



Researcher Links UK-Russia Workshop

Scientific and Technical Grounds of Future Low-Carbon Propulsion

19th - 22nd November 2018, Northumbria University at Newcastle, UK



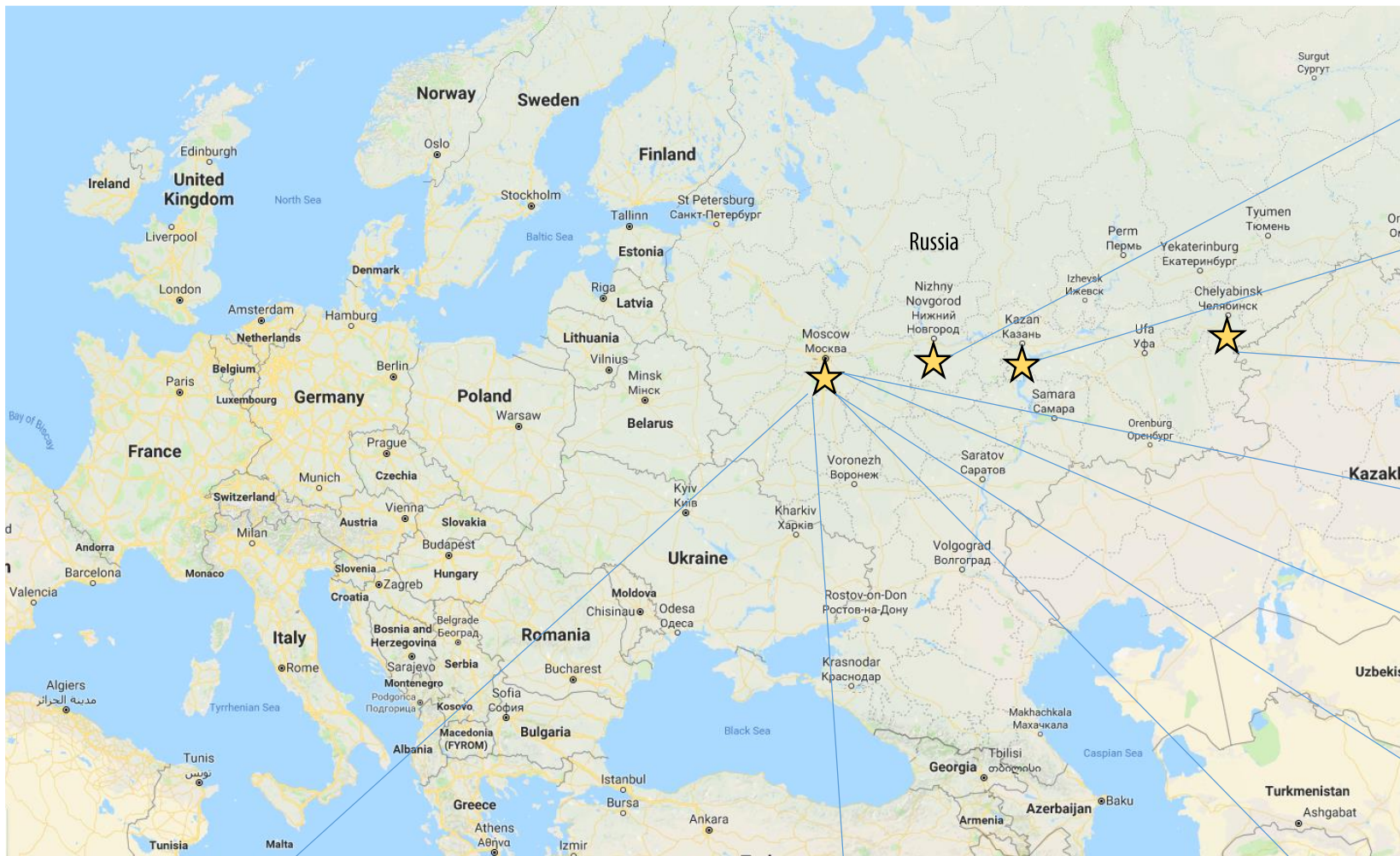
Alexey Terenchenko

Federal State Unitary Enterprise
“Central Scientific Research
Automobile and Automotive Engines Institute”
(FSUE “NAMI”)

RUSSIA, MOSCOW



Russian WorkShop Team



Nizhniy Novgorod
Technical University



Kazan National Research
Technical University



South Ural Technical University
in Chelyabinsk



Central Institute of Aviation
Motors (CIAM) in Moscow



Bauman Moscow State
Technical University



Moscow Automobile and
Road Construction State
Technical University (MADI)



Moscow Polytechnic University



Central Scientific Research
Automobile and Automotive
Engines Institute



Moscow National
University of Oil and Gas
«Gubkin University»

HISTORY

1918 Establishment of NAMI



NAMI-1. First Soviet Economy Car



AR-NATI 1. First Light Military All-Terrain Vehicle



LAZ-NAMI-751. First Soviet Electric Vehicle



NAMI-020. First Soviet Truck. URAL



2012 Era of driverless transport in Russia



Driverless KALINA. First Russian Driverless Platform



SHATL. Autonomous EcoBus



2018 Centenary of NAMI



AURUS. Luxury Vehicles Line-Up



Driverless Proving Ground. Dmitrov, Moscow Region



NAMI's TEAM results

GROWTH RATE:

↑ x 8 amount of work over the last 5 years ↑ x 2.3 personnel

2 504 employees

22 Doctors of Sciences

70 % researchers & engineers

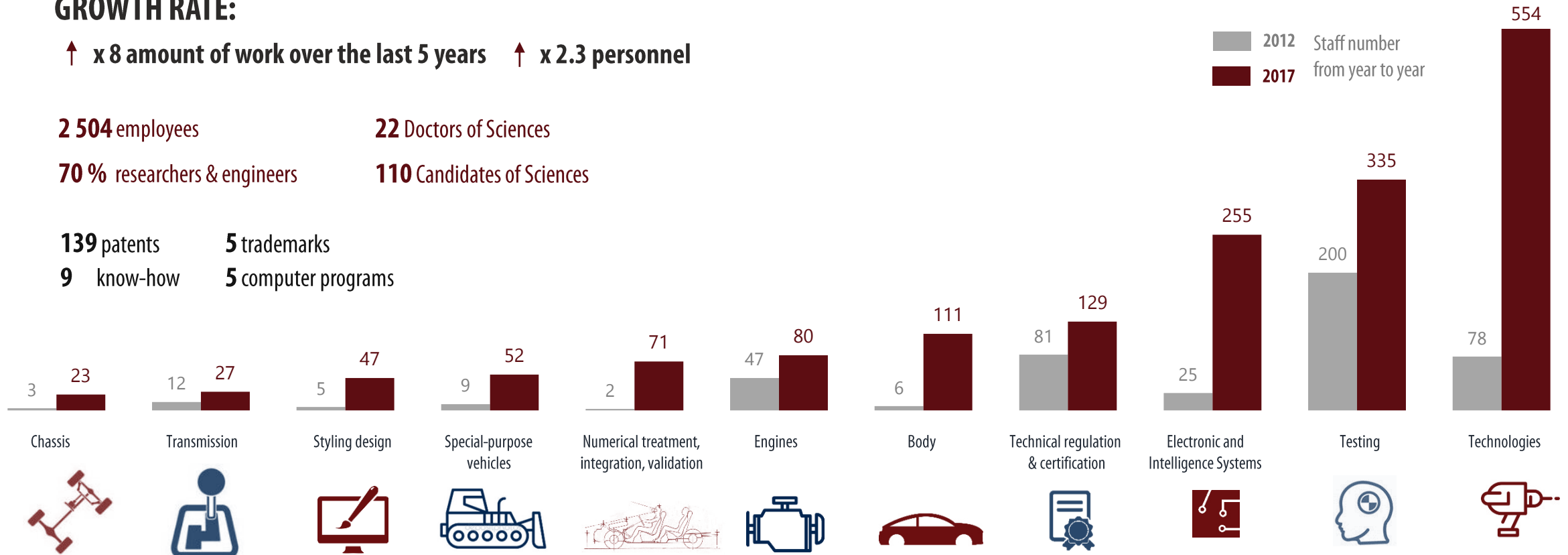
110 Candidates of Sciences

139 patents

5 trademarks

9 know-how

5 computer programs



MORE THAN 150 PARTNERS WORLDWIDE



RUSSIA: KAMAZ, SOLLERS, AVTOVAZ, Avtodor, GLONASS, Yandex, Rosseti, Rostelecom

EUROPE: Porsche Engineering, AVL, FEV, AKKA, Magna, EDAG, Bosch, BLUE Engineering

ASIA: CATARC, TAKATA, YESSUN, AGC, Booyoung Tech Co, JTR Automotive Group



Works and services



Market research, Analysis and Forecast. Marketing



Technical Regulation Compliance Assessment

Product development



Testing



Technologies



Project management



**QMS:
Implementation, Certification**



Automobile Market Research, Analysis and Forecast

Foresight, analysis, forecast, monitoring of the market, industry, equipment and technologies

Development and implementation of the industry analysis system for industrial companies and government organizations

**Industry strategies
Development programs**

Russian Federation Automotive Industry Development Strategy 2025
Export Development Strategy of Automobile industry
Strategy of ADAS Development in Russia

Technical & technological and financial & economic expert review of project

For Vnesheconombank about the projects of CLAAS, Mercedes-Benz, GAZ Group, etc.

