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The Impact of Political Risk on the Economic Efficiency of Russian Renewable Energy Projects

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ABSTRACT

This article is the second of the author's works devoted to a comprehensive study of the economic efficiency of Russian renewable energy (RE) projects. The main goal of this paper is to study the level of influence of political risk on the economic efficiency of RE projects that are implemented in the Russian energy market using a state support program. Fifty-two solar, wind and small hydropower projects, which have received support in the form of a capacity-based support scheme in 2018-2020, were selected as objects of research. The methodological basis of the work was the classical methods of investment analysis and specific industry approach. They were supplemented with the author's tool for calculating the monetary equivalent of political risk that takes into account the probability of the termination of support from the state. The practice-based assessment utilized the developed scenarios depending on changes in foreign and domestic international credit ratings of the country. The study of the impact of political risk for three stages of RE projects was carried out. Based on the results of the analysis, conclusions were drawn about generally insignificant influence of political risk on the economic efficiency of Russian RE projects. Recommendations for the development of state support programs in the event of the impact of political risks only were generated. The obtained research results are of practical and methodological value. It will be used in studying the impact of other specific risks on the effectiveness of Russian RE projects, as well as in developing recommendations enabling the Russian RE market to give up state support.

1. INTRODUCTION

Risks caused by political factors have a huge impact on the effectiveness of renewable energy (RE) projects and their value in particular. According to references [1-7], political risk in RE projects usually includes the following:

- Risks of a sudden change in the strategy for the development of RE and support schemes for the sector, such as a complete change or rejection of the existing support scheme, retroactive changes in the support scheme. This contributes to a decrease in the effectiveness of mechanisms to stimulate the development of RE [5, 7].
- Financial aspects of investors' dependence on state programs. This is due to the instability of the volume or duration of support [1-3].
- Regulatory risk involving imperfection of legislation: the emergence of legal obstacles to the participation of independent electricity producers, the absence of an independent regulatory body, and the lack of comprehensive consideration of all risks, etc. [4-7].

In this paper, political risk is viewed as caused by the provision of state support to Russian RE projects in the form of preferentially priced capacity contracts for the wholesale market (CPS RES) [1] and is associated with the probability of its complete termination or limitation of volumes. The peculiarity of this program consists in conducting competitive selection of projects for the construction of generating facilities operating on the basis of RE, and the signing of 15-year CPS RES for selected projects [8, 9].

The main objective of this work is to study the degree of the influence of political risk on the economic efficiency of Russian RE projects in various scenario conditions during the 15-year term of the CPS RES program. In addition, the task is to systematize methodological recommendations on political risk management within the framework of state support programs for the sector.

The article has the following structure. The second section presents a methodology for assessing the economic efficiency of RE projects based on classical and industry-specific tools; the author proposes an approach to assessing the value of political risk of RE projects based on rating assessment. The initial assessment of the impact of political risk on the effectiveness of projects and the relevant conclusions are presented in the third paragraph. The fourth section contains the main results of the scenario pre-default assessment of the impact of political risk on RE projects. In the conclusions part, the main results of the work are summarized, reasonable conclusions are made about the overall insignificance of the impact of political risk on the economic efficiency of the sector's projects, and directions for adjusting the support programs for RE projects by their types are proposed.

2. METHODS FOR ASSESSING THE ECONOMIC EFFICIENCY OF RE PROJECTS AND THE VALUE OF POLITICAL RISK

This paragraph provides the description of classical (section 2.1) and industry-specific (section 2.2) approaches used in the process of assessing the economic efficiency of Russian projects. Section 2.3 contains the tools suggested by the author for assessing the value of political risk for the RE projects.

2.1 Evaluation of the economic efficiency of projects

The general methodology for assessing the economic efficiency of projects is based on the calculation of generally accepted criteria: Net Present Value (NPV), Internal Rate of Return, and Discounted Payback Period [10-13].

The cash flow for RE projects takes into account the following components [14, 15]:

- The volume of investments during the construction period of the RE facility.
- Revenue received from the sale of capacity on the wholesale market (during the first 15 years as per the terms of the CPS RES, then - at the market price).
- Revenue generated from the sale of electricity on the wholesale market: from the moment when the facility is put into operation, taking into account the planned average annual output and the market price of electricity.

The discount rate is calculated according to the Irving Fisher formula [16], taking into account the following assumptions:

- The average annual inflation is assumed for the 2018-2020 project selection period at the level of 4% [17].
- The nominal return on projects is fixed in accordance with the law [14] at the level of 12%.

