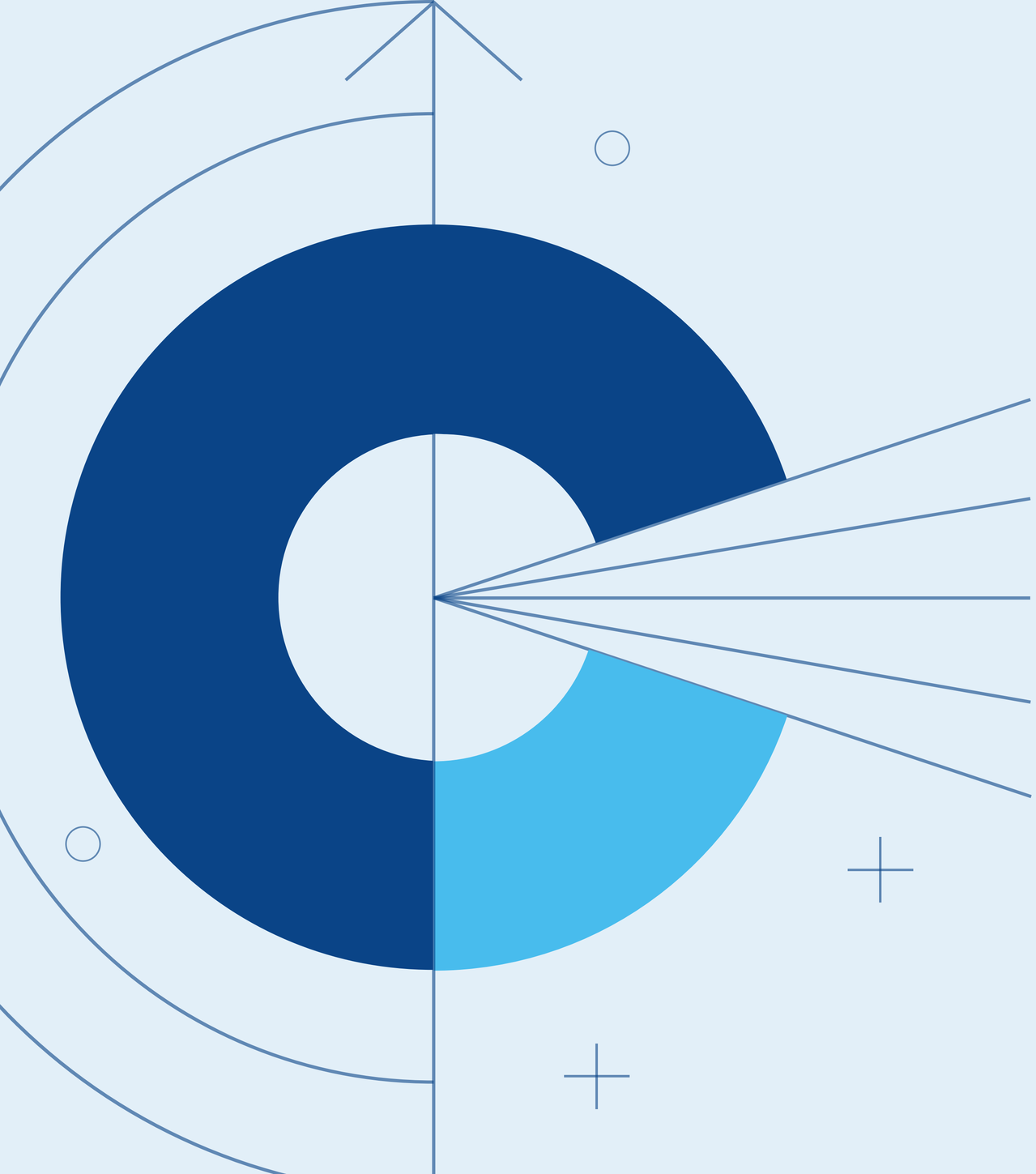


NAUKA

Advanced IT Solutions for Oil & Gas Downstream Operations

Science-Driven Digital Transformation

33
years in the Market

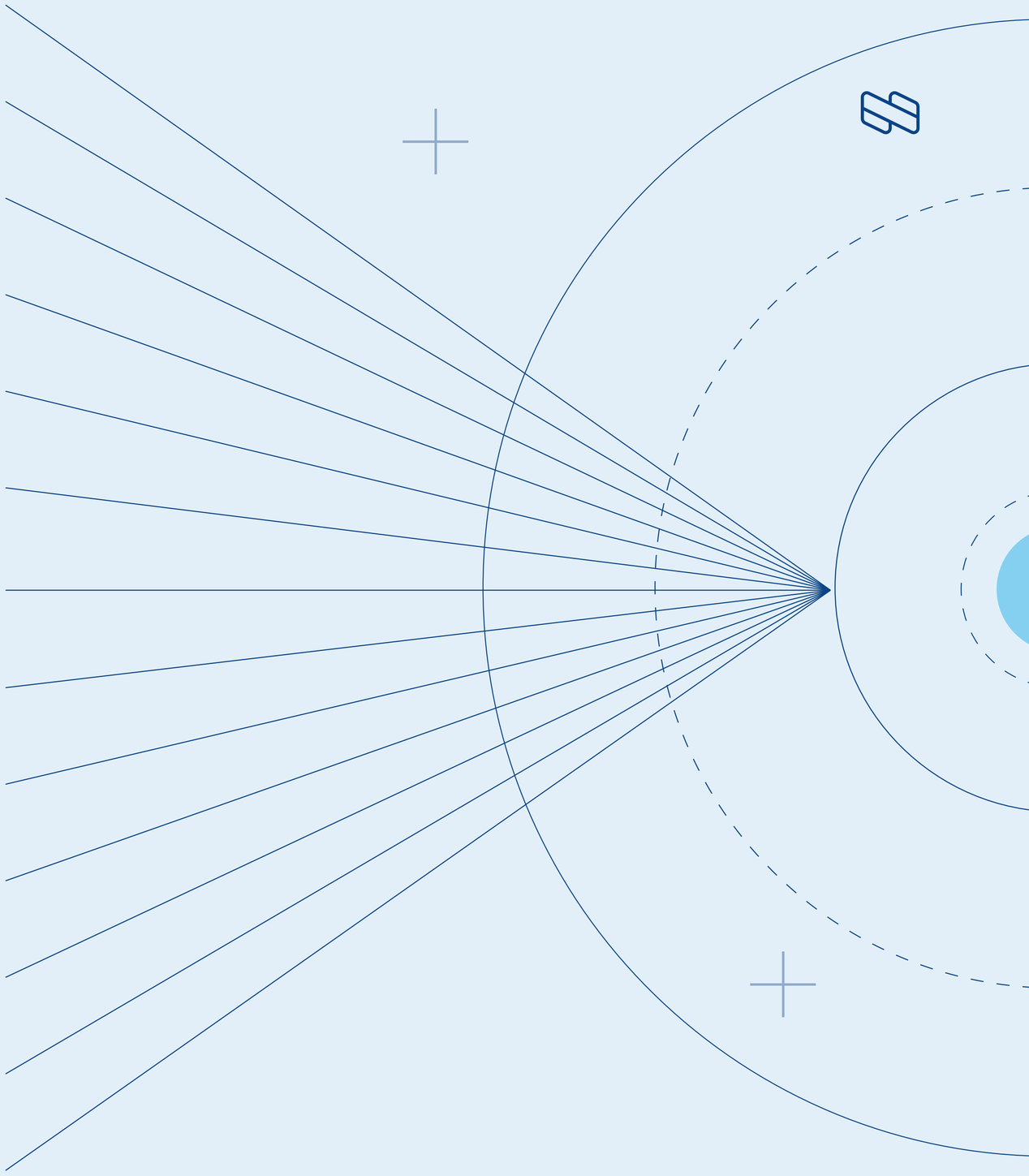
Russian Technology Leader

300 experts
process engineers mathematicians developers

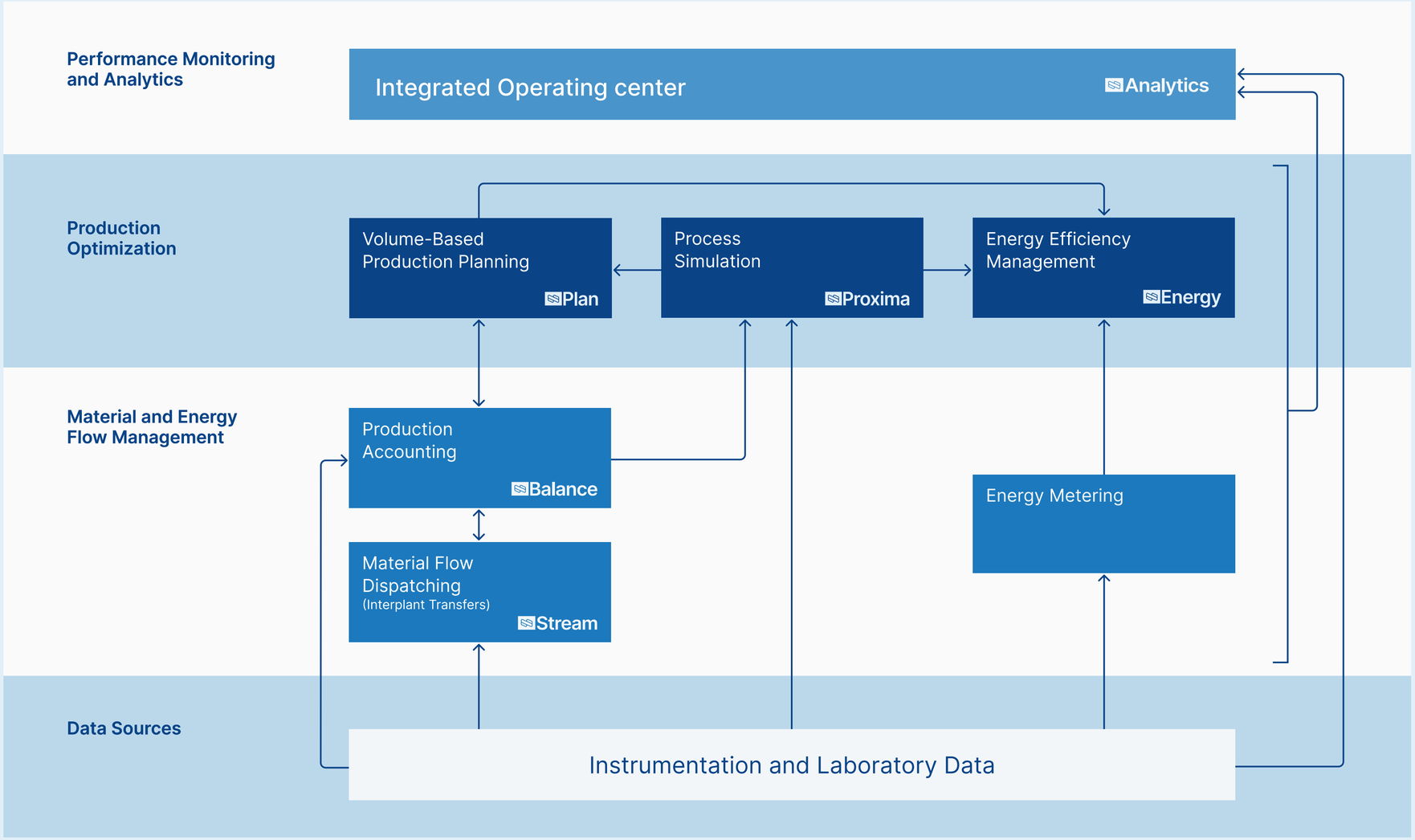
60 projects annually

Advanced IT Solutions for Oil & Gas Enterprises

