Ukrainian Railways

Concept (forecast) of locomotive fleet operations & maintenance optimization until 2033

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KEY PREREQUISITES FOR THE IMPLEMENTATION OF THE 2033 CONCEPT

PROBLEMS

- The main part of the locomotive fleet was designed and manufactured in the 60s and 80s of the last century, has low efficiency in comparison with modern locomotives, cannot provide a proper increase in the speed of freight and passenger trains, and others.
- The presence of a multi-series inventory.
- Part of the potentially active locomotive fleet is out of order and needs significant restoration.
- The inventory of locomotives exceeds their actual needs by almost a third.
- The presence in the active fleet of a significant proportion of locomotives whose average age exceeds 50 years.
- Depreciation of the locomotive inventory is almost 100%.
- There is a steady dynamics of increasing operating costs for the maintenance of the existing fleet of locomotives.

SOLUTIONS

- Restoration due to capital repairs with modernization of individual units and extension of service life.
- Update due to the purchase of new locomotives
- Unification, definition of perspective series of locomotives by types of movement.
- Reduction of operating costs for the maintenance of the park..
- Specialization of the main production facilities and optimization of the park.
- Transition to service of new locomotives.

RESULT

ORGANIZATIONAL AND TECHNICAL EFFECT

- Improving the locomotive productivity and optimizing the technology of the transportation process.
- Unification of locomotives series and optimization of nomenclature stocks of spare parts and materials for carrying out maintenance and repair.
- Rational use of production and technological capacities, their optimization.

FINANCIAL AND ECONOMICAL EFFECT

- Ensuring a sustainable transportation process and, as a consequence, the receipt of funds from transportation.
- Saving energy resources from the operation of new locomotives.
- Additional proceeds from the write-off of excess inventory.

SOCIAL EFFECT

- Saving human resources of technical staff.
- Improving the working conditions of operating personnel.
- Providing the needs of the population in passenger transportation by rail.

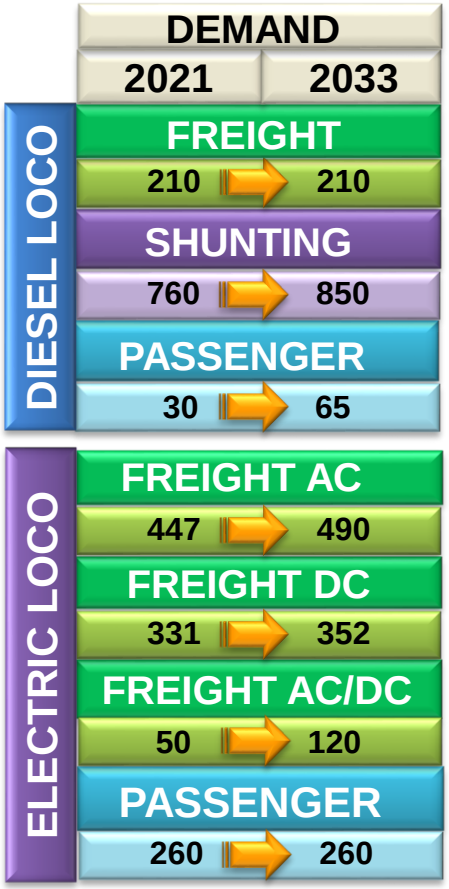
DYNAMICS OF UKRRAILWAY JSC LOCOMOTIVE FLEET DEMAND FOR THE PERIOD 2021-2033

Calculation of forecast demand is based on the operation parameters for 2020:

1. Rail traffic:
   276 894 mln ttkm brut.
2. Average daily number of passenger trains:
   100 pairs.
3. Average daily capacity: 714 K tons.
4. Average schedule speed:
   36,3 km/h.
5. Average technical speed:
   42,4 km/h.
6. Average daily mileage of electric loco:
   480 km.
7. Average daily mileage of diesel loco:
   400 km.

***Calculation of forecast locomotive demand is made with the following assumtions:**

1. Increasing rail traffic to the pre-crisis level:
   2021-2025: +2% annualy
   2026-2033: const.
2. Electrification of sections:
   - Dolynska – Mykolaiv – Kolosivka 253 km
   - Kovel – Izov – State border 94 km
3. Optimization of freight traffic on regional branch sections electrified by various power systems.

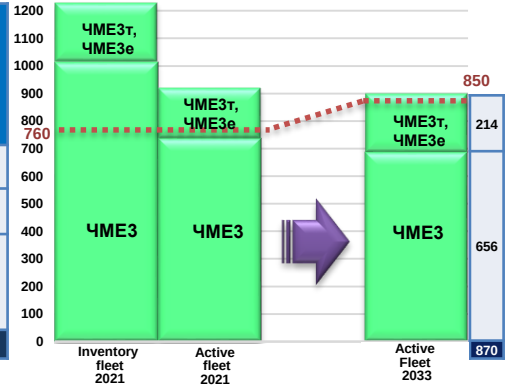


**Demand of locomotive fleet is calculated on the basis of the baseline scenario taking into account the forecast of demand for freight transportation by rail until 2035 and may vary depending on realization of main parameters of economic development of the state.*

SHUNTING DIESEL LOCOMOTIVES SERIES ЧМЕ3в/і

Dynamic of active fleet

Locomotive series	Inventory fleet	Active fleet
ЧМЕ3т	195	173
ЧМЕ3е	19	12
ЧМЕ3	1 014	736
Всього	1 228	921



PROBLEMS:

- Service wear of diesel locomotive fleet is 100% (aver.age 34 years old).
- The inventory stock of mainline diesel locomotives exceeds actual demand of locomotives by more than 40%.
- The number of locomotives requiring significant overhaul (restoration) is more than 20% (269 units) of the inventory fleet.
- Steady dynamics of increasing operating costs for maintenance of the existing fleet.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL
With modernization of individual units

- \+ Relatively small capital investments
- \+ Available engineering and manufacturing base
- \- Absence of equipment and facilities.
- \- Restoration of passport specification
- \- Low quality of repair
- \- Considerable costs of current maintenance
- \- Large amount of unscheduled repair

MODERNIZATION
Complex with remotorization

- \+ Improvement of technical specification
- \+ Decrease of maintenance and repair costs
- \+ Decrease of fuel and diesel costs.
- \- Service life extension for 10-15 years.
- \- Absence of manufacturing base, equipment and facilities for maintenance
- \- Considerable capital investments
- \- Overstated rate of return

PURCHASE OF NEW

- \+ Compliance with modern specifications
- \+ High level of technical readiness coefficient
- \+ High level of environmental parameters
- \+ Increase of locomotive performance
- \+ Decrease of transportation cost price
- \+ Service life at least 40 years
- \- Big capital investments for purchase
- \- Necessity of maintenance
- \- Limited market of spare parts

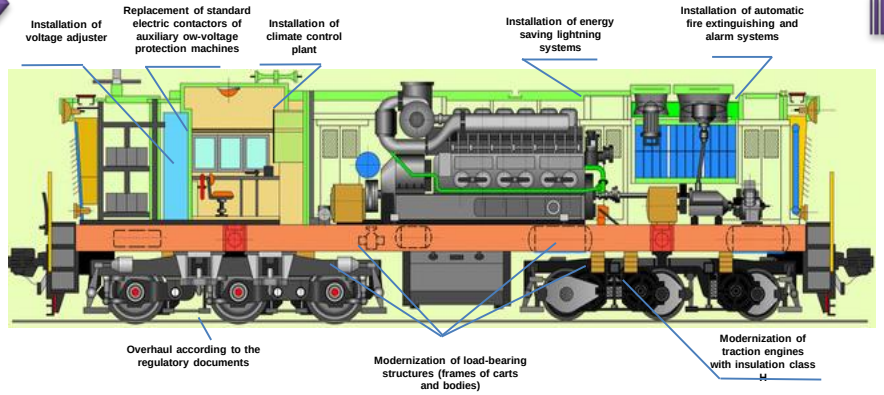
0,32 MUSD net of VAT	1,176-1,732 MUSD net of VAT	1,8 MUSD net of VAT

PRIORITIZED PERSPECTIVE:

The chosen option to solve the issue – overhaul of locomotives series ЧМЕ3в/ with modernization of individual units - BASIC PROJECT

Argument 1.
In the short term, it is not possible to update the required active fleet of shunting locomotives.
Argument 2.
Developed repair base at all regional branches, including afiliated plants
Argument 3.
Availability of qualified personnel.