2.2 Calculation of revenue (price) for capacity

The industry-specific approaches to evaluating the effectiveness of Russian projects are related to the calculation of the actual value of the revenue generated by the facility from the sale of capacity in the energy market during the 15-year term of the CPS RES. This indicator is calculated annually and individually for each project.

The rules for determining the price for the capacity of generating facilities operating on the basis of RES are regulated by the Decree of the Russian Government N449 [14]. This paper applies the methodology adopted for projects selected before 1 January 2021.

The price for the capacity of a generating facility is determined as the multiplication of the share of costs compensated by the capacity fee and the total costs, including: (1) capital expenditures, (2) operational expenditures, and (3) property tax costs [14, 15]. The method- ology for calculating the price for capacity under the CPS RES program is presented in more detail in the author's article [15].

2.3 Assessment of the political risk value

To assess the value of political risk, the author suggested the following hypothesis. The more stable the state's position in the domestic and international arenas, the less likely it is to face financial and other difficulties, in other words, the lower the probability of default. Under such conditions, the implementation of various state programs, including support for RE projects, is more stable, and the political risk is minimal [2, 3].

To assess the declared degree of stability of the state's position, it is proposed to use a rating approach - the average value of national credit ratings assigned to the state by domestic and foreign rating agencies. The averaging of assigned ratings is used to ensure the degree of objectivity of such a qualitative assessment method. The probability of political risk, i.e., the probability of a default by the state and the impossibility of providing state support to sector projects corresponds to the probability of a default on the received rating, taking into account the number of years from the date of rating assignment.

The monetary equivalent of political risk in each period 'i' is calculated by the Eq (1):

$$PR_i = PD_i \cdot RC_i, \quad (1)$$

where, PR_i is political risk; PD_i is probability of default; RC_i is the amount of state support; period i is the year of project implementation, i=0, …, 14, period '0' is the year of launching the construction of the RE facility.

The amount of state support in each period is equal to the revenue received by the facility from the sale of capacity in the energy market in accordance with the CPS RES. Political risk is only taken into account during the first 15 years of the implementation of RE projects when state support is provided.

3. PRIMARY CALCULATION OF THE VALUE OF POLITICAL RISK

3.1 Brief description of RE projects

For the period 2018-2020, 52 RE projects were competitively selected and approved for implementation [18], including: 34 wind power plants (WPP), 11 solar power plants (SPP), and 7 small hydroelectric power plants (SHPP). Their brief characteristics are presented in Table 1 of the article [15]. The results of the evaluation of the economic efficiency of these projects are quantitatively presented in Table 2 [15], the main conclusions - in the fourth paragraph of the work [15].

Table 1. The comparison of the international scales of four rating agencies

ACRA	S&P	Fitch	Moody's
…	…	…	…
A	A	A	A
BBB	BBB	BBB	Baa
BB	BBB-	BB	
B	BB+	B	Ba
CCC	BB		B
CC	B, CCC	CCC	Caa
C	CC	CC, C	Ca
RD	-	-	
…	…	…	…

3.2 Assessment of the value of political risk

For the primary calculation of the value of political risk, the national ratings assigned to Russia by leading Russian and foreign rating agencies were used. Initial calculations were carried out at the beginning of December 2021. Among the Russian rating agencies accredited by the Bank of Russia, the rating assigned by the Analytical Credit Rating Agency

(ACRA) is taken into account. Other domestic rating agencies are not included in this sample as they do not establish a national credit rating. Therefore, the national rating assigned to Russia by the ACRA agency at the level of 'A' on the international scale will be used as initial data; the forecast is 'stable' [19]. International rating agencies include Standard & Poor's Global Ratings (S&P), Fitch Ratings and Moody's, which cover 95% of the global market [20]. The ratings assigned to Russia on the international scale as of December 2021 are as follows: S&P: 'BBB-', Fitch: 'BBB'; and Moody's: 'Baa3', all ratings had 'stable' forecast.

A 'stable' forecast means that the assigned rating will not change with a high degree of probability. Therefore, for the purposes of testing the approach, it is conditionally assumed that the assigned ratings will not change significantly during the 15-year period.

To estimate the average probability of a default, the international scales of four rating agencies are compared in Table 1 [21-24].

As a result, the average value of ratings assigned to Russia on the international scale is 'BBB'. The distribution of the probability of a default by a state with a 'BBB' rating in accordance with the calculations of the S&P agency [21] and the forecast compiled for a 15-year period is presented in Table 2.

To study the impact of the value of political risk on the economic efficiency of RE projects, the author suggested calculating economic efficiency indicators in the following three stages. The first stage is the decision on the implementation of the project (zero project period). The second stage is before the commissioning of the facility. The third stage is during the 15-year period of the facility operation.