2 500 active users per site



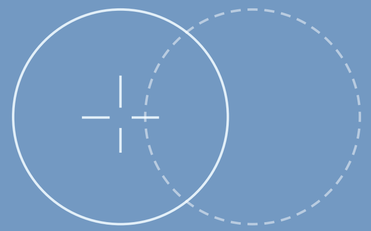
NAUKA
Digital Production Management Suite



Technology Stack

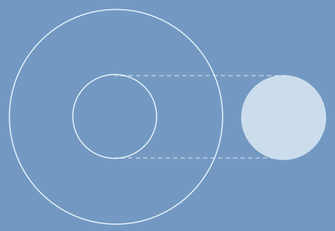
Open-source core

with API integration



Cloud/On-Premise

deployment



Cross-platform

compatibility

NAUKA

Core Modules

01 Production Accounting

02 Production Planning & Optimization

03 Process Simulation

04 Energy efficiency management

05 Material Flow Dispatching

06 Integrated Operating center

NAUKA

01

Production Accounting

business goal and use cases | description | components

02 Production Planning & Optimization

03 Process Simulation

04 Energy efficiency management

05 Material Flow Dispatching

06 Integrated Operating center

Business Goal

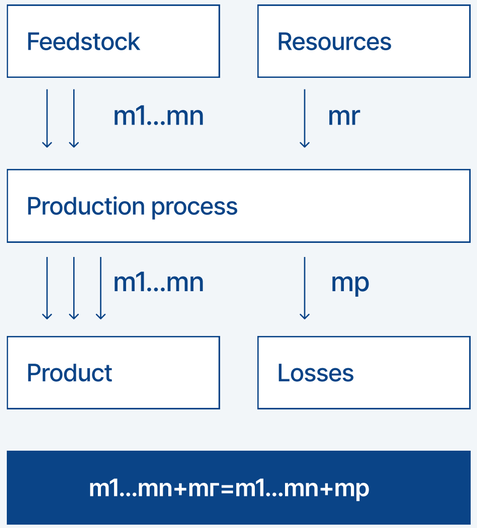
Production Accounting & Real-Time Plan Compliance

