



ASME ORC 2017

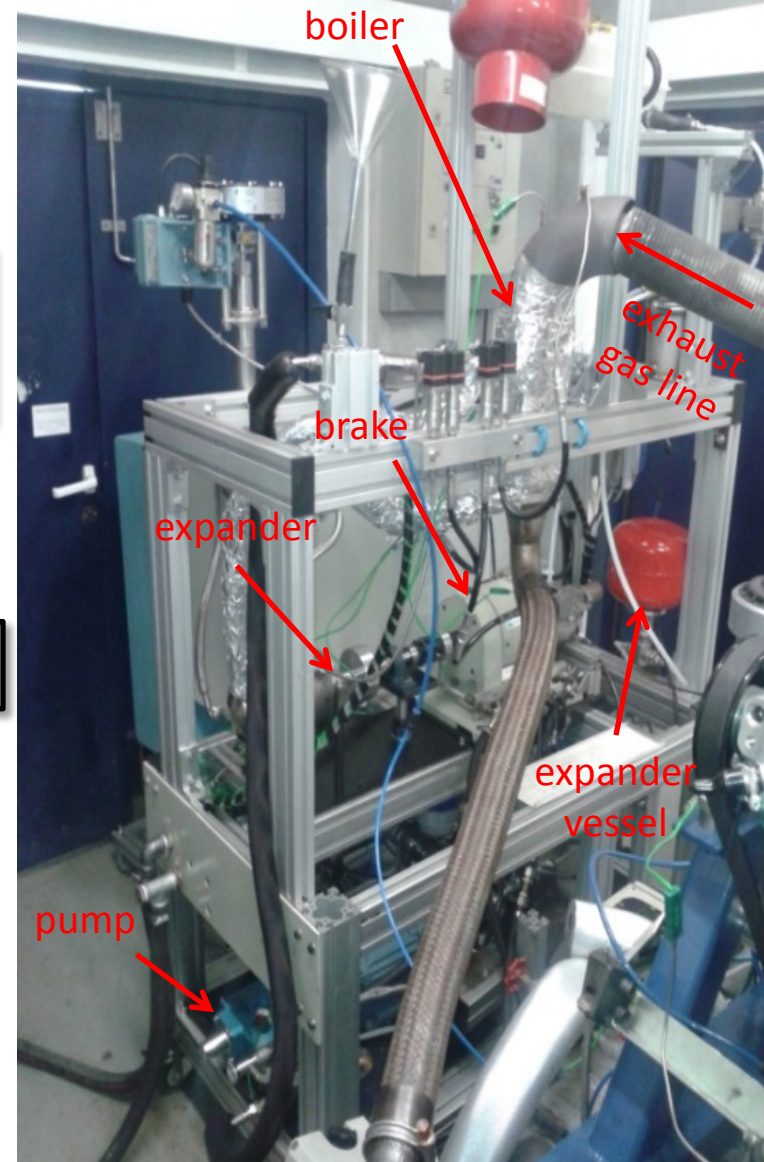
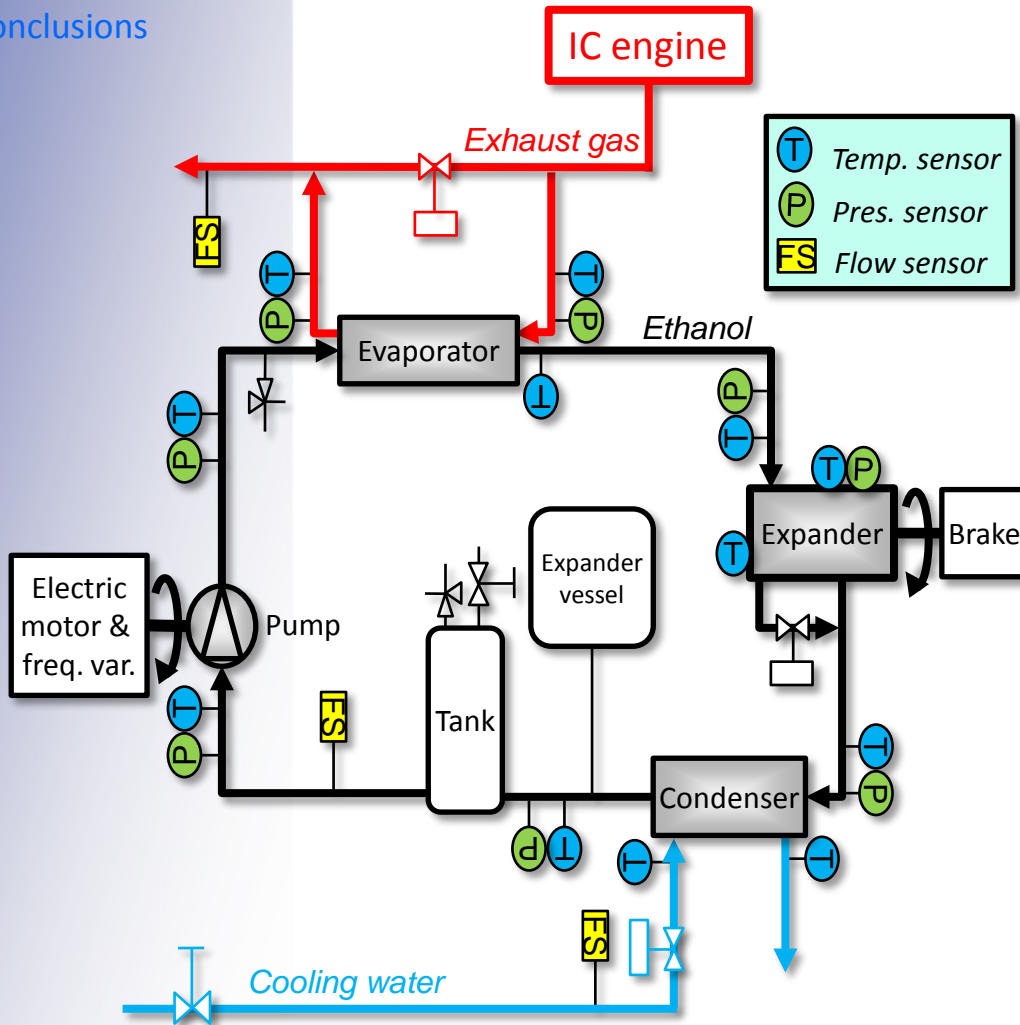
4th International Seminar on ORC Power Systems
13-15 September 2017, Milano, Italy

