NUMERICAL SIMULATION OF COMBUSTION PROCESS IN ROTARY RANGE EXTENDER WITH HYDROGEN DIRECT MULTIPLE INJECTION
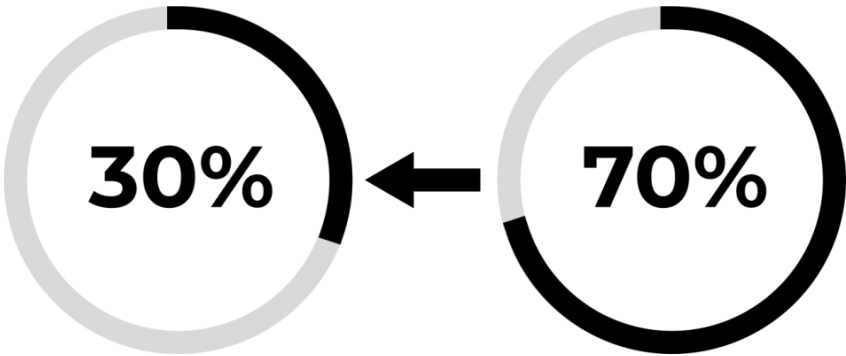
Zambalov S.D.

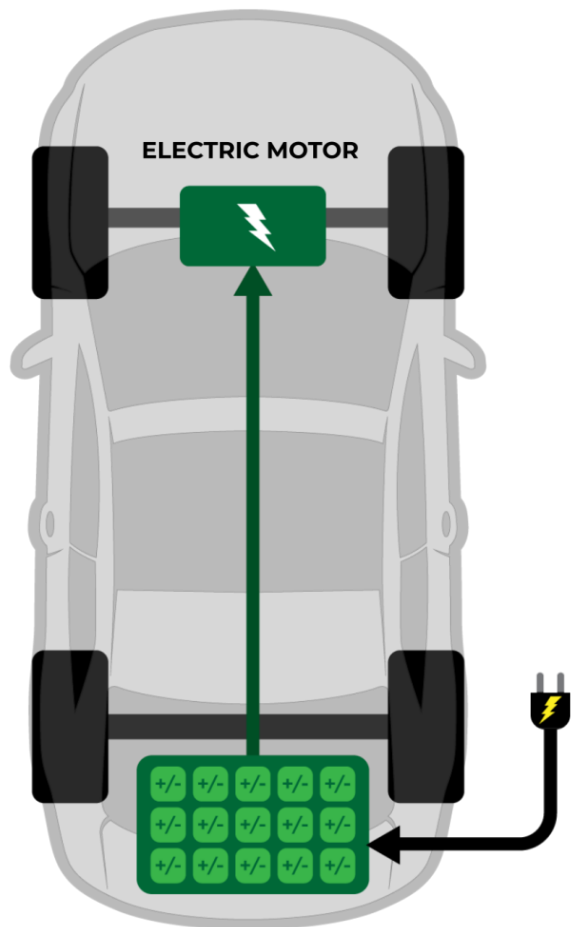Department of Structural Macrokinetics of Tomsk Scientific Center of SB RAS

