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Reference number assigned to the case by the Contracting Authority: 01/08/20/OK dated on 12.08.2020

Market research

on the procedure, conditions and expected costs of performing the task **"100% renewable energy mix in 2050/100% OZE in 2050"**

The Contracting Authority calls for proposals for the price, conditions and the timeframe, for performance of a contract regarding the report on optimisation of transformation of the electricity generation mix in Poland in order to achieve climate neutrality by 2040 and 2050, taking into account a"100% renewable by 2050" scenario.

The market research is not an offer and will not result in conclusion of an agreement. The aim of this market research is to estimate the value of the contract and state the specific scope and conditions for the contract.

Based on the findings of this price-related research, the Contracting Authority may announce a binding tender in order to conclude an agreement.

This price-related research concerns the following contract:

I. Context and scope of the contract

To limit the mean global temperatures growth to 1.5 degrees Celsius, which will protect humanity against most of the disastrous effects of climate change, global emission neutrality must be achieved by mid-century at the latest[1]. It will not be possible to achieve this goal without changing the way energy is obtained, stored and used, and decarbonisation of the energy sector will be needed in the first place. Due to the various constraints and environmental challenges related to the generation of electricity from fossil fuels, waste, biogas, and nuclear and hydropower, energy storage options will play an increasingly important role in cooperation with wind and photovoltaic power sources.

At the same time, the debate on decarbonisation in Poland is highly reliant on scenarios in which electricity currently generated from coal (coal and lignite) is replaced by gas and nuclear power plants. In the public debate there is also a deep concern about the costs of decarbonisation to the society. Moreover, the challenge of balancing electricity generation from renewable energy sources is consistently raised.

The aim of this publication is to provide a constructive proposal for transformation of the energy mix in the years 2020-2050, based on renewable energy and energy storage:

- excluding large-scale gas, nuclear, and hydropower investments,
- minimising biomass consumption,
- avoiding import of fossil fuels and energy derived from fossil fuels,
- basing the national energy security on the domestic renewable resources, in terms of climate neutrality by 2050.

[1] https://www.ipcc.ch/sr15/

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Given the "project context" described, Fundacja WWF Polska is seeking a Contractor that is ready to provide a publication in Polish and English, with an executive summary and presentation of its results in Polish and English, **on optimisation of transformation of the electricity generation mix in Poland to achieve (almost) 100% electricity production by renewable energy sources by 2050**, taking into account the electrification of other sectors such as a heating and cooling, transportation, and industrial production, at the lowest possible cost per MWh of energy supplied.

The Contractor will present the results at least twice in Poland at its own expense, in the location stipulated by the Contracting Authority upon a minimum of two weeks' notice.

The publication should consist of between thirty and sixty pages of A4 (excluding elements required in the final document, such as footnotes, the cover, the executive summary, and key recommendations) in a standard font and text layout.

A footnote must be provided in each instance in which facts and data are given, stating the source of the data, including the name of the author, name of the publication, place and year of publication, page number, a link to online sources, and the date on which the source was obtained. The publication must include a bibliography, glossary, list of contents, and list of tables and charts.

As the publication, assumptions made in scenarios, boundaries, and findings (in the form of data given in tables and charts in .docx lub .xlsx format) and presentations on optimisation as well, are covered by the scope of the contract, the proprietary rights to these goods will pass to the Contracting Authority upon completion of the contract.

The commissioned publication should include elements such as:

- a summary with the key findings and key recommendations on 1-2 pages of A4.
- a presentation of the state of research on the ways and costs of achieving climate neutrality in the energy sector, also specifying the key regulations, obligations, and trends concerning climate neutrality of the energy sector in the EU.
- selection, and arguments supporting the choice, of the appropriate method of fuel and energy system modelling.
- **a quantitative assessment of the impact of potential climate neutrality of Poland by 2050 on the costs, savings, and potential gains from transformation of the sector, with regard to both energy generation, transmission, distribution, and storage in 2020-2050, and the impact of those projects on the price of energy for end users.**
- recommendations for policymakers concerning decisions that must be made to put Poland's potential to use in transformation of the energy sector in the years 2020-2050.
- **a summary for policymakers (5-10 pages of A4, including charts).** The summary for policymakers should include:
    a. information as to the context – max 1 page of A4,
    b. description of the research issue – max 1 page of A4,
    c. recommendation regarding the decision regarding climate neutrality of the Polish energy sector by 2050 (2040),
    d. recommendations in the context of climate and energy policy – 1-2 pages of A4,
    e. technological support for the recommendations concerning climate neutrality in the energy sector – 1-2 pages of A4,
    f. cost-based support for recommendations – 1-2 pages of A4,
    g. recommendations on decisions needed according to the hypothesis that "an energy sector transformation represents a technological and economic opportunity for Poland" – 1-2 pages of A4.