Table 2. Probability of default with a 'BBB' rating by period, %

Number of years from the date of receiving the rating (fact by rating)										Forecast				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0,21	0,6	1,02	1,53	2,06	2,56	3,01	3,45	3,89	4,33	4,96	5,52	6,09	6,69	7,3

It should be noted that the fourth stage of the project, lasting up to the full planned life, is not taken into account in this study, since the period of the CPS RES program, and, consequently, the influence of political risk ceases at the end of the third stage.

Then the distribution of the value of political risk calculated according to the Eq. (1) and the indicators of economic efficiency (initial NPV and NPV taking into account risk) by stages are presented in Tables 3-5. Calculations show that the dynamics of changes in the value of political risk in all projects for all types of RE are similar: a gradual increase in the value of risk by the end of the CPS RES program. This is naturally due to a gradual increase in the probability of termination of state support closer to the completion of the CPS RES (Table 2) and the absolute value of support for the project in the form of capacity revenue.

3.3 The impact of the value of political risk on the effectiveness of projects ('BBB' rating)

Calculations shown that the value of political risk at the level of the 'BBB' rating do not significantly affect the economic efficiency of Russian RE projects.

Table 3. The value of political risk and NPV in wind energy projects ('BBB' rating)

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect	Project	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect
Experi-	NPV (initial)	-387778	-1083562	142046	522938	3	WPP	-481870	-1346377	26209,90	551809	3
mental	NPV (risk)	-387874	-1084015	134648	522938	3	Wind-	-482036	-1347167	13614,34	551809	3
WPP-121	Value of risk	95,66	453,14	7397,60	-		Farm-38	165,65	790,51	12595,56	-	
Experi-	NPV (initial)	-291057	-813296	107087	393371	3	WPP	-481870	-1346377	-3111,15	504198	4
mental	NPV (risk)	-291129	-813636	101538	393371	3	Wind-	-482036	-1347167	-15706	504198	4
WPP-127	Value of risk	71,80	340,12	5549,52	-		Farm-48	165,65	790,51	12595,56	-	
Experi-	NPV (initial)	-775557	-2167124	284092	1045876	3	WPP	-481870	-1346377	-3111,15	504198	4
mental	NPV (risk)	-775749	-2168030	269297	1045876	3	Wind-	-482036	-1347167	-15706	504198	4
WPP-130	Value of risk	191,33	906,28	14795,1	-		Farm-49	165,65	790,51	12595,56	-	
Experi-	NPV (initial)	-436251	-1219007	159973	588579	3	Experi-	-399707	-1346784	-293682	44928,9	4
mental	NPV (risk)	-436358	-1219517	151651	588579	3	mental	-399844	-1348393	-301558	44928	4
WPP-128	Value of risk	107,62	509,78	8322,29	-		WPP-52	137,41	1609,23	7876,14		-
Experi-	NPV (initial)	-387778	-1083562	142046	522938	3	WPP	-320514	-1396471	-284221	190902	4
mental	NPV (risk)	-387874	-1084015	134648	522938	3	Wind-	-320695	-1398140	-297383	190902	4
WPP-125	Value of risk	95,66	453,14	7397,60	-		Farm-61	180,31	1668,60	13162,82	-	
Experi-	NPV (initial)	-775557	-2167124	284092	1045876	3	WPP	-340643	-1484170	-390705	73407	4
mental	NPV (risk)	-775749	-2168030	269297	1045876	3	Wind-	-340835	-1485944	-403940	73407	4
WPP-129	Value of risk	191,33	906,28	14795,1	-		Farm-59	191,63	1773,39	13235,15	-	
Experi-	NPV (initial)	-1058009	-2041520	345201	1011803	3	WPP	-340643	-1484170	-390705	73407	4
mental	NPV (risk)	-1058176	-2041990	332327	1011803	3	Wind-	-340835	-1485944	-403940	73407	4

