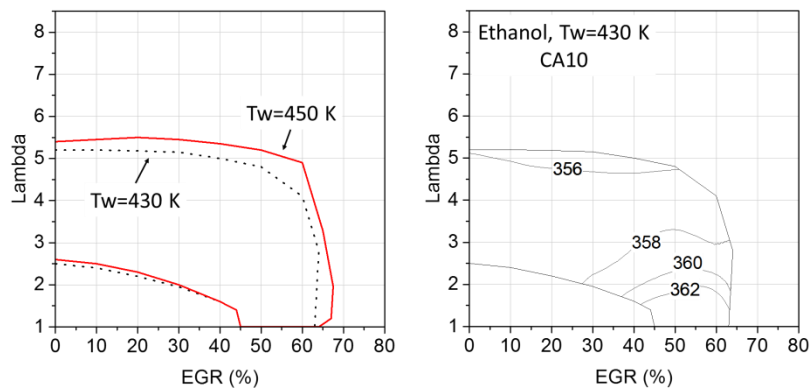


Figure A1: Sensitivity of HCCI operative region prediction to wall temperature.

PRF100,  $T_w=430$  K

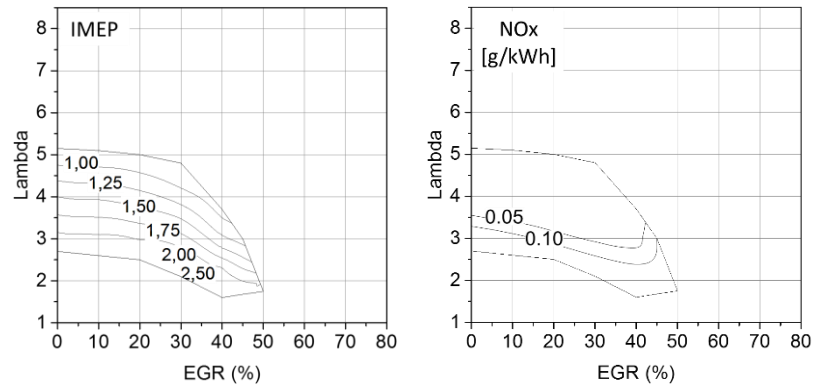


Figure A2: Sensitivity of model predictions to wall temperature.

## 1.2 Effect of engine speed, ethanol

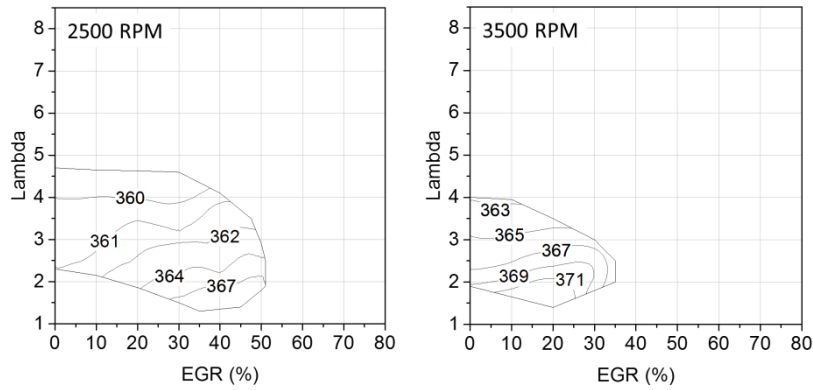


Figure A3: Effect of engine speed on the CA10 [°CA] predicted by the model.