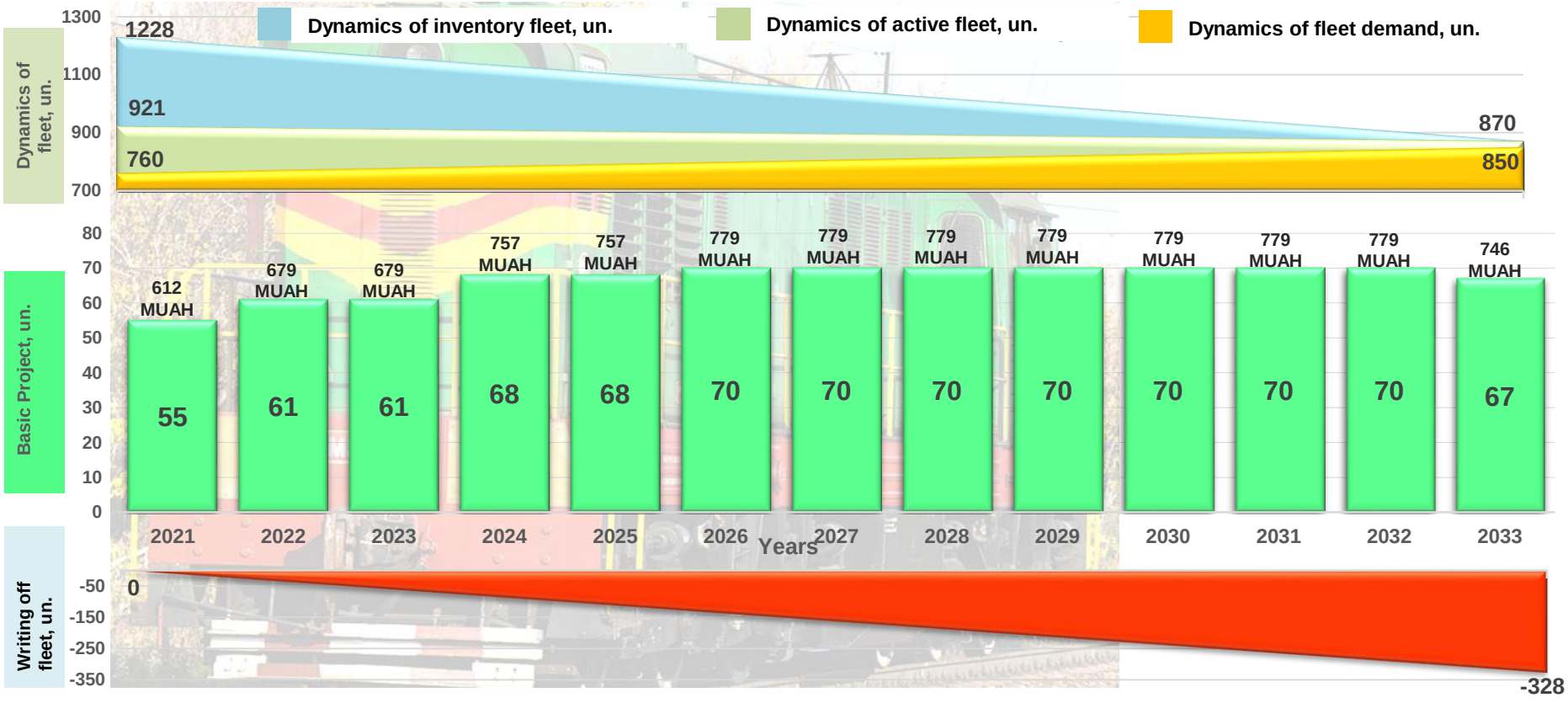
BASIC PROJECT MODEL:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation	870	9,683
Writing off overstated inventory fleet (income)	358	0,3
Conditions for implementation: BASIC PROJECT	Internal contractor (PrJSC)	

WORK WITH SHUNTING diesel locomotive fleet SERIES ЧМЕ3в/і UNTIL 2033

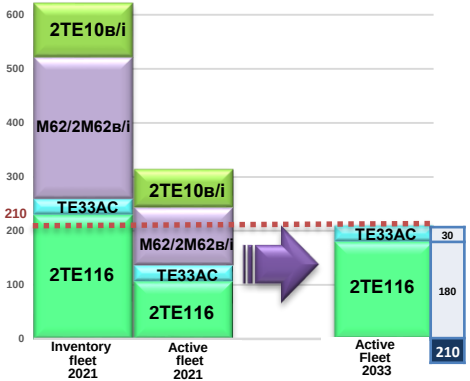


MAINLINE FREIGHT DIESEL LOCOMOTIVES

Locomotive series	Inventory fleet	Active fleet
2TE10м	60	37
2TE10ут	35	30
2TE10у	6	4
2M62	98	23
2M62у,к	115	49
M62	49	35
TE33AC	30	30
2TE116	229	107
Total	622	315

DEMAND

Dynamics of active fleet



PROBLEMS:

- Inventory availability of mainline freight locomotives is almost 3 times higher than actual demand in locomotives.
- Existence of multi-series inventory park (M62, 2M62, 2M62у, 2M62к, 2TE10м, 2TE10ут, 2TE10у, 2TE116, TE33AC).
- The number of locomotives requiring significant repair (restoration) is about half of the inventory (280) units, including 106 locomotives of 2TE116 series).
- Service wear of the locomotive inventory fleet is 100%.
- There is a steady dynamics of increasing operating costs for maintenance of the existing fleet.

CHOICE OF BASIC MODEL IN CASE OF THE SAME FORECAST PROJECT AMOUNT:

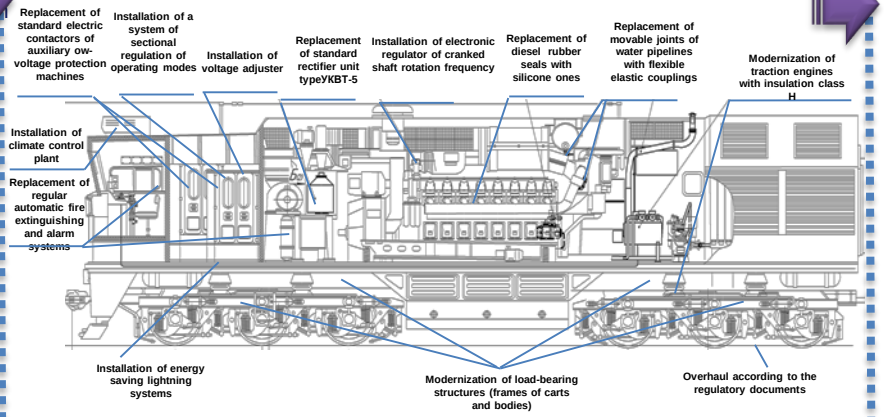
Locomotive series	Specific consumption, kg/10 K tkm br.	Cost of project implementation	Cost of basic project (section), MUSD	Forecast project amount, MUSD	Estimated project scope (sections), un.
2TE116	33,14	Overhaul with modernization of individual units	0,85	259	320
2TE10в/i	48,2	Complex modernization with remotorization	1,45/1,56	259	178/166
M62/2M62в/i	48,83	Complex modernization with remotorization	1,79	259	144

PRIORITIZED PERSPECTIVE:

The chosen option to solve the issue – overhaul with modernization of individual units - BASIC PROJECT

Argument 1. Main series in the active fleet of mainline freight locomotives of Ukrrailway JSC is 2TE116.
Argument 2. Operated by structural and production units of the locomotive facilities of all regional branches.
Argument 3. Design of the locomotive as a whole is determined by high level of reliability, maintainability, efficiency of fuel and energy consumption.
Argument 4. Traction and energy performance meet the established requirements.
Argument 5. Developed repair base at all regional branches, including PrJSC.
Argument 6. Availability of qualified production staff.
Argument 7. Main nomenclature of spare parts and equipment is already manufactured in Ukraine.
Argument 8. Ability to repair diesel units.
Argument 9. The production of a certain range of spare parts and consumables is familiar to production units and branches of Ukrrailway JSC.

