

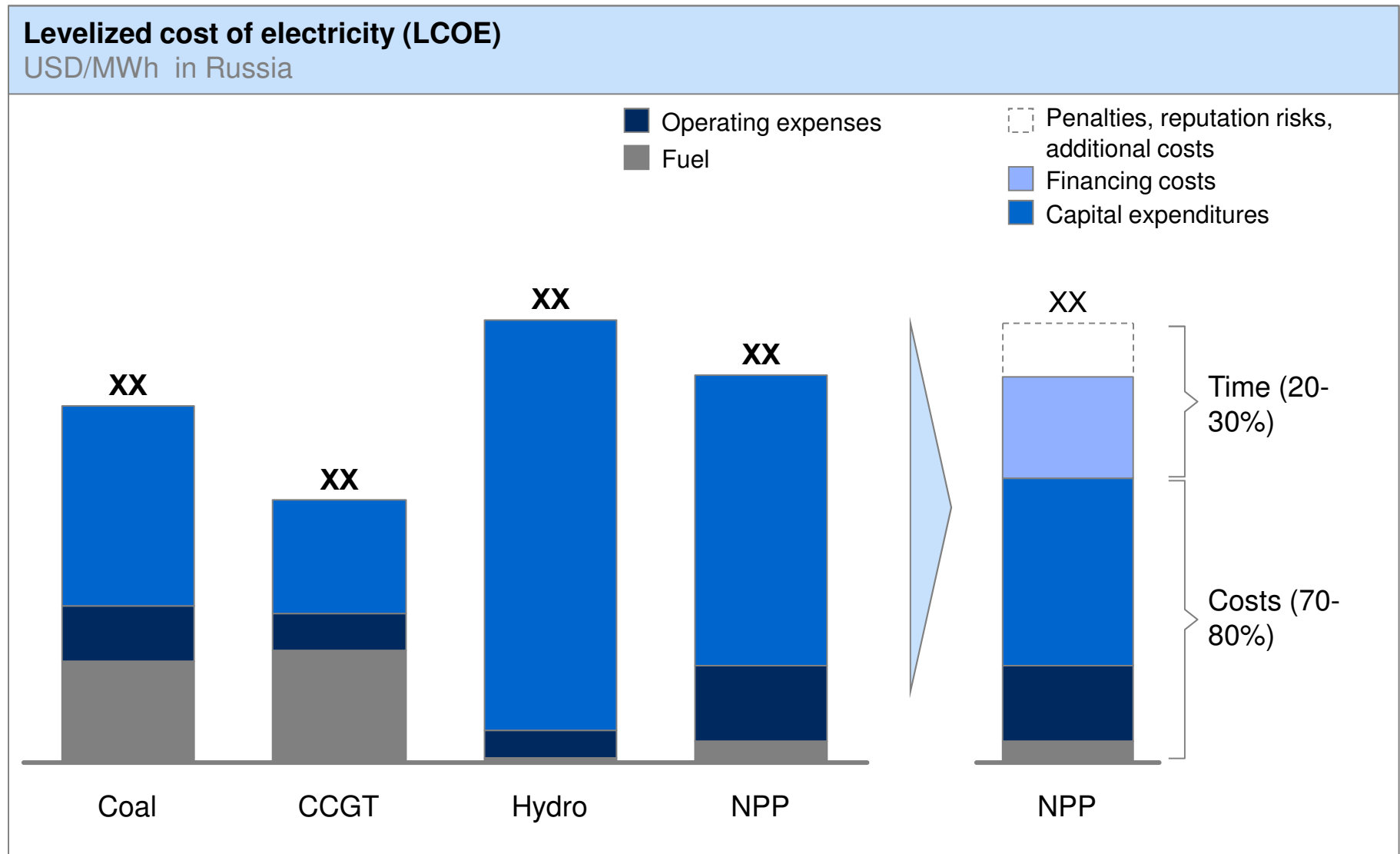
# Role of the owner-operator in optimizing the cost of electricity generated by a nuclear power plant. Based on the experience of Rosenergoatom



Report at Atopmexpo 2014 International Forum  
June 10, 2014

CONFIDENTIAL AND PROPRIETARY  
Any use of this material without specific permission of McKinsey & Company is strictly prohibited

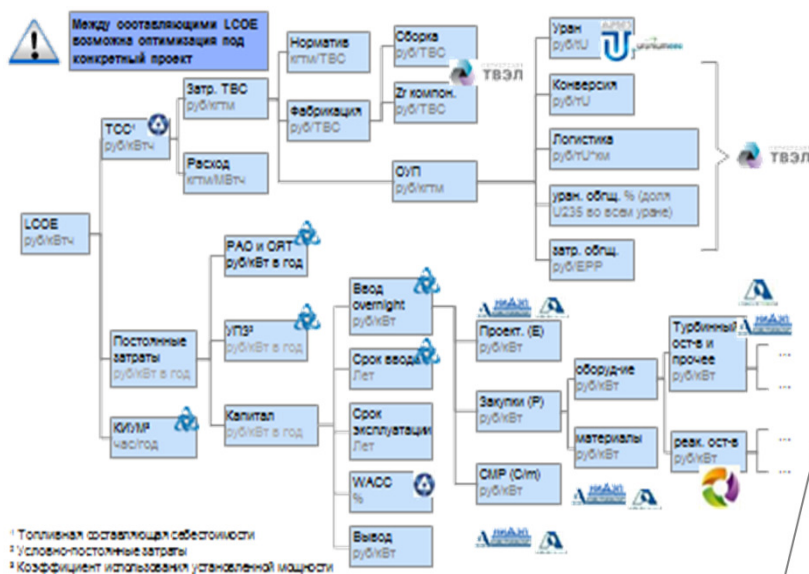
## Project's financial indicators (LCOE) are achievable through project time and cost management



# Management of project schedule and costs is the role of the owner, performed by the Rosenergoatom (REA) Concern

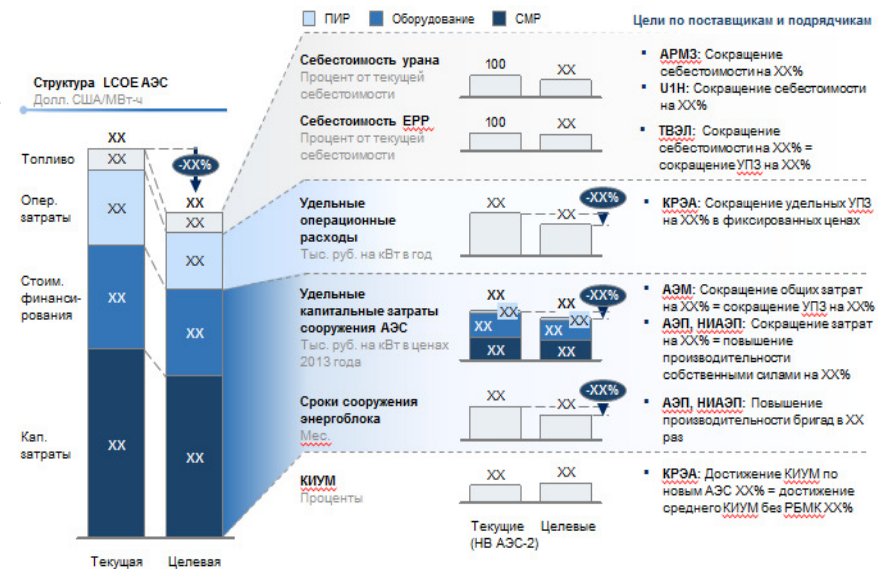
## Status quo

The overall performance of a new NPP project depends on individual performance of each of Rosatom's divisions in reducing their share of LCOE