Product marketing

Promotion of the premium class car to the Russian and export markets

Business planning, audit support, risk-assessment

For companies and projects AUTOVAZ, «Ё-Мобиль», LADA Izhevsk, UAG, YMZ, etc.

FACILITIES AND SERVICES. R&D



STYLE & DESIGN

Design Project Development
Analysis, conception
Rendering
Video visualization
Mock-ups, inc. in information environment
HMI, graphic arts



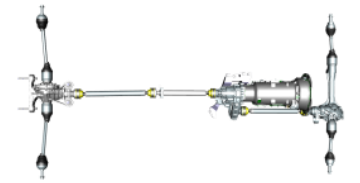
INTEGRATION

Benchmark
Packaging
NVH Comfort
Aerodynamics
HMI / Ergonomics
Functional Integration / Validation
Passive safety
Thermal management



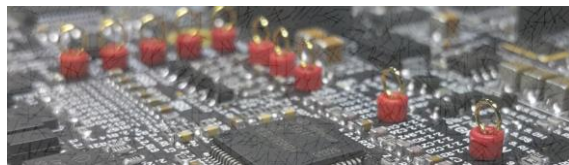
ENGINES

Oil fuel and alternative types of fuel engines
Hybrid power plants (testing methods, equipment, control systems, electric traction drive)
New research methods in the field of energy and resource conservation and saving and environmental safety of power plants within product life cycle
Applied software development



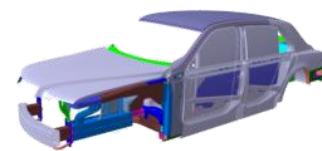
TRANSMISSION

Mechanical and automatic transmissions
Driving axles and differentials
Transfer cases
Power take-off attachments and reduction gears



ELECTRONIC AND INTELLIGENCE SYSTEMS

The high-voltage battery and components
Intelligent transport and systems
Engine's and automatic transmission's regulating system
ADAS



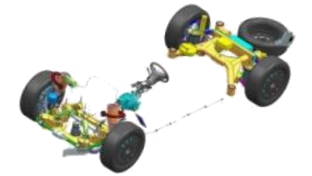
BODY

BIW
Interior
Exterior



SPECIAL-PURPOSE VEHICLES' DESIGNS

Special Multi-Purpose All-Wheel Drive Vehicles
Special- and Multi-Purpose Driverless Vehicles and Robotic Platforms
Special- and Multi-Purpose Tracked Vehicles



CHASSIS

Various types of vehicle suspension
Steering control
Brake system
Wheels and tires
Power plant suspension

Technologies



ADDITIVE TECHNOLOGIES

Functional prototypes' production
 Casting burn-out models' production
 Master-models' production
 Full-size vehicle mock-ups' production



CASTING

Production of sand cores and molds for metal casting
 Vacuum casting of nonferrous metals
 Gravity casting
 Aluminium alloys, cast-iron, steel



MACHINING

Aluminium, cast-iron, steel
 Any complexity and accuracy



MOCK-UP PRODUCTION AND TOOLING

Full-size mock-ups of vehicles, vessels and aircraft, tooling for vacuum forming and composite materials
 Tooling for hydro elastic stamping, tooling for composite materials from model materials and lightweight alloys



WELDING

Production of welding tooling
 Metal welding: spot and arc
 Laser beam cutting of metals
 CNC pipe bending
 CNC sheet metal bending
 Metalwork production
 Vehicle BIW welding



PAINTING

Use of any type of paints, inclusive of water-based ones



ADVANCED TECHNOLOGIES

Searching, analysis and definition of key directions
 Elaboration of engineering and technical policy as to development and implementation
 Projects' technological expertise and appraisal, coordination of works on development and implementation

Testing and certification of automobile products



LABORATORY TESTING

Certification, check, research testing of vehicles, ICEs and their components for evaluation of their environmental properties, fuel efficiency and reliability

Hybrid Power Plants' testing, Filters' testing

Control systems' testing

Check, development and adjustment testing of transmission with determination of climatic, strength and power properties and parameters; other transmission elements

Brake mechanisms' testing

Aerodynamic Testing

Passive and active safety testing, assessment of vehicle ergonomic properties

ROAD TESTING

Road, run testing: 15 types and versions of test roads, the total length of which is 110 km at 25 km² area

Active safety (controllability, brake dynamics, testing of wheels and tires)

Environmental properties

Noise and vibroacoustics (NVH)

Testing of road and bridge fences or guards

Determination of operating characteristics (ecology, safety, comfort, etc.)

TECHNICAL REGULATION

Standardization

Coordination of Russian Federation experts' activity within working groups and authorities of UNECE World Forum for harmonization of vehicle regulations (WP.29)

Identification

Development and actualization of systems of compliance assessment of wheeled vehicles and their components

Technical Expertise and Appraisal



PROJECT PORTFOLIO

innovative approach to relevant tasks

AURUS

Excellent Embodiment of Force, Power and Safety

LIMOUSINE



SEDAN



MPV



SUV



UNIFIED MODULAR PLATFORM

V8 engine, 600 hp, 880 Nm
Electric motor 60 hp, 400 Nm
9-speed planetary gearbox



Road clearance 200 mm
«Commander» seating
Inspired by Russian history

Characteristics presented are for Sedan model



SHATL Smart High-tech Adaptive Transport Logistics

Driverless motion control
system

Via smartphone application

Body

Made of composite materials,
the geometry can be modified
upon request

Passenger capacity

12 passengers, including 6
seats

Speed, max

110 km/h

Wheel drive

Electric

Maximum cruising range

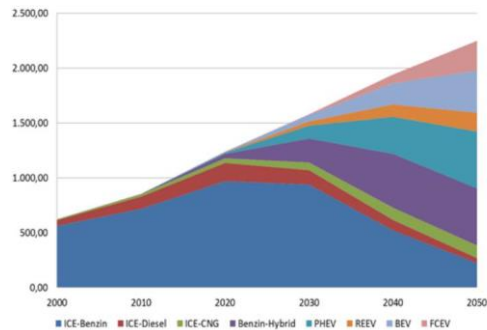
120 km



Power Units Center: 85 researchers & engineers; 4 Doctors of Sciences; 8 Candidates of Sciences

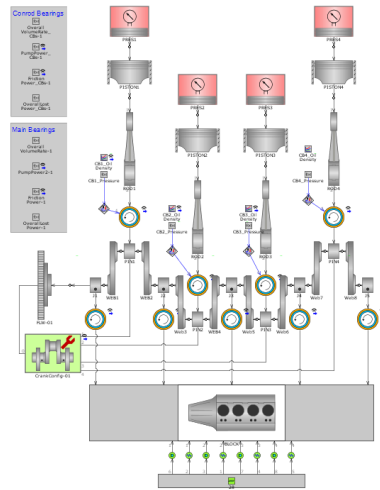
Our Works:

Strategic management.
Fundamental research



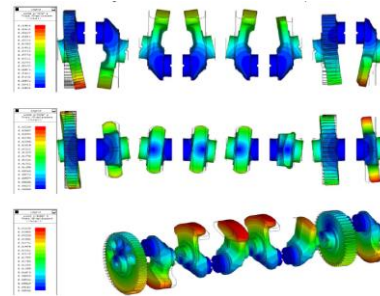
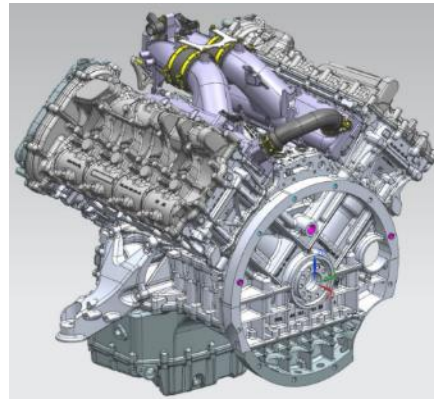
Work Process,
Combustion,
Emission,
Drivability,
Tradition Fuels,
Alternatives Fuels,
Energy Saving Technologies,
Construction materials