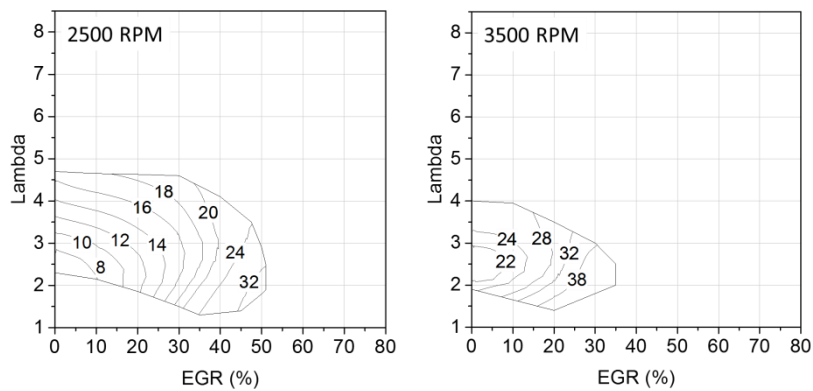


Figure A4: Effect of engine speed on the CA10-90 [°CA] predicted by the model.

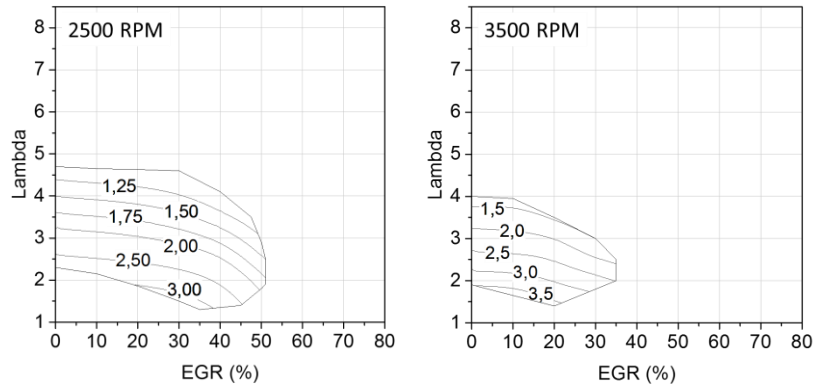


Figure A5: Effect of engine speed on the IMEP [bar] predicted by the model.

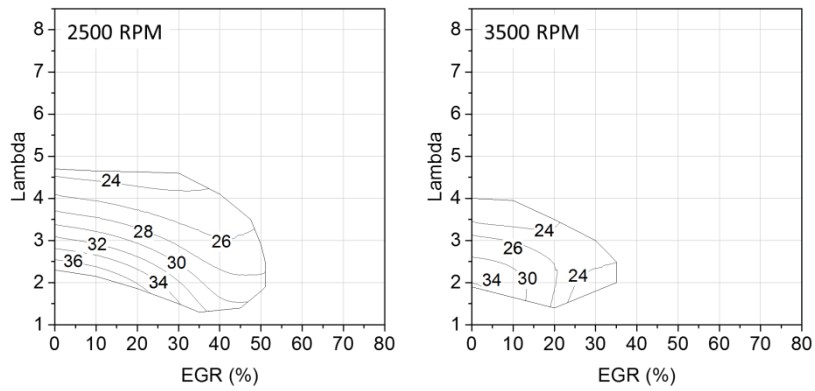


Figure A6: Effect of engine speed on the maximum in-cylinder pressure [bar] predicted by the model.

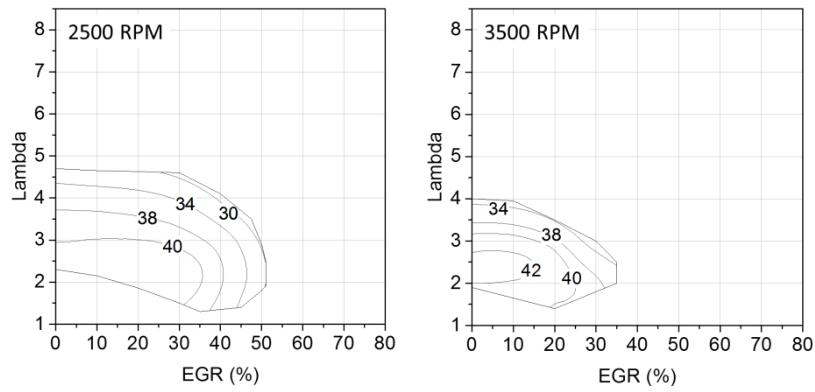


Figure A7: Effect of engine speed on the thermal efficiency [%] map predicted by the model.