WPP-131	Value of risk	166,93	470,01	12874	-		Farm-60	191,63	1773,39	13235,15	-

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect	Project	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect
Stavropol	NPV (initial)	-761640	-3310612	-86903	1153968	4	WPP	-340643	-1484170	-390705	73407	4
WPP-24	NPV (risk)	-761981	-3313834	-112233	1153968	4	Wind-	-340835	-1485944	-403940	73407	4
	Value of risk	341,70	3222,47	25329	-		Farm-57	191,63	1773,39	13235,15	-	
WPP	NPV (initial)	-709495	-709495	-128632	163546	4	WPP	-340643	-1484170	-390705	73407	4
Wind-	NPV (risk)	-709607	-709607	-135576	163546	4	Wind-	-340835	-1485944	-403940	73407	4
Farm-35	Value of risk	112,15	112,15	6944,36	-		Farm-58	191,63	1773,39	13235,15	-	
WPP	NPV (initial)	-859865	-859865	-166725	183849	4	WPP	-309110	-1346784	-187937	334160	4
Wind-	NPV (risk)	-860001	-860001	-175090	183849	4	Wind-	-309284	-1348393	-200739	334160	4
arm-34	Value of risk	135,91	135,91	8364,77	-		Farm-52	173,89	1609,23	12802,51	-	
WPP	NPV (initial)	-717446	-717446	-140167	152011	4	WPP	-312598	-1361981	-202246	319851	4
Wind-	NPV (risk)	-717560	-717560	-147141	152011	4	Wind-	-312774	-1363609	-215096	319851	4
Farm-36	Value of risk	113,40	113,40	6973,96	-		Farm-51	175,85	1627,39	12850,37	-	
WPP	NPV (initial)	-712180	-712180	-187477	76727	4	WPP	-317472	-1383216	-119904	475133	4
Wind-	NPV (risk)	-712293	-712293	-194431	76727	4	Wind-	-317651	-1384869	-133025	475133	4
Farm-31	Value of risk	112,57	112,57	6954,36	-		Farm-71	178,60	1652,76	13121,08	-	
WPP	NPV (initial)	-717411	-717411	-195064	69140	4	WPP	-317493	-1383305	-181530	364904	4
Wind-	NPV (risk)	-717524	-717524	-202038	69140	4	Wind-	-317671	-1384958	-194651	364904	4
Farm-32	Value of risk	113,40	113,40	6973,83	-		Farm-74	178,61	1652,87	13121,36	-	
Experi-	NPV (initial)	-608806	-608806	-378672	-209366	N/A*	WPP	-348753	-1519508	-309763	236671	4
mental	NPV (risk)	-608902	-608902	-383203	-209366	N/A	Wind-	-348950	-1521323	-323313	236671	4
WPP-67	Value of risk	96,23	96,23	4531,13	-		Farm-75	196,19	1815,61	13550,27	-	

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect	Project	First stage	Second stage	Third stage	Fourth stage	The stage of positive effect
WPP	NPV (initial)	-481870	-1346377	115420	696670	3	WPP	-348753	-1519508	-181130	466893	4
Wind-	NPV (risk)	-482036	-1347167	102825	696670	3	Wind-	-348950	-1521323	-194680	466893	4
Farm-41	Value of risk	165,65	790,51	12595,5	-		Farm-78	196,19	1815,61	13550,27	-	
WPP	NPV (initial)	-481870	-1346377	115420	696670	3	WPP	-348753	-1519508	-344065	175279	4
Wind-	NPV (risk)	-482036	-1347167	102825	696670	3	Wind-	-348950	-1521323	-357615	175279	4
Farm-42	Value of risk	165,65	790,51	12595,	-		Farm-82	196,19	1815,61	13550,27	-	
WPP	NPV (initial)	-481870	-1346377	26209	551809	3	WPP	-360179	-1569290	-390934	128410	4
Wind-	NPV (risk)	-482036	-1347167	13614	551809	3	Wind-	-360382	-1571165	-404641	128410	4
Farm-37	Value of risk	165,65	790,51	12595,5	-		Farm-83	202,62	1875,10	13707,04	-	

*N/A - not achieved

Table 4. The value of political risk and NPV in the solar energy projects ('BBB' rating)

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage	Project	First stage	Second stage	Third stage	Fourth stage	The stage
SPP-2022-1	NPV (initial)	-59903	-167431,62	107754,27	205278,76	3	Saratov SPP	-202387	-565483	43276,93	231545,25	3
	NPV (risk)	-59924	-167529,34	105356,28	205278,76	3		-202457,27	-565815	36688,03	231545,25	3
	Value of risk	20,58	97,72	2397,98	-			69,58	332,02	6588,90	-	
SPP - 2018-1	NPV (initial)	-567480	-567480,17	-343729	-228543	N/A	Orenburg SPP	-223810,72	-625341	14412,52	222025,59	3
	NPV (risk)	-567569	-567569,46	-349091	-228543	N/A		-223887,66	-625708	7644,27	222025,59	3
	Value of risk	89,29	89,29	5361,60	-			76,94	367,16	6768,25	-	
SPP - 2018-2	NPV (initial)	-283742	-283742,41	-171819	-114201	N/A	Privolzhskaya	-225099,71	-628942	-8541,13	187000,81	4
	NPV (risk)	-283787	-283787,06	-174500	-114201	N/A	SPP	-225177,09	-629311	-15320,17	187000,81	4
	Value of risk	44,65	44,65	2680,81	-			77,38	369,28	6779,04	-	
SPP - 2018-3	NPV (initial)	-1333600	-1333600	-638654	-277332	N/A	Privolzhskaya	-165020,79	-593807	60527,27	281696,94	3