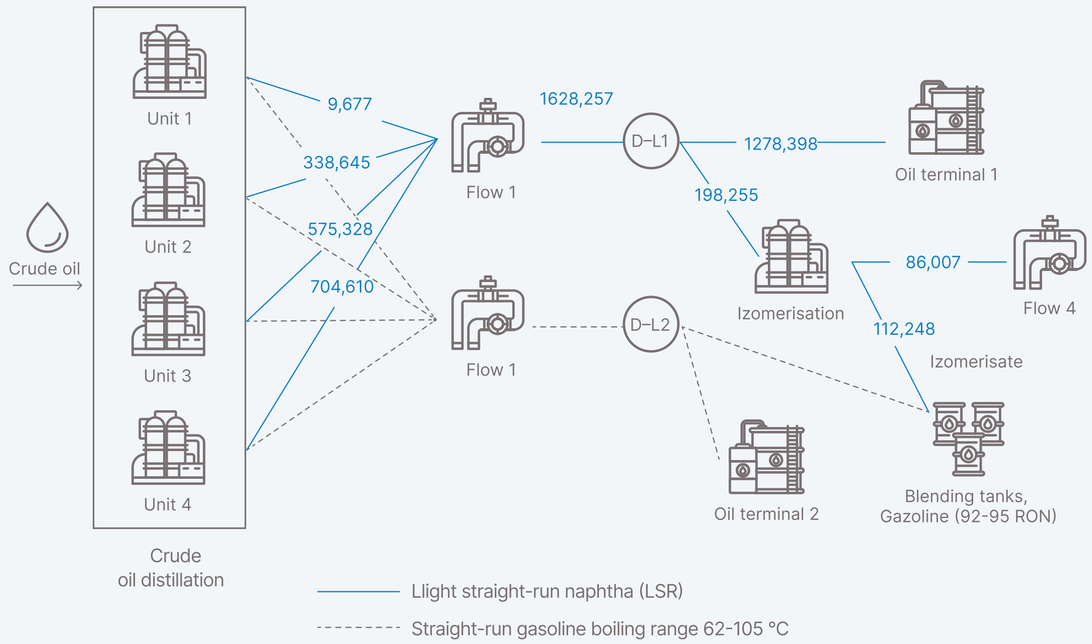
Client Use Cases:

- Material balance calculation
  Feedstock → Process → Product & Losses
- Data integration with planning systems
- Real-time plan adherence monitoring
- Operational deviation control
- Loss identification and root-cause analysis
- Incident investigation workflows

Description

Material Balance Model





Technical Note:

Supports reconciliation of 10,000+ instrument tags with <1 min latency (proven at 20M ton/year refineries).

System Components

Core Modules

Production Flow Modeling

Dynamic simulation of material and energy streams

Calculation Algorithm Editor

Customizable logic for balance and optimization tasks

NAUKA Optimizer

Proprietary solver for LP/MIP problems

Data Integrity Tools

Completeness & Validity Analyzer

Automated data quality checks

Daily Balance Reconciliation Engine

Closed-loop adjustment system

NAUKA

01 Production Accounting

02

Production Planning & Optimization

business goal and use cases | description | outcomes & benefits

03 Process Simulation

04 Energy efficiency management

05 Material Flow Dispatching

06 Integrated Operating center

Business Goal

Optimal production plan generation

Client Use Cases:

- Optimal production plan selection
- Feedstock and product optimization
- Blending optimization
- Investment project justification
- Data generation for scheduling and dispatching systems

Description

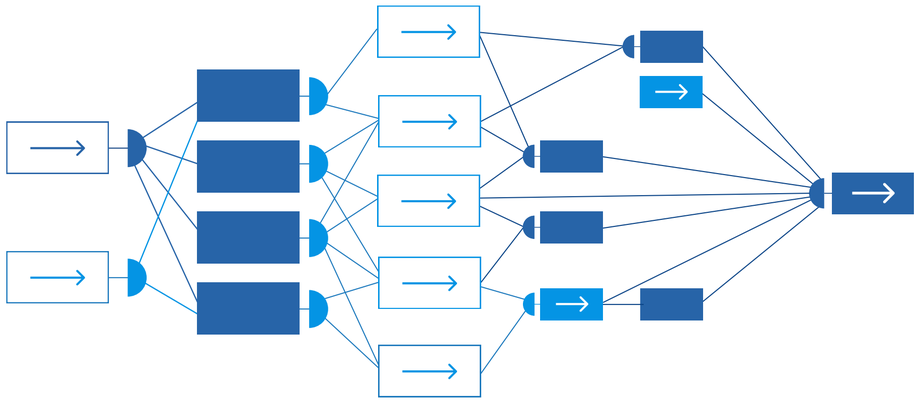
198,255 → HK-62 → Unit → Izomerisate → 195,307

Unit duty	
Min	**Max**
190	500

Energy resources			
Resource	**Number**	**UOM**	**Formula**
Electricity	0,002	MWh/ton	y=f(x)
Fuel	2	kg/ton	-

Total duty, tons per day	
Min	**Max**
150	500

Quality			
Feedstock	**Quality indicators**	**Value**	**Formula**
Llight straight-run naphtha (LSR)	RON	60	$y_1=f(x)$
	Density	500	$y_2=f'(x)$
	Aromatic hydrocarbon content	0	$y_3=f''(x)$



Objective function

$$F(x)=c_1x_1+c_2x_2+\ldots+c_nx_n$$

Restrictions

$$a_{11}x_1+a_{12}x_2+\ldots+a_{1n}x_n \{\leq = \geq\} b_1,$$
$$a_{21}x_1+a_{22}x_2+\ldots+a_{2n}x_n \{\leq = \geq\} b_2,$$
$$\ldots$$
$$a_{m1}x_1+a_{m2}x_2+\ldots+a_{mn}x_n \{\leq = \geq\} b_m,$$

where: a_{ii}, b_i, c_i - are given constants

Outcomes and benefits

Outcomes

- Multi-period planning
- Constraint management (process, energy, economic)
- Crude oil assay utilization
- Optimal blending
- NAUKA-developed solvers