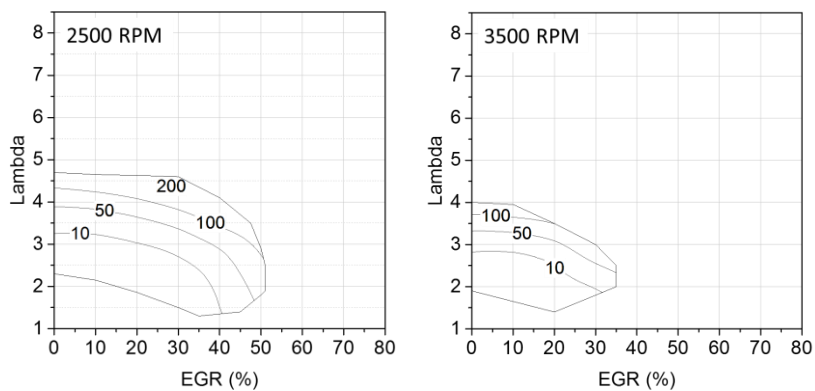


Figure A8: Effect of engine speed on the CO emissions [g/kWh] predicted by the model.

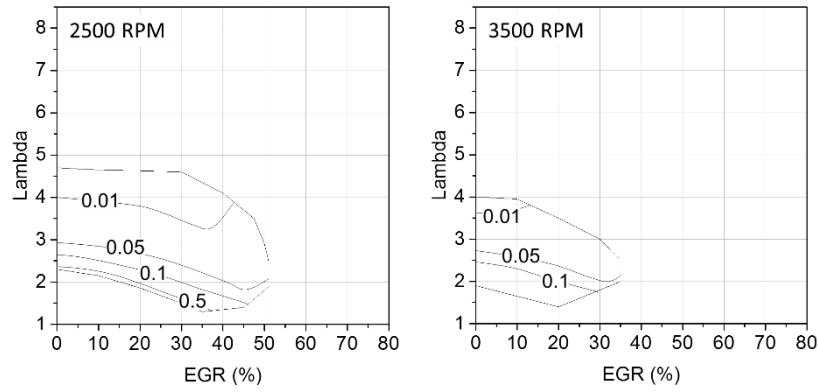


Figure A9: Effect of engine speed on the NOx emissions [g/kWh] predicted by the model.

### 1.3 Effect of boost pressure, PRF100

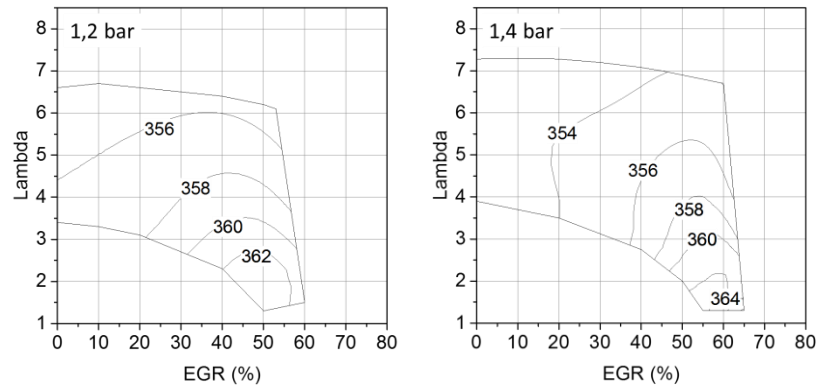


Figure A10: Effect of IVC pressure on the CA10 [°CA] predicted by the model.