World emissions

30% ← **70%**

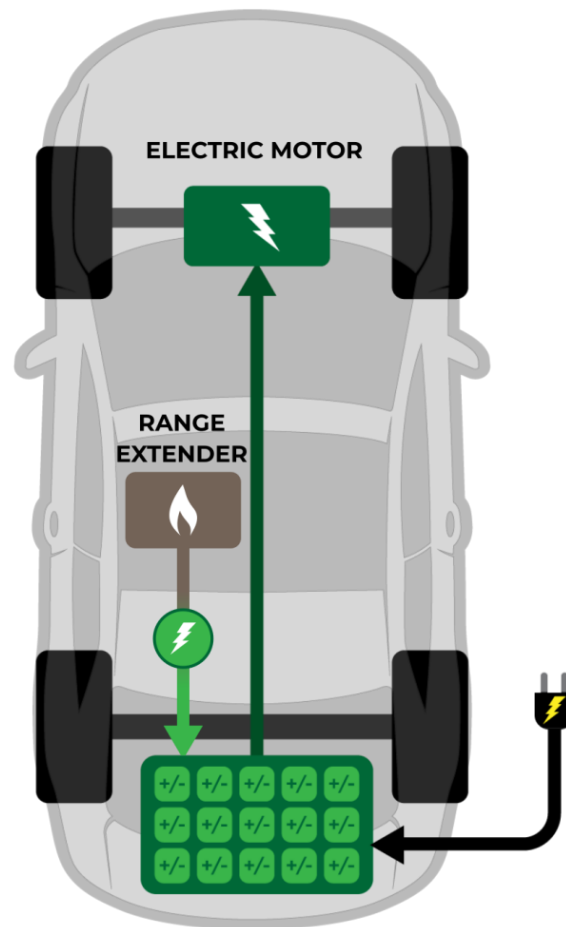International Energy Agency

Battery electric vehicle

ELECTRIC MOTOR

RECHARGEABLE BATTERY PACK

Extended range battery electric vehicle

ELECTRIC MOTOR

RANGE EXTENDER

RECHARGEABLE BATTERY PACK

Range extender engine types