Simulation



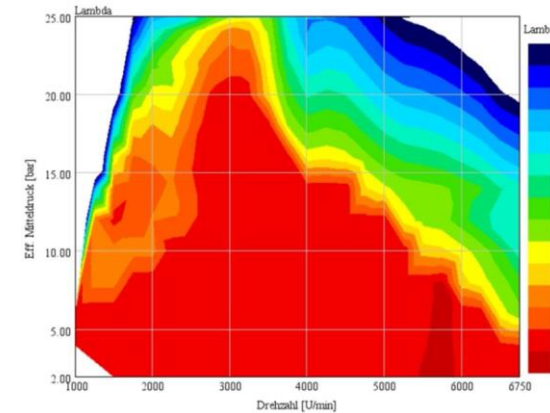
- Aftertreatment
- NVH
- Combustion and Emissions
- Powertrain Components
- Electrification
- Quenching
- EMC/EMI Simulation
- Strength and Durability
- Energy Management
- Thermal Management
- Model Based Development
- Injection Nozzle
- Turbocharging
- Model Based Testing
- Vehicle System Simulation

Engineering



Gasoline, Diesel
Engine small, middle, large
Aftertreatment
E-Drive, Battery
Fuel Cell, Power units
Vehicle/Engine System
Commercial Vehicle Hybrid
Conventional Vehicles
Electric Vehicle Powertrain System
Hybrid Vehicles
Tractor/non-road Engineering

Bench testing



Bench testing
Combustion Development
Emission,
Acoustic,
Durability,
Reliability
OBD testing
Calibration

Certification, regulation development



World Forum for Harmonization of Vehicle Regulations (WP.29)
Working Party on Pollution and Energy (GRPE)

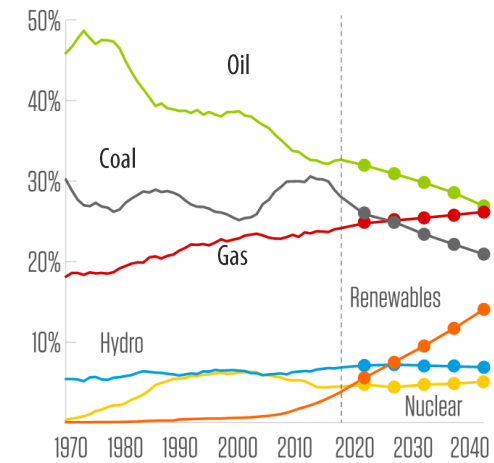


Certification testing
Homologation testing
Verification testing
Development of worldwide and national regulations, standards, rules.

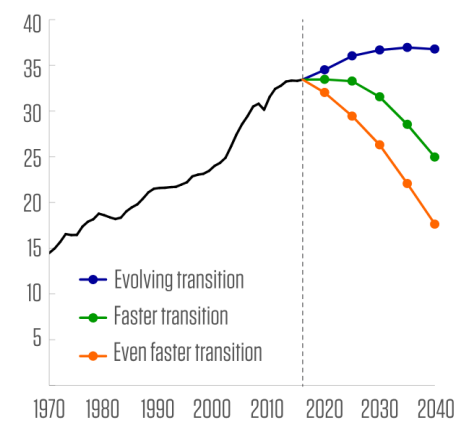


Strategic management. Selection of research directions.

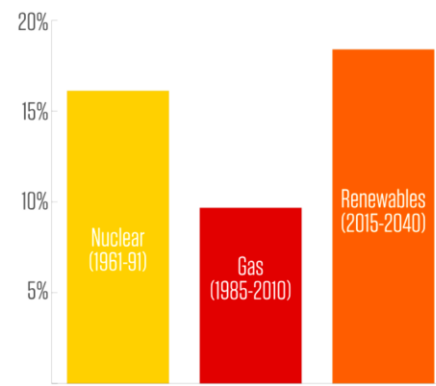
Shares of primary energy



Carbon emissions (billion tonnes CO₂)



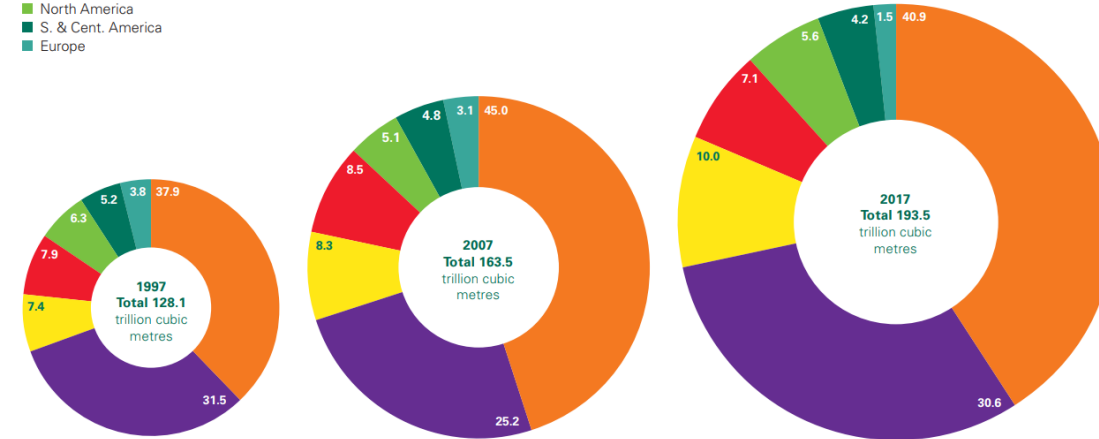
Pace of power market penetration (largest gains in market share over 25 years)



Distribution of proved reserves in 1997, 2007 and 2017

Percentage

- Middle East
- CIS
- Asia Pacific
- Africa
- North America
- S. & Cent. America
- Europe

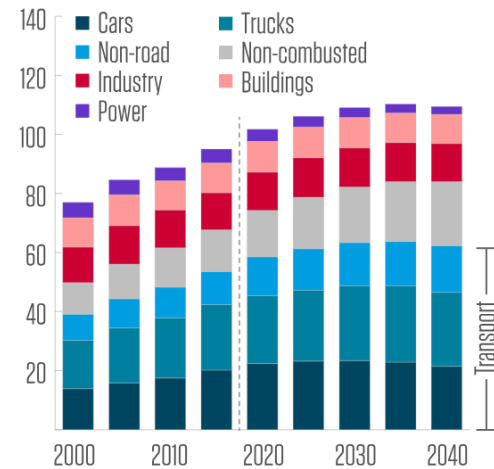


† Non-fossils includes renewables, nuclear and hydro

In the evolving transition scenario, carbon emissions from energy use increase by around 10% by 2040

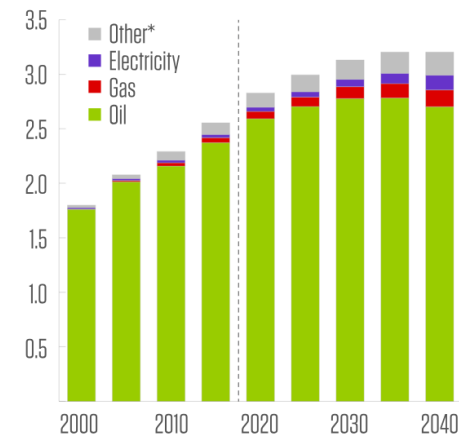
The pace at which renewables gain share in power generation over the Outlook is faster than any other energy source over a similar period

Liquids demand (Mb/d)



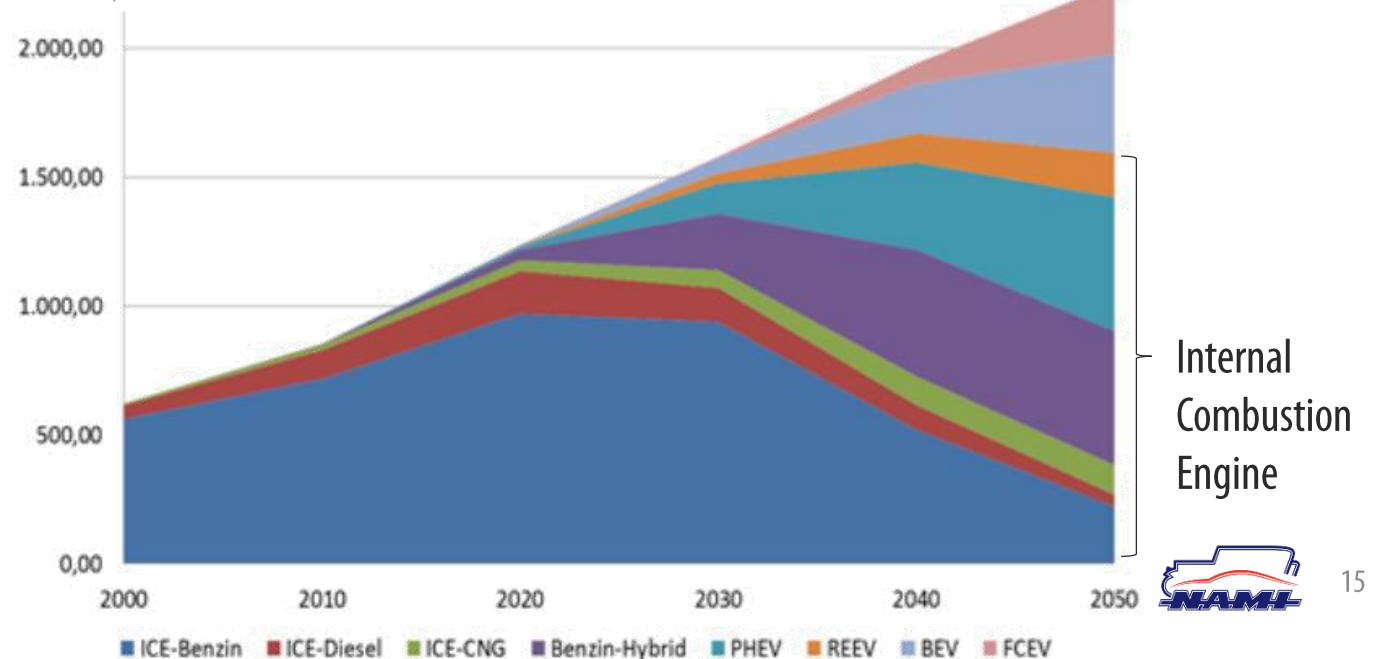
Cars include 2- and 3- wheelers. Trucks include most SUVs in North America. Non-road includes aviation, marine and rail