## Target

The owner is the key element in an NPP project – managing project costs and schedule, the owner ensures economic viability of the project



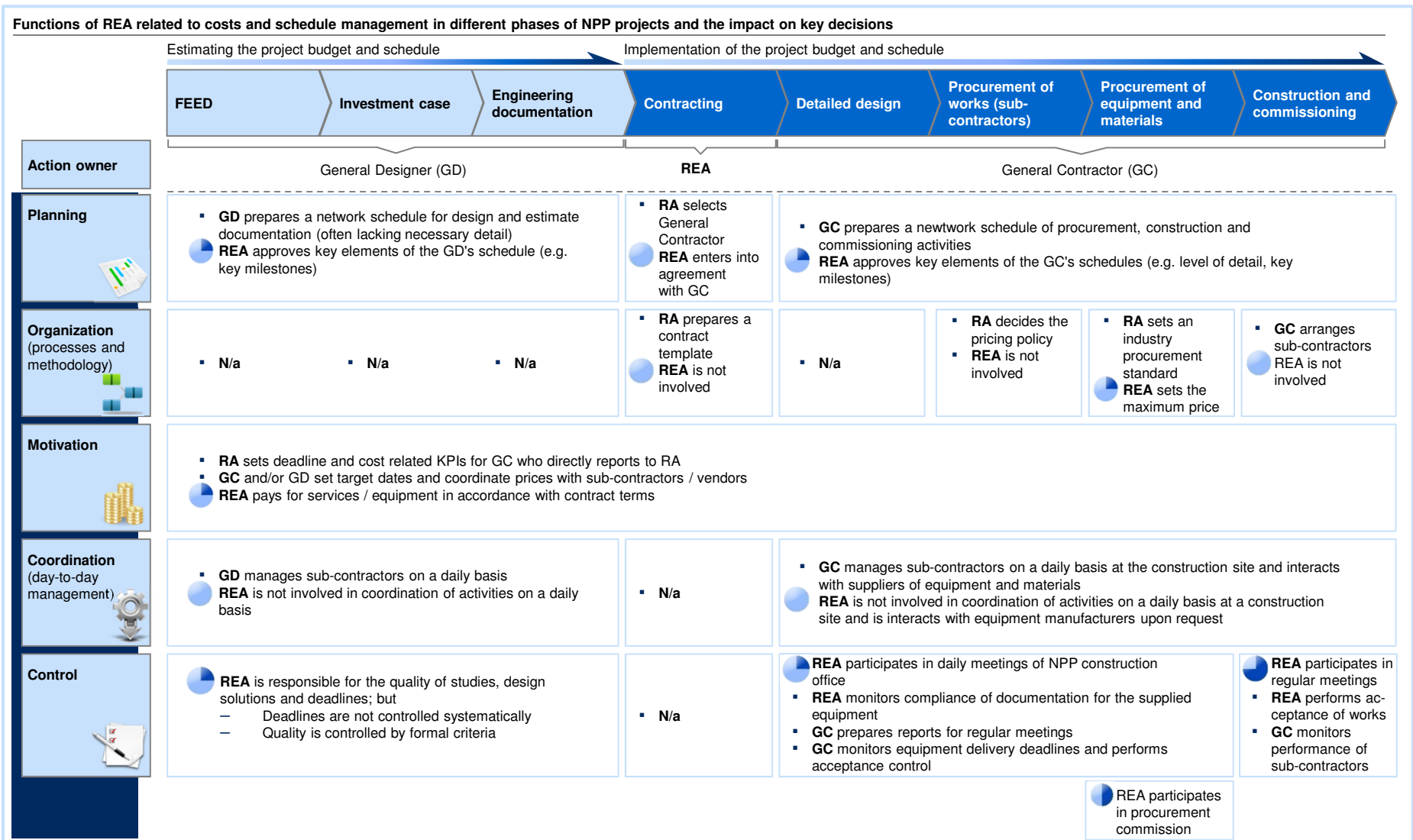
# Decisions affecting the cost and schedule of NPP construction are taken throughout the project life cycle

Decisions affecting the cost and schedule of NPP construction								
Estimating the project budget and schedule			Adoption of the project budget and schedule					
			Implementation of the project budget and schedule					
	FEED	Investment case	Engineering documentation	Contracting	Detailed design	Procurement of works	Procurement of equipment and materials	Construction and commissioning
<b>Documents affecting time and costs</b>	<ul style="list-style-type: none"> <li>Cost estimation</li> <li>Baseline construction schedule</li> </ul>	<ul style="list-style-type: none"> <li>Feasibility study</li> <li>Project master plan</li> </ul>	<ul style="list-style-type: none"> <li>Cost estimation</li> <li>Baseline construction schedule level 3</li> </ul>		<ul style="list-style-type: none"> <li>Total estimation</li> <li>Revised construction schedule, level 3</li> </ul>		<ul style="list-style-type: none"> <li>Actual schedule and costs</li> </ul>	
<b>Action owners</b>	<ul style="list-style-type: none"> <li>Engineering company</li> </ul>	<ul style="list-style-type: none"> <li>Engineering company</li> </ul>	<ul style="list-style-type: none"> <li>Engineering company</li> </ul>		<ul style="list-style-type: none"> <li>General Contractor</li> </ul>		<ul style="list-style-type: none"> <li>General Contractor</li> </ul>	
<b>Decisions affecting the costs</b>	<ul style="list-style-type: none"> <li>Engineering decisions at the FEED phase: power generation technology, safety, construction technology, operation</li> </ul> 	<ul style="list-style-type: none"> <li>Site decision</li> </ul>	<ul style="list-style-type: none"> <li>Engineering decisions outside the FEED phase: auxiliary buildings and infrastructure, construction technology</li> <li>Assumptions about baseline prices and indices</li> </ul>	<ul style="list-style-type: none"> <li>Selecting the type of contractor contract</li> <li>Selecting general contractor</li> <li>Defining the scope and price of contract</li> </ul>	<ul style="list-style-type: none"> <li>Engineering decisions at the implementation phase</li> <li>Changes in construction documentation</li> <li>Review of baseline prices and indices</li> </ul>	<ul style="list-style-type: none"> <li>Selection of contractors</li> <li>Calculation of work cost conversion factors</li> </ul>	<ul style="list-style-type: none"> <li>Selecting equipment modifications</li> <li>Selecting equipment vendors</li> <li>Using optimization levers</li> </ul>	<ul style="list-style-type: none"> <li>Estimating the actual scope of performed work</li> <li>Monitoring productive time and productivity of workforce and machines</li> </ul>
<b>Decisions affecting the schedule</b>	<ul style="list-style-type: none"> <li>Engineering decisions at the FEED phase: power generation technology, construction technology</li> </ul> 	<ul style="list-style-type: none"> <li>-</li> </ul>	<ul style="list-style-type: none"> <li>Engineering decisions outside the FEED phase: construction technology</li> </ul>	<ul style="list-style-type: none"> <li>Selecting general contractor</li> <li>Defining contract terms</li> <li>Planning the schedule</li> </ul>	<ul style="list-style-type: none"> <li>Managing the deadlines of detailed design documentation</li> </ul>	<ul style="list-style-type: none"> <li>Managing the deadlines of work procurement</li> <li>Selecting the approach to work sourcing</li> </ul>	<ul style="list-style-type: none"> <li>Managing procurement deadlines</li> <li>Supplier due diligence</li> <li>Monitoring production schedule</li> <li>Initiation of supplies</li> <li>Manufacturing quality management</li> </ul>	<ul style="list-style-type: none"> <li>Network schedule management</li> <li>Estimating the actual scope of performed work</li> <li>Monitoring productive time and productivity of workforce and machines</li> </ul>