	NPV (risk)	-1333810	-1333810	-651254	-277332	N/A	SPP -1	-165094,80	-594333	53146,39	281696,94	3
	Value of risk	209,84	209,84	12599,85	-			74,01	525,57	7380,89	-	
Astrakhan	NPV (initial)	-228089	-637296,43	118302,00	359864,31	3	SPP Kalmykia	-146105,94	-525744	103212,98	334349,26	3
SPP	NPV (risk)	-228167	-637670,61	110519,02	359864,31	3		-146171,47	-526210	96694,88	334349,26	3
	Value of risk	78,41	374,18	7782,98	-			65,53	465,33	6518,10	-	
Kalmykia	NPV (initial)	-200144	-559217,24	118266,45	349402,73	3						
SPP	NPV (risk)	-200213	-559545,58	111696,33	349402,73	3						
	Value of risk	68,80	328,34	6570,12	-							

Table 5. The value of political risk and NPV in the small hydropower projects (‘BBB’ rating)

Project	Indicators, thousand rubles	First stage	Second stage	Fourth stage	Third stage	The stage	Project	First stage	Second stage	Third stage	Fourth stage	The stage
SHPP -1_1	NPV (initial)	-680624	-1900532	-1325168	-941320,99	N/A	SHPP	-364133	-702406	-450768,73	-219078	N/A
	NPV (risk)	-680858	-1901658	-1335420	-941320,99	N/A	Prosyanskij	-364223	-702663	-454676,41	-219078	N/A
	Value of risk	233,89	1126,46	10251,90	-		sbros BSK	90,24	256,86	3907,68	-	
Bashennaya SHPP	NPV (initial)	-416023	-1161676	-672595	-267216,43	N/A	Gorko-	-468171	-903093	-579578	-281711	N/A
	NPV (risk)	-416166	-1162365	-678842,91	-267216,43	N/A	Balkovskaya	-468287	-903423	-584602	-281711	N/A
	Value of risk	142,96	688,54	6247,90	-		SHPP	116,02	330,24	5024,15	-	
SHPP	NPV (initial)	-798703	-2230249	-1398686	-751192,96	N/A	Nizhne-	-544095	-2361209	-1366997	-587684	N/A
Psygansu	NPV (risk)	-798978	-2231570	-1410660	-751192,96	N/A	Krasnogor-	-544402	-2364166	-1380460	-587684	N/A
	Value of risk	274,46	1321,89	11973,78	-		skaya SHPP	306,36	2957,20	13463,07	-	
SHPP	NPV (initial)	-306125	-854860	-567852,93	-372028,73	N/A						
Segozerskaya	NPV (risk)	-306230	-855367	-572611,14	-372028,73	N/A						
	Value of risk	105,36	506,76	4758,20	-							

3.3.1 Wind energy projects

In wind energy projects, the share of political risk in the initial NPV increases from 0.04% and 0.07% in the first and second stages, respectively, to 32% in the third stage. It is by this amount that the NPV, which was calculated taking into account the cost of risk, is reduced (Table 3). However, such an increasing negative impact of political risk does not reduce the current ability of the projects to achieve economic results at the previous stage. As shown in Table 3, all projects retain the initial stage of achieving a positive economic effect.

3.3.2 Solar energy projects

In solar energy projects, the impact of political risk on the NPV indicator is significantly lower compared to wind energy - with a similar value in the first two stages, the average risk share is 16.3% in the third stage (Table 4). The stages of achieving a positive economic result also remained unchanged.

3.3.3 Small hydropower projects

In the presented hydropower projects, the average share of political risk is the lowest among all the studied cases: 0.03%, 0.06%, and 0.87% at each stage, respectively. This is due to higher specific investments in hydropower projects. Nevertheless, the submitted projects are initially economically inefficient (Table 5), and additional consideration of the value of political risk further reduces this indicator.

4. SCENARIO ASSESSMENT OF THE VALUE OF POLITICAL RISK

4.1 Brief description of scenarios

Three scenarios were developed to assess the value of political risk under the influence of a set of rapidly changing external factors. The first scenario - with only the rating assigned to the state by the domestic agency ACRA taken into account - ‘A-’ on an international scale, the forecast is ‘stable’. The second scenario - with only new ratings assigned by foreign agencies [25]: S&P Global Ratings - ‘CC’, ‘negative’ forecast (assigned 18 March 2022); Fitch Ratings - ‘C’, ‘negative’ forecast (assigned 09 March 2022); Moody’s - ‘Ca’, ‘negative’ forecast (assigned 06 March 2022) - taken into account, the average rating is equivalent to ‘CC’ (Table 1). The third scenario - with current ratings assigned by Russian and foreign agencies factored in, the average rating is equal to ‘BB’ (Table 1).