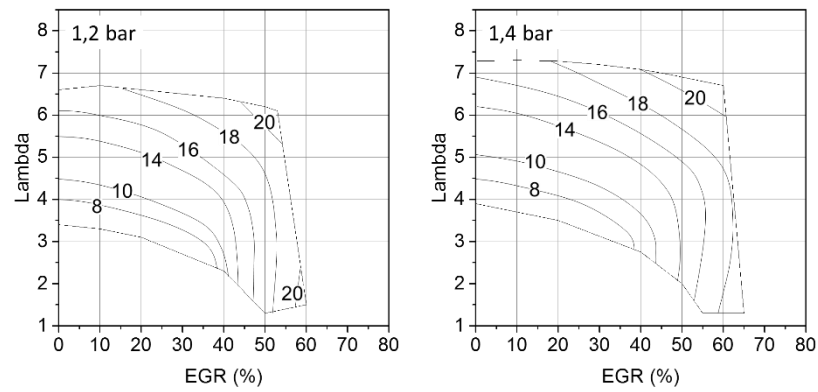


Figure A11: Effect of IVC pressure on the CA10-90 [°CA] predicted by the model.

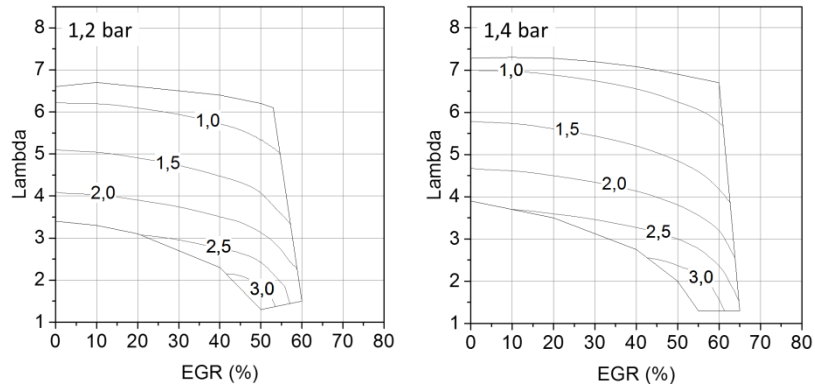


Figure A12: Effect of IVC pressure on the IMEP [bar] predicted by the model.

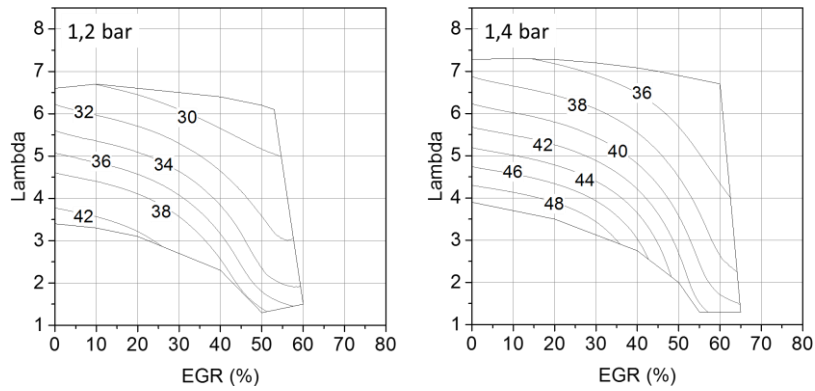


Figure A13: Effect of IVC pressure on the maximum in-cylinder pressure [bar] predicted by the model.