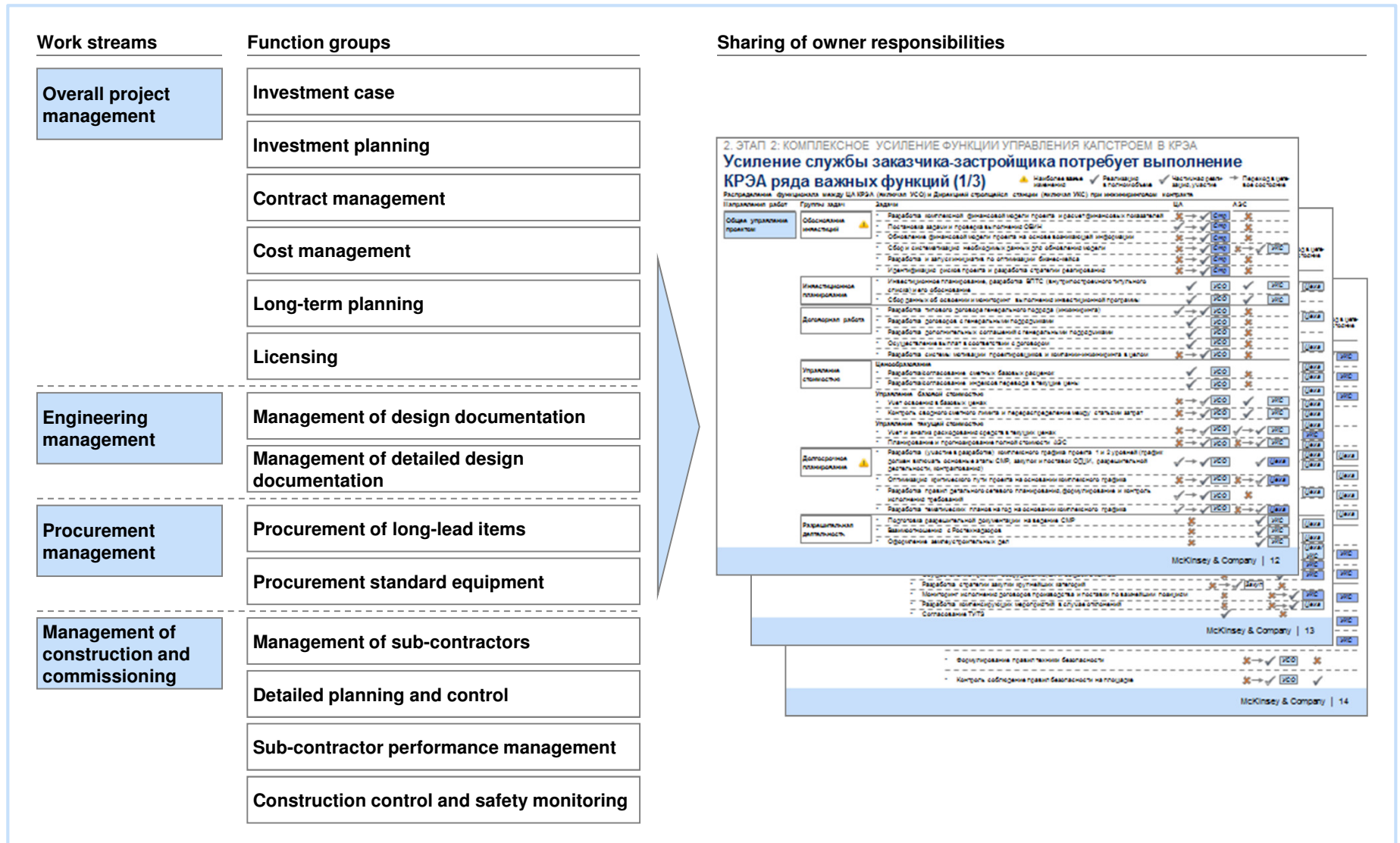
# REA has had a limited impact on costs and schedules of NPP projects in recent years