**DYNAMIC MODELING OF AN ORGANIC
RANKINE CYCLE TO RECOVER WASTE
HEAT FOR TRANSPORTATION VEHICLES**

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- ORC facility
- Model description
- NEDC modeling
- Conclusions

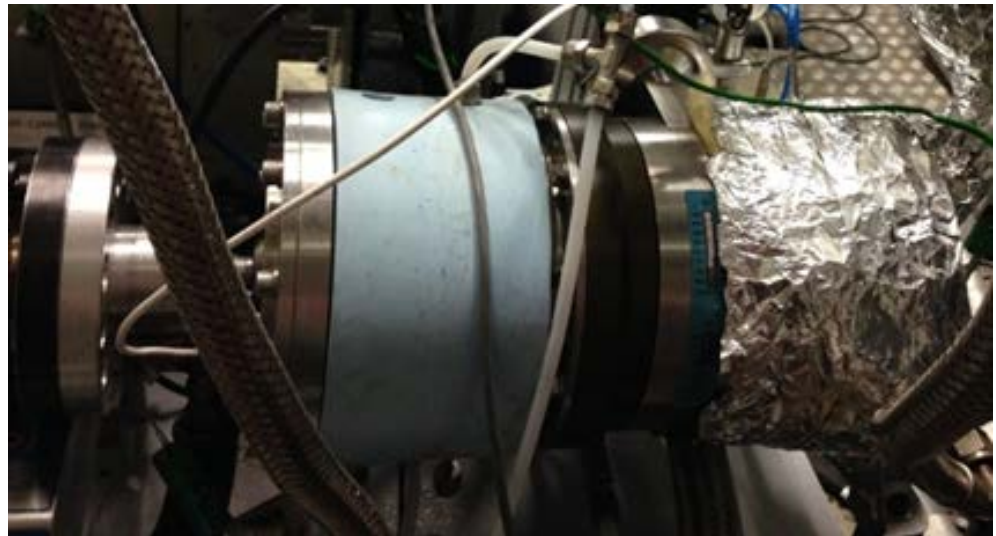


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Swash-plate characteristics

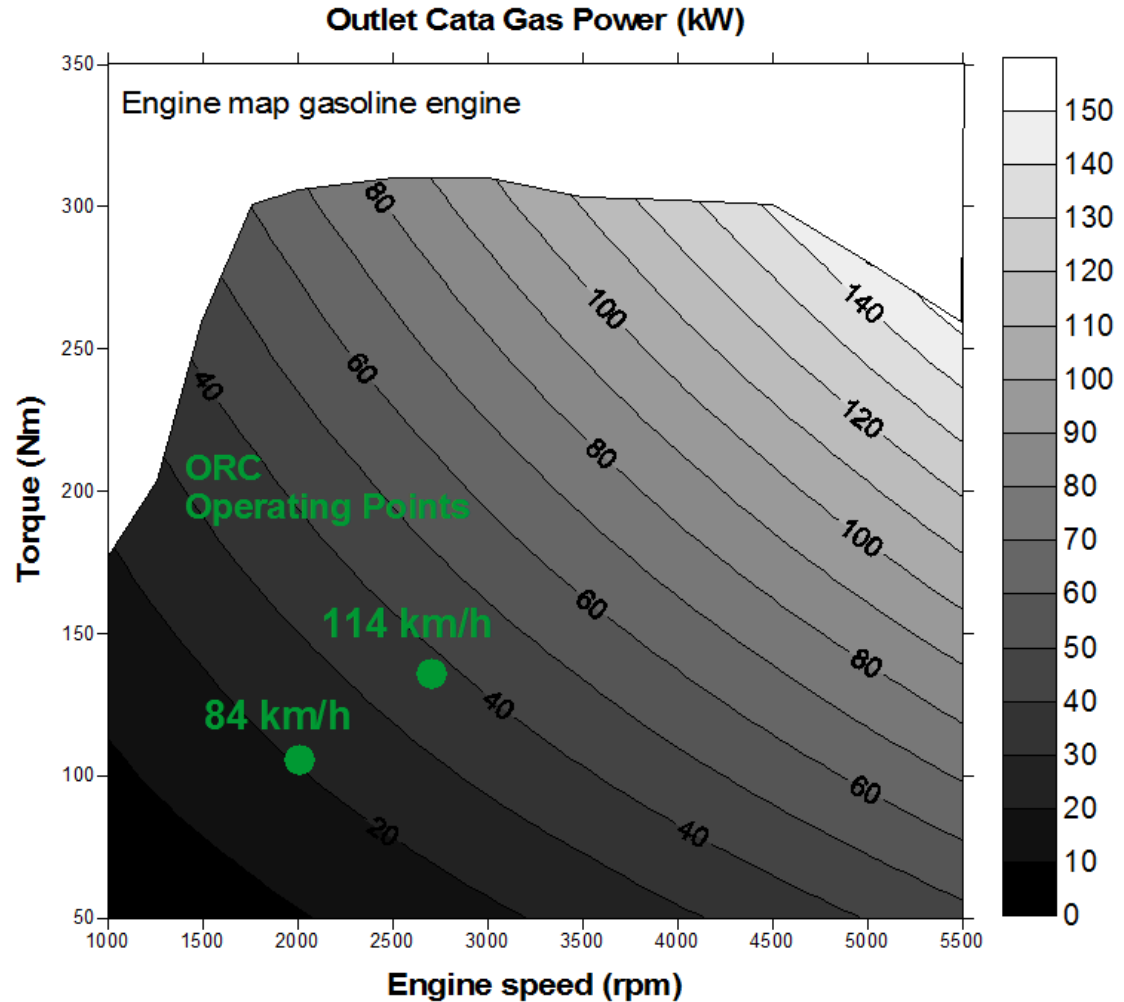
Working fluid	ethanol	
Pistons working	3	
Bore	40	mm
Stroke	31	mm
Maximum expander speed	4500	rpm