Transport energy consumption by fuel type (billion toe)

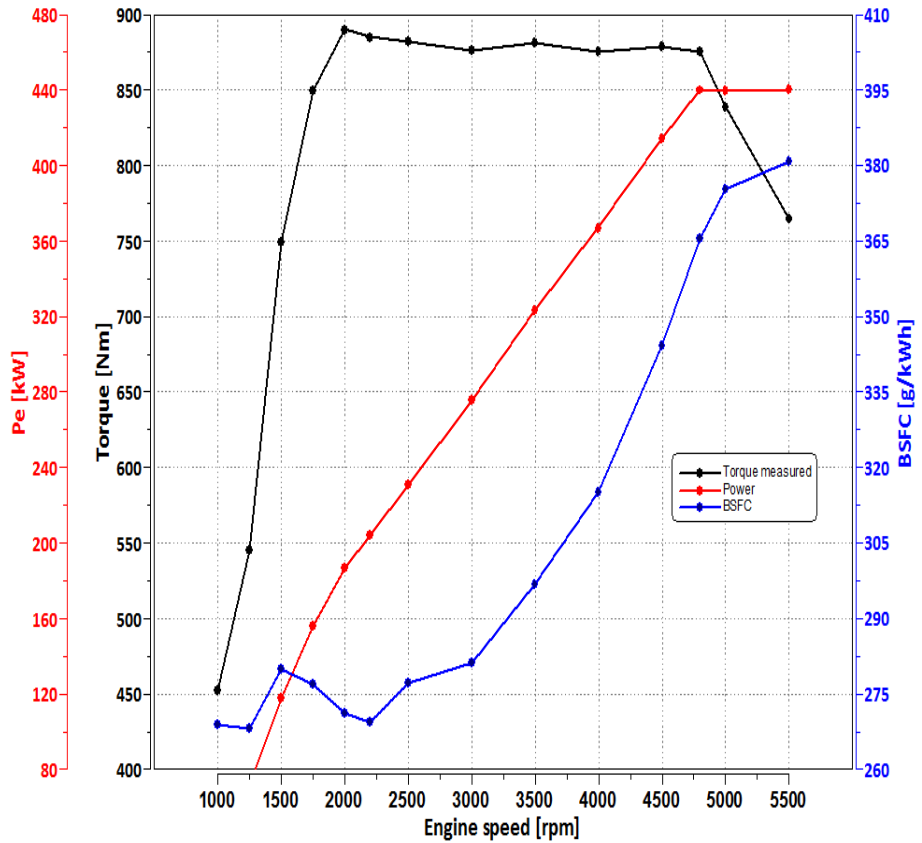
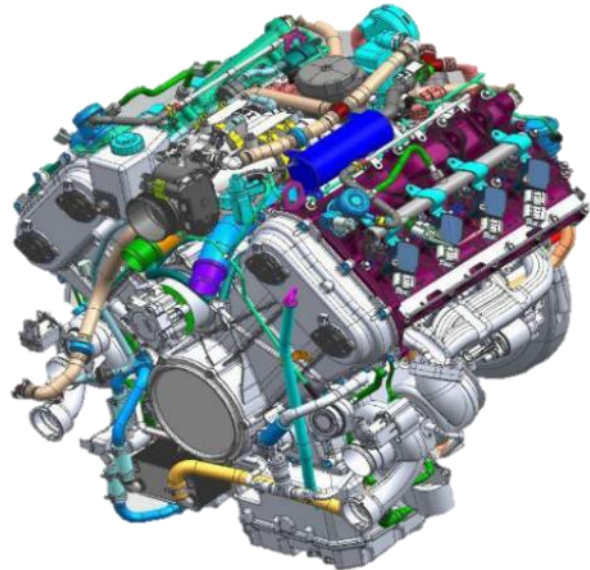


In the evolving transition scenario, oil accounts for 85% of total transport fuel demand in 2040, down from 94% currently

Internal Combustion Engine



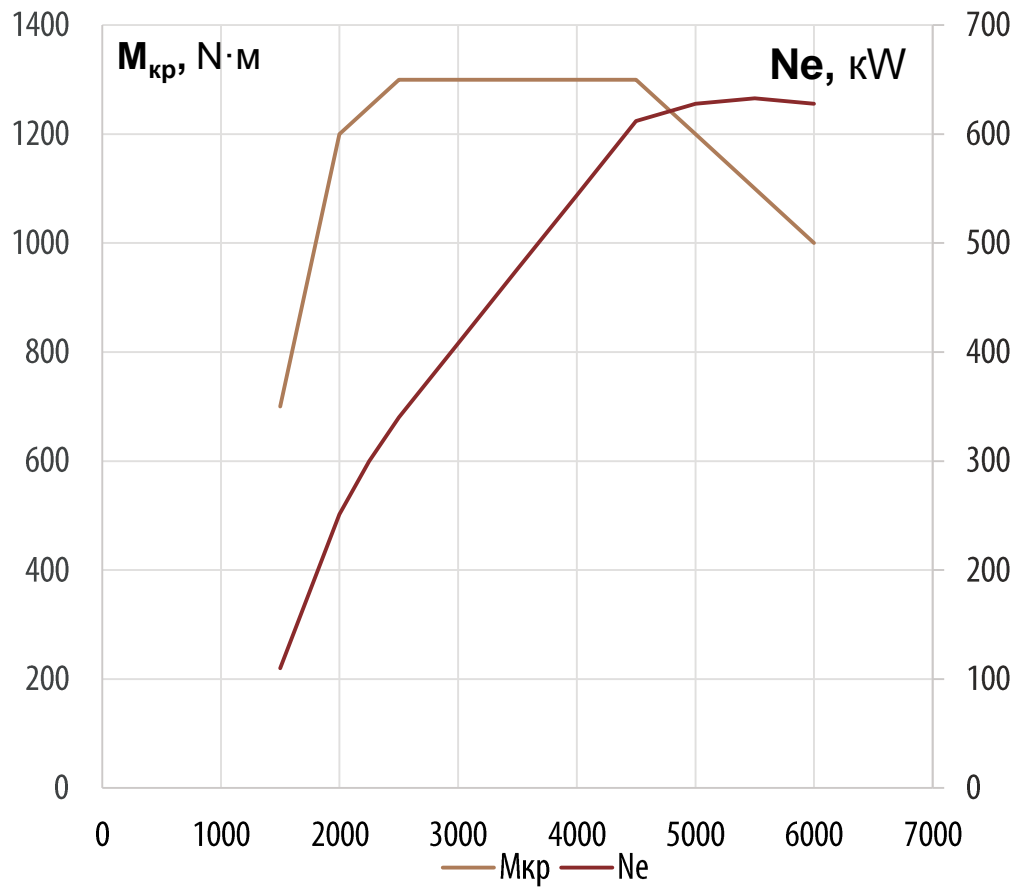
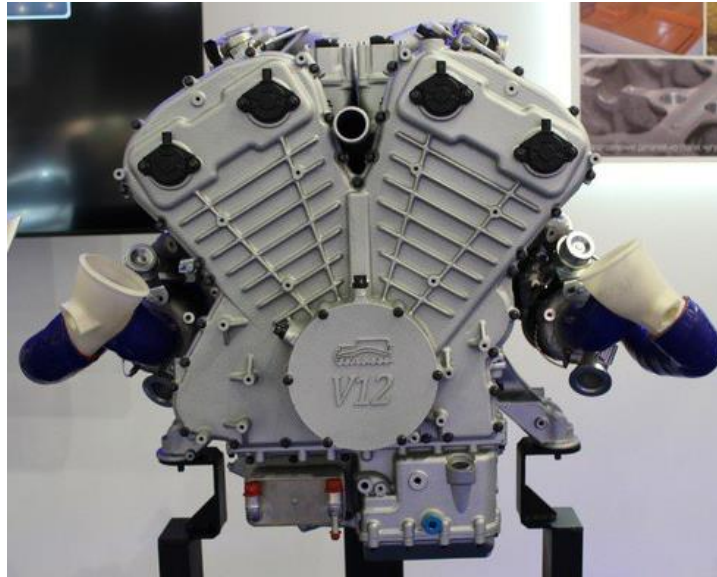
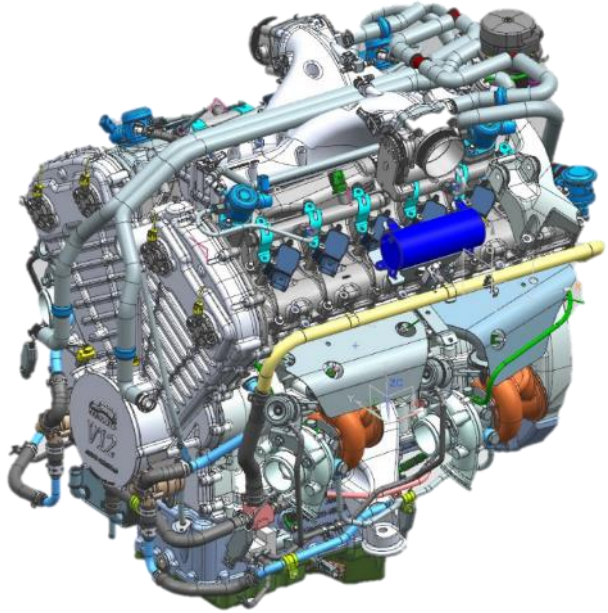
Base GDI engine UNIFIED MODULAR PLATFORM family. V8x90°, 4.4 l, 440 kW