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Presentation of the state of research on the ways and costs of achieving climate neutrality in the energy sector**, also specifying the key regulations, obligations, and trends concerning climate neutrality of the energy sector in the EU**.

The data used in the publication must be based on academic literature, publications released by renowned consultancy firms and research institutions, or strategic documents and reports released by government institutions in Poland and elsewhere. The technological potential, examples, and expected costs must be based on literature that is as recent as possible.

The publication also must refer to existing literature (by comparison) considering publications such as the following (for example):

- A review of modelling tools for energy and electricity systems with large shares of variable renewables[2] ,
- Matching demand with supply at low cost in 139 countries among 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes[3],
- Krajowy Plan na rzecz energii i klimatu (KPEiK/NECP)[4],
- Scenarios of Low-emission energy sector for Poland and the EU until 2050[5],
- Zaktualizowany projekt Polityki Energetycznej Polski do 2040 roku[6],
- Strategia Niskoemisyjna/Plan neutralności klimatycznej Polski przygotowywanego na potrzeby strategii długoterminowej UE (Long-term strategies)[7],
- Dokument pod nazwą: Zmiana celów redukcyjnych oraz cen uprawnień do emisji wynikająca z komunikatu "EUROPEJSKI ZIELONY ŁAD"[8]
- Neutralna klimatycznie Polska 2050, McKinsey[9],
- Other publications (from analyses about other countries or not envisaged when drawing up the tender enquiry) concerning construction of a model of that kind.

The publication must refer to the "Available and future methods of energy storage" produced by Warsaw University of Technology, commissioned by Fundacja WWF Polska[10] regarding energy storage cost curves.

II. Selection, and arguments supporting the choice, of the appropriate method of fuel and energy system modelling

Building a model requires the use of methodology in the area of building mathematical models and their computer implementation. The publication must select and provide arguments for the choice of the appropriate method of fuel and energy system modelling and the prospects for changes in demand for electricity in Poland and how cost curves will develop and potential implementation of new

[2] https://www.sciencedirect.com/science/article/pii/S1364032118305690
[3] https://www.sciencedirect.com/science/article/abs/pii/S0960148118301526
[4] https://www.gov.pl/web/aktywa-panstwowe/krajowy-plan-na-rzecz-energii-i-klimatu-na-lata-2021-2030-przekazany-do-ke
[5] http://climatecake.pl/wp-content/uploads/2019/11/CAKE_energy-model_EU_low_emission_scenarios_paper__final.pdf
[6] https://www.gov.pl/web/aktywa-panstwowe/polityka-energetyczna-polski-do-2040-r-zapraszamy-do-konsultacji1
[7] https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/long-term-strategies_pl
[8] http://climatecake.pl/wp-content/uploads/2020/03/CAKE_Zmiana-cel%C3%B3w-redukcyjnych-i-cen-uprawnie%C5%84-do-emisji-wynikaj%C4%85ca-z-komunikatu-Europejski-Zielony-%C5%81ad-1.pdf
[9] https://www.mckinsey.com/pl/our-insights/carbon-neutral-poland-2050
[10] https://www.wwf.pl/aktualnosci/report-energy-storage

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production technologies and energy market analyses.