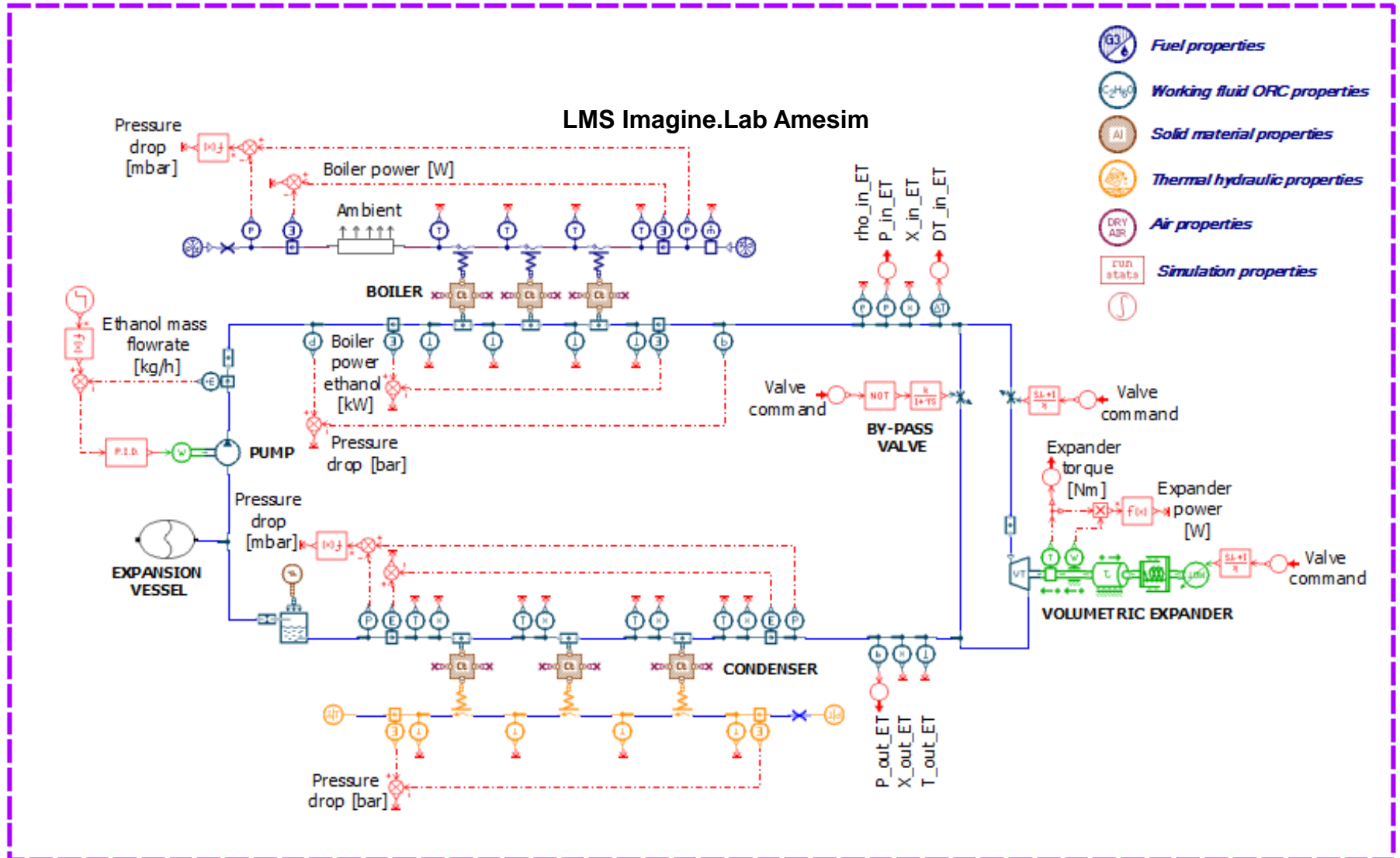
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Ford Explorer 2 liter turbocharged gasoline engine

	Point 84km/h	Point 114km/h
Vehicle speed (km/h)	84	114
Engine speed (rpm)	2000	2700
Fuel power (kW)	69.6	119.1
Engine power output (kW)	22.2	38.5
Inlet temperature of the exhaust gas (°C)	526	646
Mass flow exhaust gas (g/s)	24	41