4 stroke piston engine

Fuel cells

2 stroke piston engine

Microturbine

Wankel engine

④

Wankel engine

Apex seal

Crank shaft

Housing

Rotor

A

Rotor recess

Spark plugs

Detail A

Apex seal
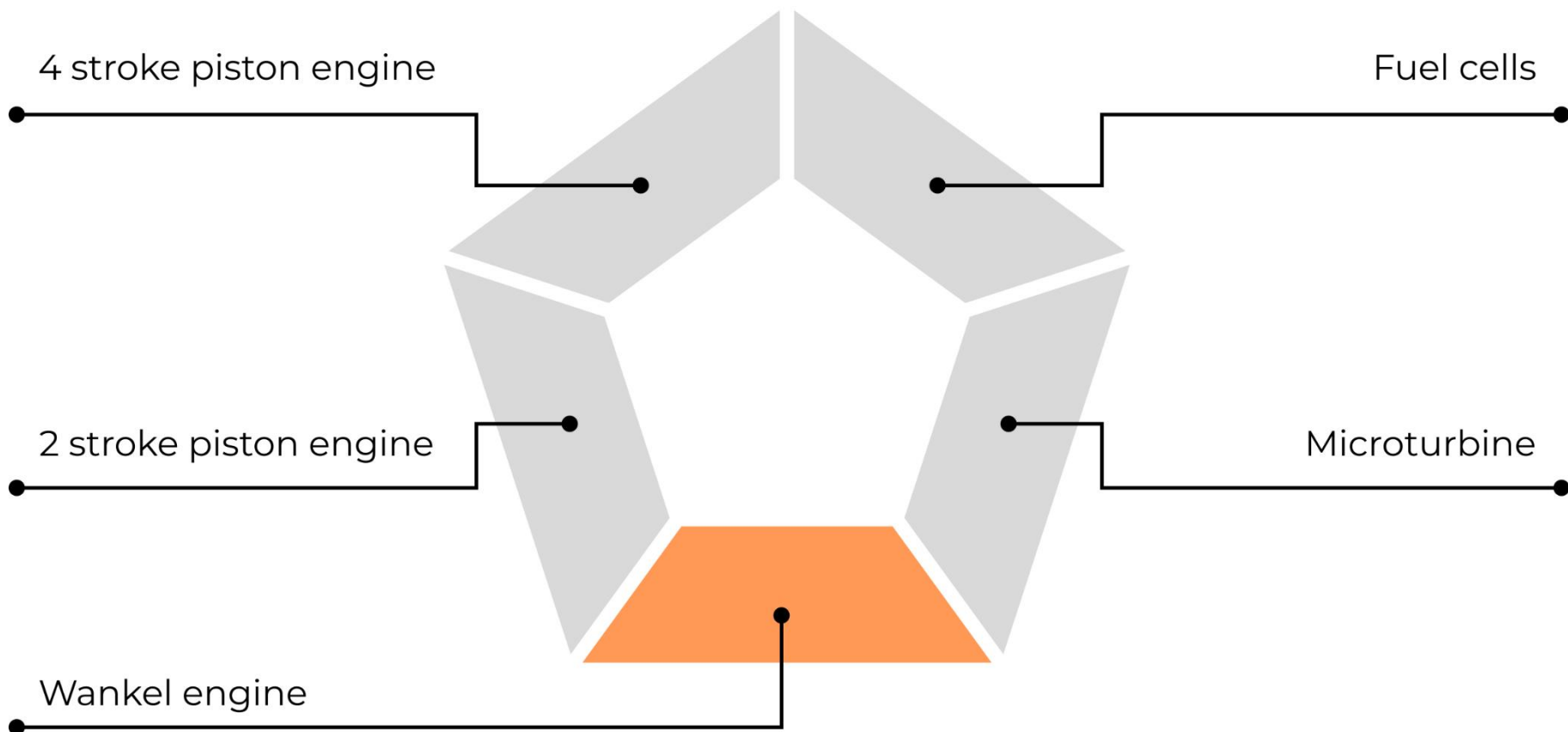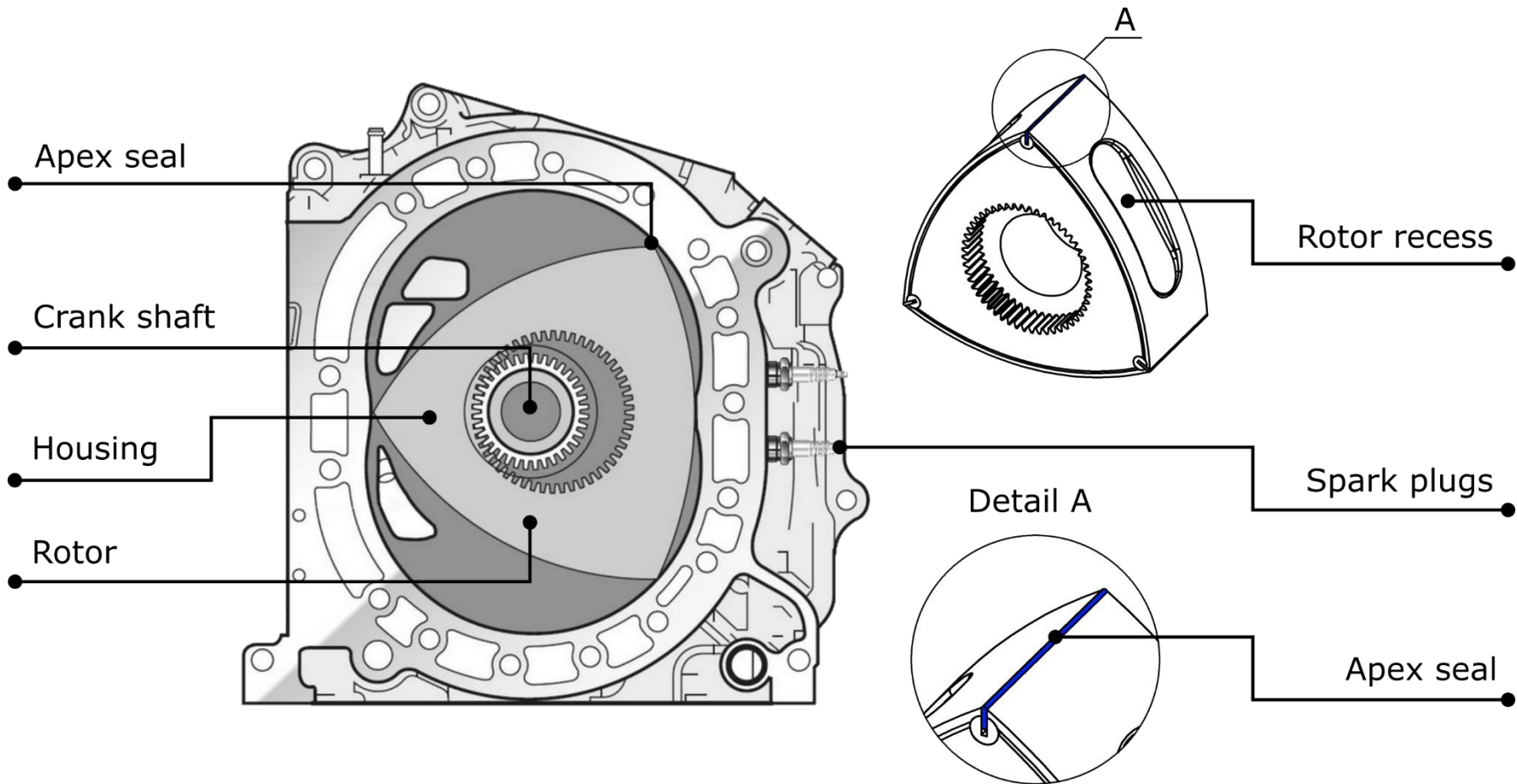
Scheme of engine