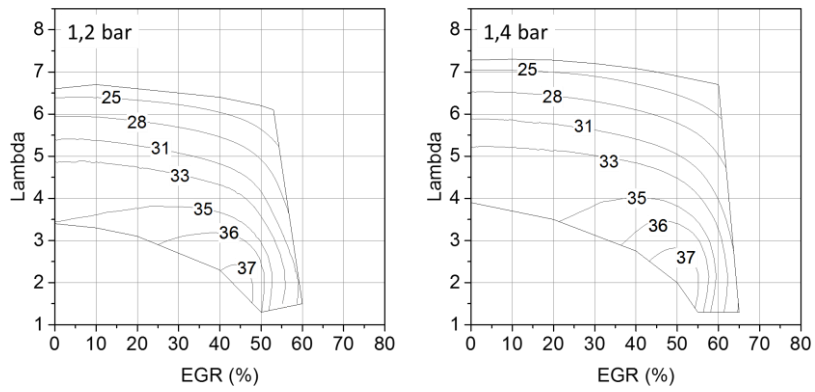


Figure A14: Effect of IVC pressure on the thermal efficiency [%] map predicted by the model.

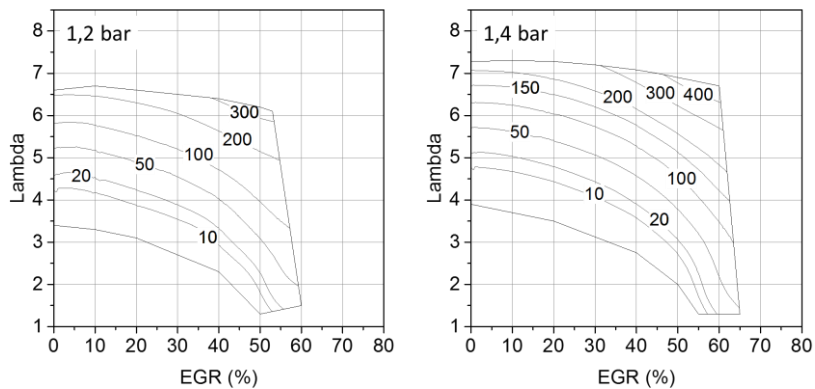


Figure A15: Effect of IVC pressure on the CO emissions [g/kWh] predicted by the model.

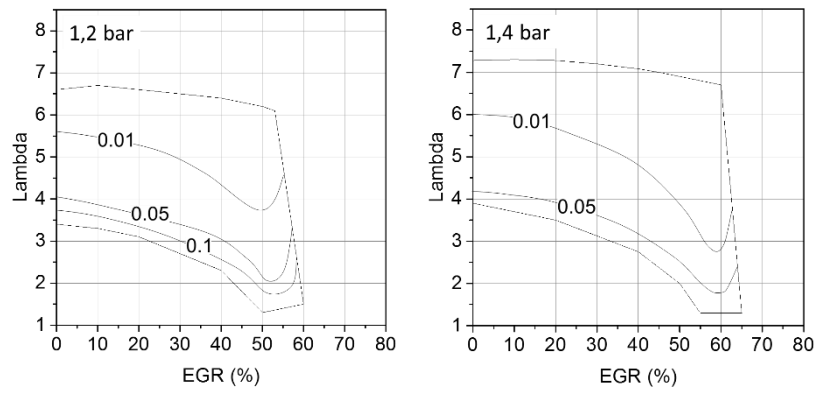


Figure A16: Effect of IVC pressure on the NOx emissions [g/kWh] predicted by the model.

## Appendix B. Operability maps of PRF80.

This section contains the comparison between experiments and model predictions of several different engine performance parameters and exhaust emissions for PRF80 combustion.