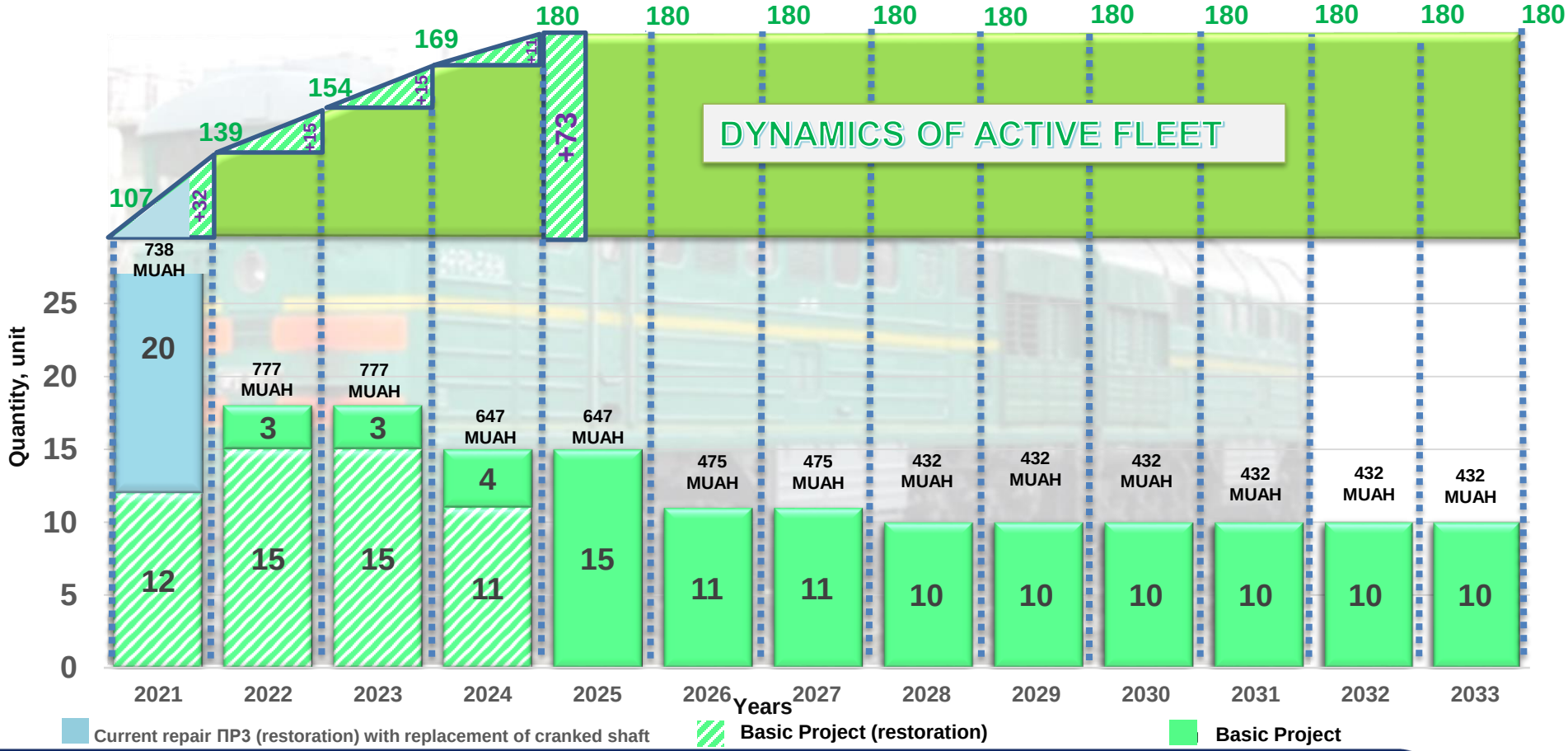
BASIC PROJECT MODEL:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation	160	6,904
Total scope of current repair in ПР-3 (restoration) with replacement of cranked shaft of diesel locomotives series TE116	20	0,220
Total scope of diesel locomotives series TE33AC	30	2,028
TOTAL COST	210	9,152
Writing off overstated inventory fleet (income)	733 sections	0,62
Unification of seriality of locomotives and optimization of nomenclature of spare parts and materials for maintenance and repair	2TE116, TE33AC	
Conditions for work: Overhaul with modernization of individual units Overhaul with modernization of individual units (restoration)	Internal contractor (PrJSC) Tender procedure, internal contractor	

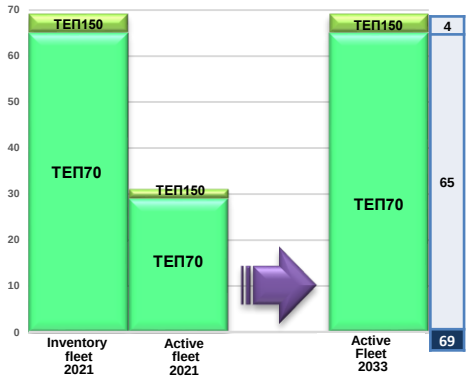
WORK WITH FREIGHT DIESEL LOCOMOTIVE FLEET SERIES 2TE116 UNTIL 2033



MAINLINE PASSENGER LOCOMOTIVES

Locomotive series	Inventory fleet	Active fleet
ТЕП150	4	2
ТЕП70	65	29
Total	69	31

DYNAMICS OF ACTIVE FLEET



PROBLEMS:

- Active fleet of diesel locomotives is less than half of their existing inventory fleet.
- A part of passenger transportations is made by freight locomotives.
- The number of locomotives requiring significant repair (restoration) is more than half of the inventory fleet (38 un. – ТЕП70, 2 un. – ТЕП150).
- 96 %. Service wear of inventory locomotive fleet is
- Steady dynamics of increasing operating costs for maintenance of the existing fleet.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL

With modernization of indiviudal units

- \+ Relatively small capital investments
- \+ Available engineering and manufacturing base
- \+ Available equipment and facilities
- \- Restoration of passport specification
- \- Low quality of repair
- \- Considerable costs of current maintenance
- \- Large amount of unscheduled repair

PURCHASE OF NEW ONES

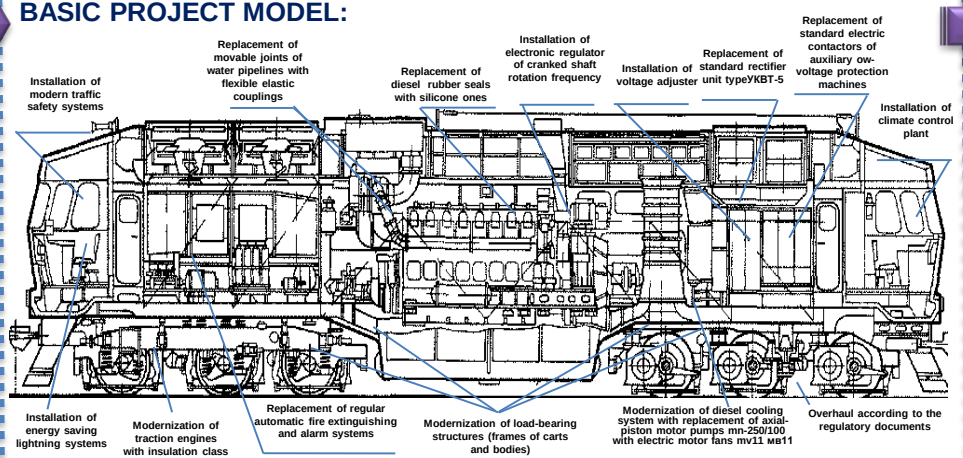
- \+ Compliance with modern specifications
- \+ High level of technical readiness coefficient
- \+ High level of environmental parameters
- \+ Increase of locomotive performance
- \+ Decrease of transportation cost price
- \+ Service life at least 40 years
- \- Big capital investments for purchase
- \- Necessity of maintenance
- \- Limited market of spare parts

PRIORITIZED PERSPECTIVE:

The chosen option to solve the issue – overhaul with modernization of individual units of locomotives series ТЕП70 - BASIC PROJECT, ТЕП150

Argument 1. The only series in the fleet of mainline passenger diesel locomotives of Ukrrailway JSC - TEP70, TEP150.
Argument 3. Design of the locomotive as a whole is determined by high level of reliability, maintainability, efficiency of fuel and energy consumption.
Argument 4. Traction and energy performance meet the established requirements.
Argument 5. Availability of qualified production staff.
Argument 6. Main nomenclature of spare parts and equipment is already manufactured in Ukraine.
Argument 8. Ability to repair diesel units.
Argument 9. The production of a certain range of spare parts and consumables is familiar to production units and affiliated branches of Ukrrailway JSC.

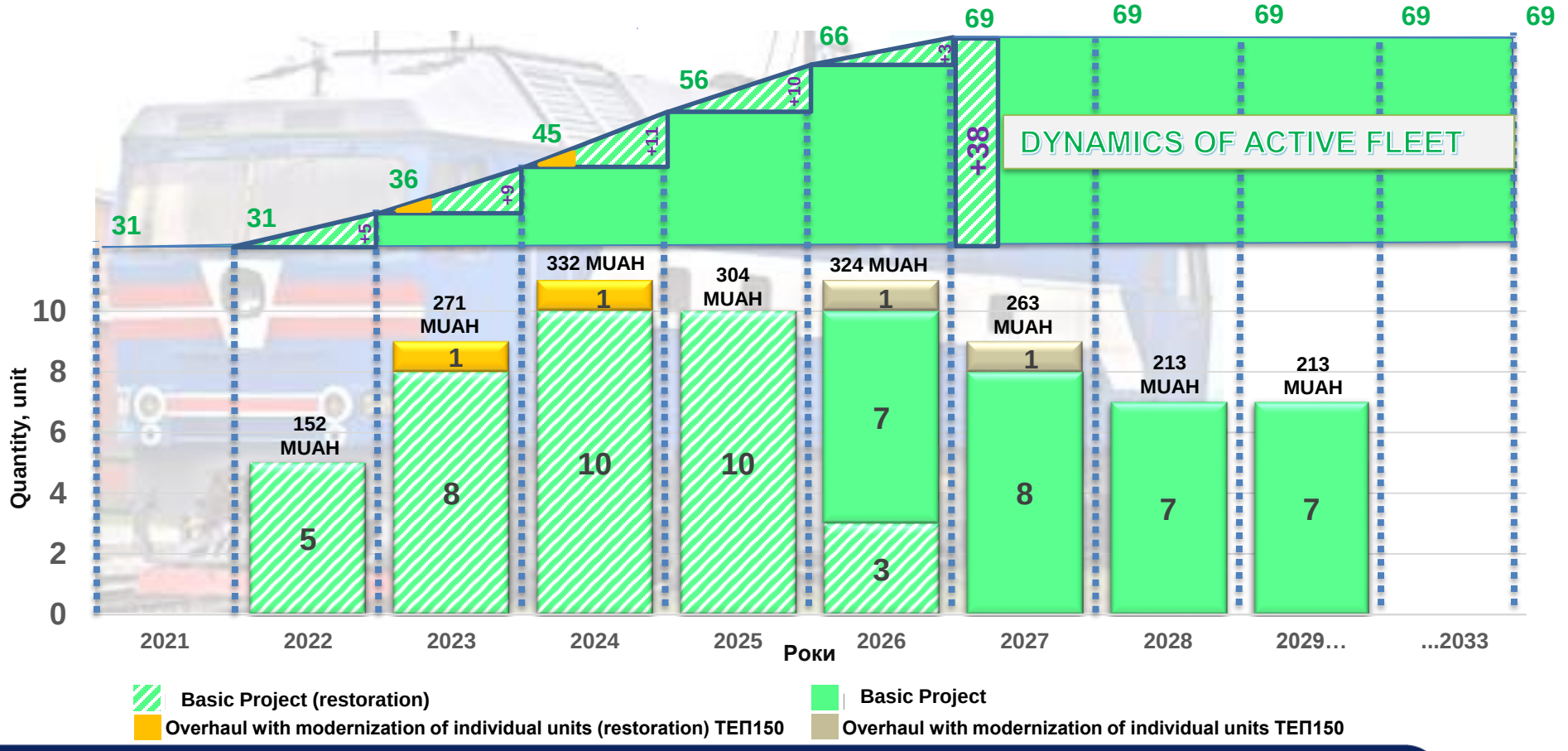
BASIC PROJECT MODEL:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation	65	1,975
Total scope of overhaul with modernization of individual units of locomotives seriesТЕП150	4	0,096
TOTAL COST	69	2,071
Conditions for work: Overhaul with modernization of individual units Overhaul with modernization of individual units (restoration)	Internal contractor (PrJSC) Tender procedure, internal contractor	