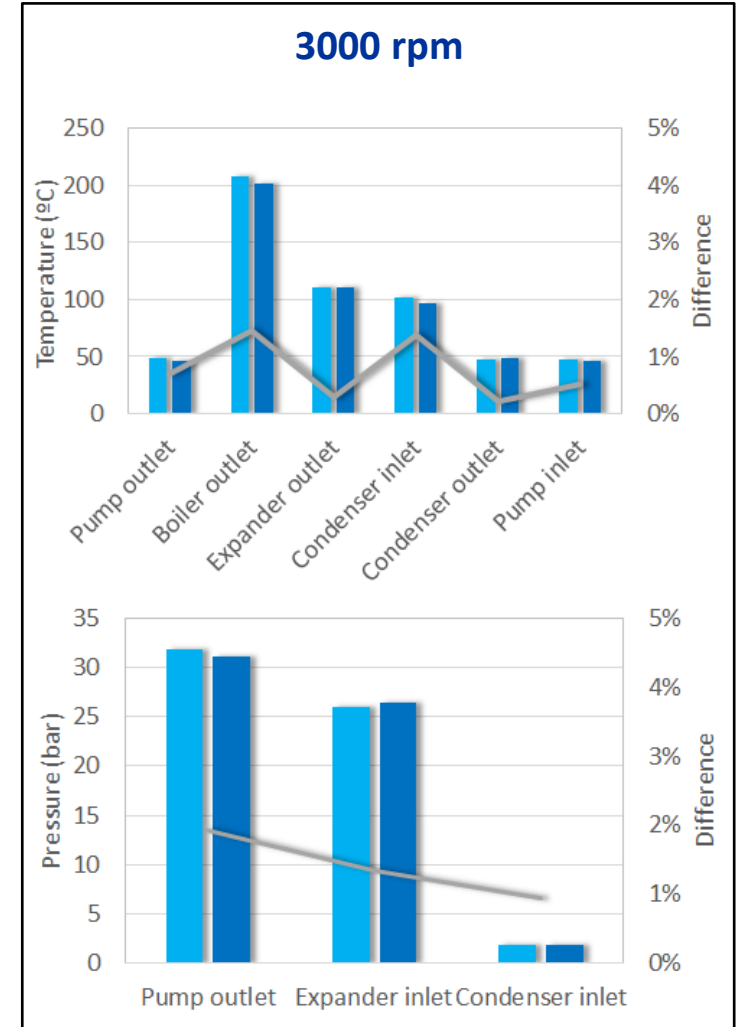
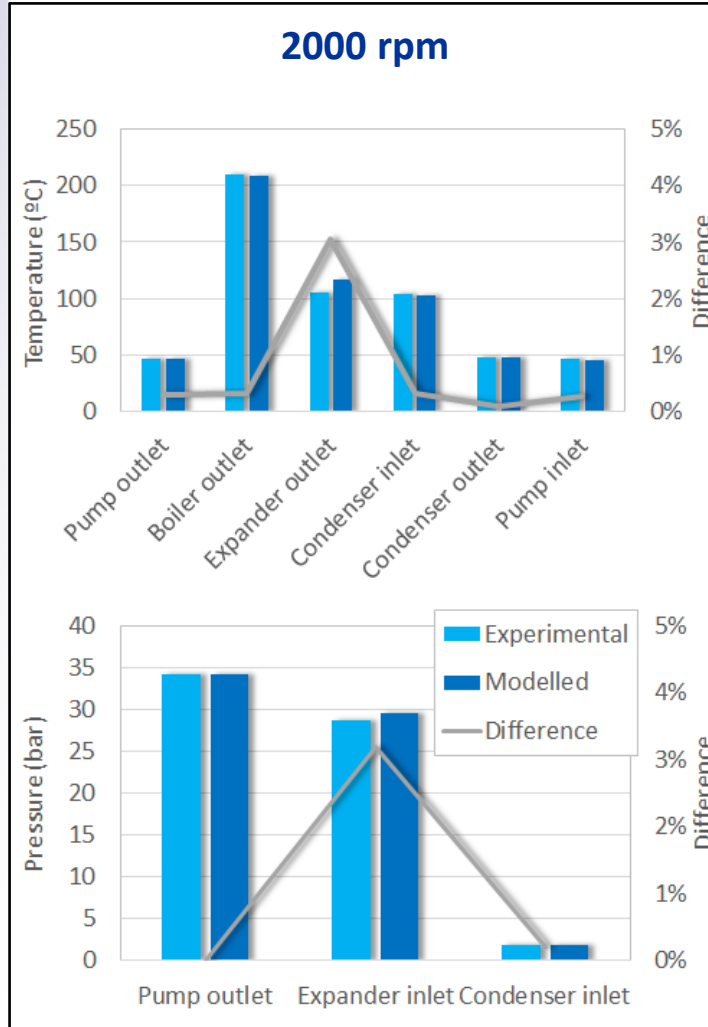