### 1.4 Ignition Timing

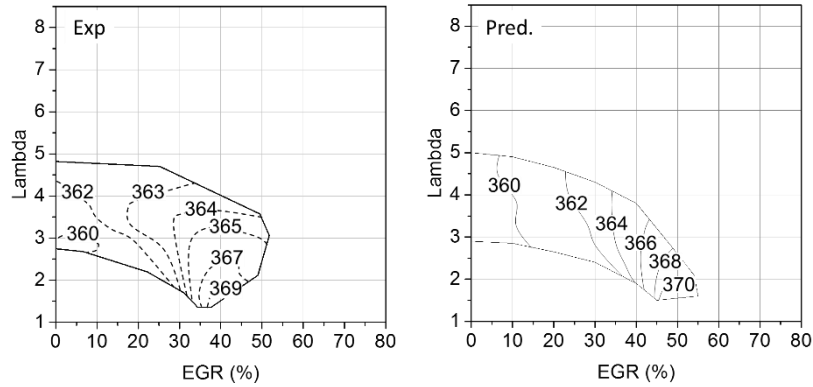


Figure B17: Ignition timing maps reported as CA10 [°CA]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).

### 1.5 Combustion duration

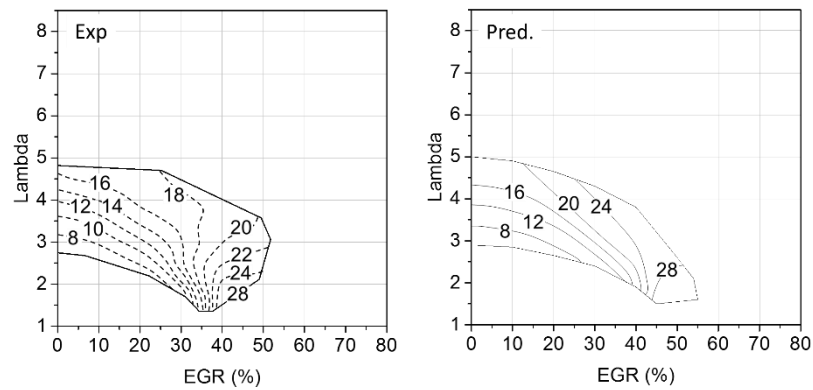


Figure B18: Combustion duration maps reported as CA10-90 [°CA]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).

### 1.6 Engine load

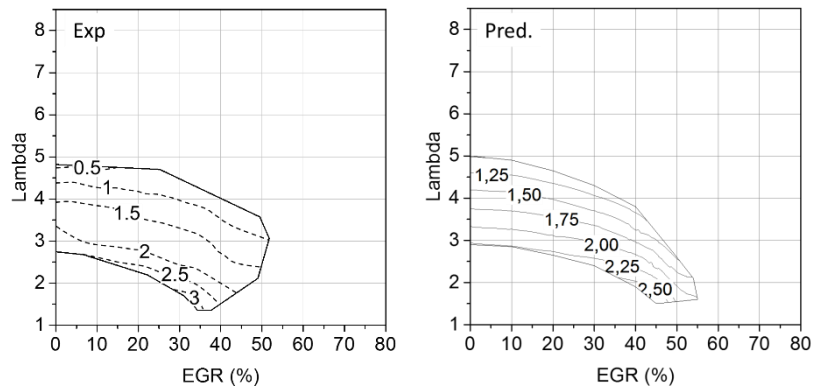


Figure B19: Engine load maps reported as IMEP [bar]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).

## 1.7 Combustion stability

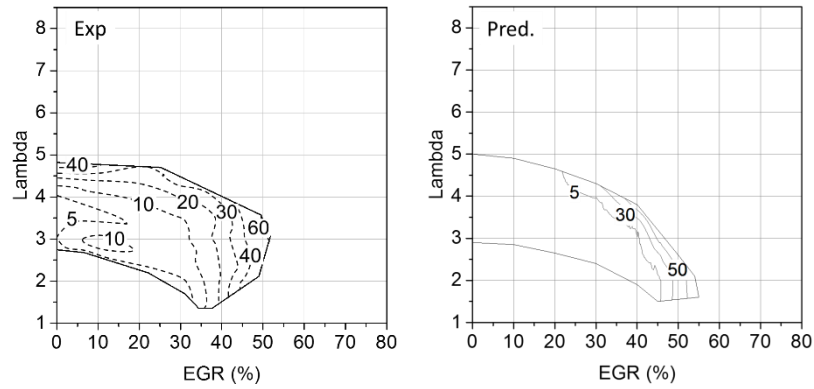


Figure B20: Combustion stability maps reported as CoV IMEP [%]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).