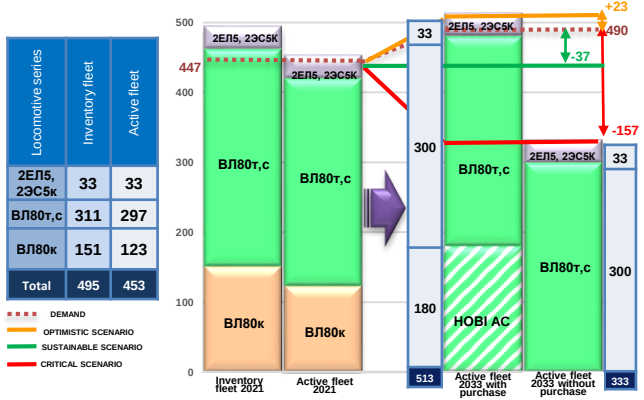
WORK WITH PASSENGER DIESEL LOCOMOTIVE FLEET UNTIL 2033



FREIGHT AC ELECTRIC LOCOMOTIVES

DYNAMICS OF ACTIVE FLEET

Locomotive series	Inventory fleet	Active fleet
2ЕЛ5, 2ЭС5к	33	33
ВЛ80т,с	311	297
ВЛ80к	151	123
Total	495	453



PROBLEMS:

- Main part of electric locomotive fleet was designed and manufactured in the 60-80s of last century, which operation requires increase of repair and maintenance cost by 40-60%, they have low efficiency compared to modern locomotives, are not able to provide a proper increase in freight and passenger train speed, etc.
- The presence of electric locomotives VL80k series in the active fleet which average age exceeds 50 years is about 27% of total active fleet of AC electric locomotives.
- Service wear of the inventory fleet of electric locomotives is 95.5%.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL (with modernization of individual units)	MODERNIZATION (complex with replacement of undercarriage)	PURCHASE OF NEW ONES
+ Relatively small capital investments	+ Improvement of technical specification .	+ Compliance with modern specifications
+ Available engineering and manufacturing base	+ Decrease of locomotive power consumption	+ High level of technical readiness coefficient
+ Available equipment and facilities	- No experience of complex modernization	+ High level of environmental parameters
- Restoration of passport specification	- Considerable capital investments	+ Increase of locomotive performance
- Low quality of repair	- Service life extension	+ Decrease of transportation cost price
- Considerable costs of current maintenance	- Long period of preparation for project implementation	+ Service life at least 40 years
- Large amount of unscheduled repair		- Big capital investments for purchase
		- Necessity of maintenance
		- Limited market of spare parts
0,46-0,74 MUSD net of VAT	0,9-1 MUSD net of VAT	5,25 MUSD net of VAT

SHORT-TERM:

The chosen option to solve the issue– overhaul with modernization of individual units of electric locomotives series ВЛ80т,с – BASIC PROJECT, 2ЕЛ5, 2ЭС5К.

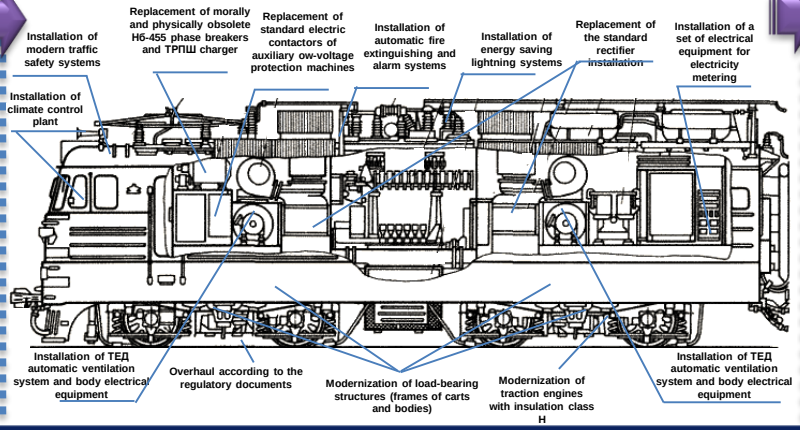
Argument 1. In the short term it is not possible to update the required number of active fleet of electric locomotives, which is 453 units.
Argument 2. Devеloped repair base at all regional branches, including PrJSC.
Argument 3. Availability of qualified production staff.
Argument 4. Main nomenclature of spare parts and equipment is manufactured in Ukraine.

LONG-TERM:

The chosen option to solve the issue – purchase of new locomotives.

Argument 1. Reduction of operating costs for repairs, due to increased maintenance periods and reduced energy costs.
Argument 2. Full compliance of the locomotive with modern technical, ergonomic and environmental requirements.
Argument 3. Improvement of working conditions of locomotive crews.
Argument 4. Modification of operation and maintenance process of locomotives.
Argument 5. Improvement of transportation process.

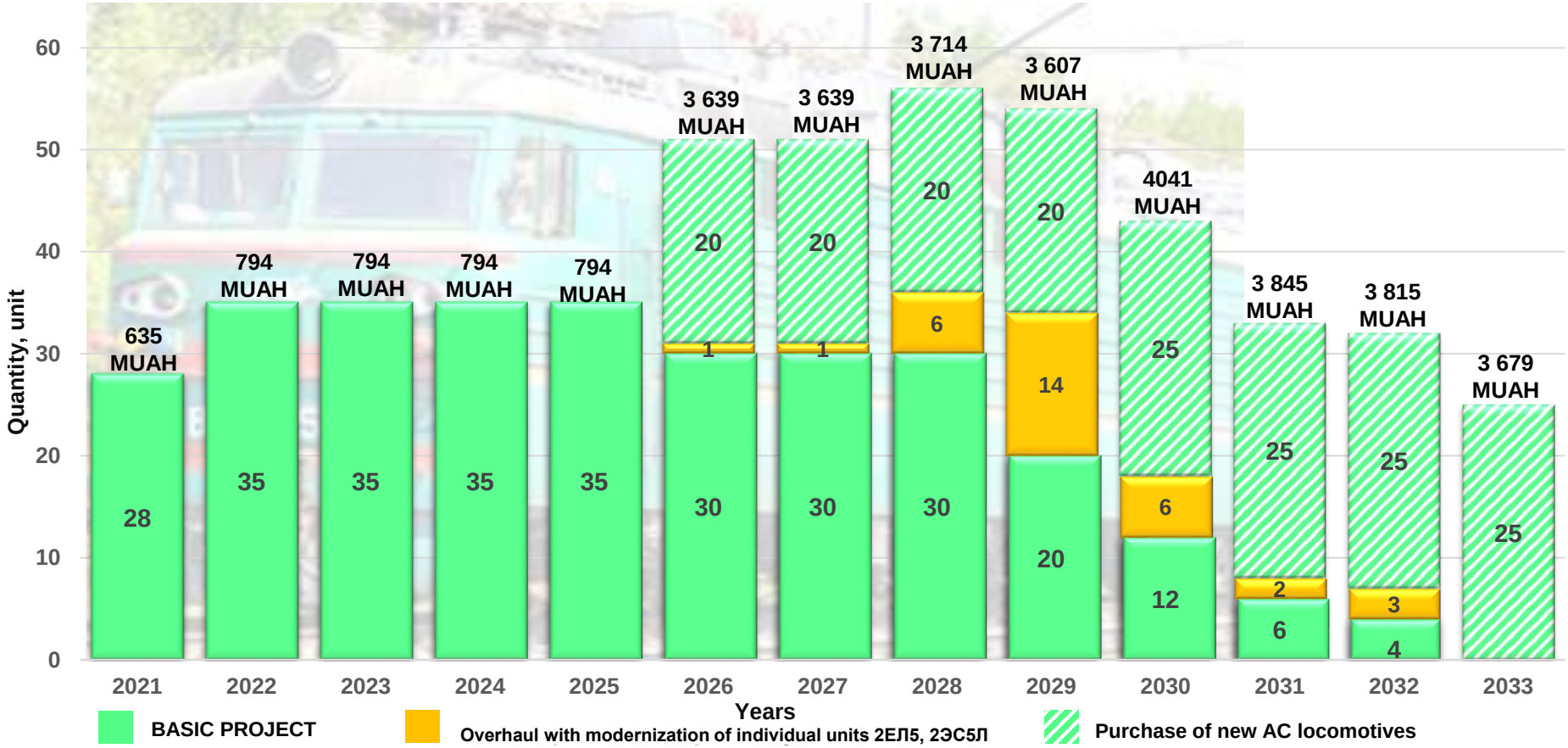
BASIC PROJECT MODEL:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation	300	6,807
Total scope of overhaul with modernization of individual units of electric locomotives series 2ЕЛ5, 2ЭС5к	33	0,495
Total scope of purchase of new ones	180	26,489
TOTAL COST	513	33,791
Writing off overstated inventory fleet (income)	324	0,28
Estimated annual power savings from operation of new electric locomotives, MUAH	64	
Conditions for work: Overhaul with modernization of individual units	Internal contractor (PrJSC)	
Purchase of new ones	Tender procedure, external contractor	

