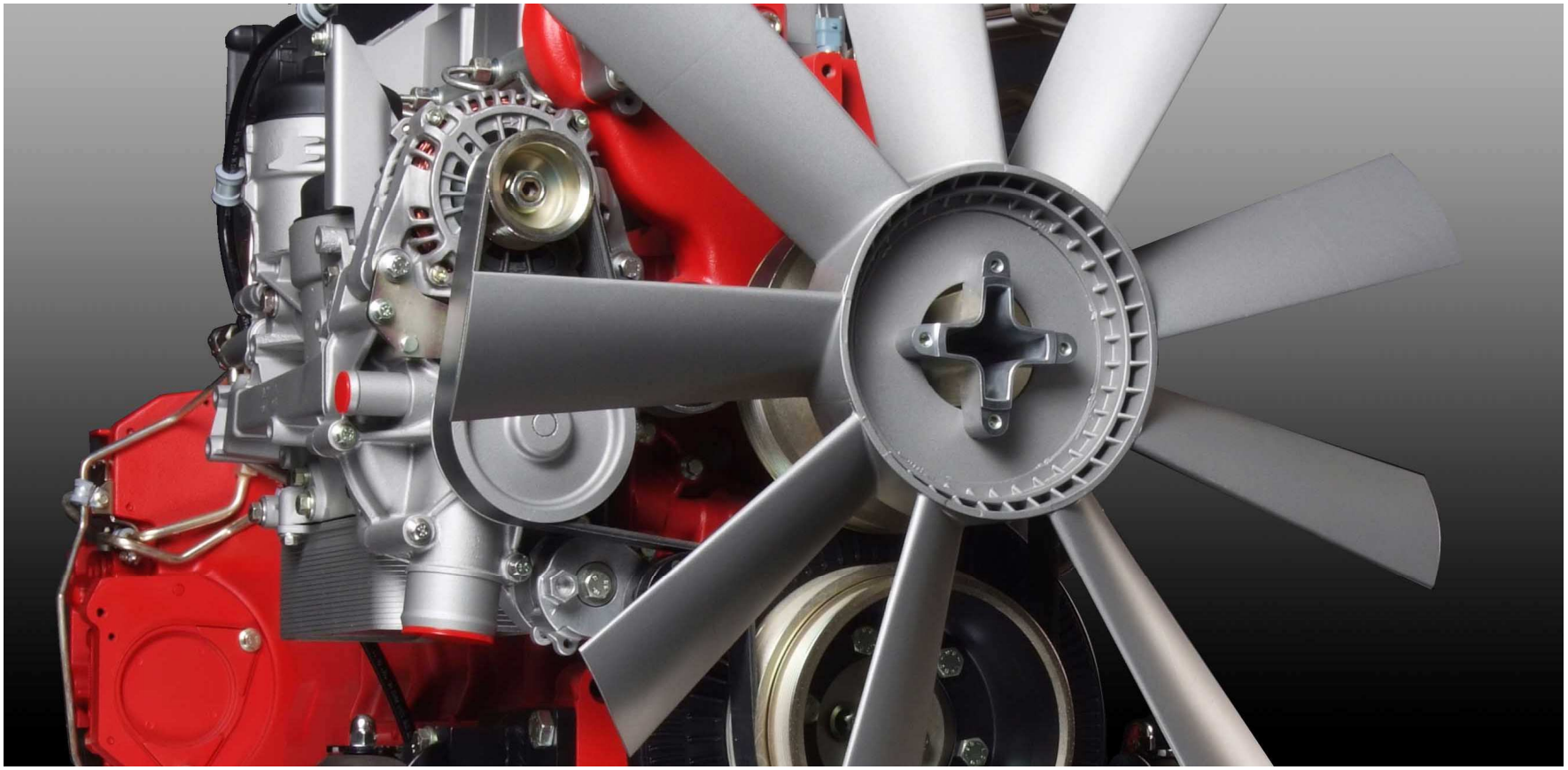


GT-SUITE for cooling circuit & engine heat-balance

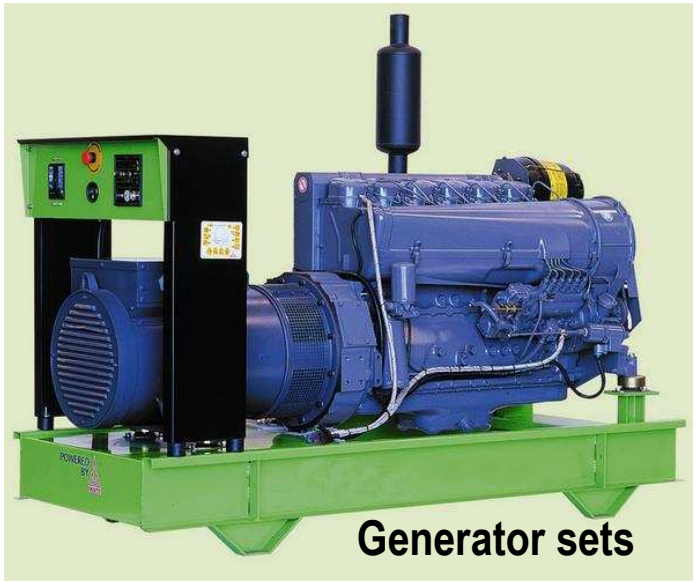
Hans-Carsten Göttsche-Götze

The engine company.

DEUTZ®

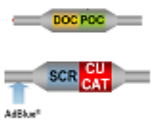
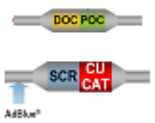
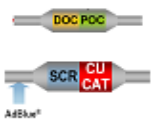
Deutz Applications for Diesel engines

The engine company. DEUTZ



Engine spec with key components from customer

The engine company. DEUTZ

Emission state	Tier4f					
Rated Power [HP] @ 2.200 rpm	50	60	70	80	90	100
Rated Power [kW] @ 2.200 rpm	37,3	44,7	52,5	59,7	67,1	74,6
Peak Torque [Nm] @ 1.500 rpm	210	252	294	336	378	406
Torque [Nm] @ 1.000 rpm	176	213	249	285	320	356
Torque Rise [%]	31	30	30	30	30	25
FIE common rail						
externally cooled EGR						
charge air cooler						
turbo charger						
dual stage turbo charger						
EAT						