Organic Rankine Cycle with volumetric expander



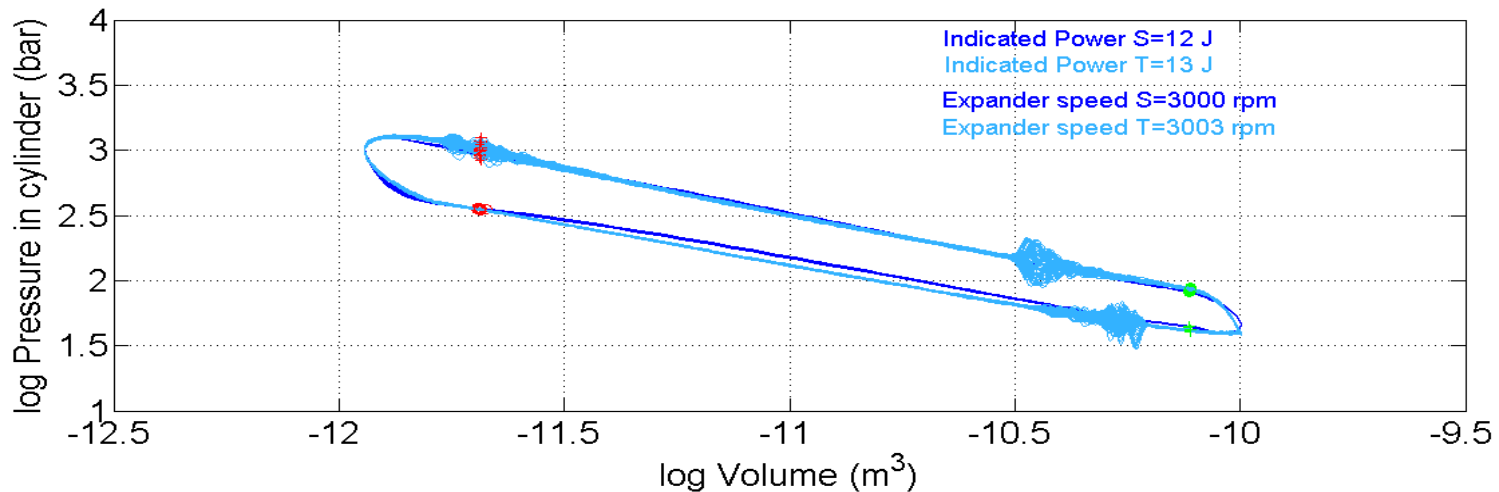
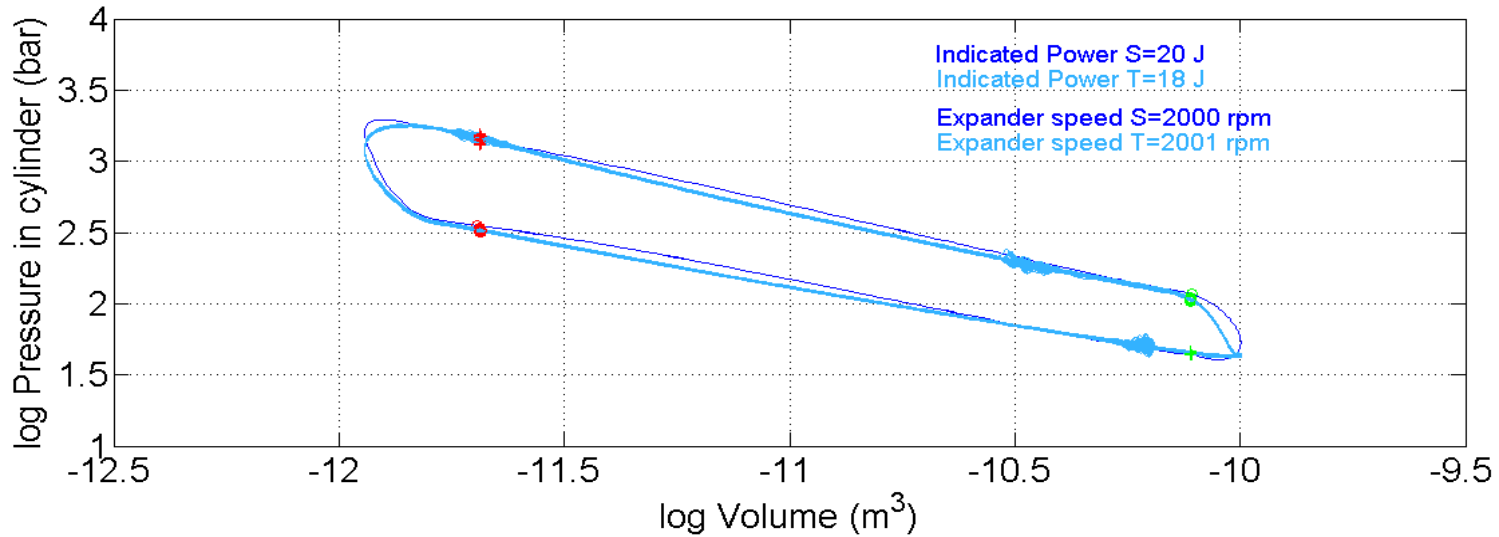
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Point 114km/h (25 kW heat power)