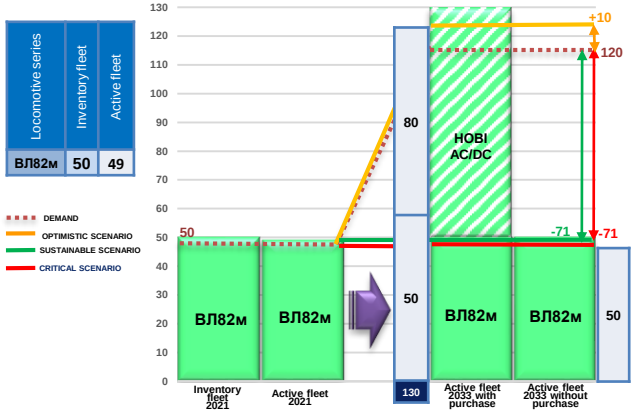
WORK WITH FREIGHT AC ELECTRIC LOCOMOTIVE FLEET UNTIL 2033



FREIGHT DOUBLE-CURRENT LOCOMOTIVES

DYNAMICS OF Active fleet

Locomotive series	Inventory fleet	Active fleet
ВЛ82м	50	49



PROBLEMS:

- Main part of electric locomotive fleet was designed and manufactured in the 60-80s of last century, which operation requires increase of repair and maintenance cost by 40-60%, they have low efficiency compared to modern locomotives, are not able to provide a proper increase in freight and passenger train speed, etc.
- The presence of electric locomotives ВЛ82м series in the active fleet which average age exceeds 45 years is about 100% of total active fleet of double-current locomotives.
- Service wear of the inventory fleet of electric locomotives is 100 %.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL (with modernization of individual units)	MODERNIZATION (complex with replacement of undercarriage)	PURCHASE OF NEW ONES
+ Relatively small capital investments	+ Improvement of technical specification .	+ Compliance with modern specifications
+ Available engineering and manufacturing base	+ Decrease of locomotive power consumption	+ High level of technical readiness coefficient
+ Available equipment and facilities	- No experience of complex modernization	+ High level of environmental parameters
- Restoration of passport specification	- Considerable capital investments	+ Increase of locomotive performance
- Low quality of repair	- Service life extension	+ Decrease of transportation cost price
- Considerable costs of current maintenance	- Long period of preparation for project implementation	+ Service life at least 40 years
- Large amount of unscheduled repair		- Big capital investments for purchase
		- Necessity of maintenance
		- Limited market of spare parts
0,6-0,8 MUSD net of VAT	0,9-1 MUSD net of VAT	6 MUSD net of VAT

SHORT-TERM:

The chosen option to solve the issue– overhaul with modernization of individual units of electric locomotives series ВЛ82м – BASIC PROJECT.

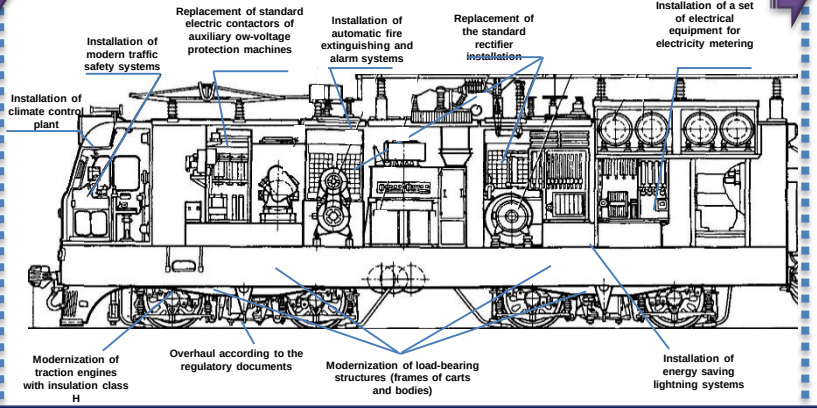
Argument 1. The only series of double-current locomotives in the freight fleet
Argument 2. Developed repair base at all regional branches, including PrJSC.
Argument 3. Availability of qualified production staff.
Argument 4. Main nomenclature of spare parts and equipment is manufactured in Ukraine.

LONG-TERM:

The chosen option to solve the issue – purchase of new locomotives.

Argument 1. Reduction of operating costs for repairs, due to increased maintenance periods and reduced energy costs.
Argument 2. Full compliance of the locomotive with modern technical, ergonomic and environmental requirements.
Argument 3. Improvement of working conditions of locomotive crews.
Argument 4. Modification of operation and maintenance process of locomotives.
Argument 5. Improvement of transportation process.

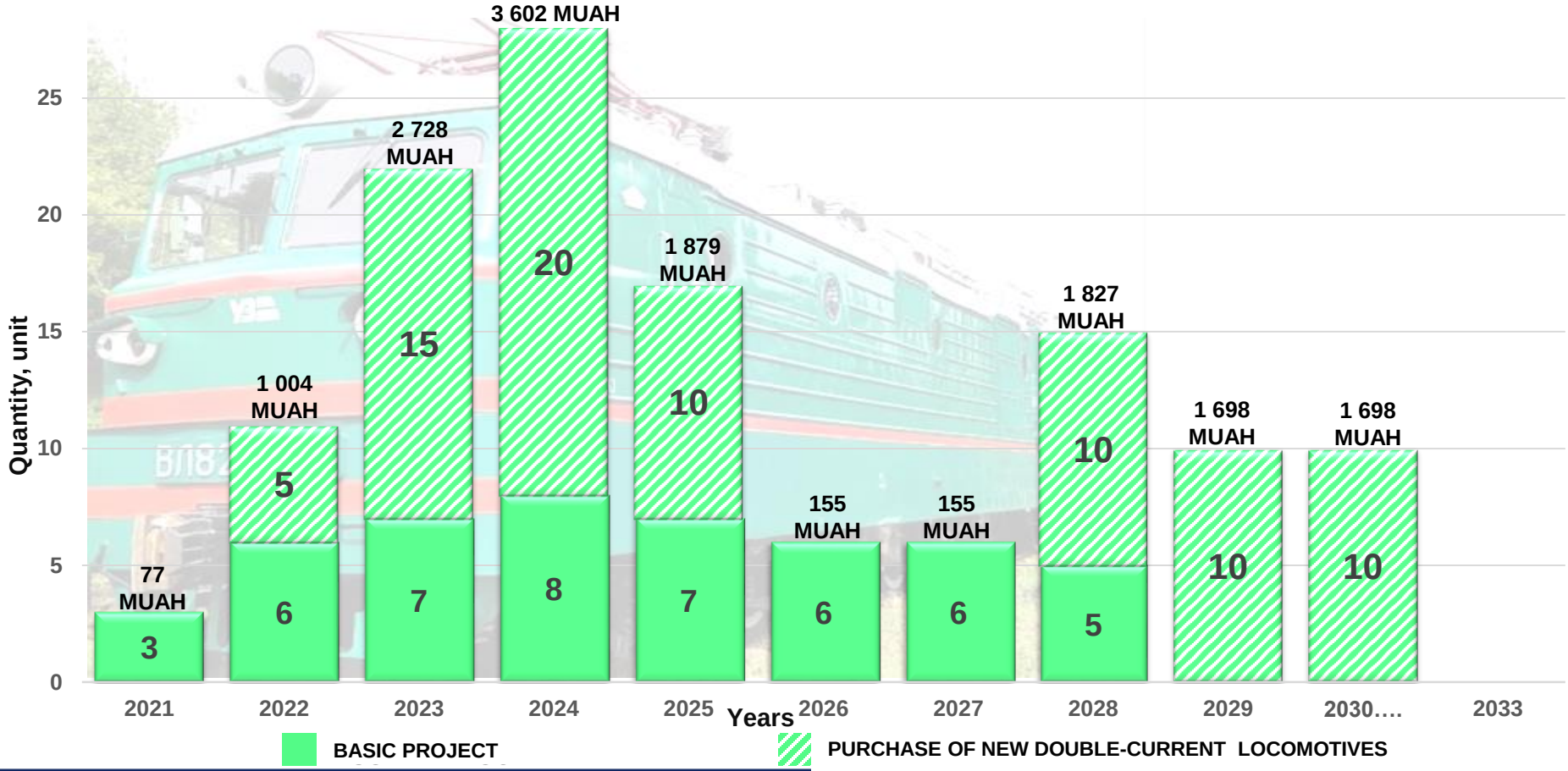
BASIC PROJECT MODEL:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation	48	1,238
Загальний обсяг закупівлі нових електровозів	80	13,584
TOTAL COST	128	14,822
Estimated annual power savings from operation of new electric locomotive fleet, MUAH	28	
Conditions for work: BASIC PROJECT Purchase of new ones	Internal contractor (PrJSC) Tender procedure, external contractor	