Cooling system development

The engine company. DEUTZ

Customer data to Deutz

Engine spec

Vehicle package

Operation limits

Deutz Cooling Team

Heat rejection, Cooler size, coolant flow

Thermostat setting

System configuration

Cooling components

Diameters, Roughness

Maps of pump, hx, Fan

Thermostat valve curve

Pressure losses

Use of GT Suite MP

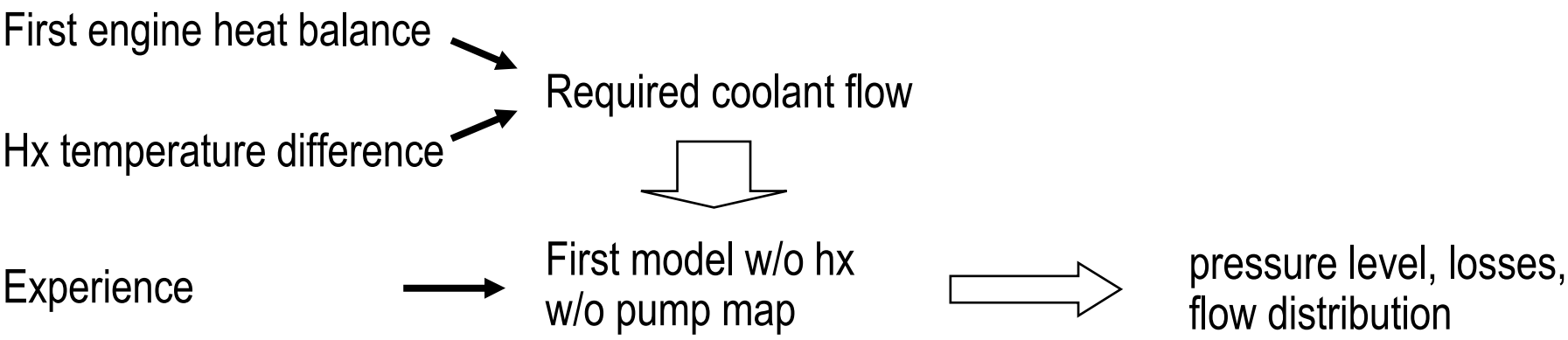
Data to Customer

Heat Rejection

Coolant flow

Charge Air flow

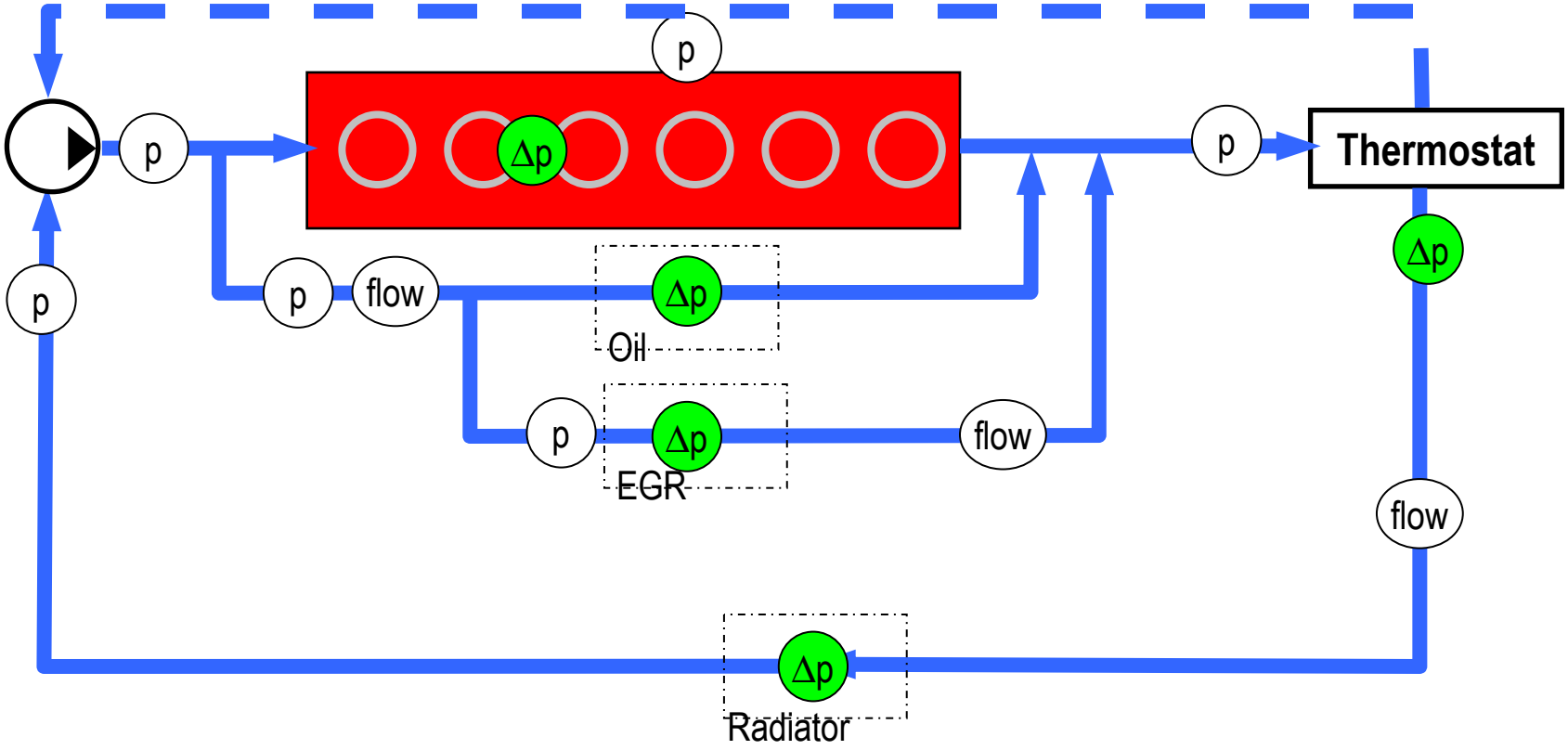
Development structure