Benefits

- Savings up to 2M RUB (25K USD)/day on energy resources at 18M ton/year feedstock capacity
- Minimized fuel additive usage
- Increased margin
- Reduced planning time

NAUKA

01 Production Accounting

02 Production Planning & Optimization

03

Process Simulation

business goal and use cases | functionality | user interface | capabilities

04 Energy efficiency management

05 Material Flow Dispatching

06 Integrated Operating center

Business Goal

Process Digital Twin — Advanced tool for decision making

Client Use Cases:

- Process optimization assessment
- Bottleneck identification
- Improved planning accuracy
- "What-if" scenario simulation
- Efficient process management

Functionality

Component Database

- 1,800 individual components
- Binary compositions of components
- Multiple component lists per scheme

Property Packages

- Physicochemical dependencies for thermodynamic parameter calculations

Solvers

- Mathematical calculation engine

Models

- Library of typical unit operations (pumps, heat exchangers, etc.)
- Kinetic models for catalytic reactor blocks

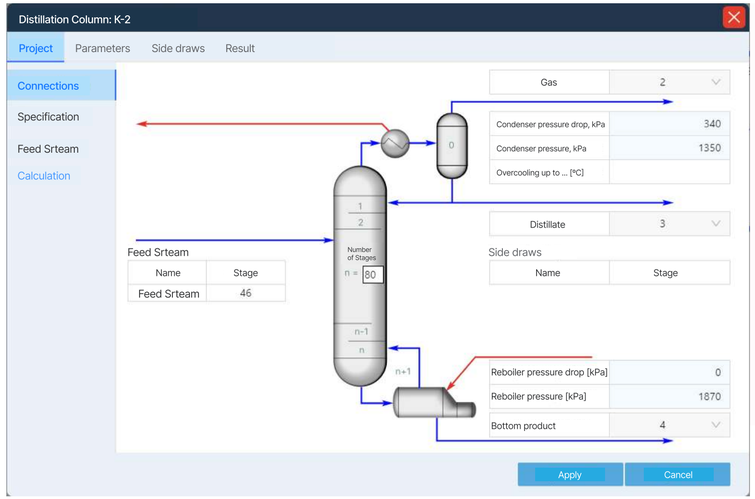
Utilities

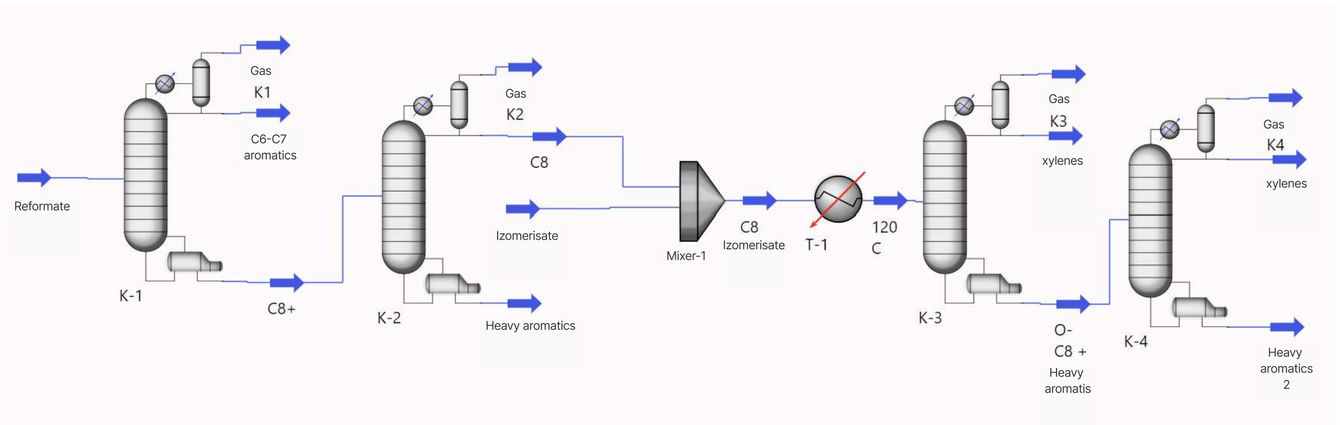
- Logical operators for scheme calculations (recycle, balance, optimizer)
- Calculation services (spreadsheet)
- Analytical services (case studies)