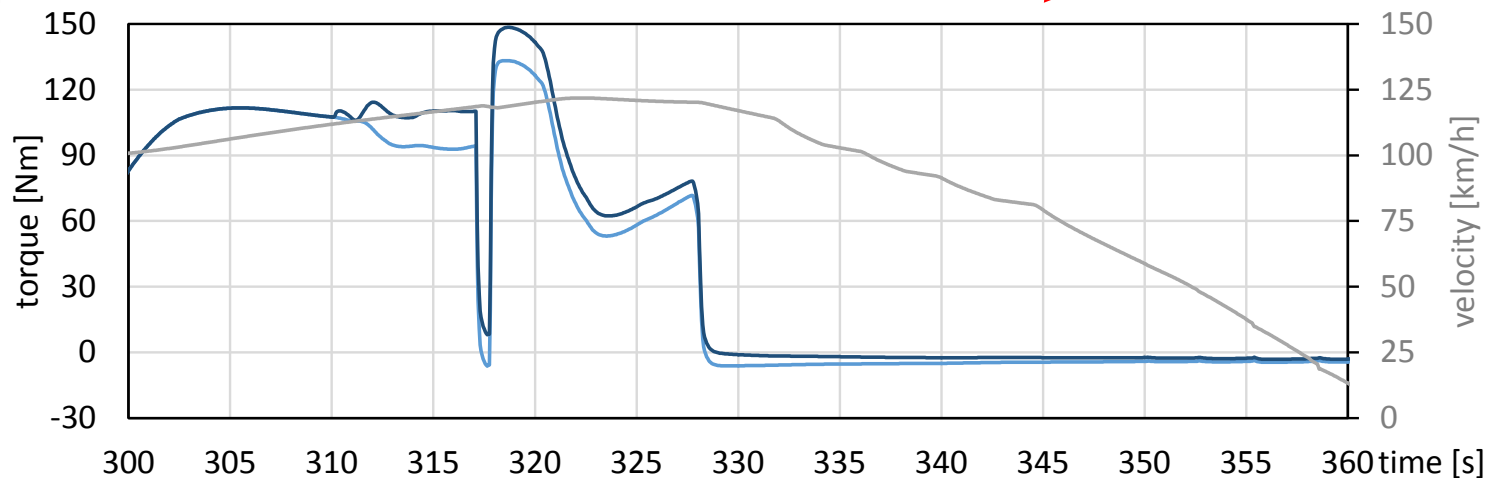
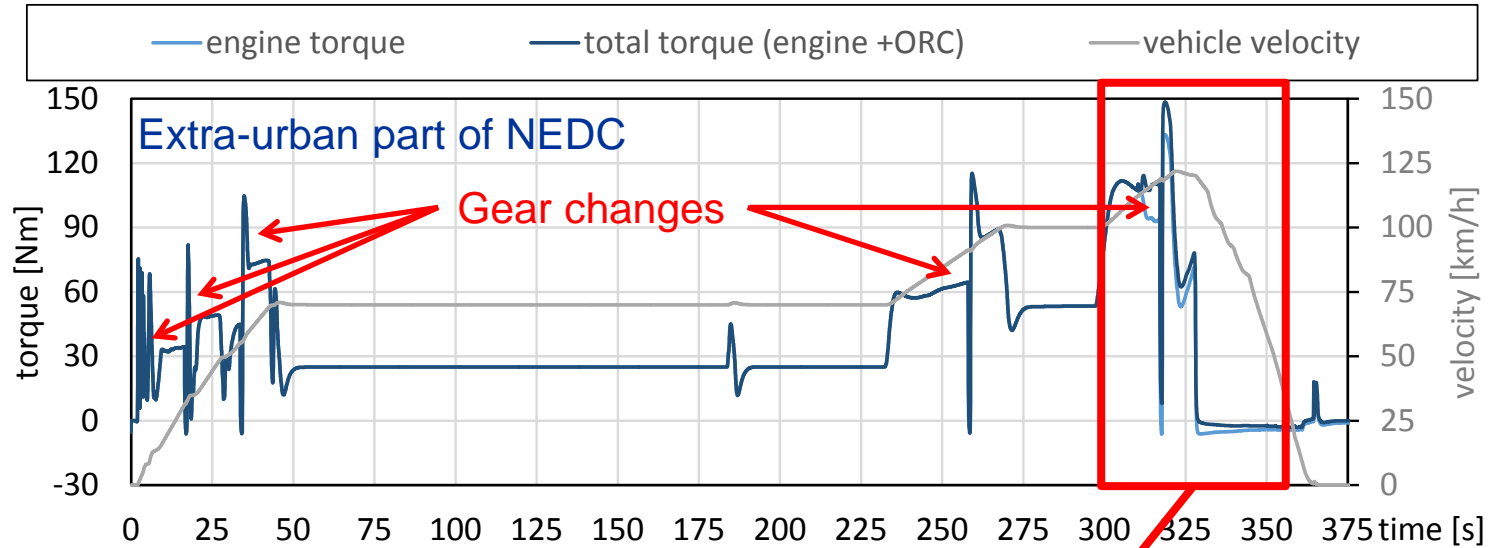