Engine coolant circuit

The engine company. DEUTZ

Measure requirements for coolant system calculation

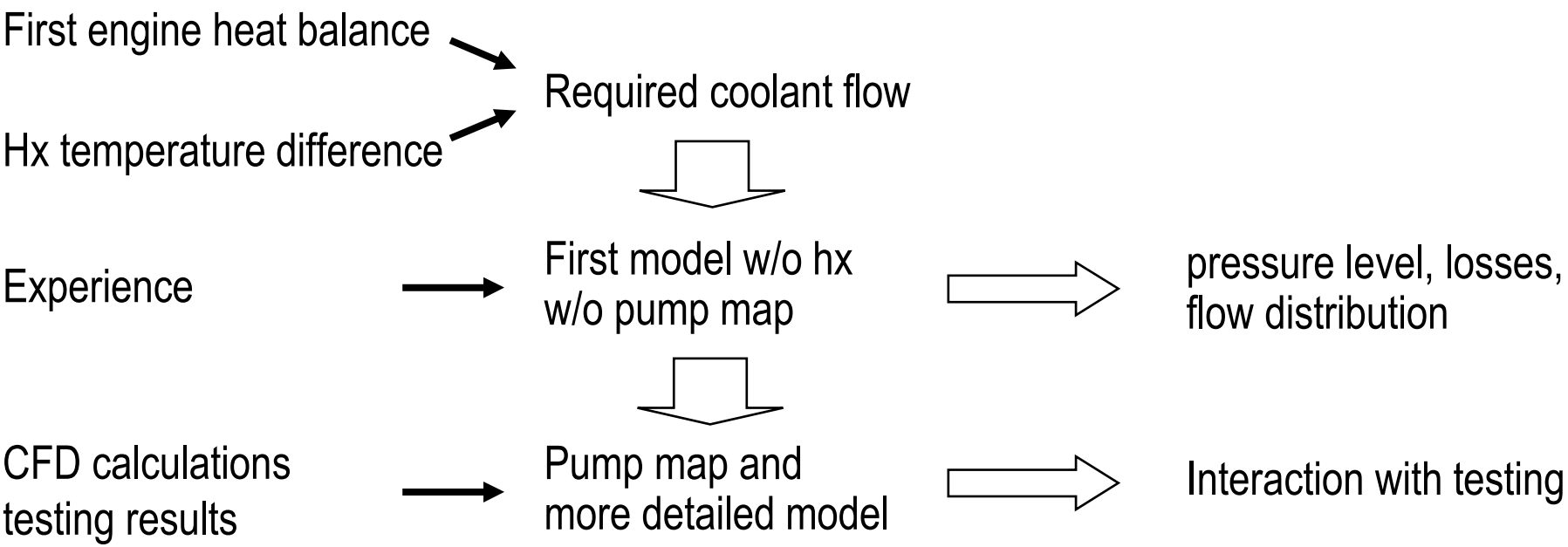


Measurement required p flow

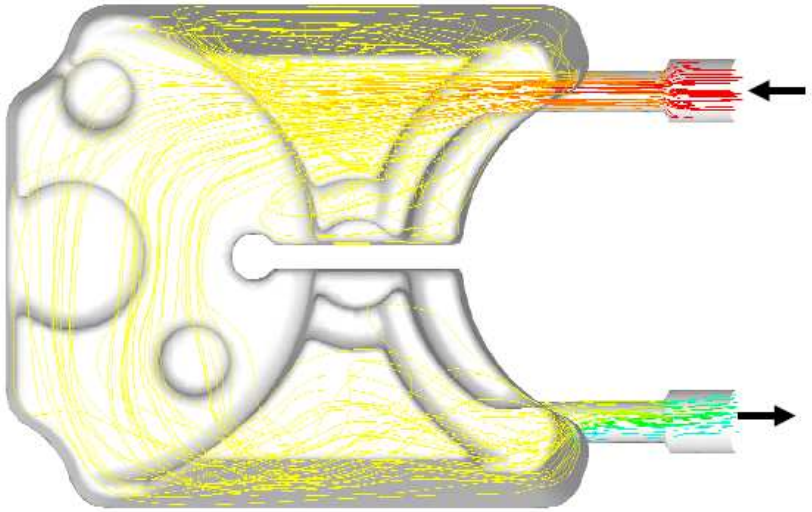
Known Δp, flow Δp

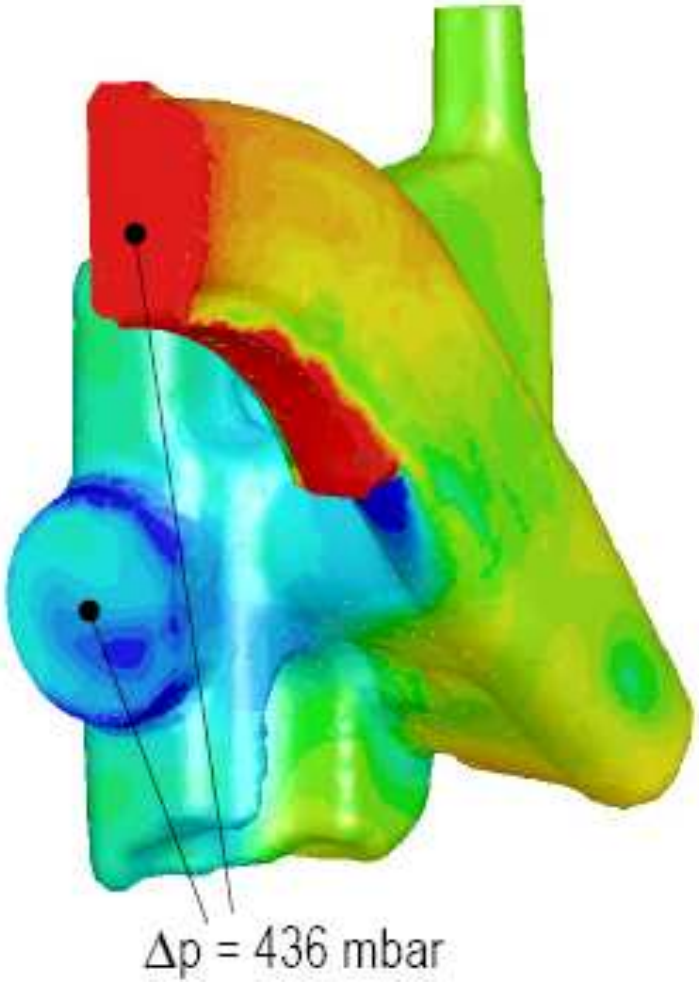
Development structure

The engine company. DEUTZ



CFD of difficult geometries

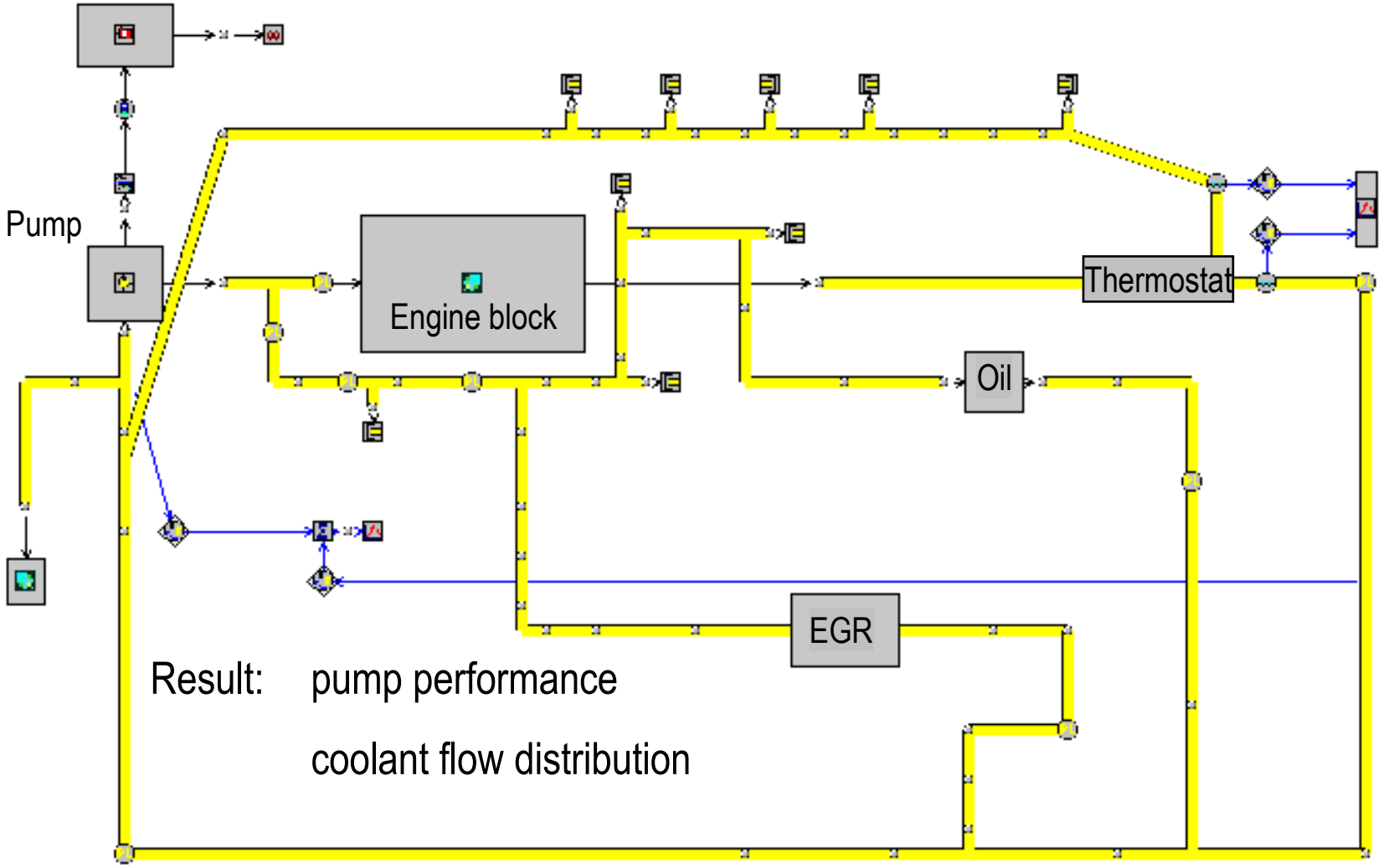




Result: pressure resistance

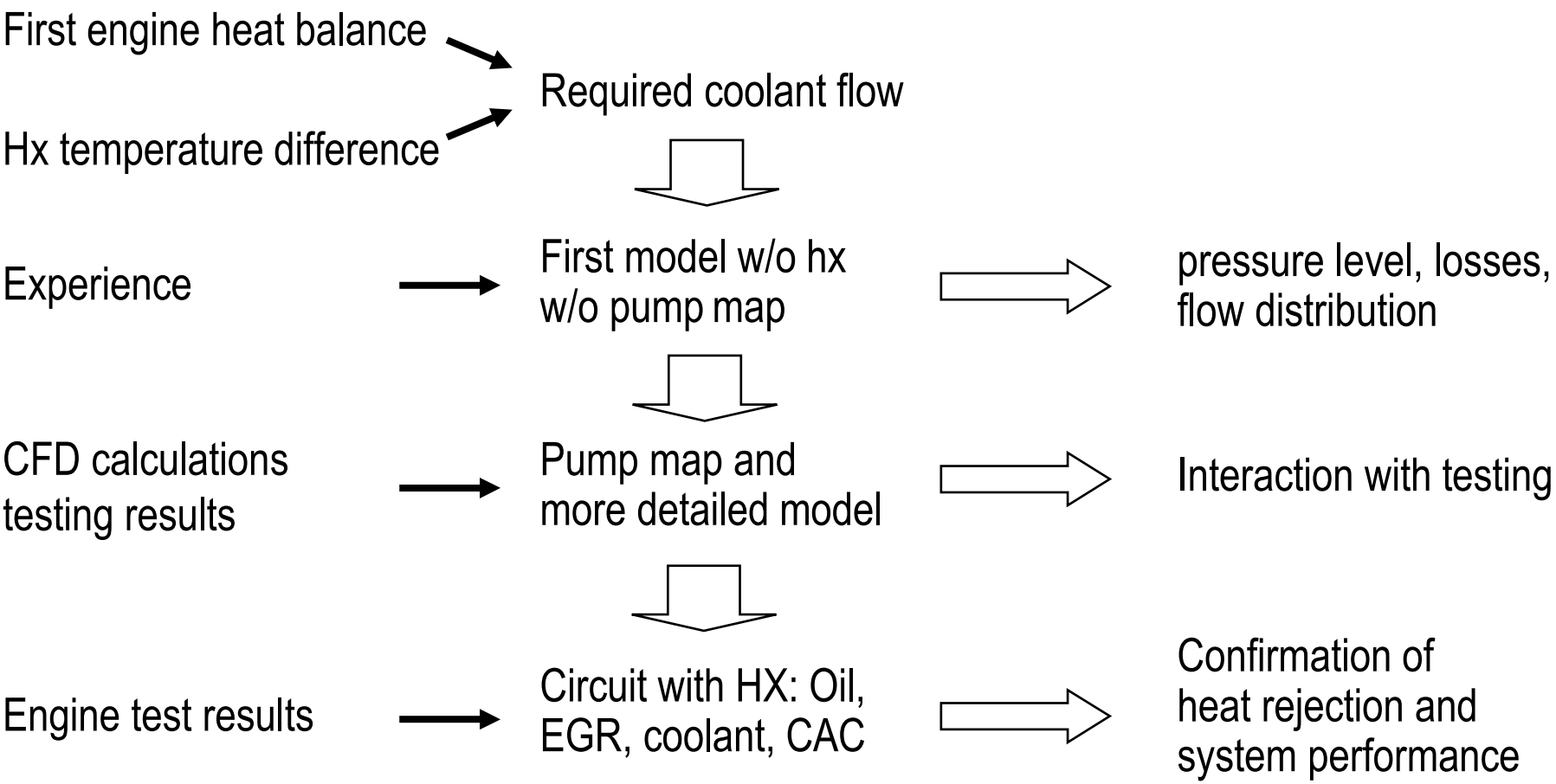
Example: full circuit w/o heat exchangers