The model:

- must concern the Polish electricity generation market from a nationwide perspective,
- must identify, quantitatively, the change in demand for energy in Poland or base information on existing studies and reports,
- must identify, quantitatively, the impact of implementation of energy storage and hydrogen technologies, and electrification of industrial processes and transportation,
- must identify, quantitatively, the overall unit cost of electricity generation,
- must identify, quantitatively, the impact of Poland achieving potential climate neutrality (including the scenario of ultimate decarbonisation of the energy sector by 2040) by 2050 on the costs of transformation of the production sector in the years 2020-2050, and how those costs will affect prices on the wholesale electricity market,
- must consider limitations such as:
    a. the energy potential of renewable sources (mainly wind and solar power) and potential energy storage in relation to the location and surface area of the facility (for example how many pumped hydroelectric storage facilities are envisaged, and of what size),
    b. competition for space/surface area, for example in relation to agriculture,
    c. the impact of the unit cost of electricity generation on the acceptability of prices by Polish society,
- must minimise the cost of transformation of the production sector in the years 2020-2050, in order to achieve Poland's climate neutrality by 2050 (including in the scenario of complete decarbonisation of the energy sector by 2040),
- must use renowned and the most recent sources of information such as reviewed academic publications, Reuters, Bloomberg, and government or consultancy documents, and describe all sources from which information is collected, so that it can be verified and / or updated later
- must state the calibration and analysis of sensitivity of the model,
- **must consider a minimum of three research scenarios:**
    a. a transformation scenario to achieve 100% renewables by 2050 (100% RES),
        - including a version of this scenario in which a complete decarbonisation of the electricity production sector is achieved by 2040.
        - A variant regarding the withdrawal from the combustion of hard coal and lignite until 2030 and 2035 (“coal phase-out by 2030 (2035)”).
    b. Business as Usual or Reference (BAU or REF),

The scenario on the transformation to achieve 100% renewables by 2050 (100% RES), including a version in which a complete decarbonisation of the electricity generation sector is achieved by 2040, should envisage:

- the lowest possible share of biomass and biogas in the energy mix, excluding forest biomass obtained for energy purposes and biomass that can be used in production in the wood industry,
- the role of biogas, taking into account the quantity of sustainable biogas, correlated with the amount of consumption of products of animal origin, i.e. taking into account necessary changes to production of animal products due to mitigating measures in agriculture and changes in consumer habits (reducing the amount of meat and animal products consumed),
- methane capture and combustion,
- not importing biomass for energy purposes,
- assessment (or using existing sources) of obtaining biomass in a sustainable manner in Poland,
- zero share of hydropower stations (excluding pumped hydro storage),

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- zero share of nuclear energy,
- technological possibilities for energy storage,
- including a scenario in which there is a zero share of coal and lignite in energy production by 2030 and 2035 ("coal phase-out by 2030 (2035)"),
- including a scenario of energy self-sufficiency of Poland and unrestricted (technically feasible) import of electricity.
- takes into account RES limitations in the context of spatial management, in particular the space used by mining areas, and agricultural needs, (concerning for example transformation of arable land into sites for wind farms, photovoltaic facilities, or growing of plants for energy purposes) and protection of areas of high nature value,
- optimises the electricity production mix in Poland to achieve 100% renewables of electricity production by 2050 at the lowest possible cost per MWh.

Quantitative assessment of the impact of potential climate neutrality of Poland by 2050 (including a scenario of complete decarbonisation of the electricity production sector, not necessarily with 100% renewables, by 2040) on costs, savings, and potential gains from transformation of the production sector in the years 2020-2050 and the impact of those projects on the price of energy for end users.

The report must:

- present the findings of a quantitative analysis conducted using a devised research tool and scenario-based analysis.
- analyse the findings about the values obtained for the reference scenario (BAU), and present the findings of model research in relation to the main goal of the analysis,
- include the attached initial data and final data in an editable format (such as excel), and
- describe the modelling methodology.

The costs of electricity production for the research scenarios under analysis in the period up until 2050 must be presented in the form of a chart/graph making a comparison of the total unit costs of production and purchase of electricity between the research scenarios.

The report must state the information that serves as a basis for the assumed costs of production and energy storage using various technologies, and this includes:

- describe at least four examples of technical/economic analyses, relating to generation and distribution of energy, being for example a hybrid system (generation source + energy storage).
- depicting the assumptions made about the price calculation, and LCOE and LCOS technologies, including energy storage technology. The information concerning price calculation must be based on the publication "Dostępne i przyszłe formy magazynowania energii"[11], unless the authors of that publication obtain reliable cost curves for energy storage technology indicating prices lower than those forecasted in the above-mentioned report (according to the scenarios).

III. Requirements regarding the Contractor

Proposals can be submitted in the market research by Contractors that have:

a. at least five years' professional experience in energy market analysis.