REA decides

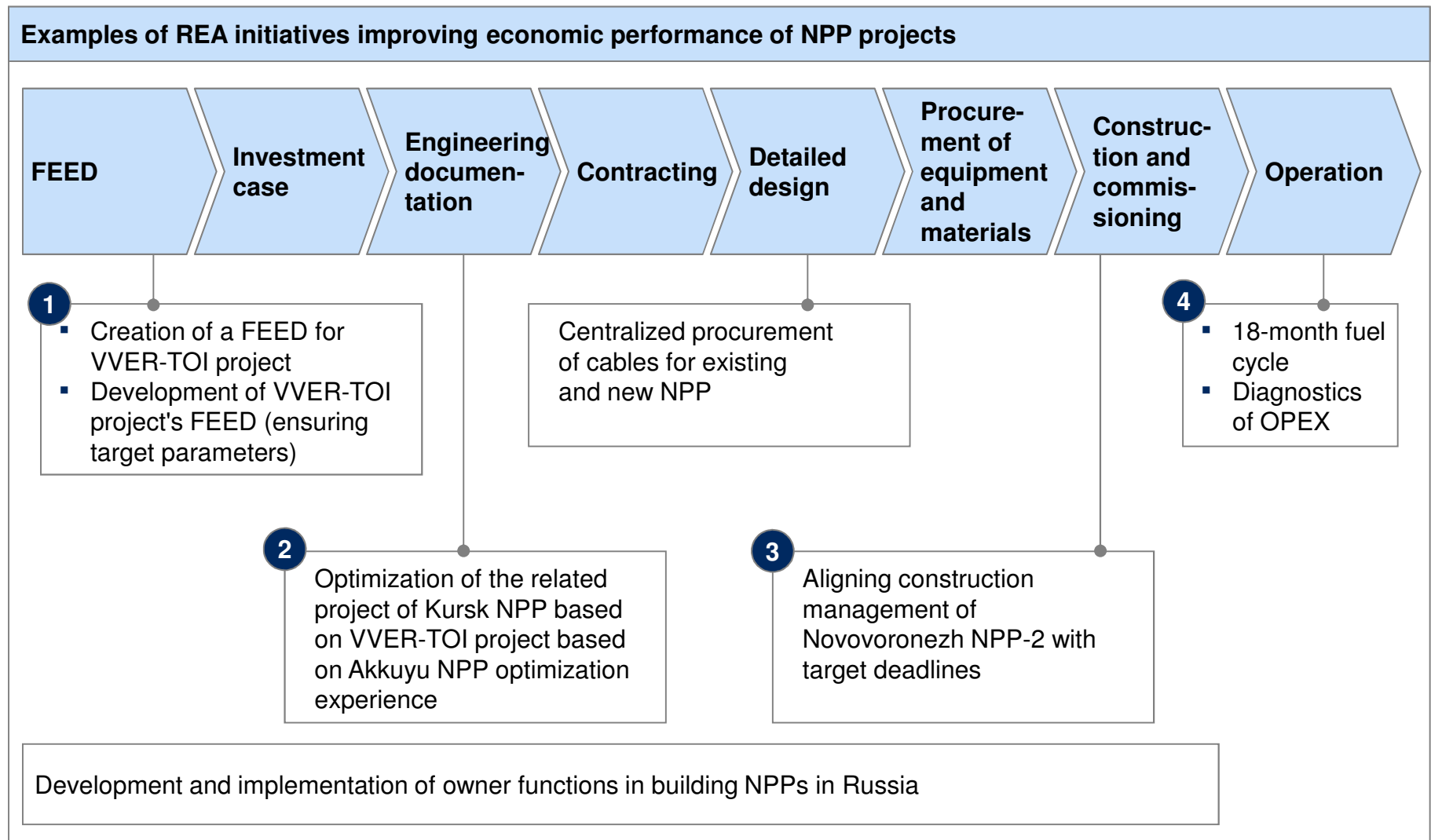
REA has no effect









# A strong Owner organization builds up key functions, 73 of them according to one analysis



# REA implements improvement initiatives which focus on economic performance of NPP projects



# 1. The main goal of the VVER-TOI project's FEED is to ensure the project's excellence in key technical and economic indicators

Parameters	 HITACHI		 KHN	 HITACHI	 AREVA	 ATOMENERGOPROEKT	Advanced technology
	ABWR 1350 MW	AP-1000 1170 MW	APR-1400 1400 MW	ESBWR 1550 MW	EPR 1600 MW	VVER-TOI 1255 MW	
Efficiency, gross percent	35.5-37.2	32.9-35.3	35.0-36.5	33.0-35.6	35.0-37.0	3X.X	>35
Availability, percent	>87	>90	90	>87	>90	XX	>85
Construction of the first power unit from first concrete to start-up, months	43	36	48	35	54	X0	<40
Probability of reactor core melting	$1.6 \cdot (10)^{-7}$	$5 \cdot (10)^{-7}$	$2.3 \cdot (10)^{-6}$	$3.2 \cdot (10)^{-8}$	$6.1 \cdot (10)^{-7}$	$X.9 \cdot (10)^{-7}$	$<X.X \cdot (10)^{-7}$
Specific area of unalterable part, m <sup>2</sup> /MW	47.4	49.8	57.9	46.5	57.4	4X.8	—
Specific CAPEX in USA (NC) (estimated by B&R including contingencies), USD/kWh, net	4484	4121	4590	<b>3244</b>	4244	<b>3XXX</b>	<3000
Cost of electricity, USD/kWh	0.0240	0.0230	0.0259	0.0211	0.0253	0.0XX	<0.0200

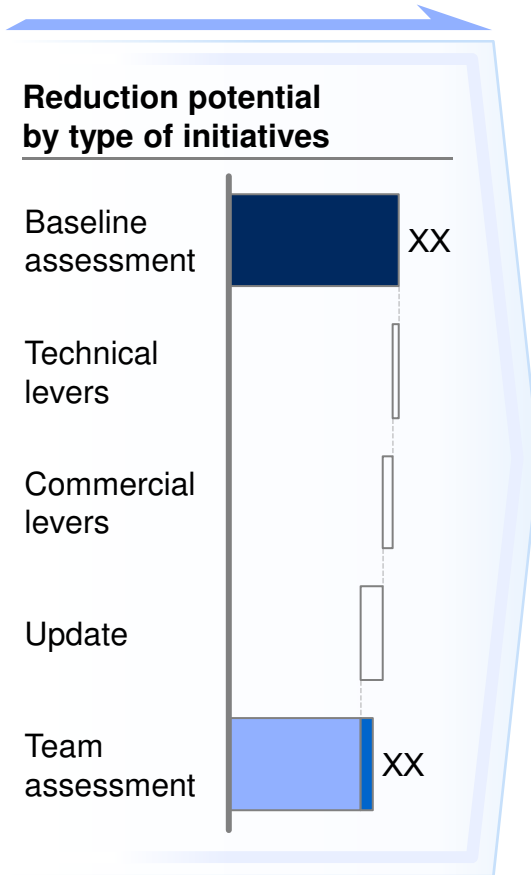


## 2. After revision of the project, optimization potential was identified along three initiatives

EXAMPLE: AKKUYU PROJECT

Rubles, sanitized

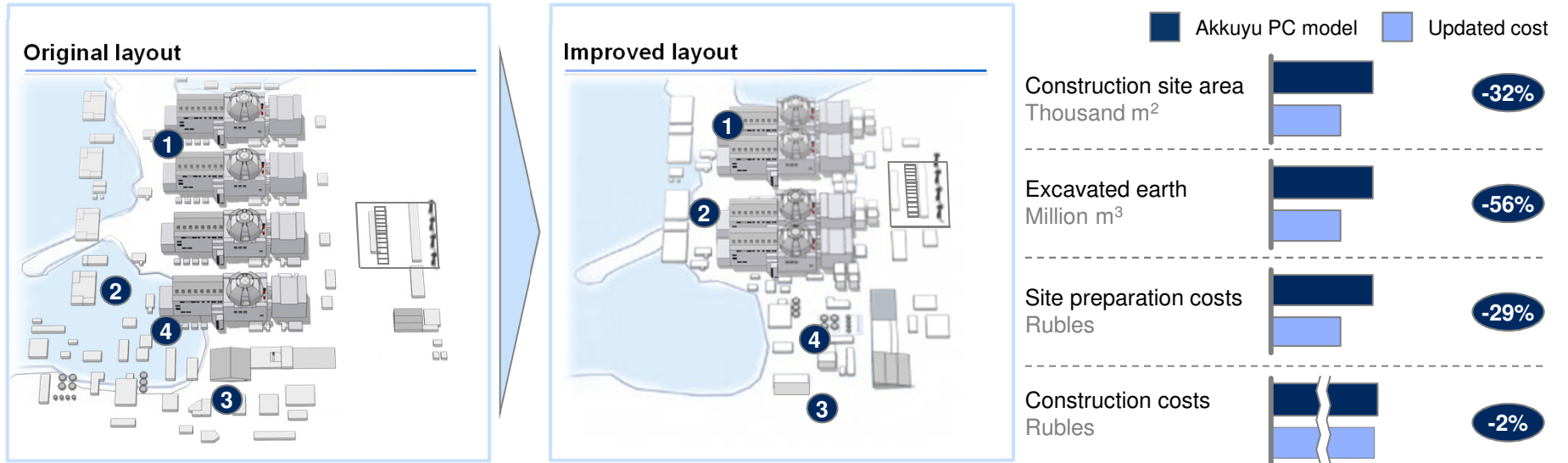
■ Baseline estimate ■ Team assessment ■ Discussed optimization potential