The initial assessment showed that the credit rating at the level of ‘BBB’ does not significantly affect the economic efficiency of RE projects. In this case, it is natural that the estimated ratings in the first and third scenarios will also not have a significant impact on the final performance indicators. Therefore, subsequent calculations will be carried out for the most pessimistic second scenario, according to which the national rating of the state sharply decreases to the pre-default value of ‘CC’.

4.2 The impact of the value of political risk on the effectiveness of projects ('CC' rating)

The distribution of the probability of default estimated by S&P [21] and the calculated fore- cast for the 'CC' rating is presented in Table 6. The distribution of the value of political risk by stages and the value of NPV indicators, taking into account new conditions, are presented in Tables 7-9.

Table 6. Probability of default with a rating of 'CC' by probability of default with a rating of 'CC' by period, %

Number of years from the date of receiving the rating (fact by rating)										Forecast				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
26,87	36,05	41,23	44,27	46,75	47,77	48,85	49,67	50,64	51,35	51,86	52,38	52,90	53,43	53,96

Table 7. The value of political risk and NPV in wind energy projects ('CC' rating)

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage	Project	First stage	Second stage	Third stage	Fourth stage	The stage
Experimental	NPV (risk)	-400019,41	-1101878,79	87355,58	522938,44	3	WPP	-503066	-1378331	-66909,91	551809,86	4
WPP-121	Value of risk	12240,46	18316,57	54690,89	-		Wind-Farm-38	21195,79	31953,85	93119,81	-	
Experimental	NPV (risk)	-300245,34	-827044,79	66059,82	393371,03	3	WPP	-503066	-1378331	-96230,96	504198,40	4
WPP-127	Value of risk	9187,41	13747,99	41027,99	-		Wind-Farm-48	21195,79	31953,85	93119,81	-	
Experimental	NPV (risk)	-800038,83	-2203757,59	174711,17	1045876,88	3	WPP	-503066	-1378331	-96230,96	504198,40	4
WPP-130	Value of risk	24480,93	36633,14	109381,79	-		Wind-Farm-49	21195,79	31953,85		-	
Experimental	NPV (risk)	-450021,84	-1239613,64	98446,69	588579,78	3	Experi-	-417289	-1383304	-351911	44928,99	4
WPP -128	Value of risk	13770,52	20606,14	61527,26	-		mental WPP-52	17581,71	36520,15	58228,84	-	
Experimental	NPV (risk)	-400019,41	-1101878,79	87355,58	522938,44	3	WPP	-343585	-1434338	-381534	190902,42	4
WPP-125	Value of risk	12240,46	18316,57	54690,89	-		Wind-Farm-61	23070,85	37867,50	97313,59	-	
Experimental	NPV (risk)	-800038,83	-2203757,59	174711,17	1045876,88	3	WPP	-365163	-1524416	-488553	73407,68	4
WPP-129	Value of risk	24480,93	36633,14	109381,79	-		Wind-Farm-59	24519,72	40245,60	97848,32	-	
Experimental	NPV (risk)	-1079368,80	-2069759,83	250020,29	1011803,82	3	WPP	-365163	-1524416	-488553	73407,68	4
WPP-131	Value of risk	21359,02	28239,81	95181,64	-		Wind-Farm-60	24519,72	40245,60	97848,32	-	
Stavropol	NPV (risk)	-805361,62	-3383743,66	-274169,19	1153968,73	4	WPP	-365163	-1524416	-488553	73407,68	4
WPP-24	Value of risk	43721,39	73131,32	187266,17	-		Wind-Farm-57	24519,72	40245,60	97848,32	-	
WPP	NPV (risk)	-723844,33	-723844,33	-179972,49	163546,48	4	WPP	-365163	-1524416	-488553	73407,68	4
WindFarm-35	Value of risk	14349,22	14349,22	51340,13	-		Wind-Farm-58	24519,72	40245,60	97848,32	-	
Project	**Indicators, thousand rubles**	**First stage**	**Second stage**	**Third stage**	**Fourth stage**	**The stage**	**Project**	**First stage**	**Second stage**	**Third stage**	**Fourth stage**	**The stage**
WPP	NPV (risk)	-877255,52	-877255,52	-228566,57	183849,73	4	WPP	-331360	-1383304	-282587	334160,06	4
WindFarm-34	Value of risk	17390,39	17390,39	61841,27	-		Wind-Farm-52	22249,97	36520,15	94649,78	-	
WPP Wind-	NPV (risk)	-731956,65	-731956,65	-191726,39	152011,40	4	WPP	-335099	-1398914	-297249	319851,53	4
Farm-36	Value of risk	14510,04	14510,04	51558,95	-		Wind-Farm-51	22501,05	36932,26	95003,61	-	
WPP Wind-	NPV (risk)	-726584,49	-726584,49	-238891,38	76727,91	4	WPP	-340324	-1420724	-216909	475133,62	4
Farm-31	Value of risk	14403,54	14403,54	51414,04	-		Wind-Farm-71	22851,87	37508,08	97005,00	-	
WPP Wind-	NPV (risk)	-731920,59	-731920,59	-246622,84	69140,39	4	WPP	-340346	-1420816	-278537	364904,72	4
Farm-32	Value of risk	14509,32	14509,32	51557,98	-		Wind-	22853,34	37510,48	97007,07	-	