$N_e=440$ kW, $M_{kp}=880$ Nm
 $S/D = 90/88$ (mm)
 $\epsilon = 10$
 Fuel: Gasoline Ai-95-98 (Premium);
 Ethanol E-10
 $L \times W \times H = 683 \times 779 \times 823$ mm
 $m = 230$ kg



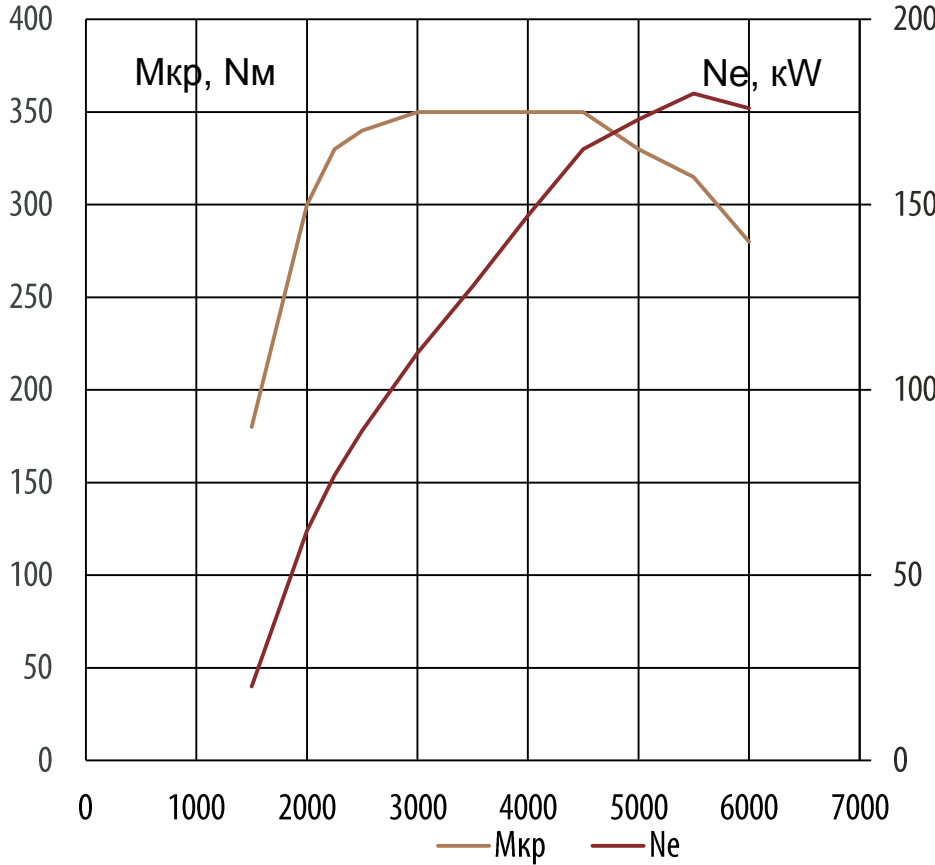
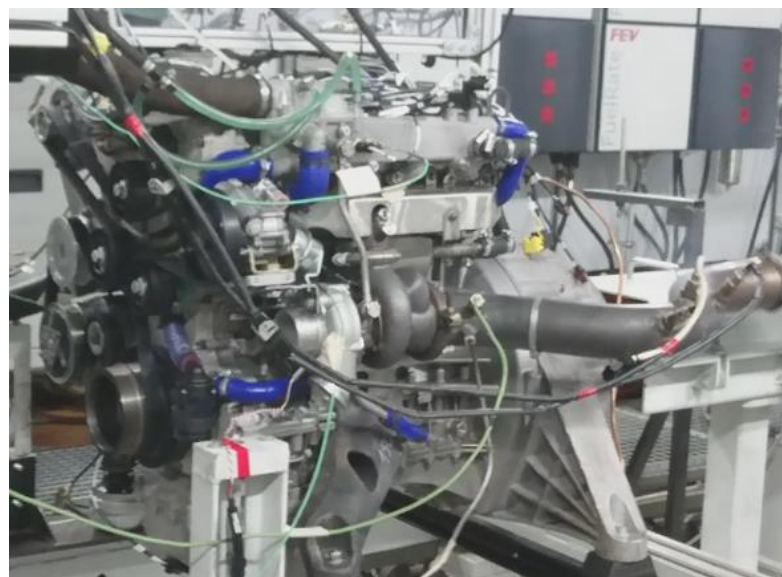
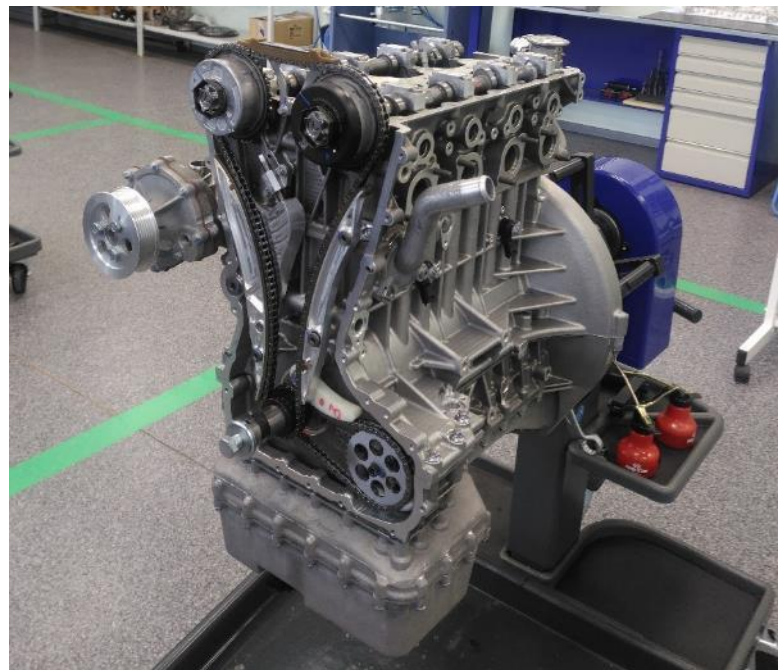
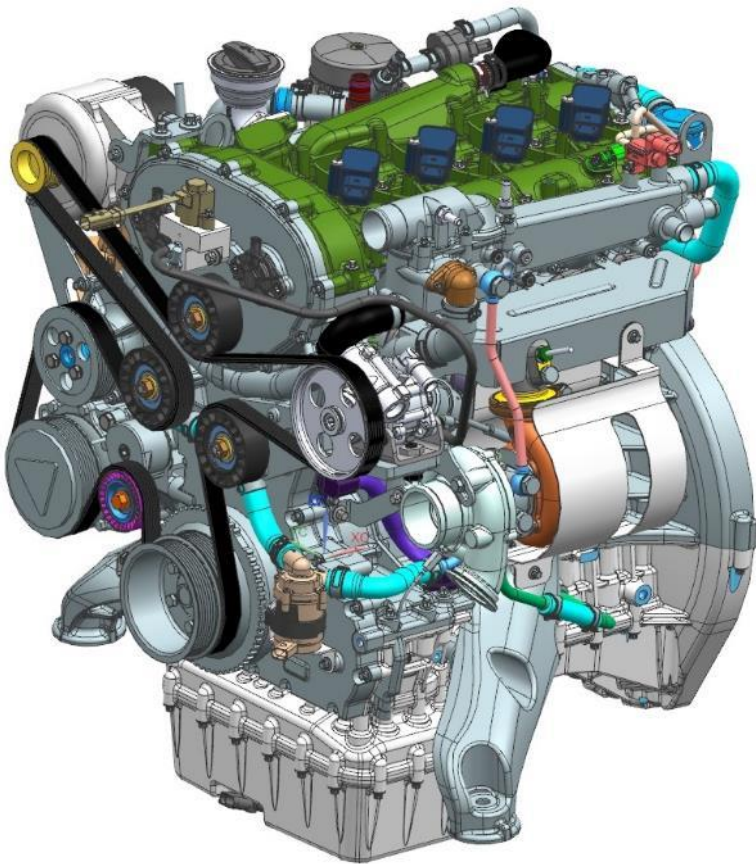
Top GDI engine UNIFIED MODULAR PLATFORM family. V12x60°, 6.6l, 630 kW