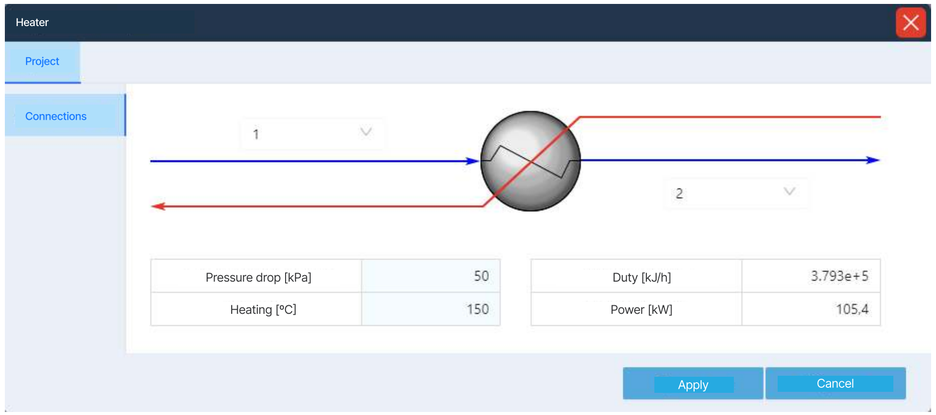
Fluid Manager

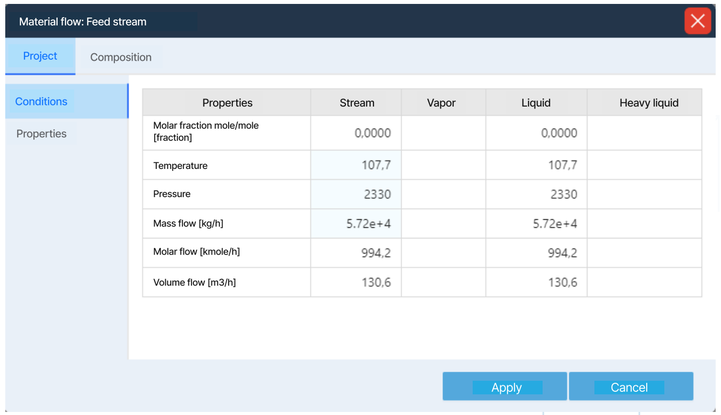
- Molecular characterization
- Fraction yield potential calculation
- Hypothetical components and properties

User interface









Capabilities

1. Optimization of individual processes
2. Production chain optimization
3. Real-time database integration
4. LP vector generation for planning systems
5. GAIN matrix generation for online process optimization
6. CAPE-OPEN, SDK support for embedding third-party models
7. Vendor file format support (HYSYS, Petro-SIM) for model reuse/integration
8. On-premise / cloud software deployment

NAUKA

01 Production Accounting

02 Production Planning & Optimization

03 Process Simulation

04 **Energy efficiency management**

business goal and use cases | platform architecture | capabilities

05 Material Flow Dispatching

06 Integrated Operating center

Business goal

Operational monitoring of fuel and energy resource consumption at industrial facilities

Client Use Cases:

- Energy resource consumption tracking and monitoring
- Loss control and root cause analysis of deviations from norms
- Fuel and energy resource consumption benchmarking

Platform Architecture

Energy Accounting Process

- Formation of consolidated energy consumption reports
- Algorithm development for real-time monitoring calculations
- Energy distribution scheme design and calculation methodology

Energy Efficiency Process

- Enterprise-grade expert reporting systems
- Analytics and indicators for energy-efficient resource consumption
- Energy distribution scheme optimization methodologies

Energy Management Process

- Expert monitoring of process energy efficiency
- Energy efficiency improvement proposal generation and ROI evaluation
- Key Performance Indicator (KPI) tracking from enterprise to unit level

Capabilities

1. Monitoring and analysis of fuel/energy resource consumption
(electricity, liquid/gaseous fuels, steam, cooling water, etc.)
2. Timely deviation detection in energy consumption volumes
3. Rapid response to energy consumption fluctuations
4. Optimal fuel/energy consumption norm establishment
5. Technological compliance monitoring against regulatory standards
6. Equipment performance analysis (e.g., furnace efficiency monitoring)