Expenses	Effect	Optimization example
Site preparation	-28%	Optimization of the lay-out and <b>reduction</b> of construction site by <b>32%</b> as well as <b>reduction of excavation by 56%</b>
Study	-24%	Optimization of study costs by 24% based on the benchmarking with best practices
Equipment	-7%	Optimization of the cost of <b>long-lead items by 9%</b> thanks to itemized benchmarking Optimization of the cost of <b>typical NPP equipment by 6%</b>
Construction and installation	-42%	Reduction of the cost of 60 buildings (~76% of construction costs) also by <b>reviewing the physical scope and prices</b> for materials and manpower
Project management	-38%	Optimization of project management costs by 38% based on best practices
Other expenses	-8%	Reduction of other expenses by 8% by reducing the calculation base

## 2. Optimization of NPP layout helps achieve saving in site preparation and construction costs

EXAMPLE: AKKUYU PROJECT

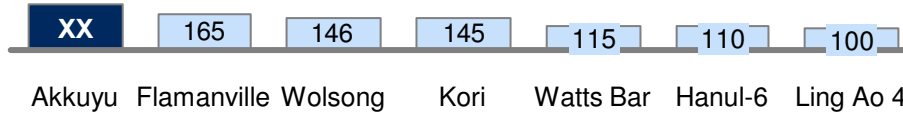


### Examples of layout optimization initiatives

#### Observations<sup>1</sup>

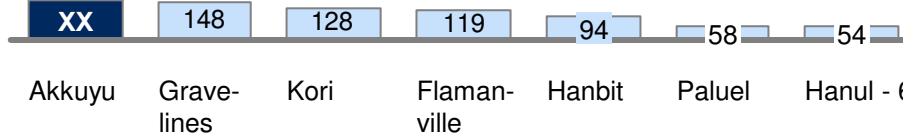
Too much distance between buildings

Distance between units, m



Other facilities do not have optimal layout

Fenced site, sq m



#### Initiatives<sup>1</sup>

- 1** The distance between Power Units 1 and 2, 3 and 4 reduced
- 2** The distance between machine hall and pump station reduced
- 3** Administrative and other general buildings combined
- 4** Location of other auxiliary buildings changed according to the new layout