$N_e = 630 \text{ kW}$, $M_{кр} = 1320 \text{ Nm}$
 $S/D = 90/88 \text{ (mm)}$
 $\epsilon = 10$
Fuel: Gasoline Аи-95-98 (Premium); Ethanol E-10
 $L \times W \times H = 935 \times 813 \times 860 \text{ mm}$
 $m = 310 \text{ kg}$



Commercial GDI engine UNIFIED MODULAR PLATFORM family. L4, 2.2l, 180 kW



$N_e = 180 \text{ kW}$, $M_{кр} = 350 \text{ Nm}$
 $S/D = 90/88 \text{ (mm)}$
 $\epsilon = 9,5$
Fuel: Gasoline Аи-95-98 (Premium);
Ethanol E-10
 $L \times W \times H = 727 \times 723 \times 773 \text{ mm}$
 $m = 150 \text{ kg}$



Small 1-4 cylinders diesel and gasoline engine UNIFIED MODULAR PLATFORM family

Purpose: passenger cars of class B, C, D, small garden and construction equipment, small diesel generator sets, motorcycles and Range Extenders for hybrid engines.

Type	Engine	Displacement, L	Brake power, kW	Boost	Compression ratio
Gasoline, Ethanol	R1	0,55	30	-	12
	R2	1,1	56	-	12
	R3	1,65	133	1TC	9,5
	R4	2,2	157	1TC	9,5

Type	Engine	Displacement, L	Brake power, kW	Boost	Compression ratio
Diesel, Biodiesel	R1	0,55	11	-	17
	R2	1,1	24	-	17
	R3	1,65	104	1TC	17
	R4	2,2	135	1TC	17

148,8/9

248,8/9

34H8,8/9

44H8,8/9





Hybrid electric cargo vehicle with hydrogen fuel cells



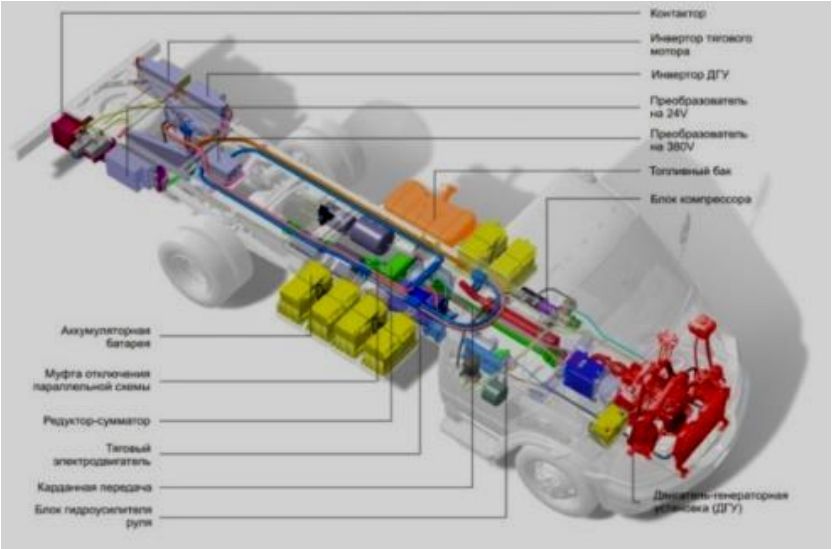
Car VAZ-2111 using hydrogen - ethanol mixtures with the production of hydrogen on board



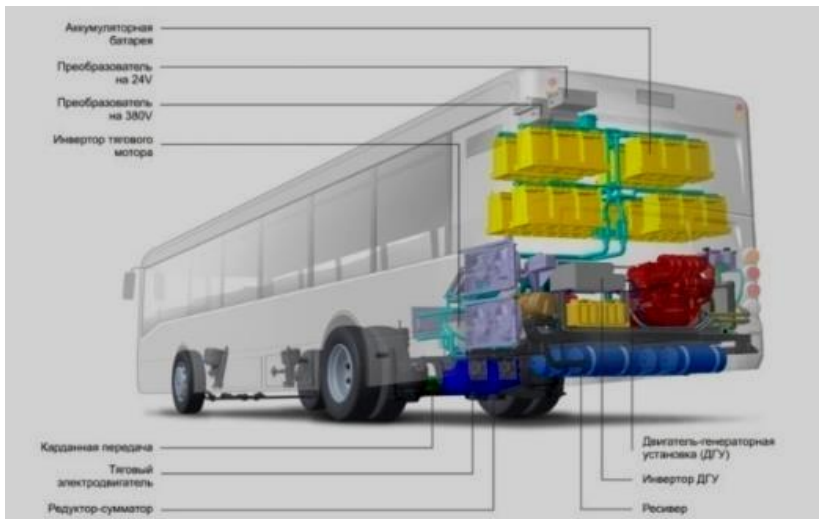
Hybrid cargo city car with ICE using hydrogen produced from methanol in a thermocatalytic converter



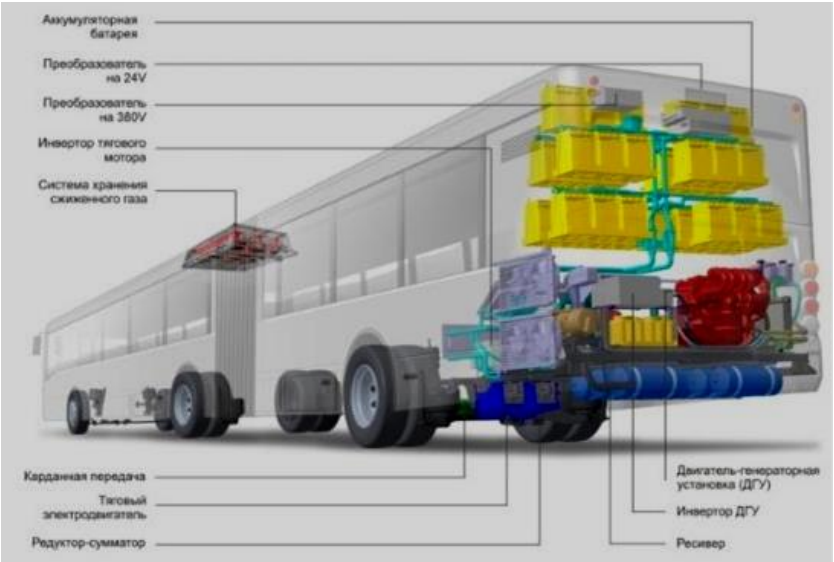
Development of a modular design of the series hybrid power unit for the autoplants LiAZ and PAZ



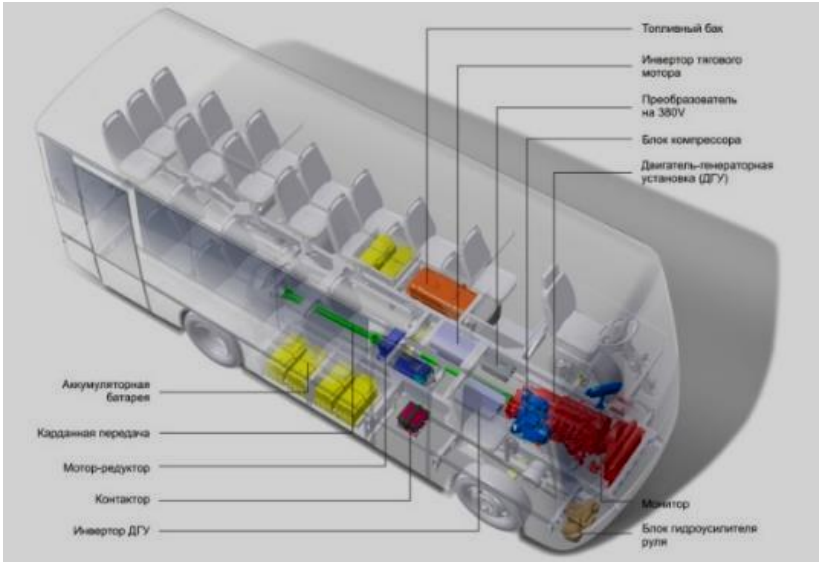
Commercial vehicle GAZ-3310 HN «Valday»