Technical specifications

|	
Displacement	250 cc
Generating radius	84 mm
Eccentricity	11 mm
Width	52 mm
Compression ratio	10
Intake port open	3 CA ATDC
Intake port close	60 CA ABDC
Exhaust port open	40 CA BBDC
Exhaust port close	3 CA BTDC
Injection start	210 CA BTDC
End of injection	90 CA BTDC
Leading spark plug	35 CA BTDC
Trailing spark plug	25 CA BTDC
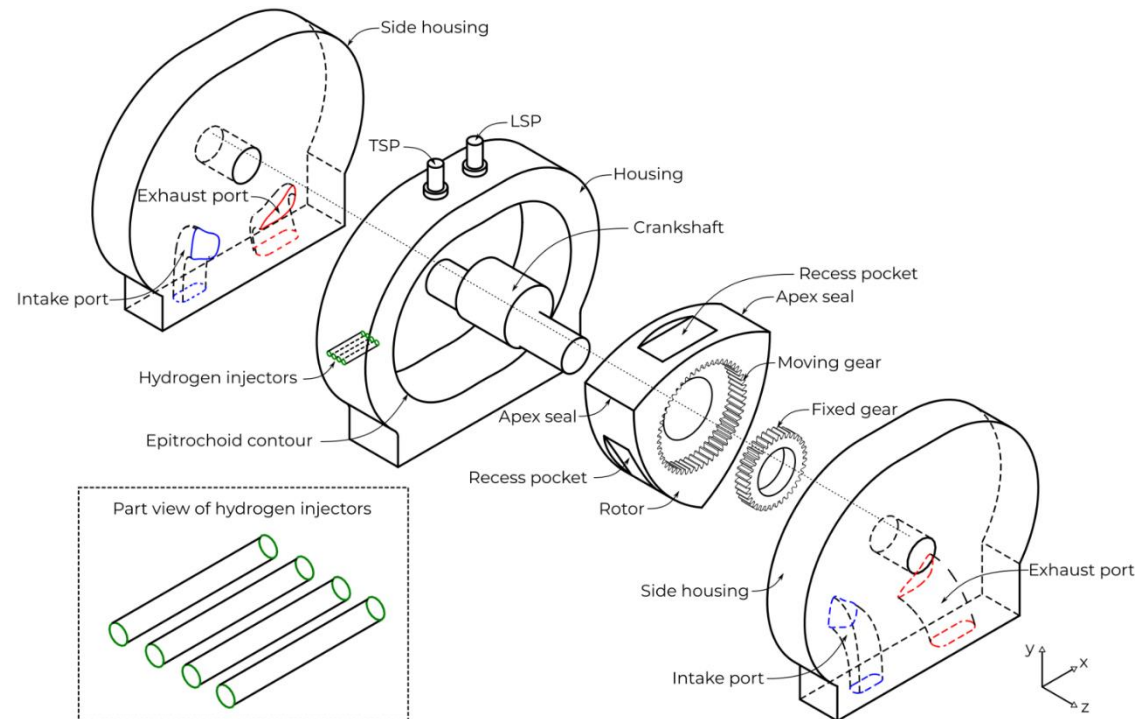
Multiple injection types
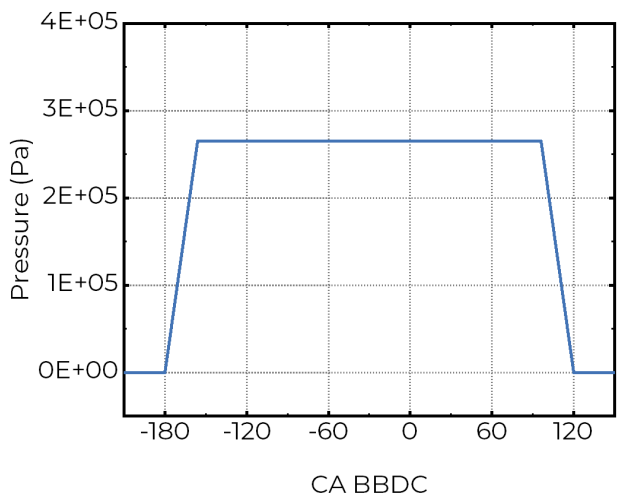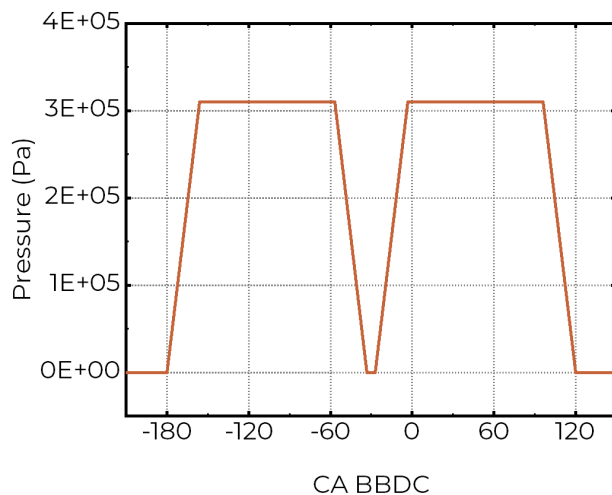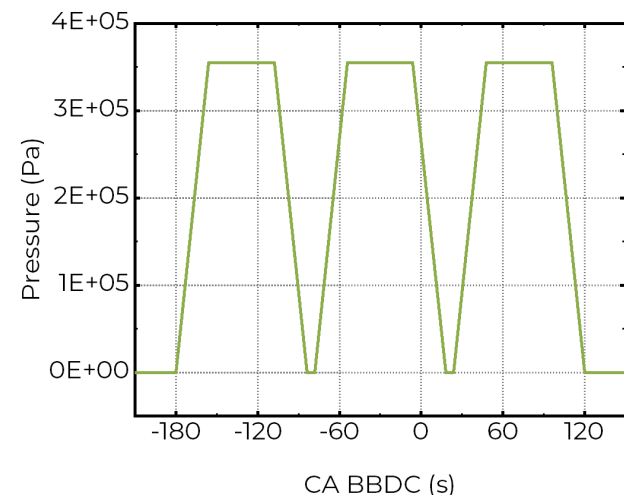
Induction stroke
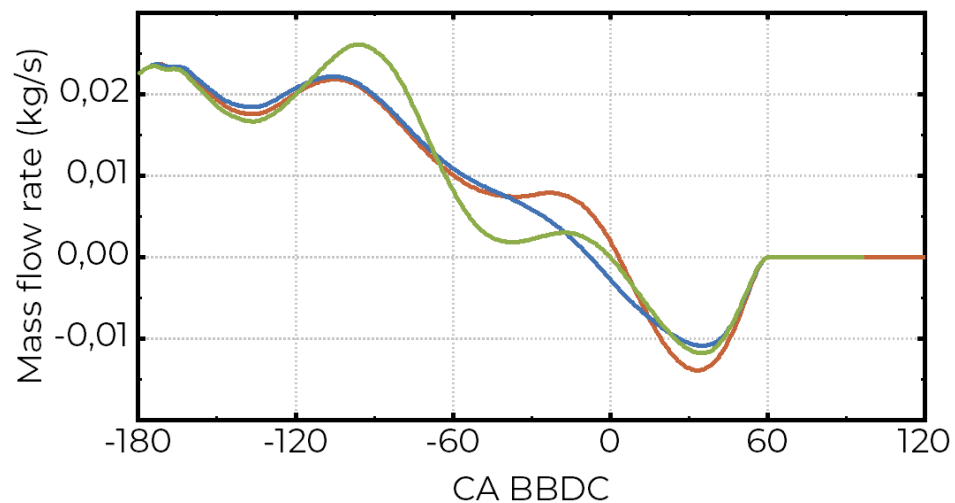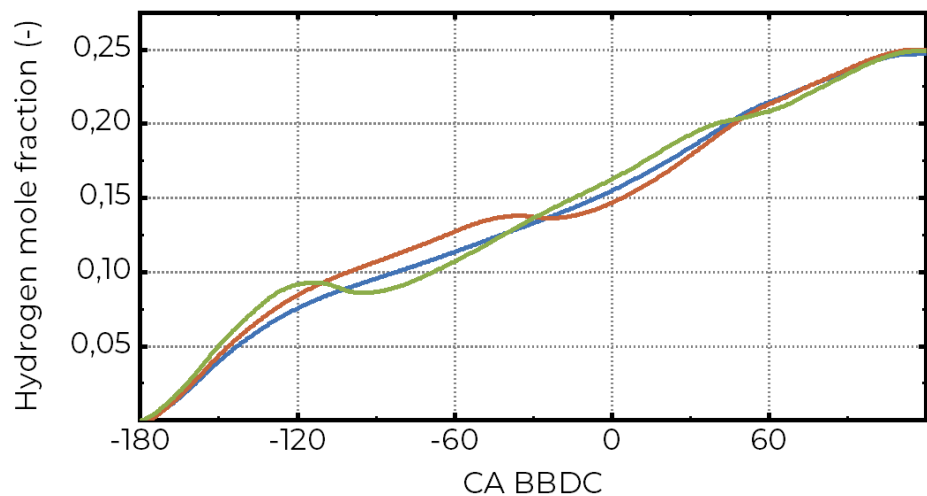
Case A   Case B   Case C