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01 Production Accounting

02 Production Planning & Optimization

03 Process Simulation

04 Energy efficiency management

05 Material Flow Dispatching

business goal and use cases | user interface | benefits

06 Integrated Operating center

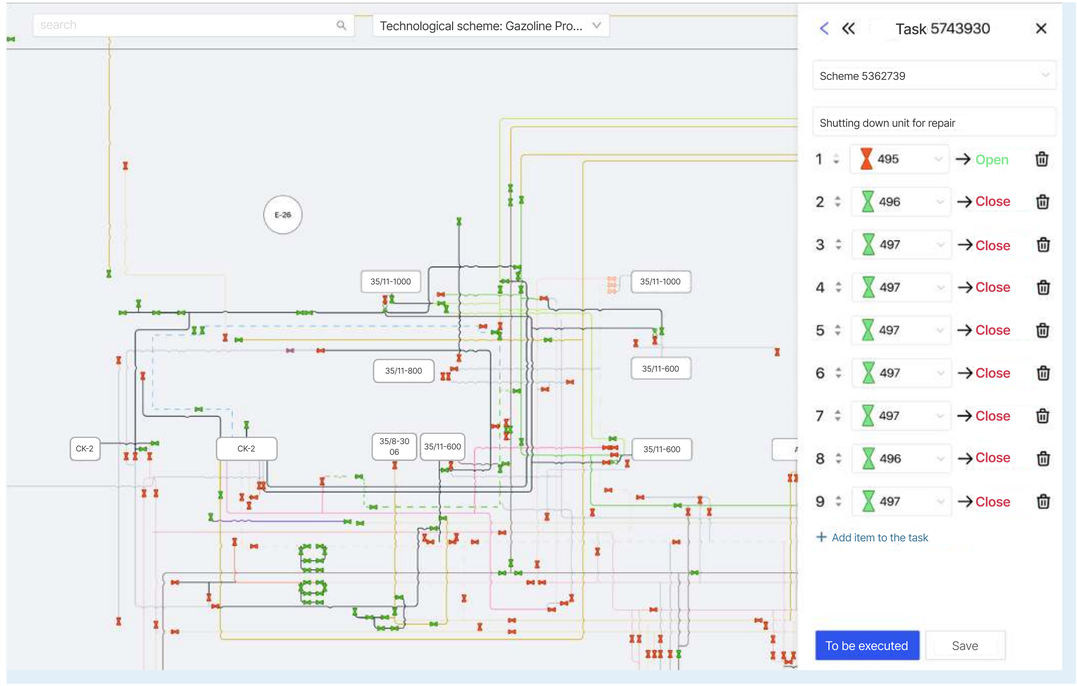
Business goal

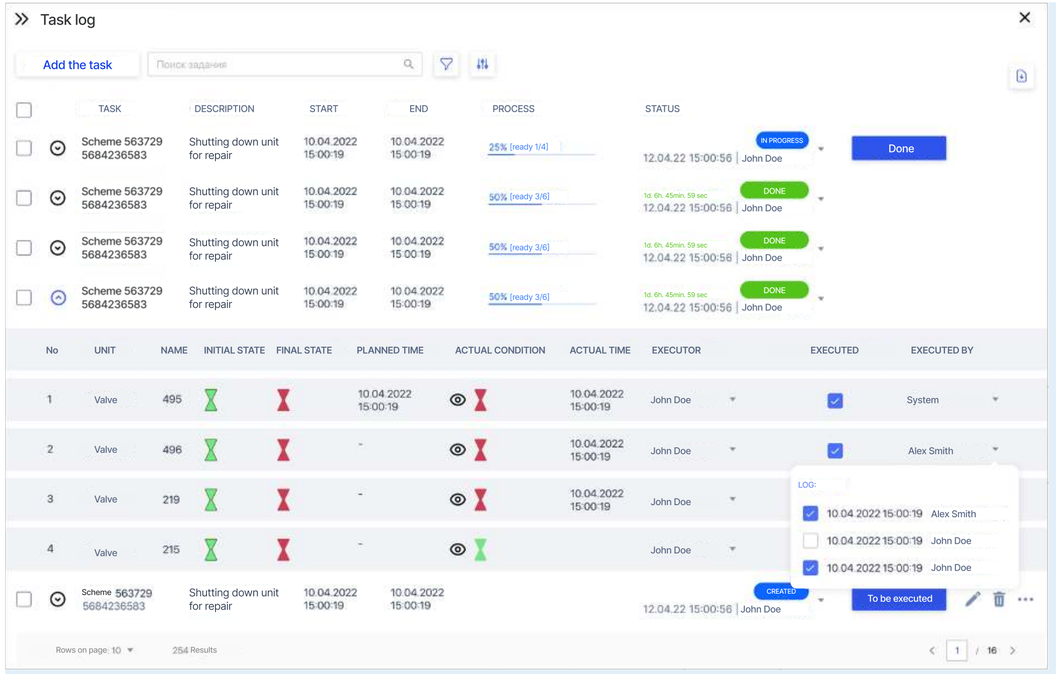
Enhancing dispatch operation effectiveness in industrial facilities

Client Use Cases:

- Supervision of transitional process protocols (startup/shutdown/mode switching)
- Abnormal situation root cause analysis
- Improved plant-wide material balance accuracy
- Material flow discrepancy identification
- Personnel training and competency development

User interface





Operational Benefits

- Reduced dispatching labor effort
- Enhanced production monitoring effectiveness
- Personnel upskilling
- Compliance control for transitional processes
- Improved abnormal situation analysis
- Higher accuracy in plant material balance calculations
- Faster material flow data reconciliation