Bus LIAZ-5292 HN



Bus LIAZ-6213 HN

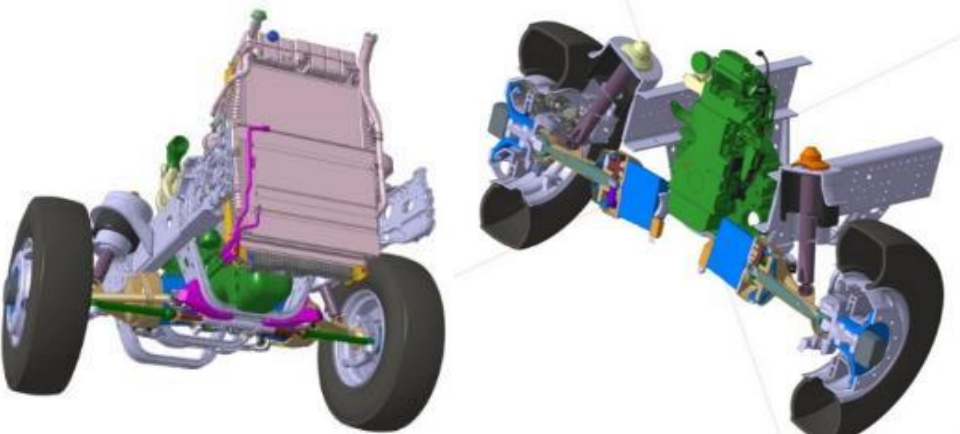
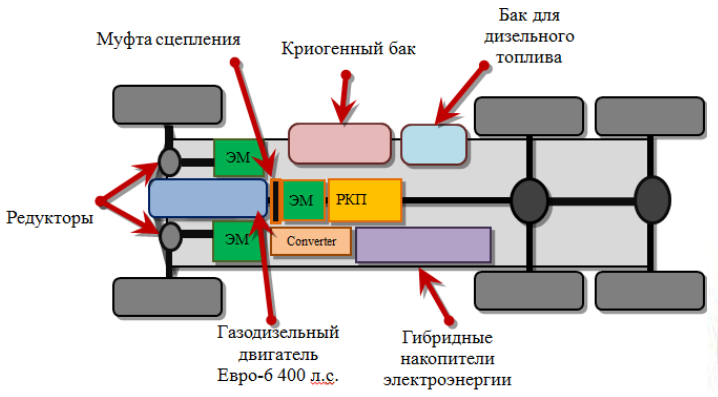


Bus PAZ-3204 HN



Development of all-wheel drive truck type 6x6 with a parallel hybrid power unit for KAMAZ

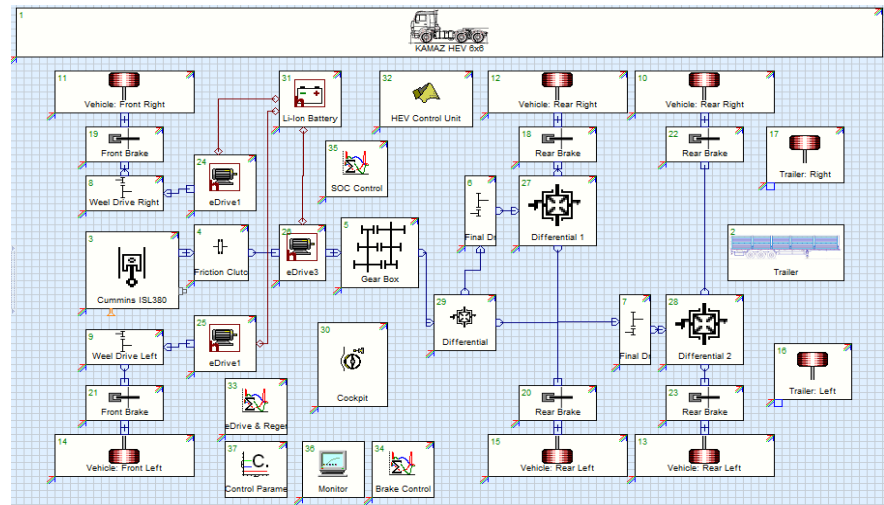
Layout schemes of the truck with individual electric drive of the front wheels



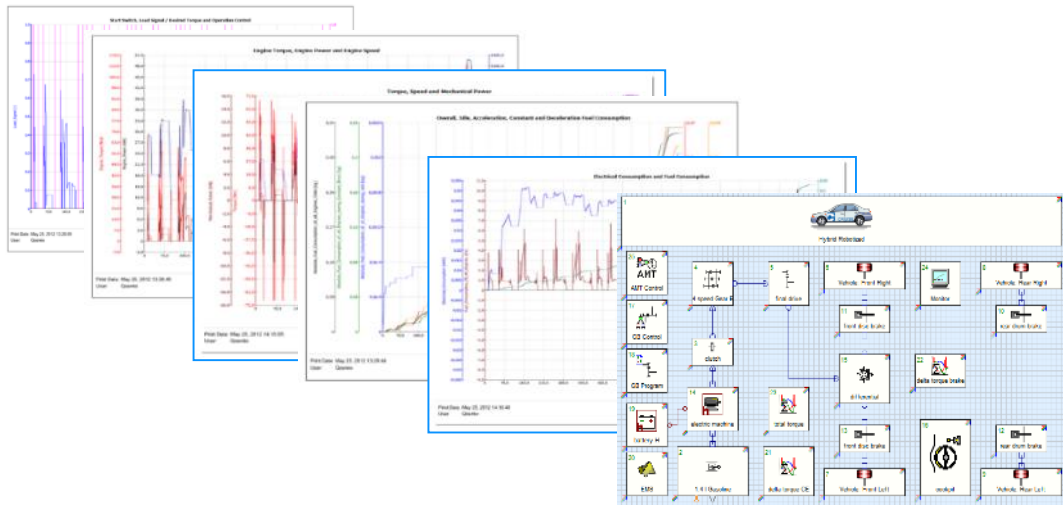
KAMAZ-65206 (6x6)