The engine company. DEUTZ



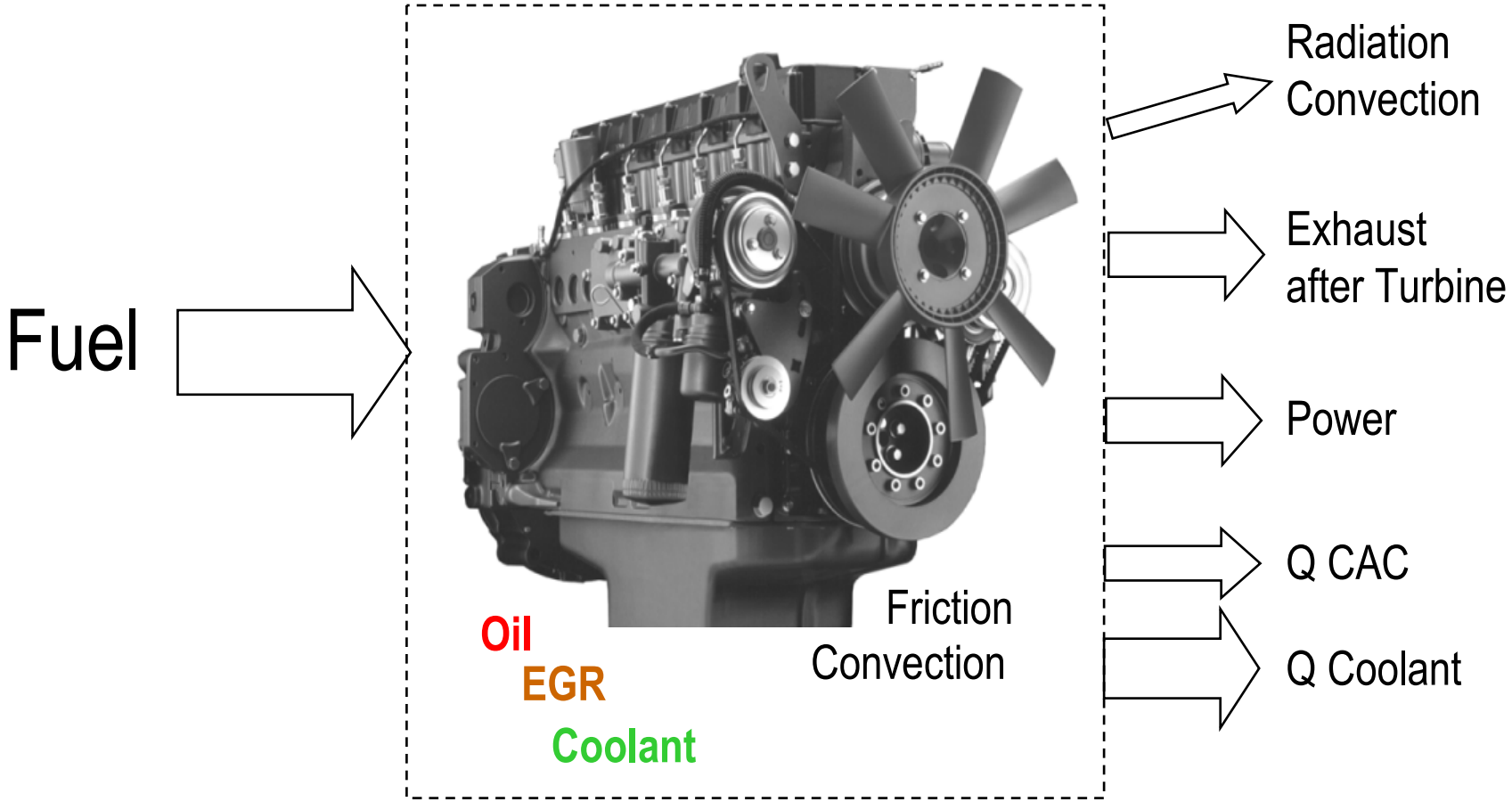
Development structure

The engine company. DEUTZ



Heat Balance Schematic

The engine company. DEUTZ



Heat balance calc for full circuit

The engine company. DEUTZ

Principle:

Q_fuel = Power + Q_Exhaust + Q_Coolant + Q_CAC + Q_amb
= BSFC x Power x Fuel Heat/3600000

Q_Exhaust = f(heat cap Exh, mass flow, Temperature after Turbine)

Q_CAC = f(heat cap Air, mass flow, Temperature after compressor)

Q_amb ~ 4%Q_fuel

Q_Coolant = Q_Engine + Q_oil + Q_EGR

Q_EGR = f(heat cap Exh_EGR, mass flow, Temp diff over EGR cooler)

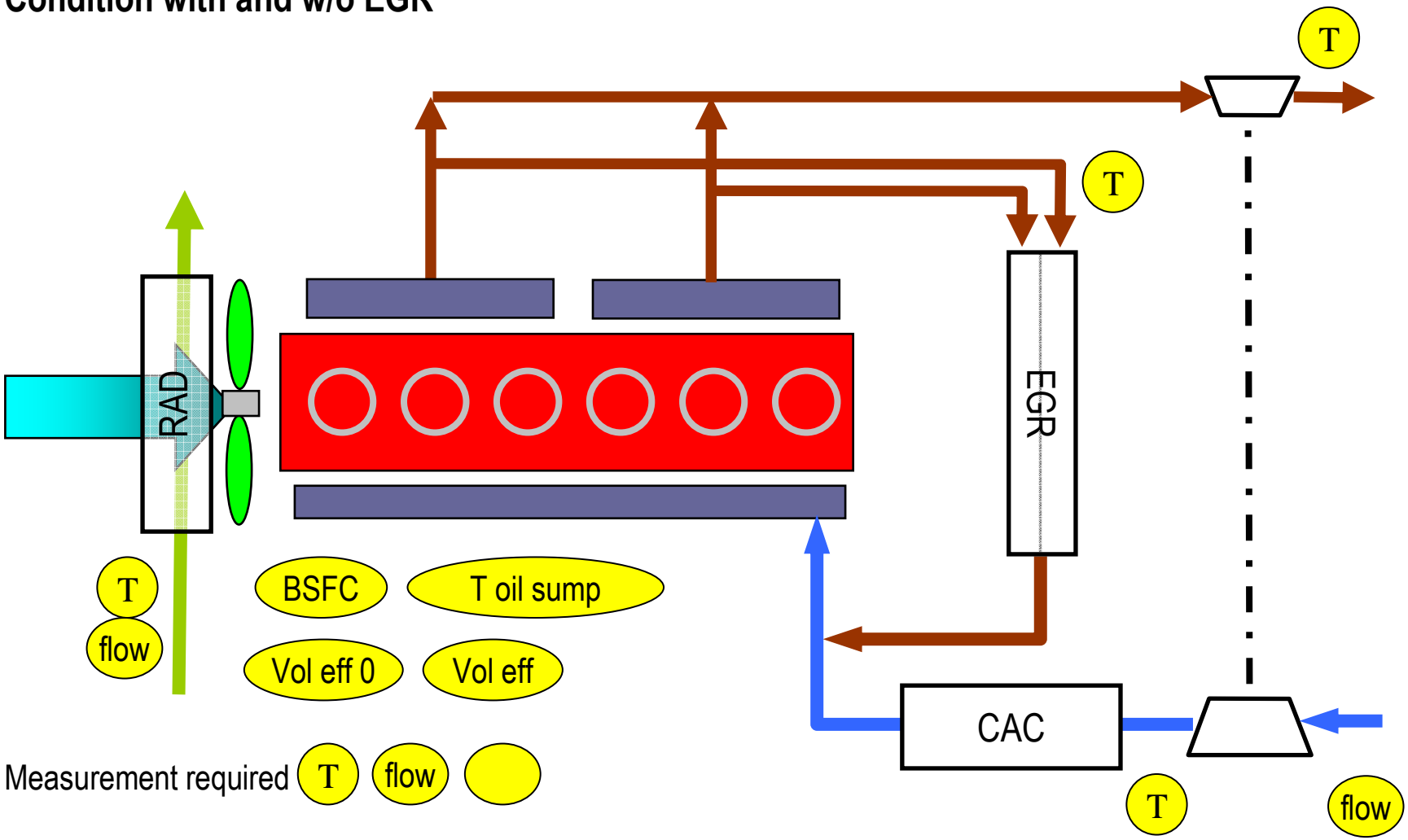
EGR mass flow = f(EGR rate, air mass flow)

Q_Oil = f(heat cap, mass flow, Temp diff over oil cooler)