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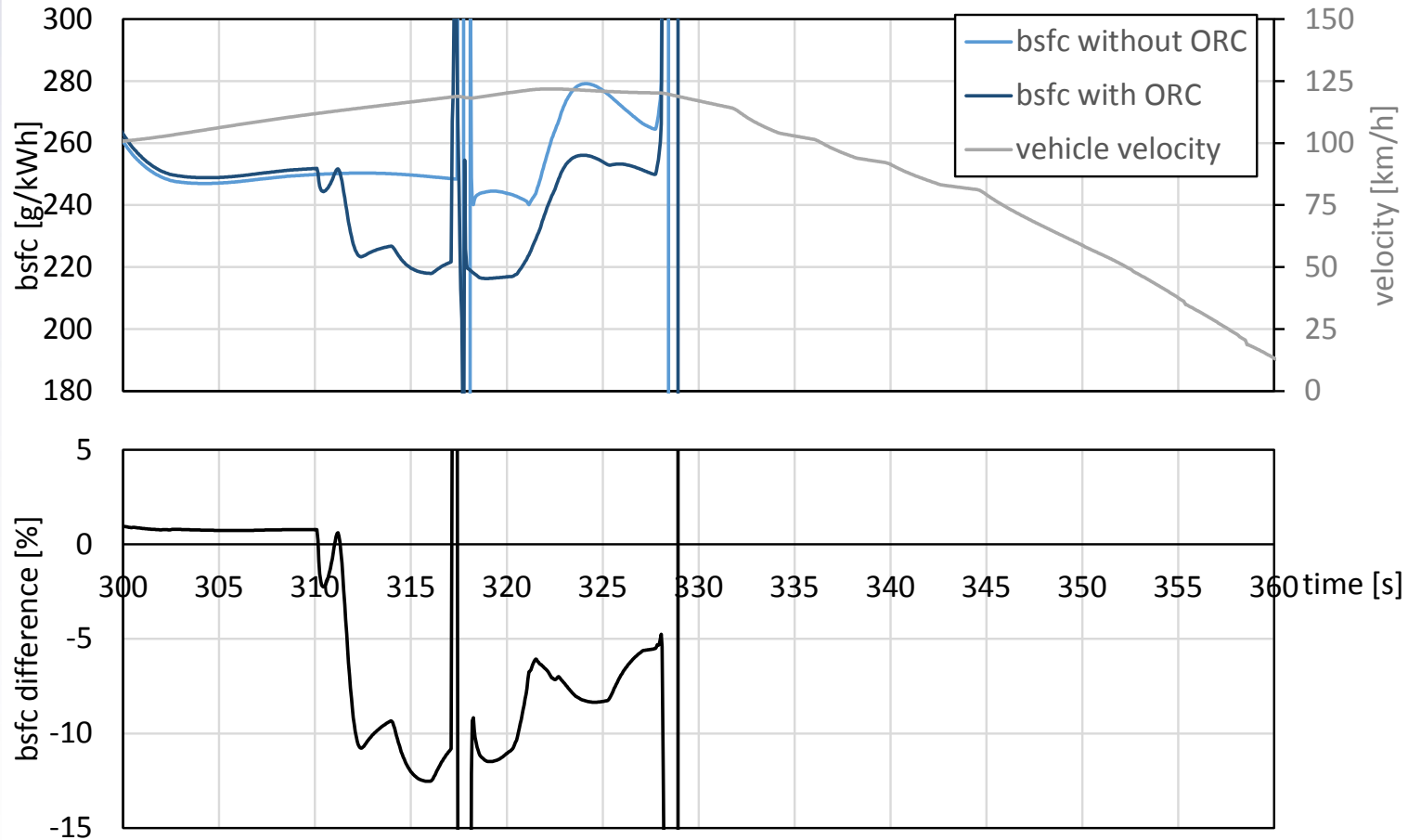
Point 114km/h (25 kW heat power)



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- A vehicle model to reproduce the vehicle behavior has been coupled to an ORC system model with ethanol as working fluid. In this model, **the engine shaft is directly coupled to the expander shaft** to estimate the fuel consumption reduction during the extra-urban part of the NEDC.
- The ORC system is more **efficient on extra-urban conditions** (vehicle speeds higher than 50 km/h). At 120 km/h bsfc can be reduced a 10% by using an ORC. On the other hand, **on urban driving conditions** (speeds below 50km/h), these systems have not enough power to start the cycle (to evaporate the ethanol).
- This model **can be used in complex engine layouts to optimize different strategies**. In case of hybrid vehicles the ORC mechanical power can be used to increase the engine shaft torque or to recharge the batteries. The strategy to answer this question could be optimized by using similar models.



**Thanks for
your
attention**