							Farm-74					
Experimental	NPV (risk)	-621119,11	-621119,11	-412171,70	-209366,96	N/A	WPP	-373857	-1560712	-409941	236671,90	4
WPP-67	Value of risk	12312,84	12312,84	33498,95	-		Wind-Farm-75	25103,52	41203,83	100178,04	-	
WPP Wind-	NPV (risk)	-503066,62	-1378331,16	22300,96	696670,25	3	WPP	-373857	-1560712	-281308	466893,90	4
Farm-41	Value of risk	21195,79	31953,85	93119,81	-		Wind-Farm-78	25103,52	41203,83	100178,04	-	
WPP Wind-	NPV (risk)	-503066,62	-1378331,16	22300,96	696670,25	3	WPP	-373857	-1560712	-444243	175279,37	4
Farm-42	Value of risk	21195,79	31953,85	93119,81	-		Wind-Farm-82	25103,52	41203,83	100178,04	-	
WPP	NPV (risk)	-503066,62	-1378331,16	-66909,91	551809,86	4	WPP	-386105	-1611844	-492271	128410,22	4
WindFarm-37	Value of risk	21195,79	31953,85	93119,81	-		Wind-Farm-83	25925,96	42553,75	101337,03	-	

Table 8. The value of political risk and NPV in solar energy projects ('CC' rating)

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage	Project	First stage	Second stage	Third stage	Fourth stage	The stage
SPP-2022-1	NPV (risk)	-62536,85	-171381,78	90025,82	205278,76	3	Saratov SPP	-211290	-578904,64	-5435,21	231545,25	4
	Value of risk	2633,12	3950,17	17728,45	-			8902,32	13420,75	48712,13	-	
SPP - 2018-1	NPV (risk)	-578905,25	-578905,25	-383368,58	-228543,20	N/A	Orenburg SPP	-233655	-640182,53	-35625,57	222025,59	4
	Value of risk	11425,08	11425,08	39638,69	-			9844,64	14841,35	50038,09	-	
SPP - 2018-2	NPV (risk)	-289455,00	-289455,00	-191638,76	-114201,07	N/A	Privolzhskaya	-235001	-643869,53	-58659,00	187000,81	4
	Value of risk	5712,59	5712,59	19819,41	-		SPP	9901,34	14926,83	50117,87	-	
SPP - 2018-3	NPV (risk)	-1360449,64	-1360449,64	731806,27	277332,96	N/A	Privolzhskaya	-174490	-609014,81	5959,91	281696,94	3
	Value of risk	26849,37	26849,37	93151,51	-		SPP -1	9469,69	15207,14	54567,37	-	
Astrakhan	NPV (risk)	-238122,37	-652421,52	60761,96	359864,31	3	SPP Kalmykia	-154490	-539208,90	55024,28	334349,26	3
SPP	Value of risk	10032,85	15125,09	57540,04	-			8384,26	13464,08	48188,70	-	
Kalmykia	NPV (risk)	-208948,51	-572489,26	69693,13	349402,73	3						
SPP	Value of risk	8803,66	13272,02	48573,32	-							

Table 9. The value of political risk and NPV in small hydropower projects ('CC' rating)