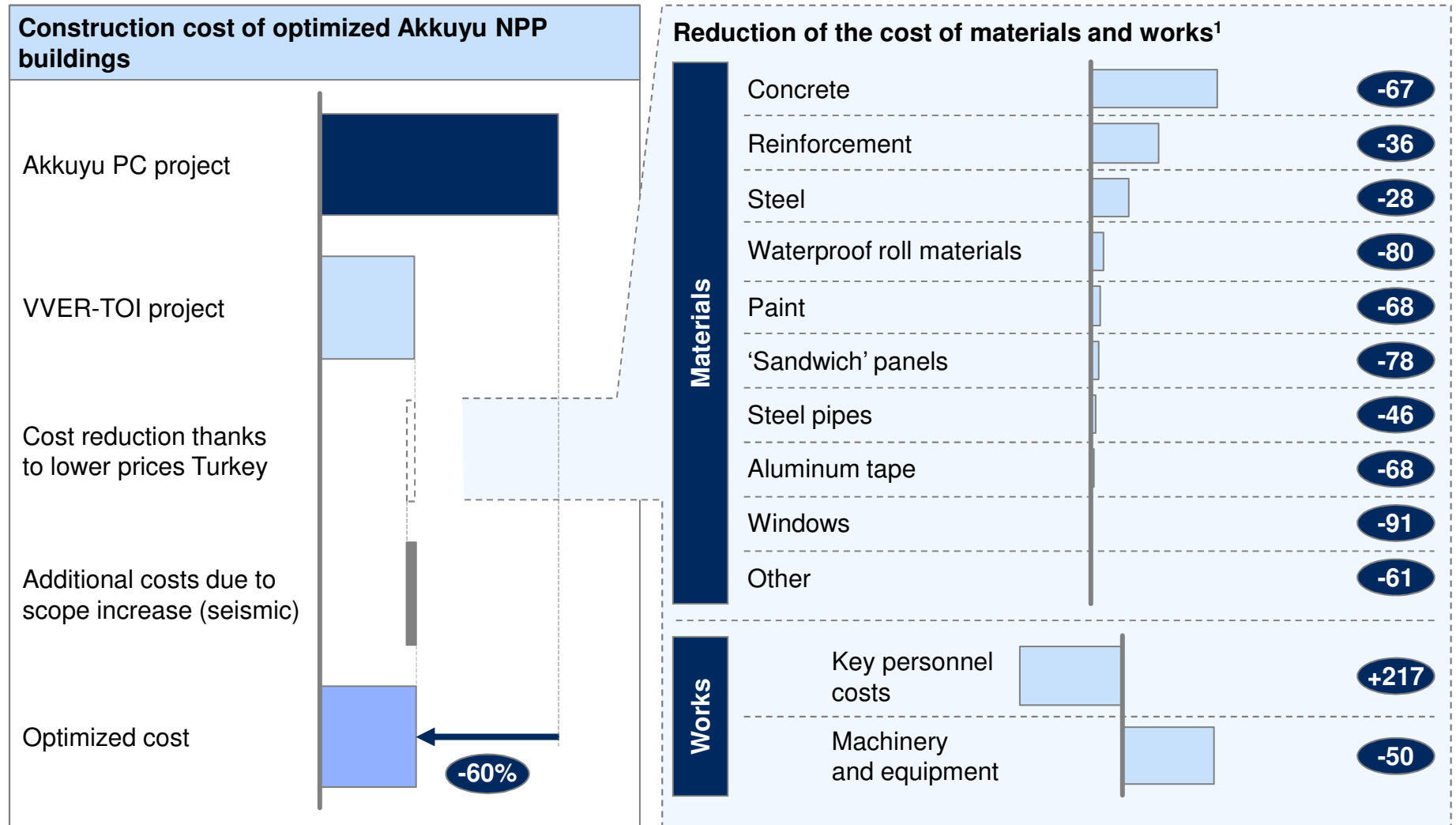
<sup>1</sup> Not exhaustive

## 2. Lower price for materials sourced in the area of NPP construction

EXAMPLE: AKKUYU PROJECT

Rubles

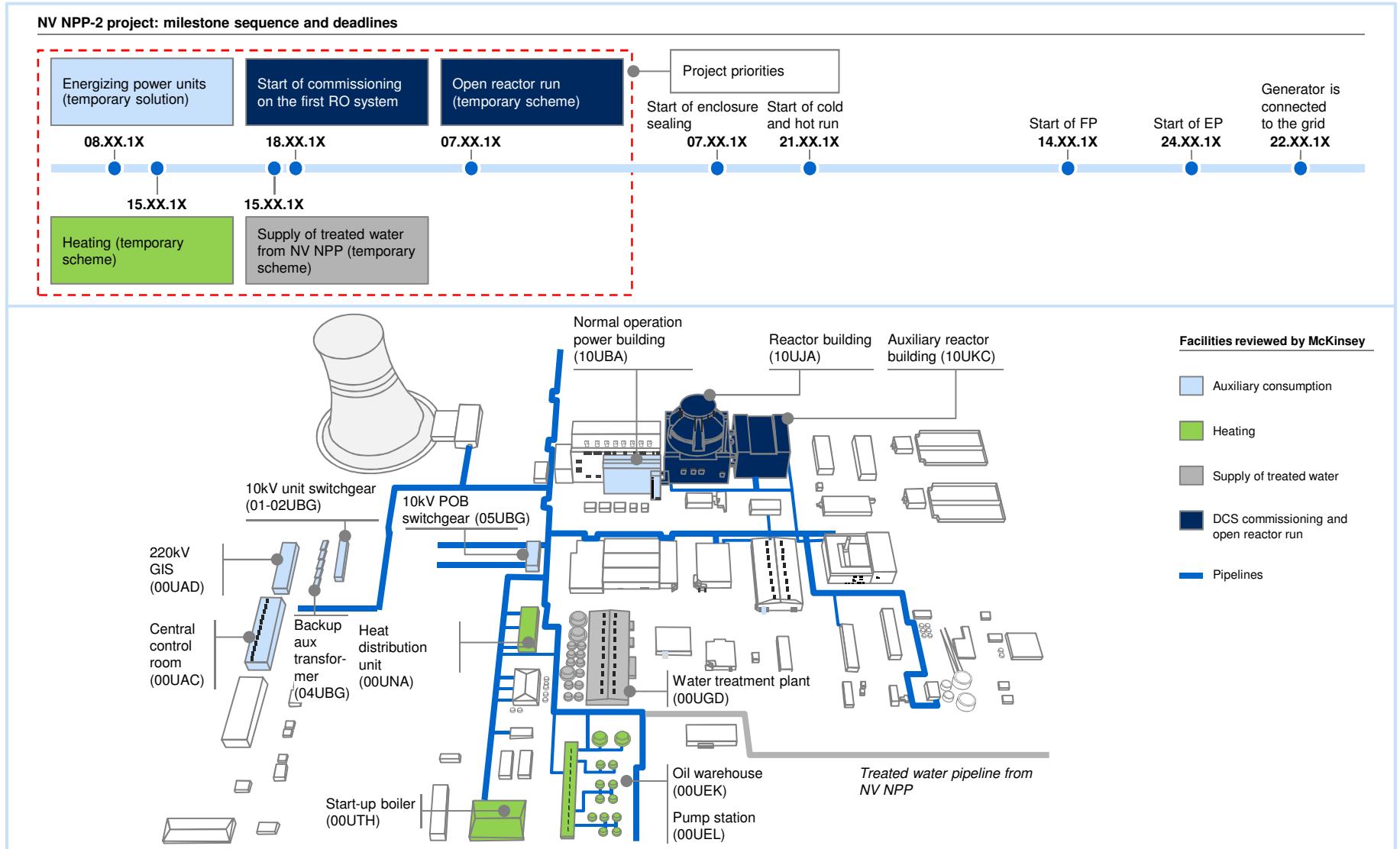
**-xx** Percent of cost saving



<sup>1</sup> Reduction of the cost of work and materials does not include a 12% increase of the physical scope due to higher seismic requirements

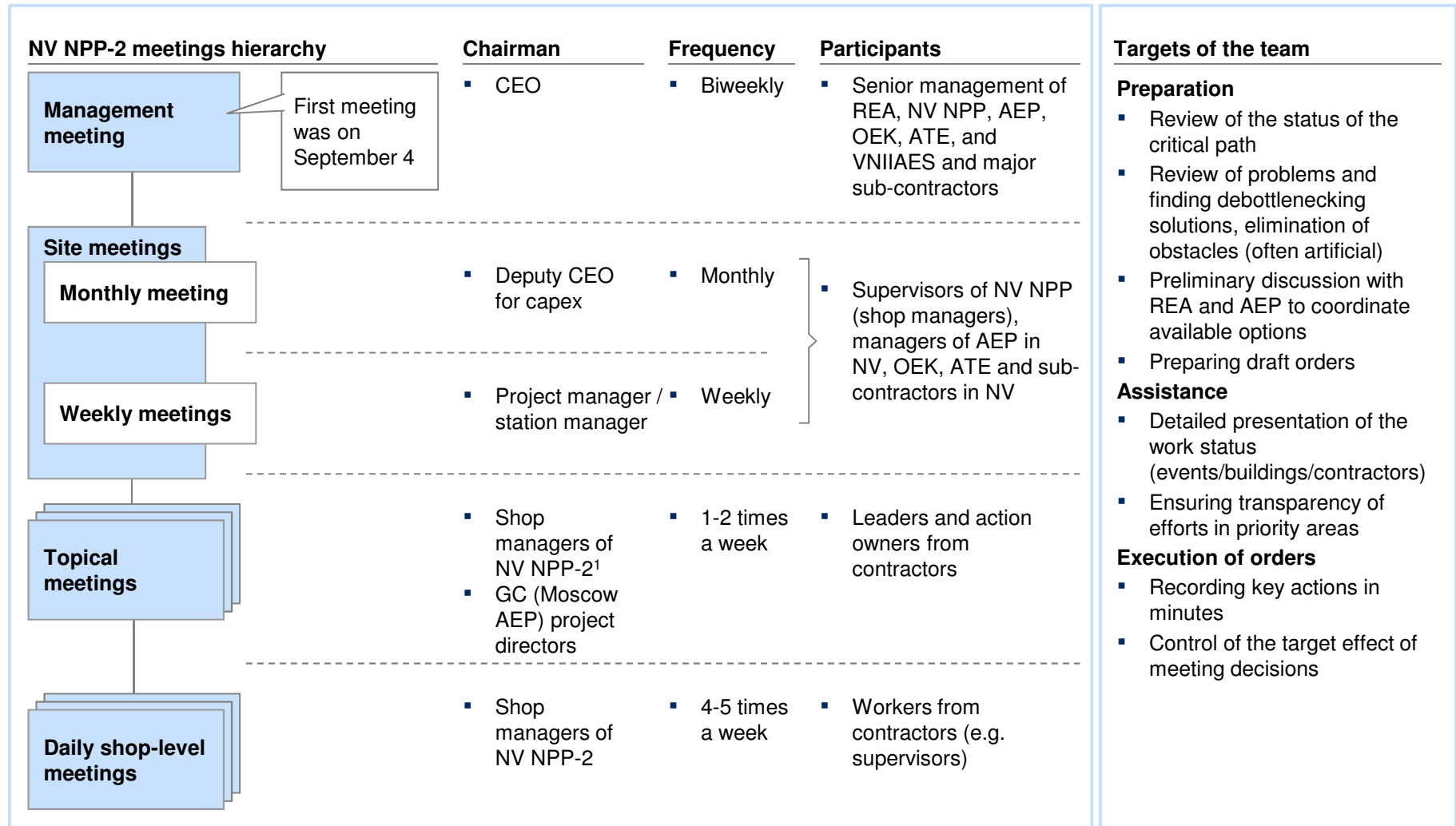
# 3. REA strengthens the role of the owner in the management of key events during construction and commissioning phases