Measure requirements for heat balance

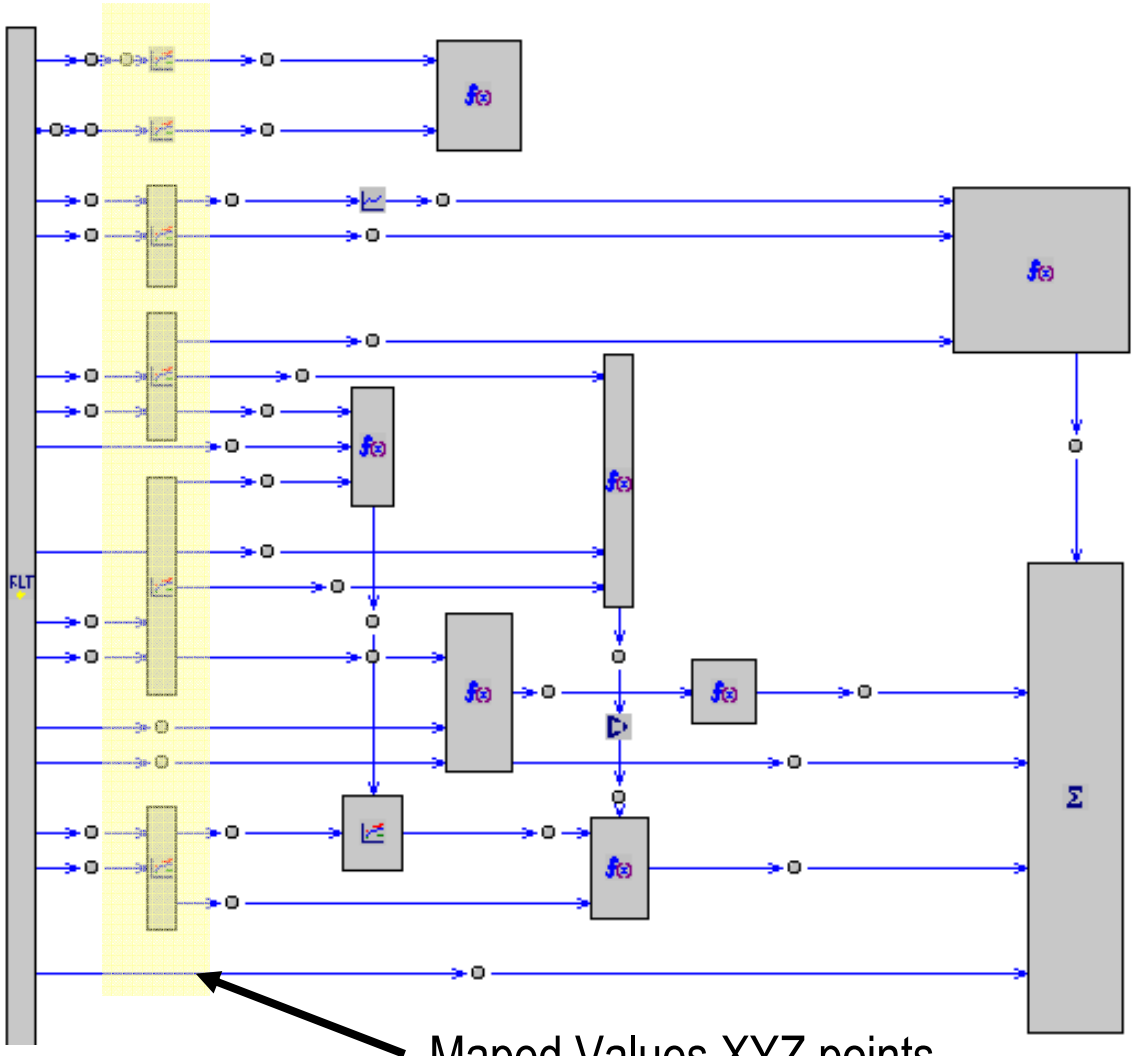
The engine company. DEUTZ

Condition with and w/o EGR



Calculation of heat rejection with GT controls

The engine company. DEUTZ



6 value maps out of measures

4 condition values out of case setup

<u>Result out:</u>

Q_Coolant

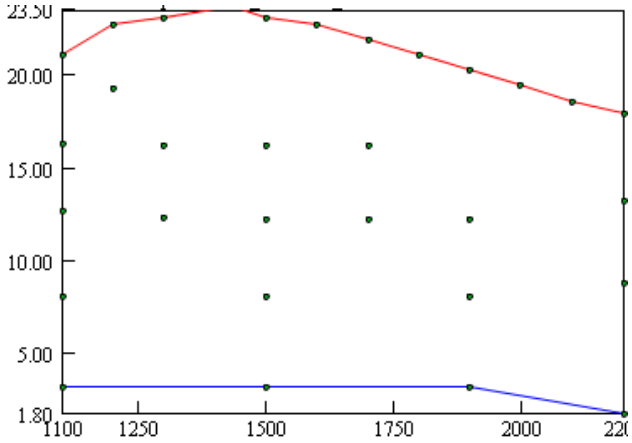