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01 Production Accounting

02 Production Planning & Optimization

03 Process Simulation

04 Energy efficiency management

05 Material Flow Dispatching

06

Integrated Operating center

business goal and use cases | advantages | user interface | benefits

Business goal

Decision Support System for Enterprise Management

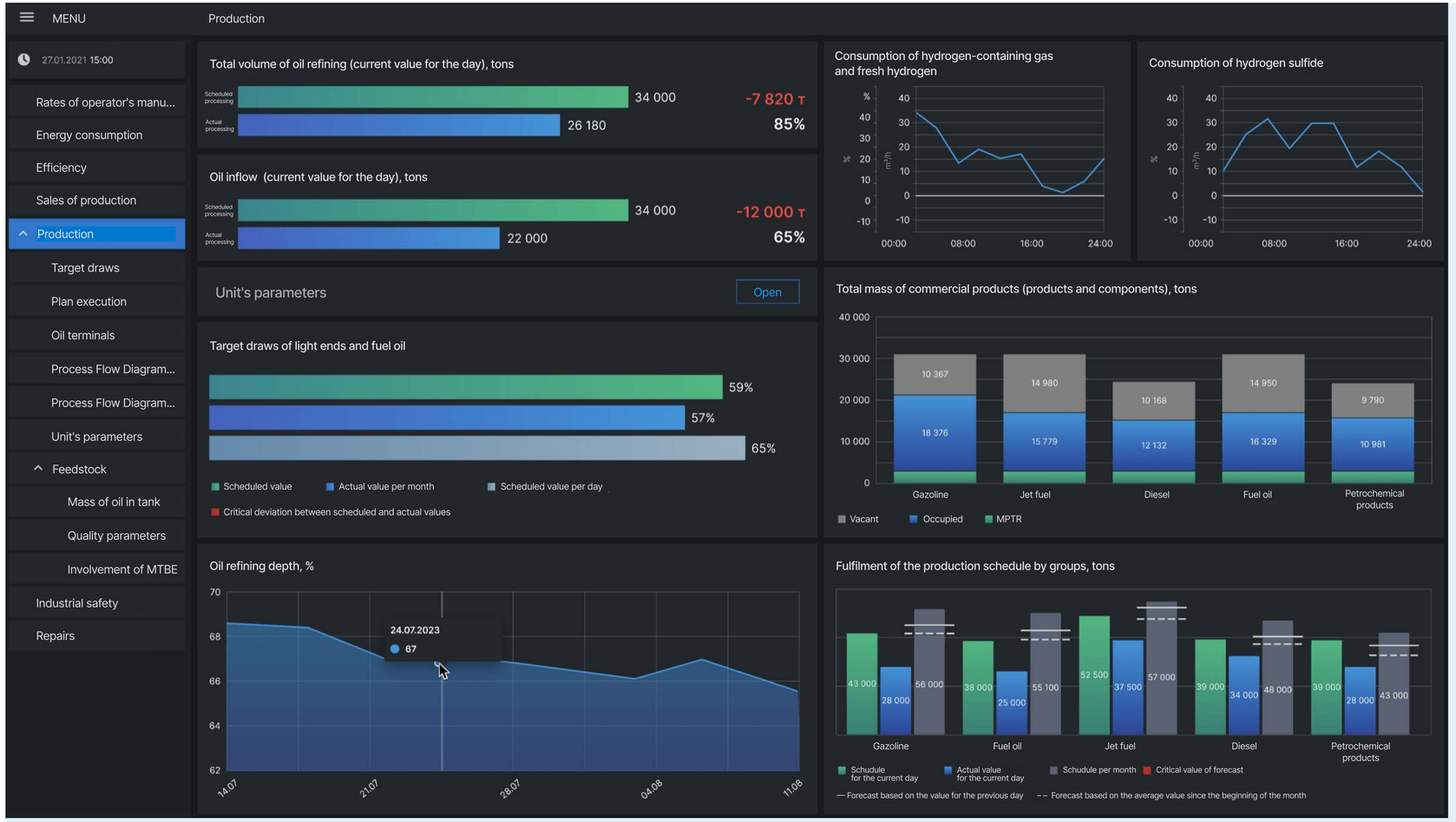
Client Use Cases:

- Real-time data integration from DCS/SCADA and MES systems
- Visualization and KPI tracking for operational excellence
- Production activity and product shipment monitoring
- Decision-making support for normal/abnormal situations
- Mitigation of technology risks impacting financial performance
- Optimization of planned task execution
- Energy resource consumption analysis and optimization
- Maintenance planning (PPM/PdM) optimization

Solution Advantages

1. Extensible visualization component library
2. Seamless integration with DCS/MES data sources
3. Knowledge base development tools
4. Customizable production performance metrics
5. Configurable information dashboards
6. Role-based data presentation for decision-makers

User interface



User interface

Operational Benefits

- Faster incident detection and response (MTTR reduction)
- Root cause analysis acceleration
- Enhanced cross-functional team collaboration
- Improved operational decision velocity
- Resource consumption optimization (energy/raw materials)
- Equipment maintenance cost reduction

NAUKA

Workforce Development

Solution: Academic licenses
for NAUKA.Proxima & NAUKA.Plan

- Cloud access
- Role-based access control
- Load testing for core stability
- Real-production training datasets

Future Roadmap:

- New mathematical model deployment
- LP-vector generation
from NAUKA.Proxima to NAUKA.Plan

Current Status:

- 2 university partners
- Multiple organizations in pilot phase

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nauka.com

Digital Transformation for Process Industries