Project	Indicators, thousand rubles	First stage	Second stage	Third stage	Fourth stage	The stage	Project	First stage	Second stage	Third stage	Fourth stage	The stage
SHPP -1_1	NPV (risk)	-710551,28	-1946065,90	-1325169,11	-941320,99	N/A	SHPP Prosyanskij	-375679	-717839,07	-479658	-219078,61	N/A
	Value of risk	29926,53	45533,39	0,15	-		sbros BSK	11546,19	15432,83	28889,70	-	
Bashennaya	NPV (risk)	-434315,50	-1189508,21	-718786,15	-267216,43	N/A	Gorko-Balkovskaya	-483016	-922935,95	-616722	-281711,45	N/A
SHPP	Value of risk	18292,21	27831,71	46191,14	-		SHPP	14845,10	19842,21	37143,89	-	
SHPP	NPV (risk)	-833822,25	-2283681,86	-1487209,74	-751192,96	N/A	Nizhne-Krasnogorska-	-583295	-2428320,29	-1466530	-587684,03	N/A
Psygansu	Value of risk	35118,38	53432,82	88522,95	-		ya SHPP	39199,78	67111,14	99533,31	-	
SHPP	NPV (risk)	-319605,60	-875344,31	-603030,64	-372028,73	N/A						
Segozerskaya	Value of risk	13480,60	20483,97	35177,71	-							

4.2.1 Wind energy projects

The level of influence of political risk in wind energy projects increases significantly in the new conditions. Its average shares are 4.8%, 2.3%, and 236.4% at each stage, respectively. Such an increase in the share of political risk is provided primarily by three projects ('WPP WindFarm-48', 'WPP WindFarm-49' [in each - almost 3000% of NPV], and 'Stavropol WPP-24' [215%]), in which the payback period is initially achieved only at the fourth stage. In addition, two wind energy projects ('WPP WindFarm-37' and 'WPP WindFarm-38') have a payback period migrated from the third to the fourth stage. This means that under the new set

conditions, these projects fail to achieve a positive economic result within the term of the CPS RES.

4.2.2 Solar energy projects

Similar trends are typical for solar energy projects. The average share of political risk by stages increases to 4%, 2.3% and 120.7%, respectively. The greatest increase in the risk share is shown by the project 'Privolzhskaya SPP' (almost 600% of NPV at the third stage), which becomes cost-effective only at the fourth stage. Along with this, in two projects ('Saratov SPP' and 'Orenburg SPP'), the payback period also migrated from the third to the fourth stage.

4.2.3 Small hydropower projects

Undoubtedly, in hydropower projects, the share of political risk also increases in stages to 4.5%, 2.4%, and 5.6%, respectively. However, this growth is less significant compared to wind and solar energy projects. Naturally, such projects remain economically impractical under the conditions of deteriorating national ratings and the increasing influence of political risk.

5. CONCLUSIONS

The calculations have shown that under basic conditions, when the national rating is fixed at the average level of 'BBB', the economic efficiency of Russian RE projects decreases. Thus, by the end of the CPS RES program, the NPV of wind projects may decrease by up to 32%, solar energy - 16%, and hydropower - less than 1% under the influence of political risk. However, in such external conditions, Russian projects have enough resilience to maintain the initial stages of payback at the same level, including a third of projects within the framework of the CPS RES program.

In stressful conditions, when the national rating is reduced to the critical level of 'CC', due to individual projects, the impact of political risk on NPV can reach 236% in wind energy projects, 121% - in solar energy and up to 6% - in small hydropower. Nevertheless, calculations have shown that the margin of safety is also sufficient and the breakeven point of only four of the 52 projects (two each in wind and solar energy) migrated from the third to the fourth stage of project implementation. The other projects remained at the previous payback stages and none of the previously effective projects entered the default zone.

As a result, this means that at the present moment the necessary conditions have been created in the Russian energy market not only to achieve a positive economic result by RE projects, but also to create the necessary margin of safety in case of adverse foreign economic and political changes.

The calculations carried out allow us to offer the following recommendations for the development of state programs to support the sector in the event of the impact of exclusively political risks. Limitation of terms and/or volumes of support for wind and solar energy projects. These projects, especially in the 2019-2020 selection years, demonstrate excellent performance indicators and high reserves of economic strength. Consequently, WPP and SPP can become pilot projects in a transition to predominantly private rather than public investments in the sector that is planned to happen in the Russian energy market after 2035 [26, 27]. Extension of the terms and/or volumes of support for small hydro- power projects. These projects are initially characterized by a high degree of economic inefficiency, which increases in the case of additional consideration of the impact of political risk. Along with economic incentives, an important step for SHPP is the development of appropriate technologies, which will reduce the amount of specific investments in such RE facilities.

The results obtained will be used to producing more specific recommendations in terms of the timing and volume of reduction/extension of state support for RE projects. This requires additional research related to the study of the impact of a set of specific risks of the sector (political, social, and economic) on the implementation of RE projects and the preliminary development of appropriate tools.

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