Q_CAC

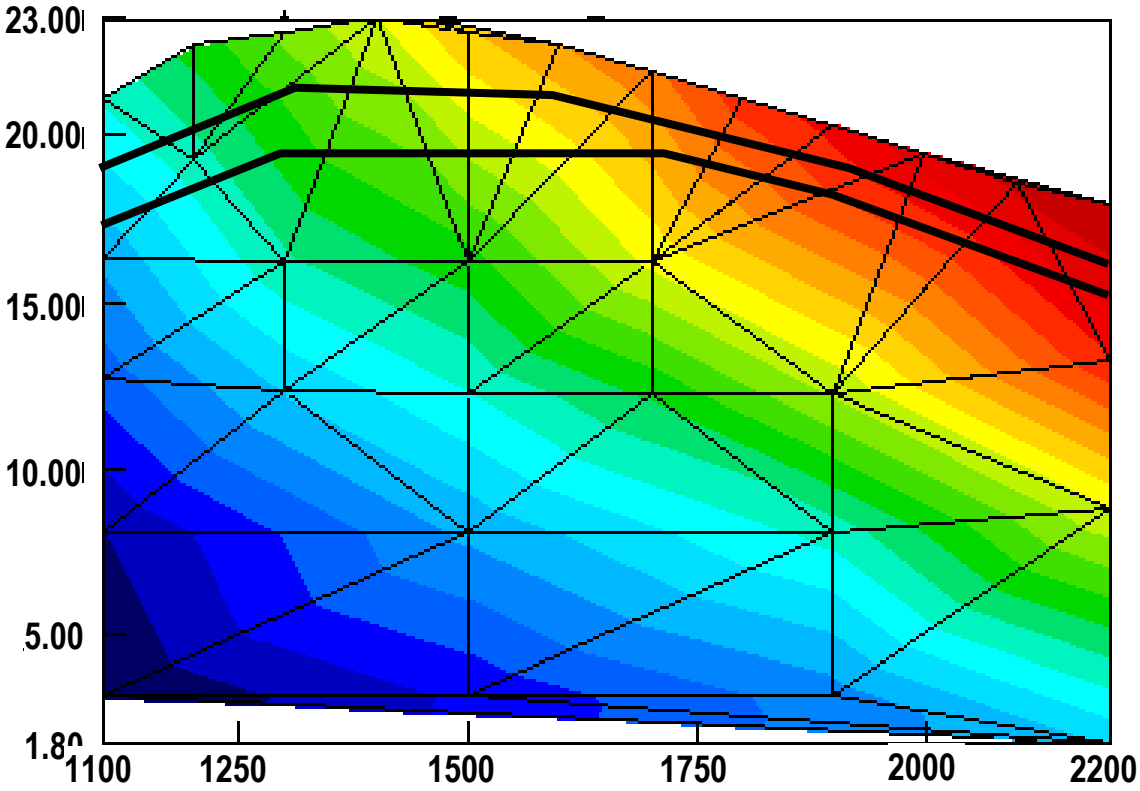
EGR rate

Map generation with XYZ points

The engine company. DEUTZ

Example: charge air flow over speed and BMEP

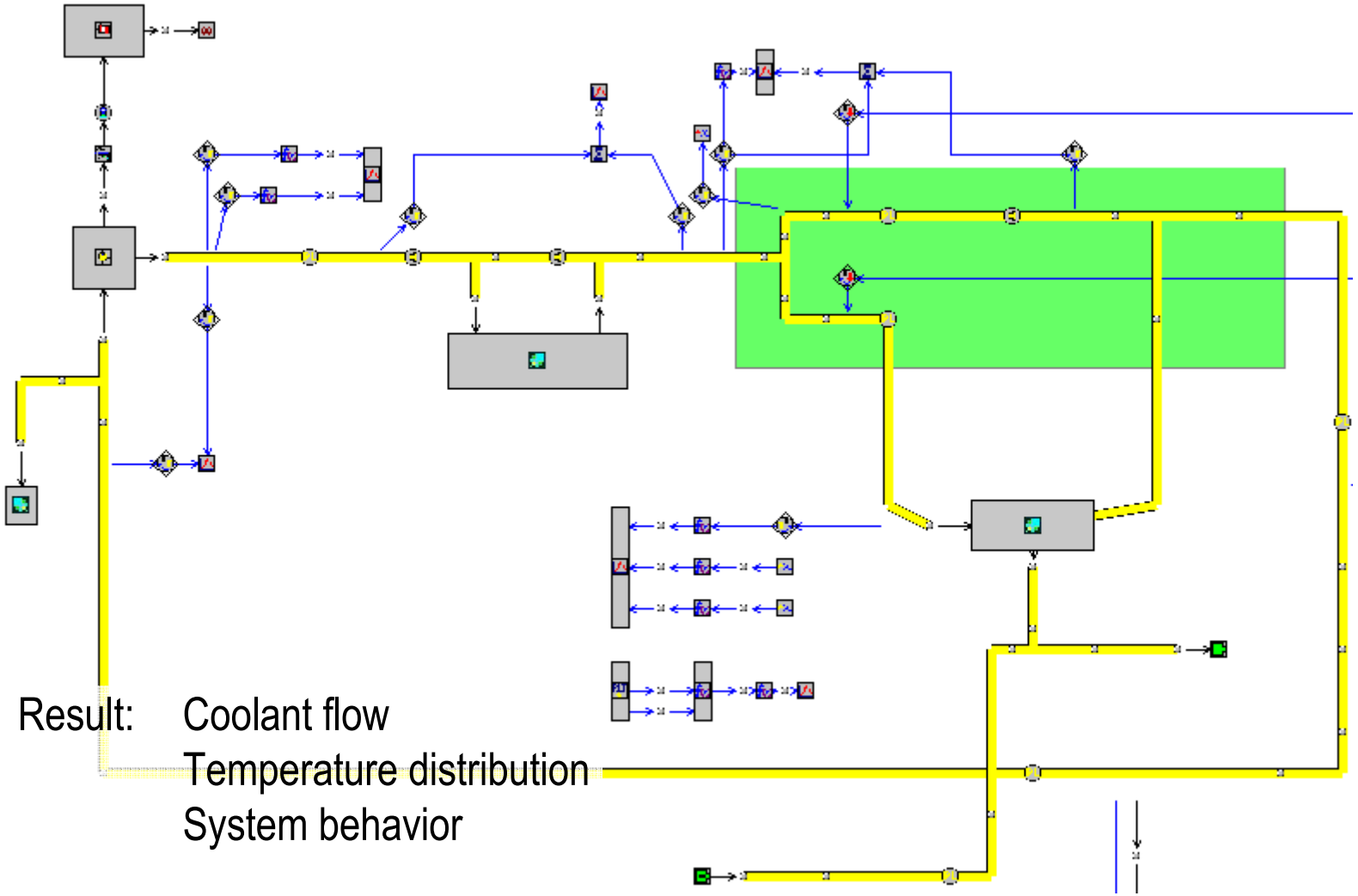




Full cycle with heat exchangers

The engine company. DEUTZ

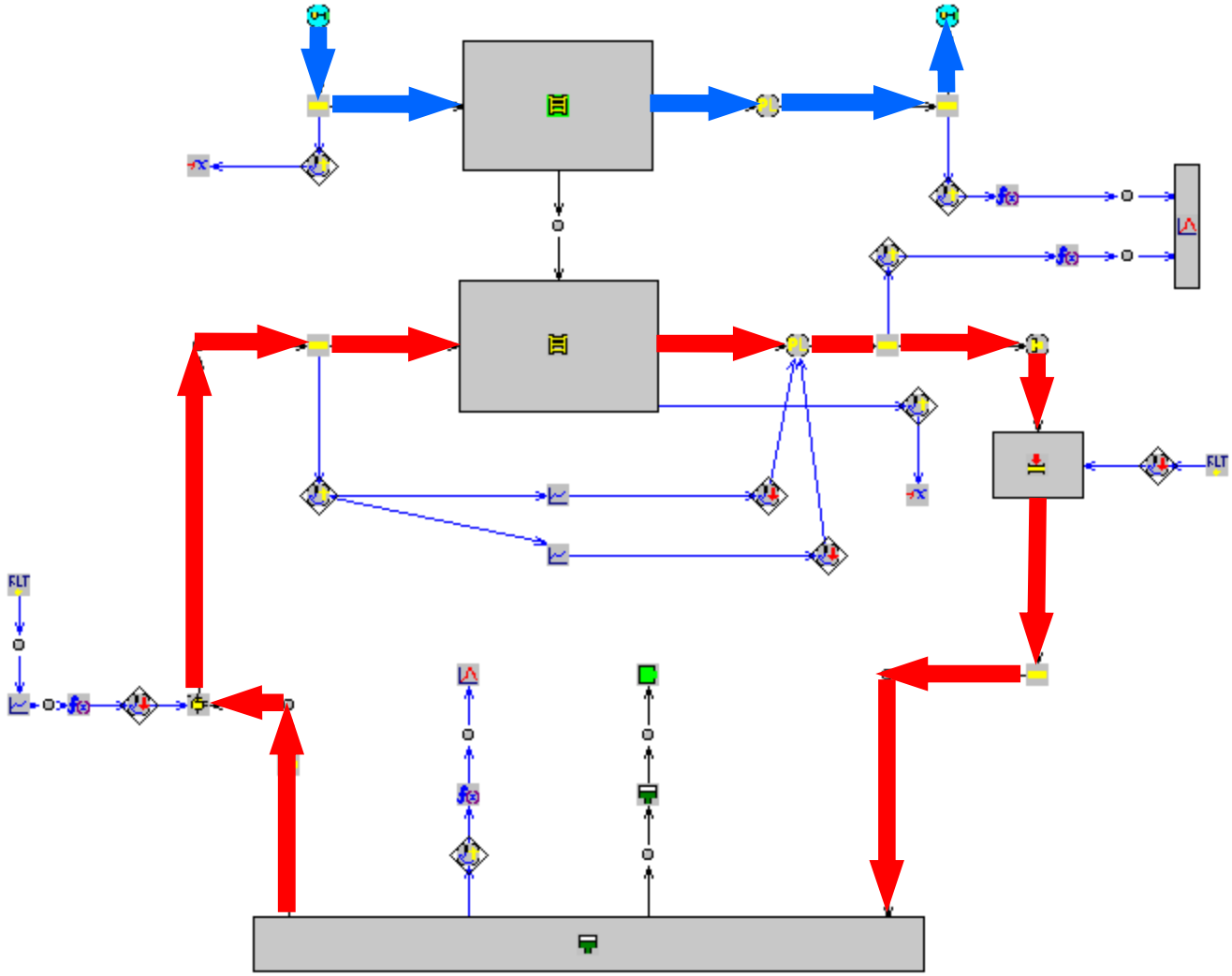
Oil cicuit, EGR flow, CAC flow, Cooling Air flow