WORK WITH FREIGHT DOUBLE-CURRENT LOCOMOTIVE FLEET UNTIL 2033

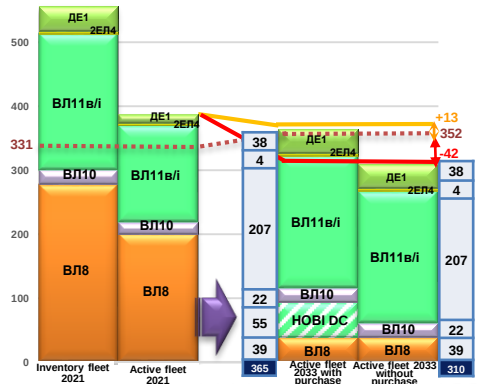


FREIGHT DC ELECTRIC LOCOMOTIVES

Locomotive series	Inventory fleet	Active fleet
ДЕ1	38,5	13
2ЕЛ4	4	3
ВЛ11в/і	213	152
ВЛ10	22	18
ВЛ8	279	201
TOTAL	556,5	387

DEMAND
OPTIMISTIC SCENARIO
CRITICAL SCENARIO

DYNAMICS OF ACTIVE FLEET



PROBLEMS:

- Main part of electric locomotive fleet was designed and manufactured in the 60-80s of last century, which operation requires increase of repair and maintenance cost by 40-60%, they have low efficiency compared to modern locomotives, are not able to provide a proper increase in freight and passenger train speed, etc.
- Inventory availability of mainline freight DC electric locomotives exceeds actual demand by 40%.
- The presence of electric locomotives ВЛ8 series in the active fleet which average age exceeds 50 years is about 50% of total active fleet of DC electric locomotives.
- Service wear of the inventory fleet of electric locomotives is 92 %.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL (with modernization of individual units)	PURCHASE OF NEW ONES
+ Relatively small capital investments	+ Compliance with modern specifications
+ Available engineering and manufacturing base	+ High level of technical readiness coefficient
+ Available equipment and facilities	+ High level of environmental parameters
- Restoration of passport specification	+ Increase of locomotive performance
- Low quality of repair	+ Decrease of transportation cost price
- Considerable costs of current maintenance	+ Service life at least 40 years
- Large amount of unscheduled repair	- Big capital investments for purchase
	- Necessity of maintenance
	- Limited market of spare parts
0,4-0,89 MUSD net of VAT	5 MUSD net of VAT

SHORT-TERM:

The chosen option to solve the issue– overhaul with modernization of individual units of electric locomotives series ВЛ11, ДЕ1 – BASIC PROJECT 2ЕЛ4, ВЛ10

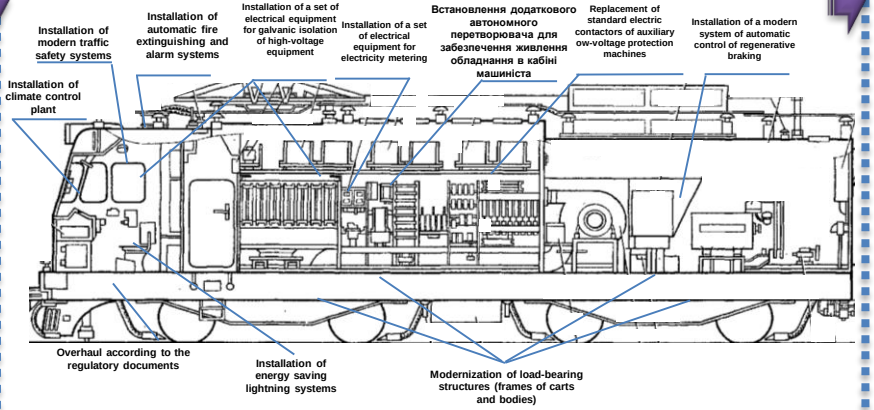
Argument 1. In the short term, it is not possible to update the required number of active fleet of freight electric locomotives, which is 387 units.
Argument 2. Developed repair base at all regional branches, including PrJSC.
Argument 3. Availability of qualified production staff.
Argument 4. Main nomenclature of spare parts and equipment is manufactured in Ukraine.

LONG-TERM:

The chosen option to solve the issue – purchase of new locomotives

Argument 1. Reduction of operating costs for repairs, due to increased maintenance periods and reduced energy costs.
Argument 2. Full compliance of the locomotive with modern technical, ergonomic and environmental requirements.
Argument 3. Improvement of working conditions of locomotive crews.
Argument 4. Modification of operation and maintenance process of locomotives.
Argument 5. Improvement of transportation process.

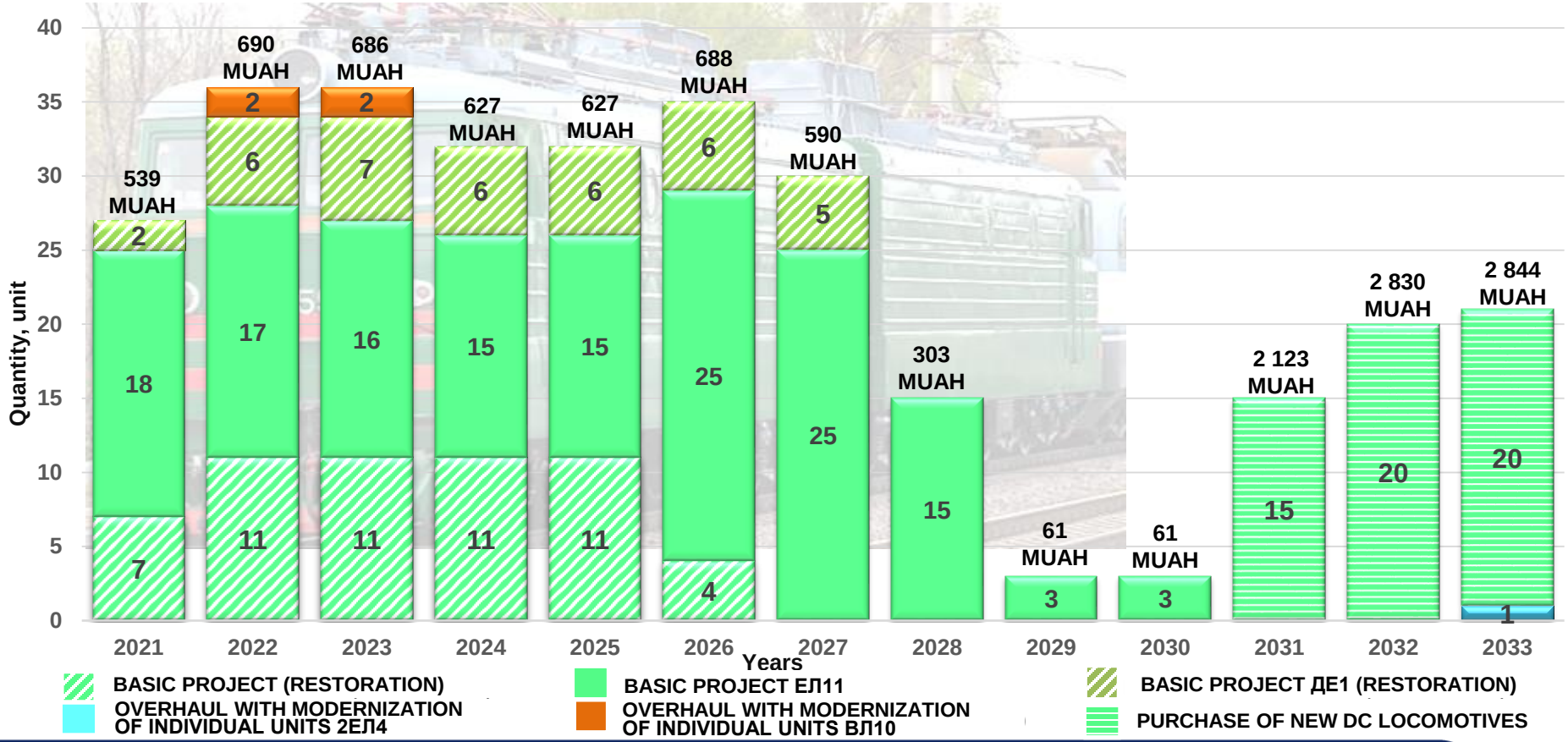
BASIC PROJECT MODEL ELECTRIC LOCO SERIES ВЛ11:



RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation of electric locomotives series ВЛ11	207	4,181
Total scope of BASIC PROJECT implementation of electric locomotives series ДЕ1	38	0,646
Total scope of overhaul with modernization of individual units of electric locomotives series 2ЕЛ4	1	0,014
Total scope of overhaul with modernization of individual units of electric locomotives series ВЛ10	4	0,044
Total scope of purchase of new electric locomotives	55	7,783
TOTAL COST	305	12,668
Writing off overstated inventory fleet (income)	490 секцій	0,41
Estimated annual savings of electricity from operation of new electric locomotive fleet, MUAH	20	
Conditions of work: Overhaul with modernization of individual units	Internal contractor (PrJSC)	
Purchase of new ones	Tender procedure, external contractor	

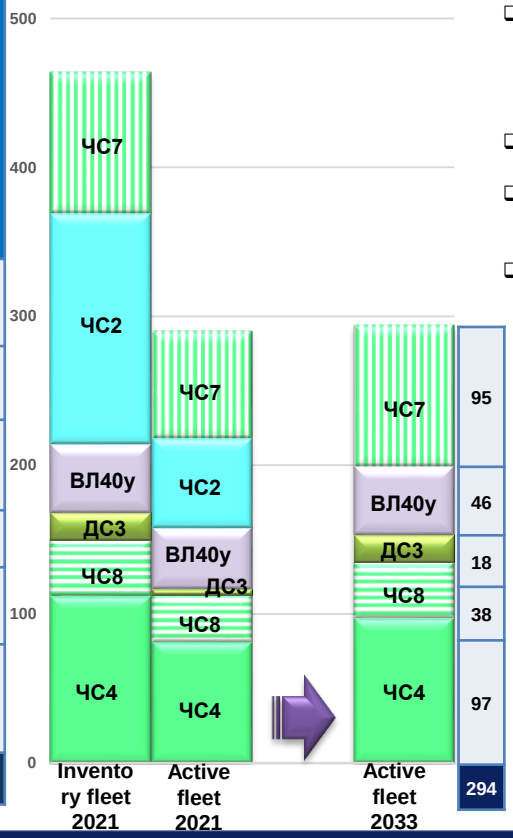
WORK WITH FREIGHT DC ELECTRIC LOCOMOTIVE FLEET UNTIL 2033



PASSENGER ELECTRIC LOCOMOTIVES

Locomotive series	Inventory fleet	Active fleet
ЧС7	95	72
ЧС2	155	60
ВЛ40у	46	41
ДС3	18	4
ЧС8	38	32
ЧС4	112	81
Total	464	290

DYNAMICS OF Active fleet



PROBLEMS:

- Main part of electric locomotive fleet was designed and manufactured in the 60-80s of last century, which operation requires increase of repair and maintenance cost by 40-60%, they have low efficiency compared to modern locomotives
- Inventory availability of mainline passenger electric locomotives exceeds actual demand by 35 %.
- The presence of electric locomotives series ЧС2, ЧС4 in the active fleet which average age exceeds 53 years is about 48 % of total active fleet of DC electric locomotives.
- Service wear of the inventory fleet of electric locomotives is 99,7 %.

OPTIONS TO SOLVE THE ISSUE OF FLEET MAINTENANCE:

OVERHAUL (with modernization of individual units)	PURCHASE OF NEW ONES
+ Relatively small capital investments	+ Compliance with modern specifications
+ Available engineering and manufacturing base	+ High level of technical readiness coefficient
+ Наявна матеріально-технічна база	+ High level of environmental parameters
- Restoration of passport specification	+ Increase of locomotive performance
- Low quality of repair	+ Decrease of transportation cost price
- Considerable costs of current maintenance	+ Service life at least 40 years
- Large amount of unscheduled repair	- Big capital investments for purchase
	- Necessity of maintenance
	- Limited market of spare parts
0,36-0,73 MUSD net of VAT	4,5 MUSD net of VAT

PRIORITIZED PERSPECTIVE:

The chosen option to solve the issue– overhaul with modernization of individual units of individual units of electric locomotives series ЧС4, ЧС7, ЧС8, ДС3 – BASIC PROJECTS, ВЛ40у

Argument 1. In the short term, it is not possible to update the required number of active fleet of passenger electric locomotives, which is 290 units.

Argument 2. Developed repair base at all regional branches, including PrJSC.

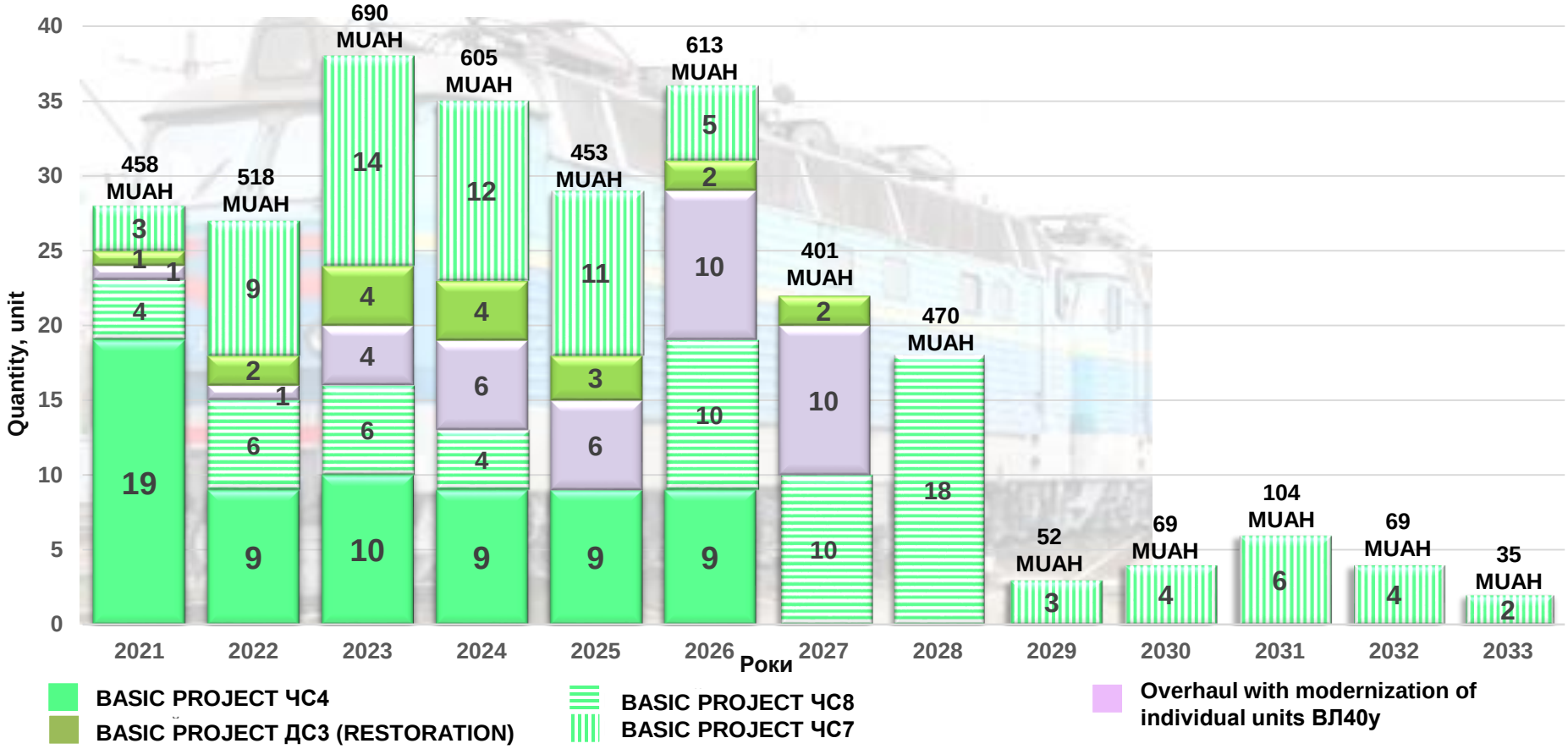
Argument 3. Availability of qualified production staff.

Argument 4. Main nomenclature of spare parts and equipment is manufactured in Ukraine

RESULT BY 2033:

Work description	Quantity, unit	Cost, bil UAH
Total scope of BASIC PROJECT implementation of electric locomotives series ЧС4	65	0,9
Total scope of BASIC PROJECT implementation of electric locomotives series ЧС8	58	1,515
Total scope of BASIC PROJECT implementation of electric locomotives series ЧС7	73	1,265
Total scope of BASIC PROJECT implementation of electric locomotives series ДС3 (restoration)	18	0,527
Total scope of overhaul with modernization of individual units of electric locomotives series ВЛ40у	38	0,33
TOTAL COST	252	4,537
Writing off overstated inventory fleet (income)	170 sections	0,15
Conditions of work: Overhaul with modernization of individual units	Internal contractor (PrJSC)	

WORK WITH PASSENGER ELECTRIC LOCOMOTIVE FLEET UNTIL 2033



MODEL FOR OVERHAUL OF ELECTRIC LOCOMOTIVES SERIES ДС3, ДЕ1

1. In the PERIOD 2021-2027, overhaul with modernization of individual units of electric locomotives series DS3, DE1 is planned - BASIC PROJECT.