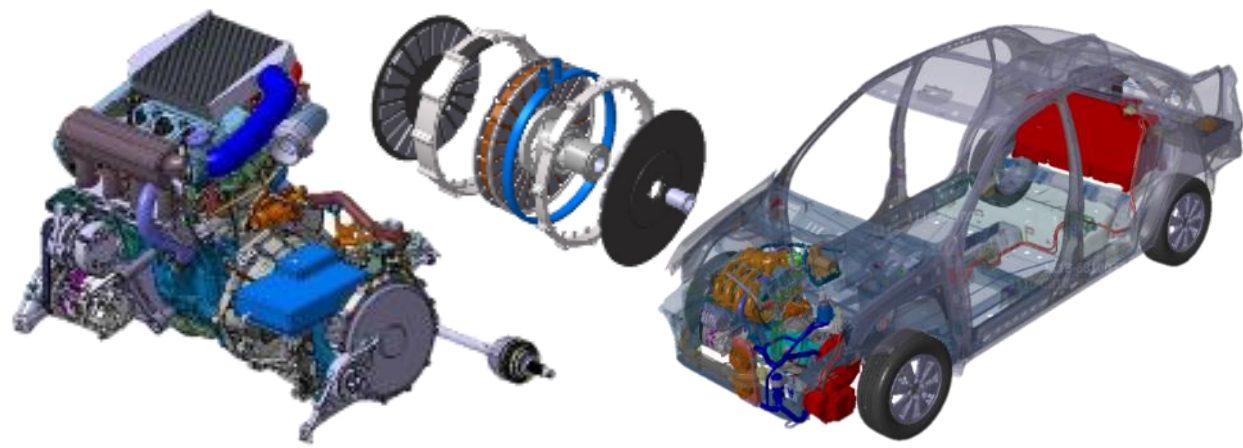
Simulation model



Simulation model

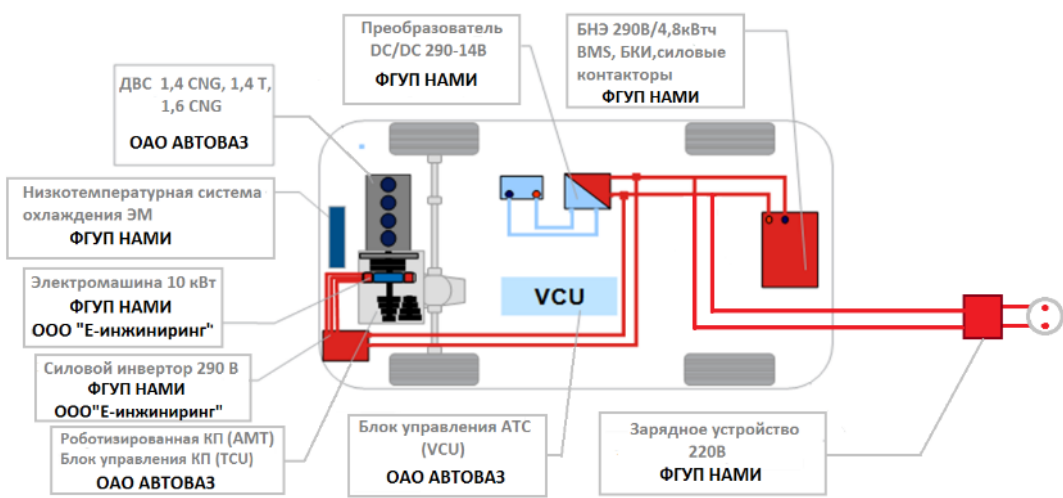


3D Design



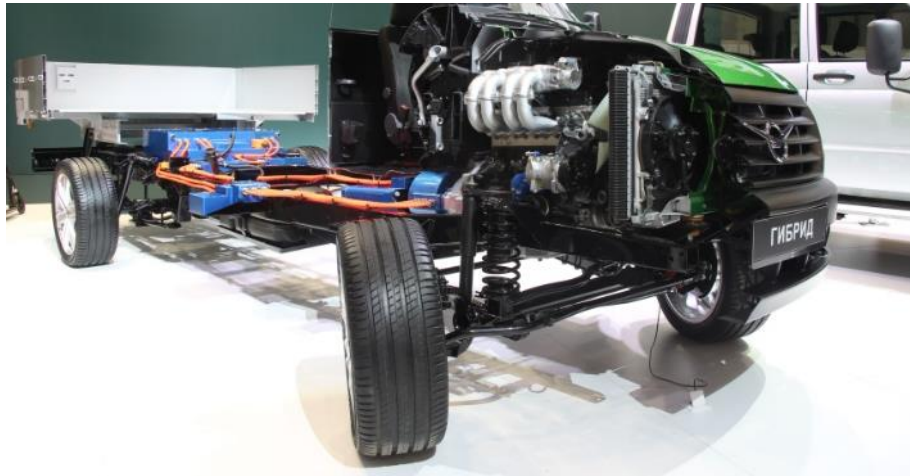
Manufacturing and conducting a complex of functional tests

Project cooperation



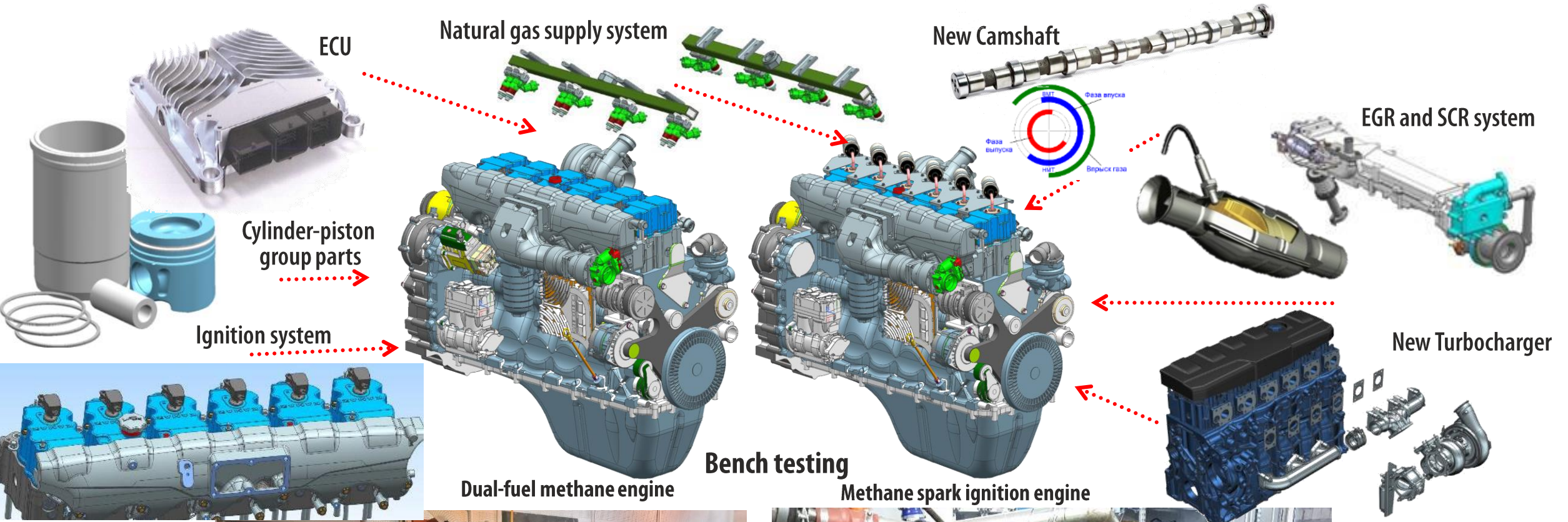
Development hybrid electric commercial vehicles for SOLLERS Group

Operation mode	ICE mode	E-mode	e-Boost mode
Description	Mode of movement from the ICE	Electric motor driving mode	Split hybrid mode
Engine		Capacity: 2.3l, gasoline Brake power: 131.6 hp Torque: 214 Nm	
Gearbox		Automatic 6-speed	
E-machine		Brake power: 126.44 hp Torque: 288 Nm	
Battery		Capacity: 14.5 kWh Rated voltage: 355V	
Environmental class		EURO 6	
Fuel consumption, l/100km	13.5	2.8	7.6
Range, km	777	more 76	more 850
Brake power, hp	131.6	126.4	258
Torque, Nm	214	288	500
Max vehicle speed, km/h	108	Up to 50	141
Acceleration time to 100 km/h, s	20	-	10.7



Dual-fuel methane engine KAMAZ family

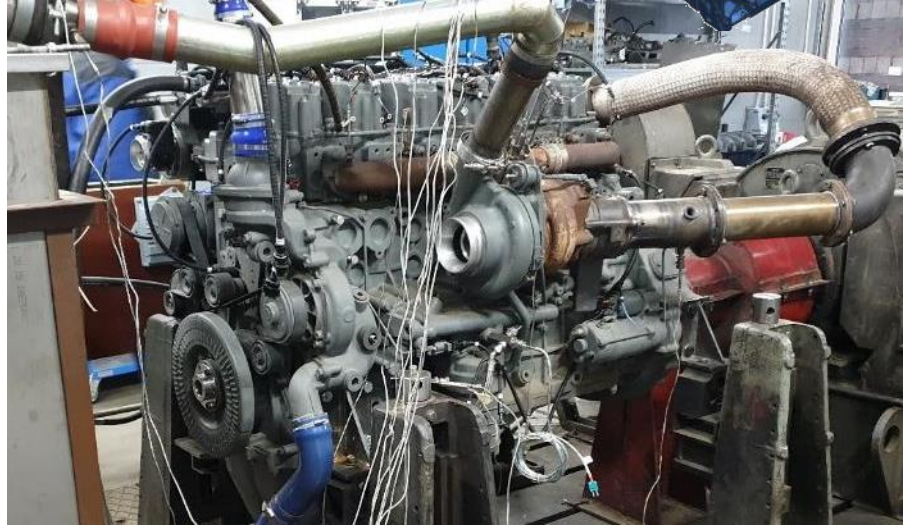
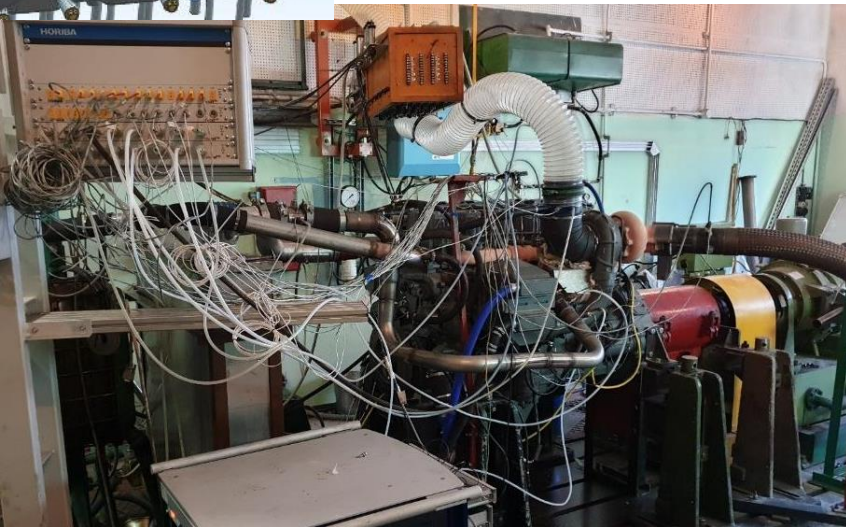
Methane spark ignition engine with Miller cycle KAMAZ family



Dual-fuel methane engine

Bench testing

Methane spark ignition engine





Researcher Links UK-Russia Workshop

Scientific and Technical Grounds of Future Low-Carbon Propulsion

19th - 22nd November 2018, Northumbria University at Newcastle, UK

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Thank you for your attention