[11] https://www.wwf.pl/aktualnosci/raport-magazynowanie-energii

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a. at least five consultancy, academic, or analytical publications (reports for NGOs or inter-governmental organisations, state, or research institutions (including think tanks), of companies in the energy sector regarding energy mix modelling, including:
   i. at least one publication in English, and
   ii. at least two published in the last three years.

Upon the market research, Fundacja WWF Polska plans to draw up the optimal description for the subject matter of the tender and conduct a procedure to conclude an agreement for the task. We expect proposals from natural persons or corporate entities that have knowledge and experience in energy market modelling and emission and energy scenarios.

IV. Scope of the research

In order to enable the Contracting Authority to determine the scope of the tender and its procedure, a potential Contractor should consider the following methods/options for performing the tender:

BASIC OPTION: "100% RES by 2050%"

1. Including energy storage with the costs given in the publication, posted on our website (https://www.wwf.pl/aktualnosci/raport-magazynowanie-energii)

2. With cost curves from other available sources, showing potentially lower prices for specific energy storage technologies.

Please also provide additional price quotations for the following four scenarios assuming "100% RES by 2050%":

1) coal phase-out by 2030
2) coal phase-out by 2035
3) zero-emission energy mix in Poland by 2040 (may be given in combination with the above-mentioned coal phase out by 2030 or 2035 and zero-emission mix by 2040)
4) energy self-sufficiency (100% of needs met domestically) vs. model that includes import – this relates to all of the above – i.e. separate calculation of what that model would be in the "self-sufficiency scenario" vs. the "including import" scenarios.

Moreover, please, provide a total price estimation for rendering services encompassing all the aforementioned variants.

V. Person assigned to perform the price research

Please refer any questions or requests concerning this tender contract to Oskar Kulik, Climate and Energy Policy Officer at WWF Poland:
e- mail: okulik@wwf.pl tel: +48 785 851 411

VI. Deadline and procedure for submitting proposals

Please submit proposals by 4.00 PM on September 15, 2020, to this e-mail address okulik@wwf.pl and mark them: ***Market research -RES***

We recommend using the research form below – appendix 1

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Appendix 1

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Proposal
for the procedure and conditions, and envisaged costs of performing the task
"100% renewable by 2050/100% OZE w 2050 roku",

In response to the call for proposals in connection with market research for the task "100% renewable by 2050/100% OZE w 2050 roku", please find a description, conditions, and estimated costs of performing the task:

General information about the Contractor	
	Please give the contractor's details
Name of Contractor or Contractors acting jointly (and full name of person authorised to represent the Contractor/s)	
Address	
Telephone number	
E-mail	
	Please propose the conditions that the Contractor believes the Contractor and/or team assigned to perform the tender contract should fulfil (in the context of knowledge, skills, experience, equipment held, proposed methodology)
Type of experience held, essential to perform the tender contract – proposed conditions regarding	

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the contractor	
Scope of the tender contract	
	Please state how the proposed scope might possibly differ from the proposed scope of the tender contract, the methodology, and where applicable proposals regarding scope, and state the price and the turnaround time for the completion of the tender contract
AS A BASIS: "100% renewable by 2050/100% OZE w 2050 roku" for the following scenarios:	
1) including energy storage, with the costs given in the publication posted on our website (https://www.wwf.pl/aktualnosci/raport-magazynowanie-energii)	Price: ..... Estimated timeframe .....
2) with cost curves from other available sources, showing potentially lower prices.	Price: ..... Estimated timeframe .....
Estimated price for the following scenarios:	
1) coal phase-out by 2030	Price: ..... Estimated timeframe .....
2) coal phase-out by 2035	Price: ..... Estimated timeframe .....
3) zero-emission energy mix in Poland by 2040 (may be given in combination with the	

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above-mentioned coal phase out by 2030 or 2035 and zero-emission mix by 2040)	Price: ……. Estimated timeframe ……
4) energy self-sufficiency (100% of needs met domestically) vs. model that includes import – this relates to all of the above – i.e. separate calculation of what that model would be in the "self-sufficiency scenario" vs. the "including import" scenario.	Price: ……. Estimated timeframe ……
Other remarks and proposals	

……
(date and signature)