Result: Coolant flow
Temperature distribution
System behavior

Full cycle with heat exchangers
Detail: Oil module

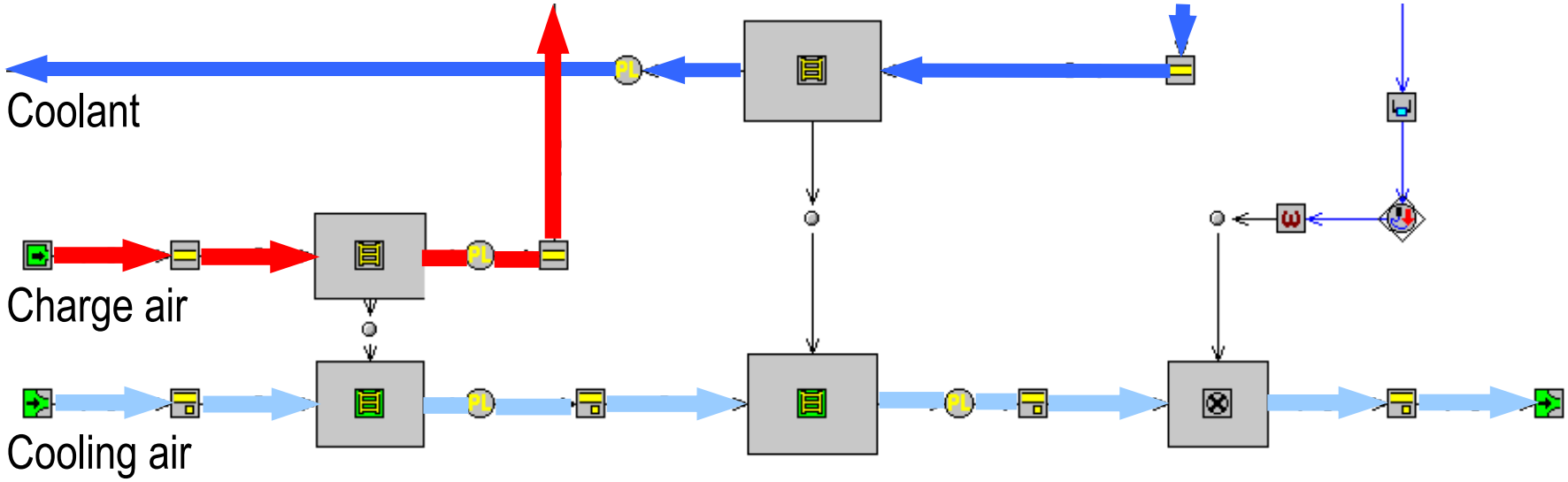
The engine company. DEUTZ



Full cycle with heat exchangers
Detail: Cooling pack

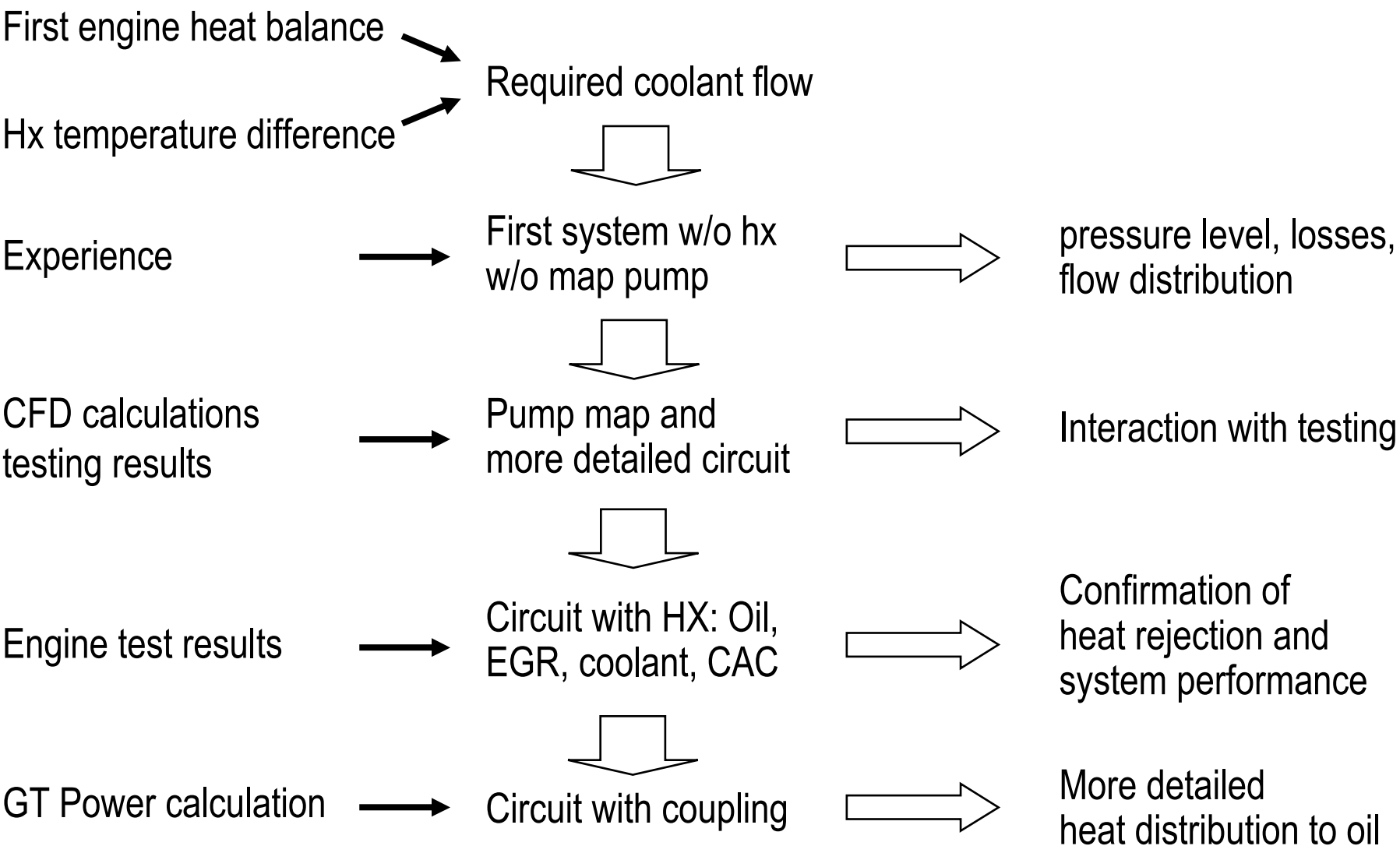
The engine company. DEUTZ

Air side of water circuit

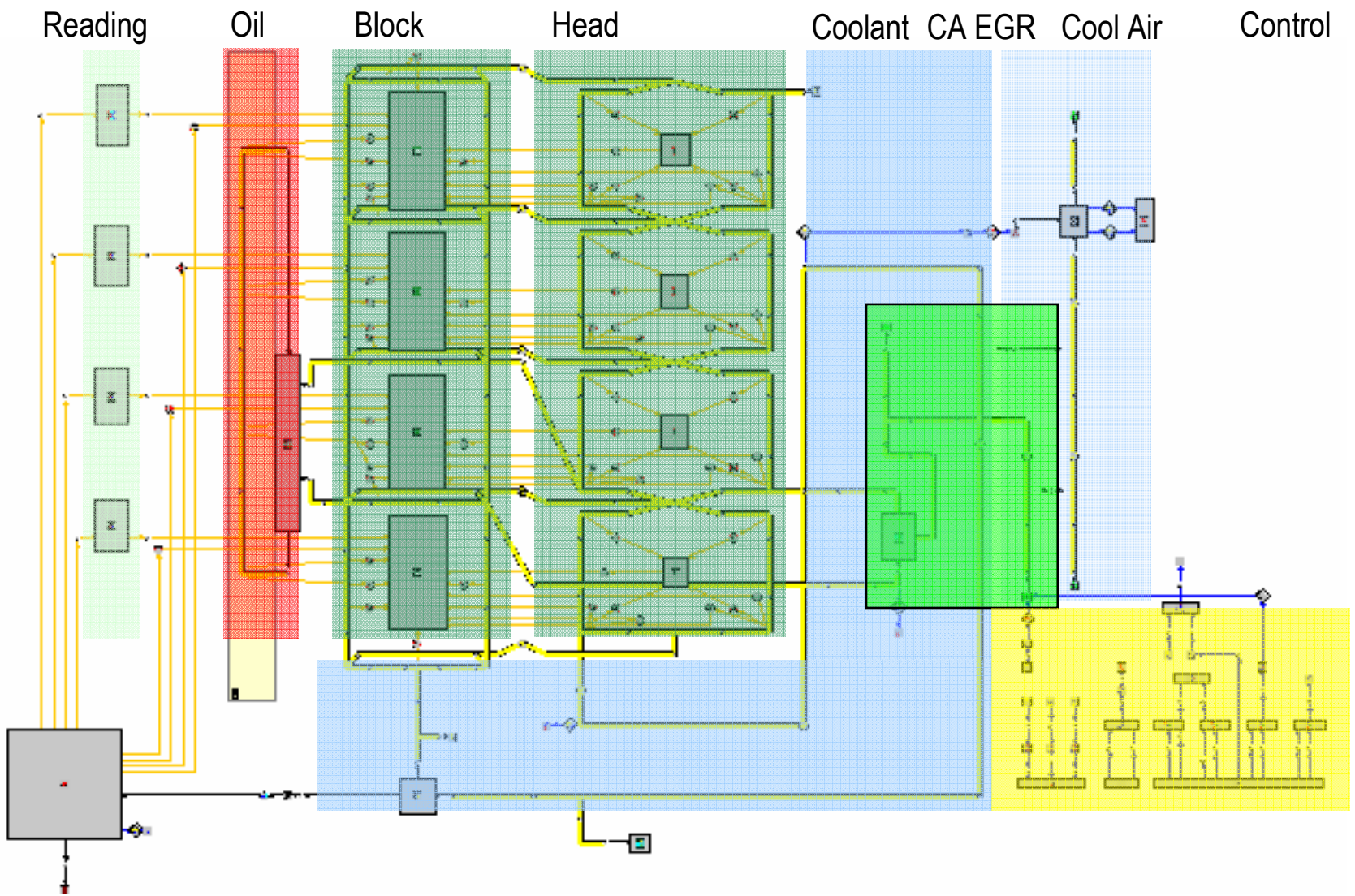


Development structure

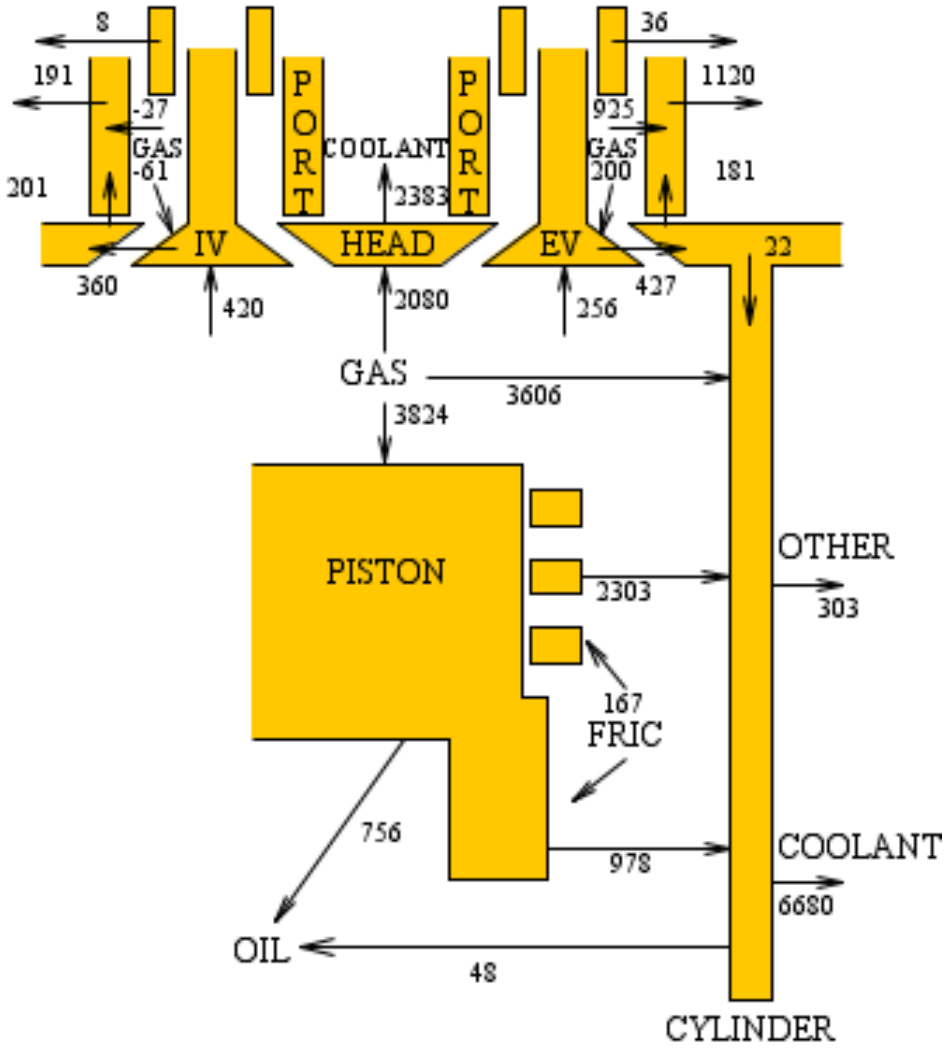
The engine company. DEUTZ

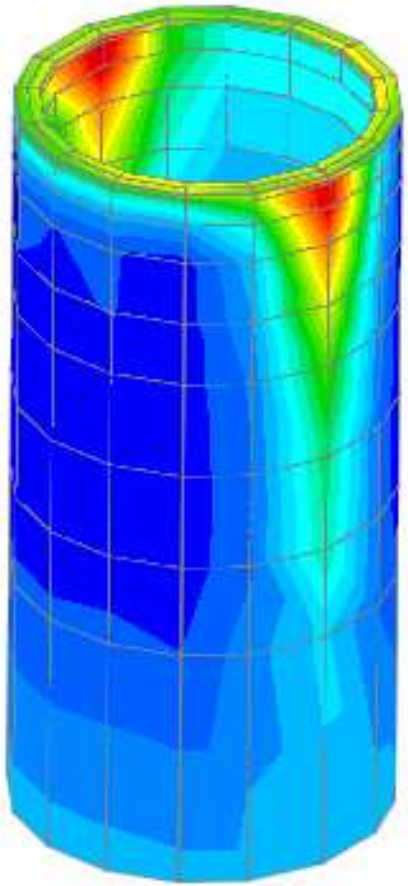


Split coupling with GT Power: model 4cyl-2V