Combustion stroke
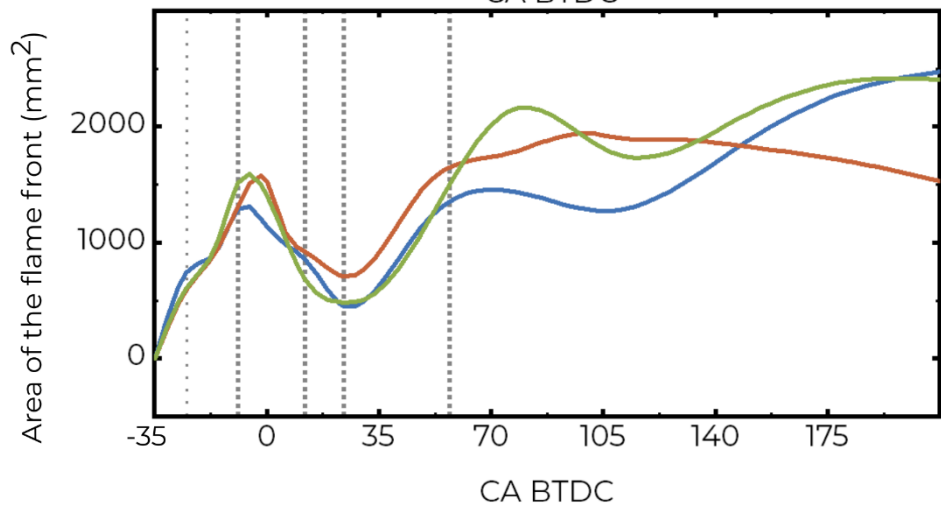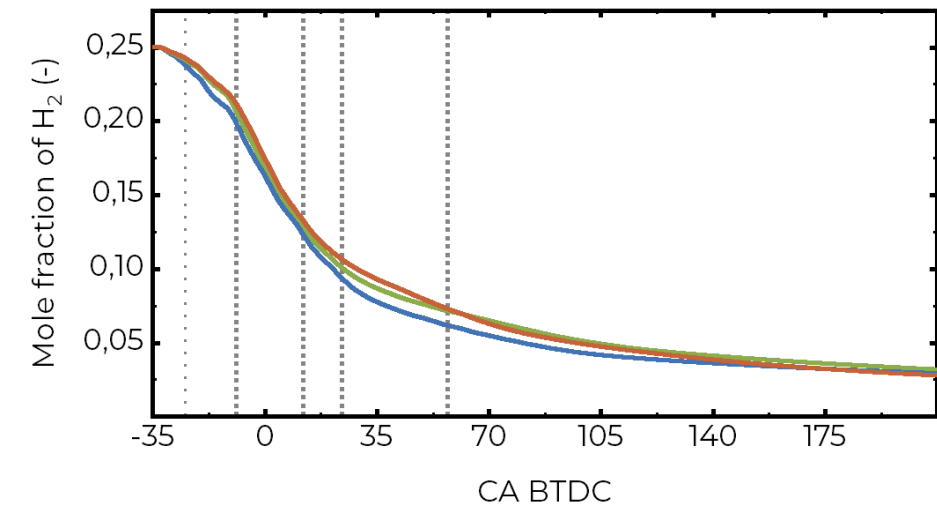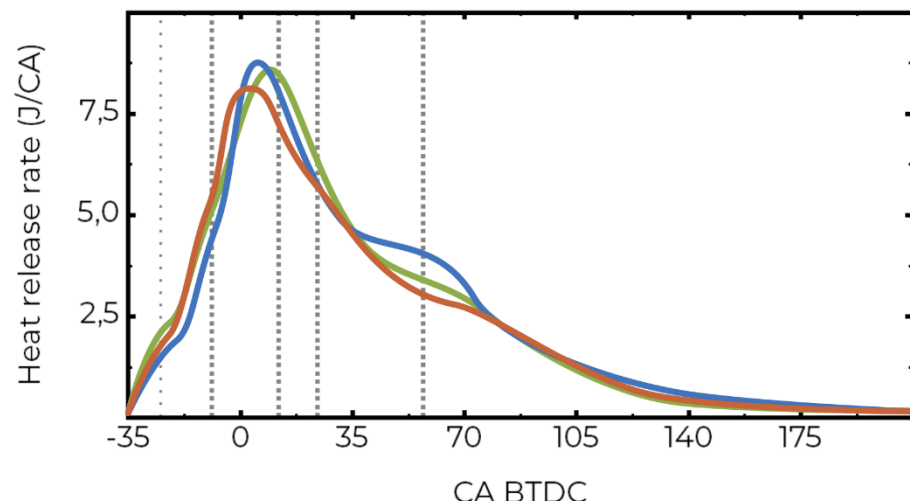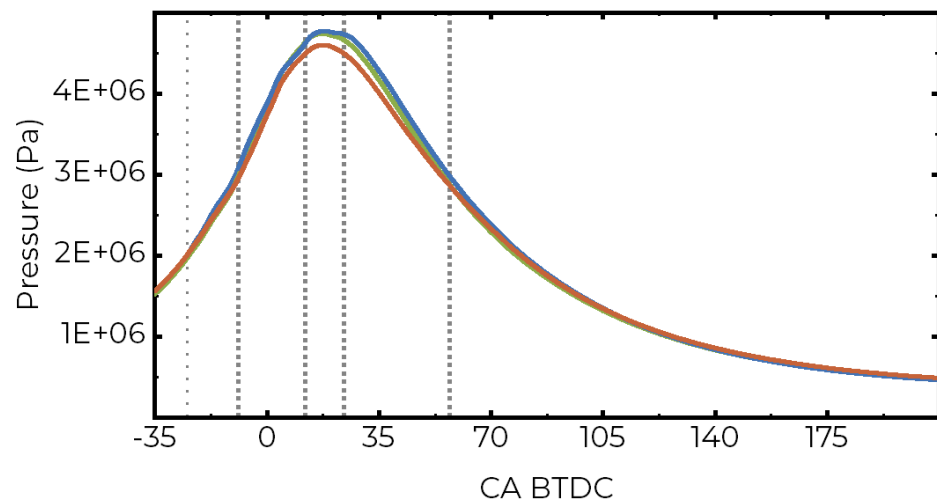
Equivalence ratio