EXAMPLE: PROJECT NOVORONEZH NPP-2



### 3. The management hierarchy enhances the efficiency of owner interaction with EPC contractor, sub-contractors and suppliers

EXAMPLE: PROJECT NOVORONEZH NPP-2



<sup>1</sup> If necessary, the meeting can be lead by project manager / station manager

### 3. Staff training and development is a special focus area

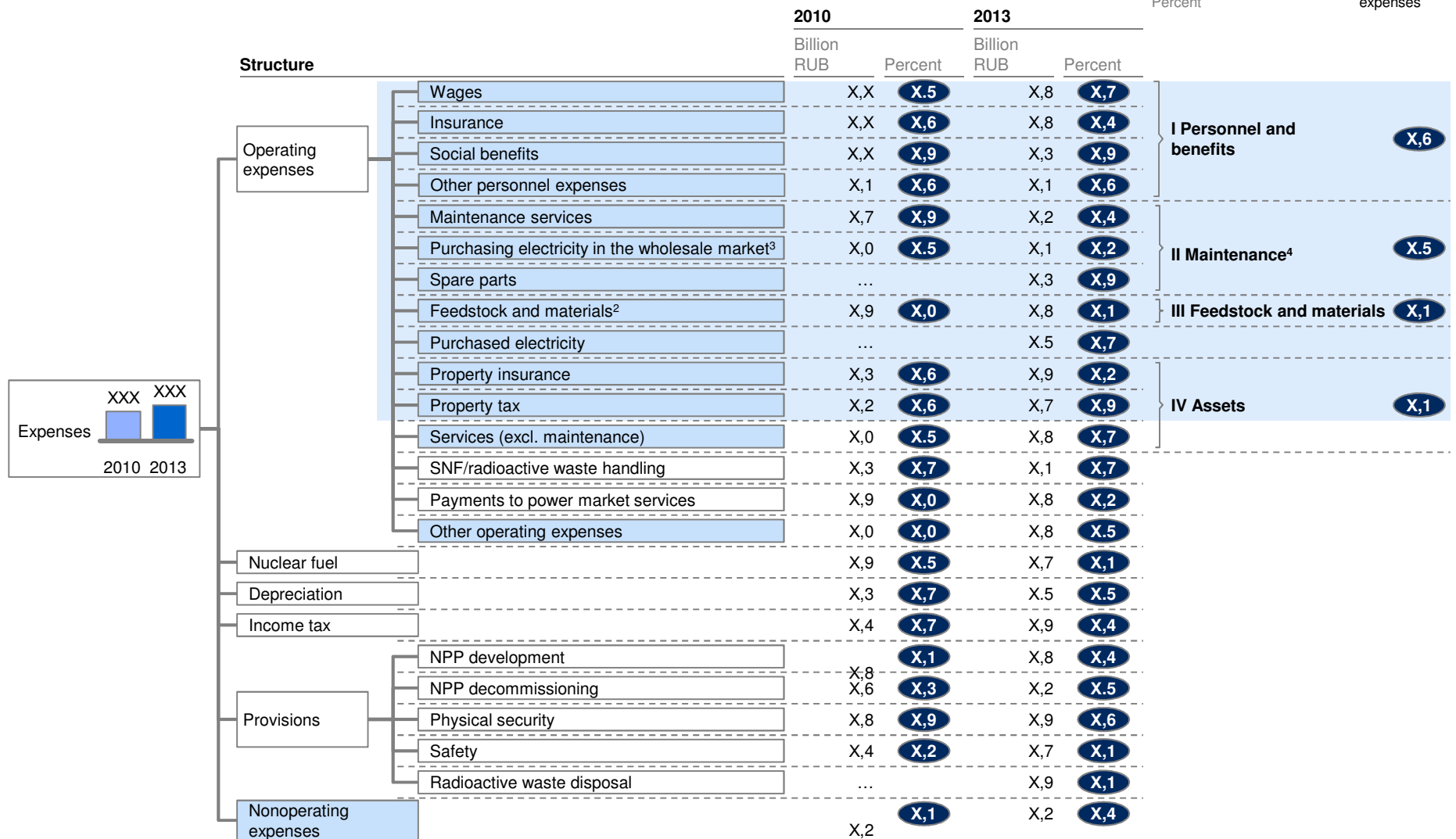
EXAMPLE: PROJECT NOVovorONEZH NPP-2



# 4. OPEX reduction should be ensured in all controlled sources

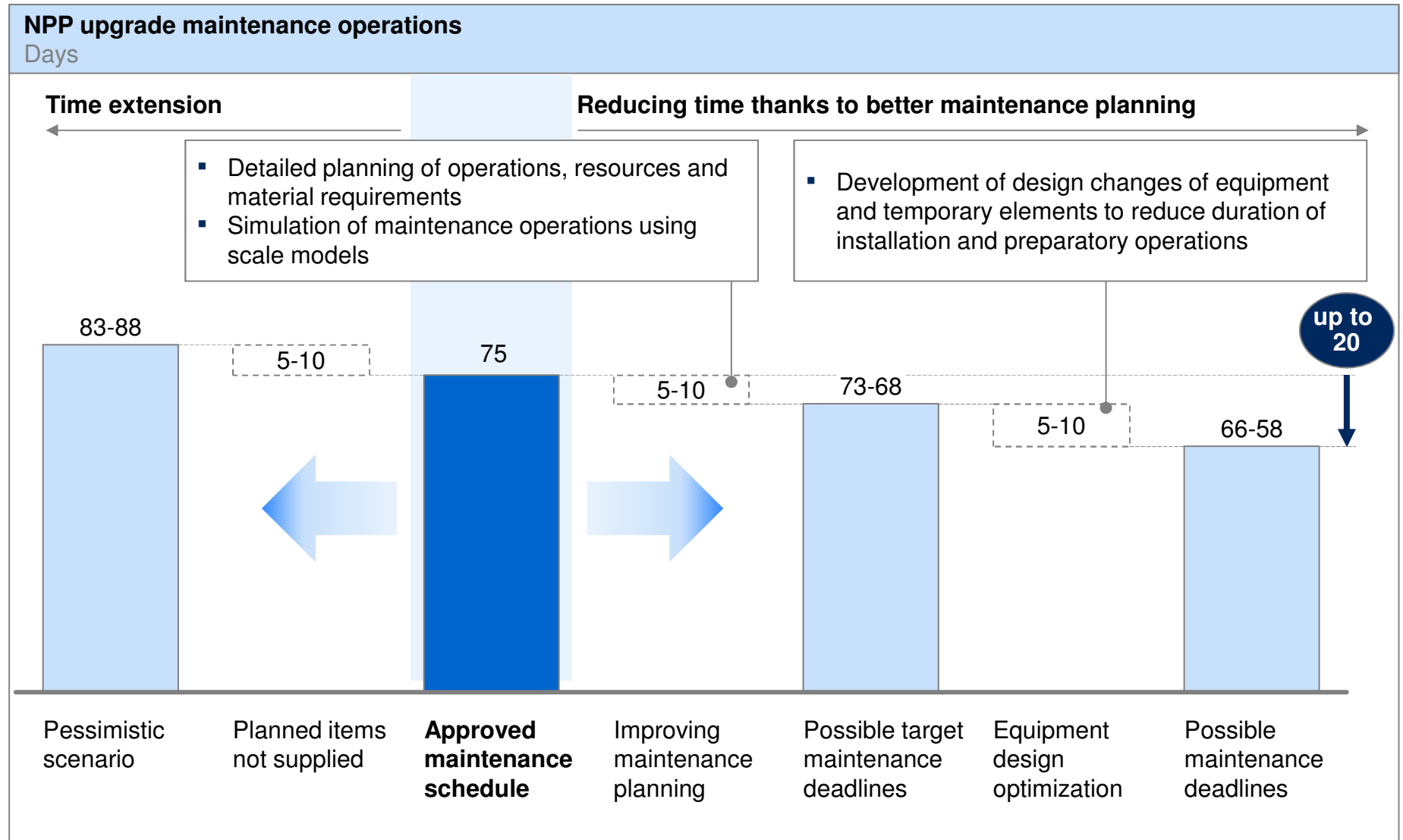
Billion RUB

**xx** Proportion in total costs Percent    Controlled expenses



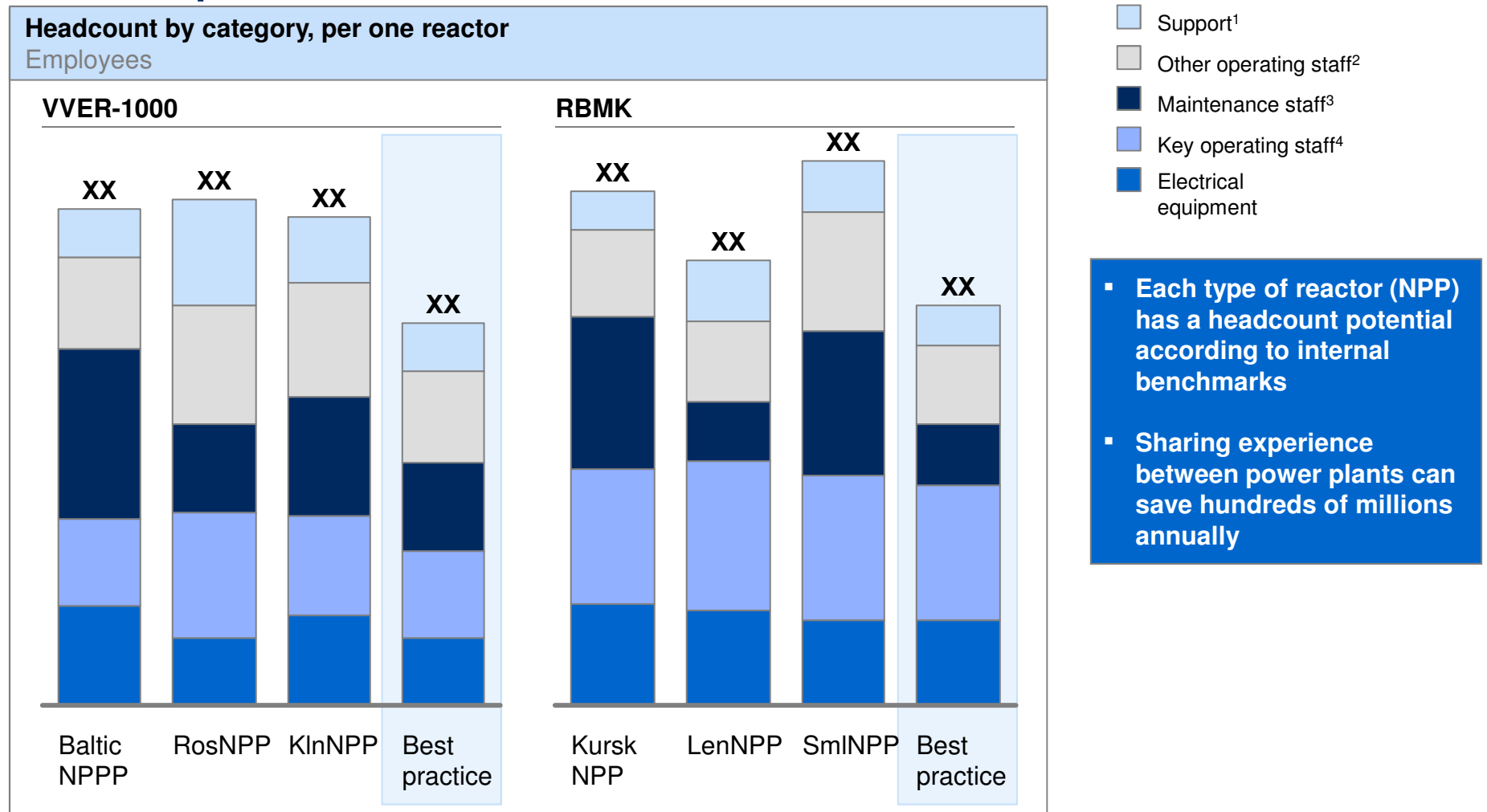
1 Data for 2013    2 Excluding nuclear fuel and spare parts  
 3 For contractual obligations    4 Electricity is reflected only in the margin and cost of production (0.5 bn)

## 4. Maintenance can be reduced thanks to detailed planning and initiatives with equipment vendors





## 4. Personnel costs may be reduced by sharing best practices between Rosatom plants



1 Accounting, Finance, Human Resources, Production, Procurement, Transportation  
 2 Safety and Reliability, Engineering Support, Production and Quality, Radiation Protection  
 3 Including AER branches  
 4 Operation of the main equipment (turbine, reactor, chemical plant, ventilation, plant support systems)