Result of coupling with GT Power





Cooling system deveopment

The engine company. DEUTZ

Customer data to Deutz

Engine spec

Vehicle package

Operation limits

Deutz Cooling

Heat rejection

Hx size, ATB, coolant flow

Thermostat setting

System configuration

Cooling components

Diameters, Roughness

Maps of pump, hx, Fan

Thermostat valve curve

Pressure losses

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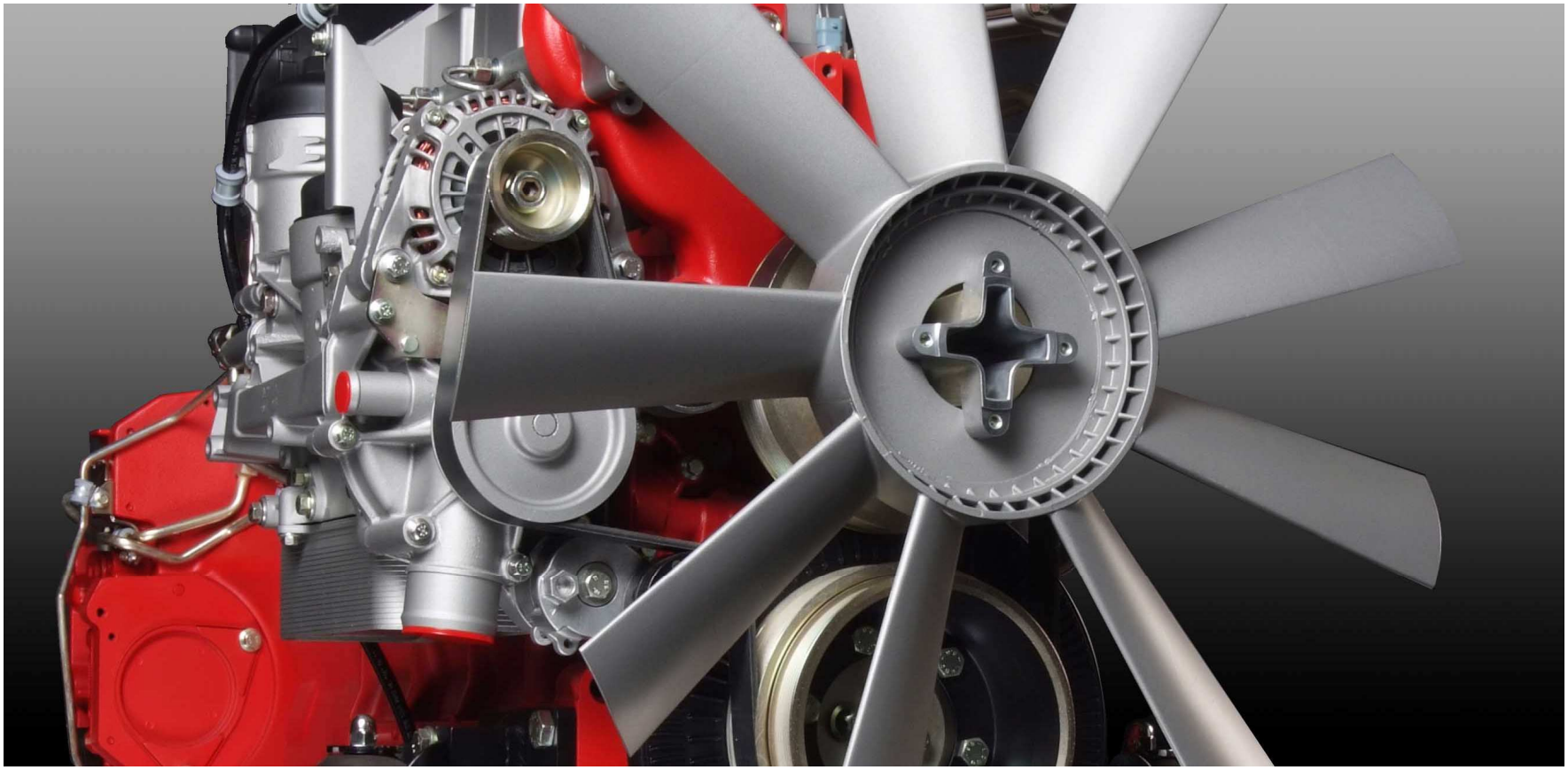
Coolant flow

Charge Air flow



Vielen Dank

The engine company.

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