## 1.8 Indicated thermal efficiency

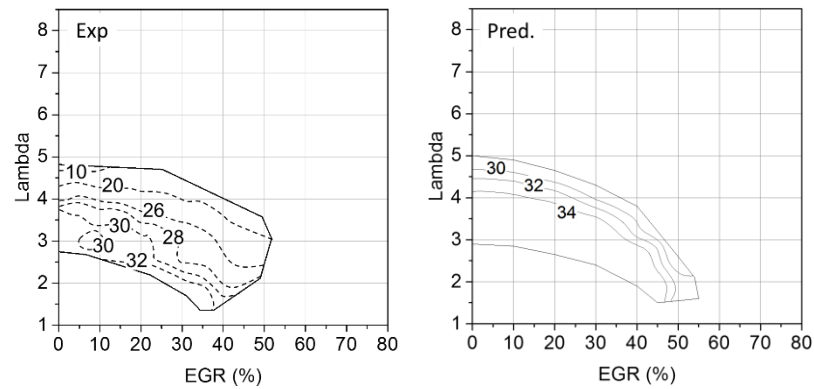


Figure B21: Indicated thermal efficiency [%] maps. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).

## 1.9 Exhaust emissions

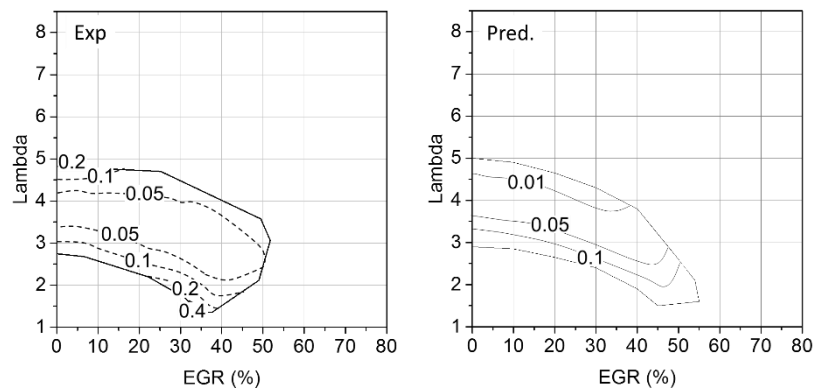


Figure B22: NO<sub>x</sub> exhaust emissions [g/kWh]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).



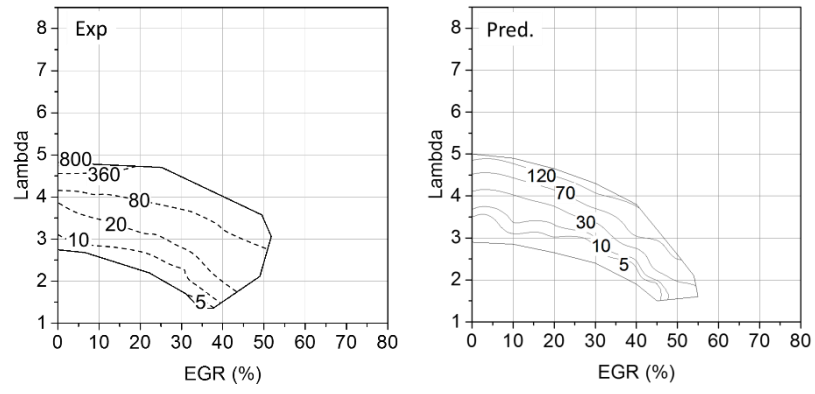


Figure B23: CO exhaust emissions [g/kWh]. Comparison between experiments<sup>55</sup> (left panels) and model predictions (right panels).