0.0   0.3   0.7   1.1   1.5
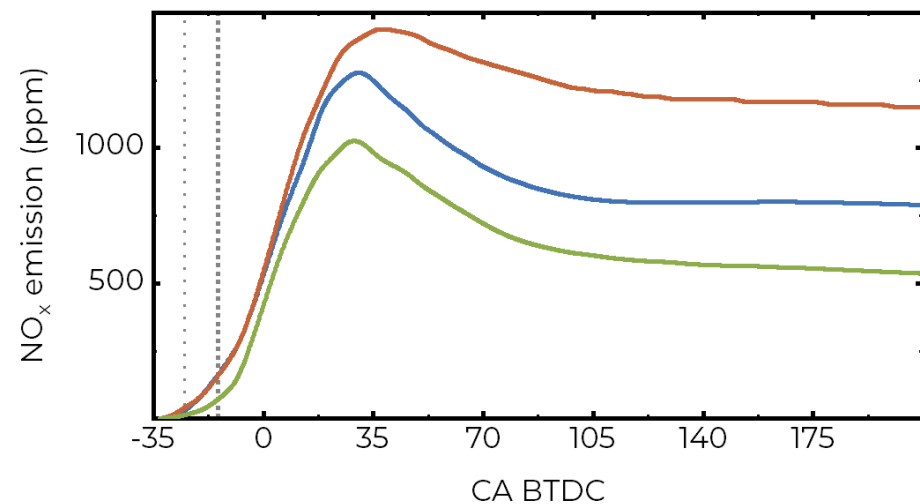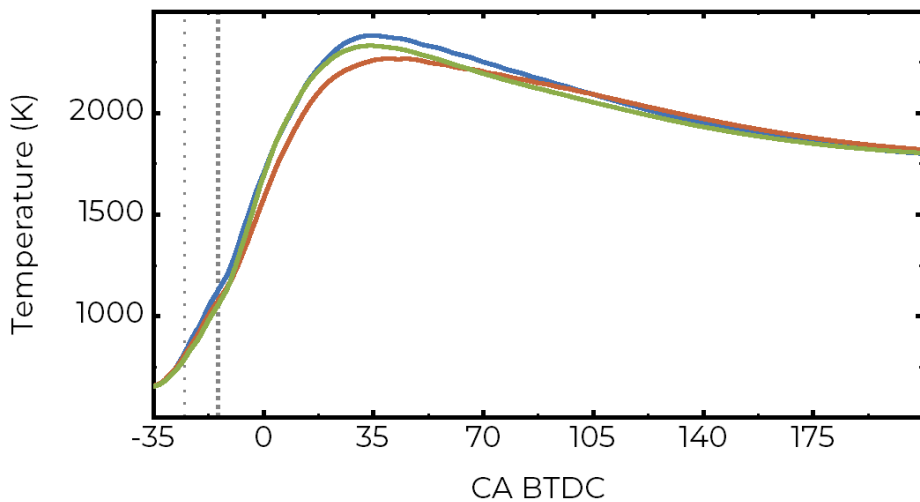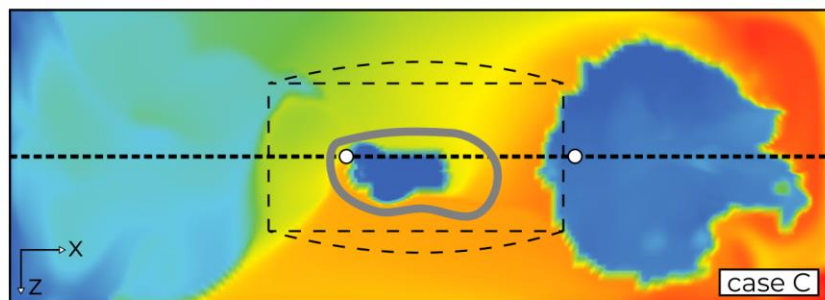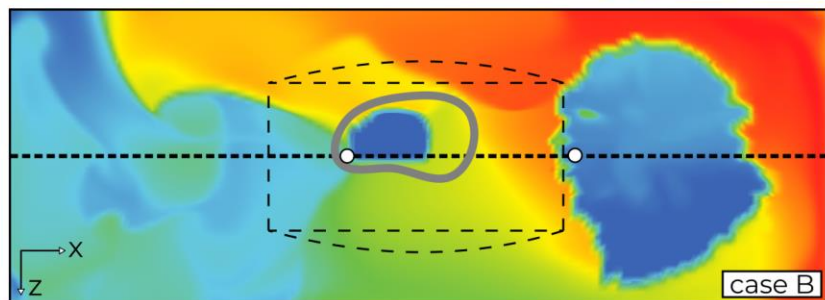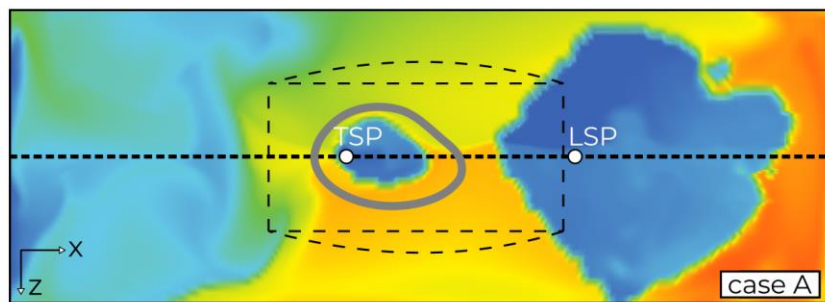
Performance parameters

Case	Indicated mean effective pressure, kPa	Indicated power, kW	Thermal conversion efficiency	NO$_x$ emission, ppm
A	987	20.5	0.36	781
B	965	20.1	0.34	1130
C	965	20.1	0.35	526

Range extender prototypes comparison

Company	Type	Displacement, cc	Power, kW	Power per unit volume, kW/cc
Lotus engineering	Piston engine, 3 cyl, Gasoline	1200	36.8	0.03
Mahle Powertrain	Piston engine, 2 cyl, Gasoline	900	30	0.03
Mazda Motor	Rotary engine, 1 section, Gasoline	330	22	0.06
University of Toronto	Rotary engine, 1 section, Hydrogen	654	13.8	0.02
Tomsk Scientific Center	Rotary engine, 1 section, Hydrogen	250	20.5	0.08

Thank you for your attention!