2. The draft capital investment plan for the locomotive facilities for 2021 envisages the production of a prototype model of the BASIC PROJECT of the electric locomotive series DS3 and DE1 at a cost of 17 MUAH per unit.

3. BASIC PROJECT envisages to bring technical specifications of units, systems and equipment of electric locomotive in line with passport specifications, and also includes a number of modernizations.

4. A detailed list of modernizations and their scope will be determined after the production of a prototype model of electric locomotive series DS3, DE1 in 2021.

RESULT OF MAIN WORK ON MAINTENANCE OF LOCOMOTIVE FLEET UNTIL 2033:

TRS type			Work description	Bcost per unit, bil UAH	2021		2022		2023		2024		2025		2026		2027	
					un.	bil UAH	un.	bil UAH	un.	bil UAH	un.	bil UAH	un.	bil UAH	un.	bil UAH	un.	bil UAH
DIESEL LOCOMOTIVES	SHUNTING		BASIC PROJECT diesel locos series ЧМЕ3ві/	0,01113	55	0,612	61	0,679	61	0,679	68	0,757	68	0,757	70	0,779	70	0,779
	FREIGHT		BASIC PROJECT diesel locos series 2ТЕ116	0,04315	12	0,518	18	0,777	18	0,777	15	0,647	15	0,647	11	0,475	11	0,475
			ПР-3 (restoration) with replacement of cranked shaft of diesel loccomotives series 2ТЕ116	0,011	20	0,220	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
			Repair of diesel locomotives series ТЕ33АС		-	0,156	-	0,156	-	0,156	-	0,156	-	0,156	-	0,156	-	0,156
	PASSENGER		BASIC PROJECT oil locomotives series ТЕП70	0,03039	0	0,000	5	0,152	8	0,243	10	0,304	10	0,304	10	0,304	8	0,243
			Overhaul with modernization of individual units of diesel locomotives series ТЕП150 (restoration)	0,028	0	0	0	0,000	1	0,028	1	0,028	0	0,000	0	0,000	0	0,000
			Overhaul with modernization of individual units of diesel locomotives seriesТЕП150	0,020	0	0	0	0,000	0	0,000	0	0,000	0	0,000	1	0,020	1	0,020
DIESEL LOCOMOTIVES in total					87	1,506	84	1,764	88	1,883	94	1,892	93	1,864	92	1,734	90	1,673
ELECTRIC LOCOMOTIVES	FREIGHT	AC	BASIC PROJECT of electric loco series ВЛ80т,с	0,0227	28	0,635	35	0,794	35	0,794	35	0,794	35	0,794	30	0,681	30	0,681
			Overhaul with modernization of individual units of electric loco series 2ЕЛ5, 2ЭС5к	0,015	0	0	0	0	0	0	0	0	0	0	1	0,015	1	0,015
			Закупівля нових	0,14716	0	0	0	0	0	0	0	0	0	0	20	2,943	20	2,943
		DOUBLE-CURRENT	BASIC PROJECT of electric locoseries ВЛ82м	0,0258	3	0,077	6	0,155	7	0,181	8	0,206	7	0,181	6	0,155	6	0,155
			Purchase of new ones	0,16980	0	0	5	0,849	15	2,547	20	3,396	10	1,698	0	0	0	0
		DC	BASIC PROJECT of electric loco series ВЛ11	0,0202	25	0,505	28	0,566	27	0,545	26	0,525	26	0,525	29	0,586	25	0,505
			BASIC PROJECT of electric loco series ДЕ1	0,017	2	0,034	6	0,102	7	0,119	6	0,102	6	0,102	6	0,102	5	0,085
			Overhaul with modernization of individual units of electric loco series 2ЕЛ4	0,014	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Overhaul with modernization of individual units of electric loco series ВЛ10	0,011	0	0	2	0,022	2	0,022	0	0	0	0	0	0	0	0
			Purchase of new ones	0,14150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PASSENGER	AC	BASIC PROJECT of electric loco seriesЧС4	0,01385	19	0,263	9	0,125	10	0,139	9	0,125	9	0,125	9	0,125	0	0
			BASIC PROJECT of electric loco series ЧС8	0,02612	4	0,104	6	0,157	6	0,157	4	0,104	0	0	10	0,261	10	0,261
			BASIC PROJECT of electric loco series ДС3 (restoration) EXPERIMENTAL	0,017	1	0,017	0	0	0	0	0	0	0	0	0	0	0	0
			BASIC PROJECT of electric loco series ДС3 (restorationя)SERIAL	0,030	0	0	2	0,060	4	0,120	4	0,120	3	0,090	2	0,060	2	0,060
			Overhaul with modernization of individual units of electric loco series ВЛ40у	0,008	0	0	0	0	4	0,032	6	0,048	6	0,048	10	0,080	10	0,080
			Overhaul with modernization of individual units of electric loco series ВЛ40у and extension of service life	0,021	1	0,021	1	0,021	0	0	0	0	0	0	0	0	0	0
		DC	BASIC PROJECT of electric loco series ЧС7	0,01733	3	0,052	9	0,156	14	0,243	12	0,208	11	0,191	5	0,087	0	0
Total electric locomotives					86	1,709	109	3,006	131	4,898	130	5,629	113	3,753	128	5,094	109	4,785
Total TRS					173	3,215	193	4,769	219	6,781	224	7,521	206	5,617	220	6,828	199	6,458
including purchase of new TRS					0	0,000	5	0,849	15	2,547	20	3,396	10	1,698	20	2,943	20	2,943

RESULT OF MAIN WORK ON MAINTENANCE OF LOCOMOTIVE FLEET UNTIL 2033:

TRS type			WORK DESCRIPTION	2021-2025		2026-2033		Total	
				Quantity un.	Cost bil UAH	Quantity un.	Cost bil UAH	Quantity un.	Cost bil UAH
DIESEL LOCO	SHUNTING		BASIC PROJECT of diesel locomotives series ЧМЕ3ві/	313	3,484	557	6,199	870	9,683
	FREIGHT		BASIC PROJECT of diesel locomotives series 2ТЕ116	78	3,366	82	3,538	160	6,904
			ПР-3 (restoration) with replacement of cranked shaft of diesel locomotives series 2ТЕ116	20	0,220	0	0,000	20	0,220
			Repair of diesel locomotives series ТЕ33АС	-	0,780	-	1,248	30	2,028
	PASSENGER		BASIC PROJECT of diesel locomotives series ТЕП70	33	1,003	32	0,972	65	1,975
			Overhaul with modernization of individual units of diesel locomotives series ТЕП150	2	0,056	2	0,040	4	0,096
Total diesel locos				446	8,908	673	11,998	1149	20,906
ELECTRIC LOCO	FREIGHT	AC	BASIC PROJECT of electric locomotives series ВЛ80т,с	168	3,812	132	2,995	300	6,807
			Overhaul with modernization of individual units of electric locomotives series 2ЕЛ5, 2ЭС5к	0	0,000	33	0,495	33	0,495
			Purchase of new ones	0	0,000	180	26,489	180	26,489
		Double-current	BASIC PROJECT of electric locomotives series ВЛ82м	31	0,800	17	0,439	48	1,238
			Закупівля нових	50	8,490	30	5,094	80	13,584
		DC	BASIC PROJECT of electric locomotives series ВЛ11	132	2,666	75	1,515	207	4,181
			BASIC PROJECT of electric locomotives series ДЕ1	27	0,459	11	0,187	38	0,646
			Overhaul with modernization of individual units of electric locomotives series 2ЕЛ4	0	0,000	1	0,014	1	0,014
			Overhaul with modernization of individual units of electric locomotives series ВЛ10	4	0,044	0	0,000	4	0,044
			Purchase of new ones	0	0,000	55	7,783	55	7,783
	PASSENGER	AC	BASIC PROJECT of electric locomotives series ЧС4	56	0,776	9	0,125	65	0,900
			BASIC PROJECT of electric locomotives series ЧС8	20	0,522	38	0,993	58	1,515
			BASIC PROJECT of electric locomotives series ДС3 (відновлення)	14	0,407	4	0,120	18	0,527
			Overhaul with modernization of individual units of electric locomotives series ВЛ40у	18	0,170	20	0,160	38	0,330
		DC	BASIC PROJECT of electric locomotives series ЧС7	49	0,849	24	0,416	73	1,265
Total electric loco				569	18,995	629	46,823	1 198	65,818
Total TRS				1 015	27,904	1 302	58,821	2 347	86,725
Including purchase of new TRS				50	8,490	265	39,365	315	47,855

Note: The estimated cost of project implementation (**BASIC, EXTENDED, COMPLEX, OPTIONS**) is for information only in accordance with the expert assessment, the list of modernizations may be adjusted. Final cost will be forme based on the results of development (updating) of relevant modernization projects and their calculations.