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Report on implementation of the work plan for 2022-2023

Assessment of coal demand in Tajikistan to 2050 and the alternative options for replacing coal in the country's energy mix

Note by the Secretariat

I. Introduction

1. The United Nations Economic Commission for Europe (ECE) is working on decarbonizing the energy sector in accordance with the principles of carbon neutrality and just transition. In its efforts, ECE recognizes, however, that the scope and pace of the transformation process should be aligned with the capabilities and needs of individual member States, taking into account their endowment of natural resources, technological and industrial base, cultural heritage, as well as their legal and regulatory frameworks. Adopting a technology-neutral approach, ECE accepts member States' unique circumstances and does not exclude any of the available solutions that can help attain the nationally determined goals.

2 In that context, in 2022 Tajikistan requested ECE to develop a study on the dynamics of coal demand in the country until 2050.

3. This document summarizes the draft of the study, so that members of the Group of Experts on Coal Mine Methane and Just Transition can familiarize themselves with its content and provide their feedback during the eighteenth session of the Group, serving as guidance for the authors while finalizing the text.

II. The scope and the purpose of the study

4. The goal of the report is to analyse the dynamics of coal demand in Tajikistan until 2050, in the industrial (including energy) and residential sectors, to assess the efficiency of coal industry management in the country, to analyse the price factor (including environmental costs) of coal consumption, as well as the viability of replacing coal with alternative domestic energy sources, taking into account local conditions and the principle of energy security.

III. Actors involved

5. To deliver the requested task, an international consultant was hired by ECE to provide the technical expertise, analyse the situation in the country, and draft the document.[1]

6. To support the international consultant's work and ensure access to the necessary local data and stakeholders, a local consultant was also hired.[2]

7. The work of both consultants was monitored, supervised, guided, and assessed by the ECE Secretariat and the Bureau of the Group of Experts on Coal Mine Methane and Just Transition, who also reviewed and approved the drafts of the study, as well as the final document.

IV. Methodology

8. The final document was prepared based on a thorough literature review, information obtained during a fact-finding mission to Tajikistan, and input provided by the local consultant.

9. A fact-finding mission to Tajikistan was conducted to obtain the relevant information and data. It comprised visits to mining and industrial sites and a workshop during which a draft of the study was discussed with local stakeholders. The stakeholders provided feedback on the gathered materials, conducted analysis, identified problems, and proposed recommendations.

V. Overview of the final study

A. General overview of the current situation in Tajikistan

10. Hydropower plants (HPP) account for more than 90% of the country's electricity generation.

11. Ensuring energy security and efficient use of electricity is one of the strategic goals outlined in the "National Development Strategy of the Republic of Tajikistan for the period until 2030" (hereafter National Development Strategy), adopted in 2016.[3] According to the Strategy, achieving that goal entails "establishing an effective system of risk management and monitoring of energy security, including unrestricted and equal access to energy resources for all consumers".

12. One of the key problems hindering the achievement of that goal is recurring shortages of electricity in the country in the autumn-winter period.

13. When shortages occur, electricity supply to a significant number of households (usually in the rural areas) is restricted. Unable to rely on electricity, the affected households utilize coal, wood, and other solid biofuels to provide heating.

14. The main reasons for electricity shortage in the autumn-winter period are:

(a) a sharp seasonal increase in electricity demand due to mass use of electric heaters by households, and

(b) limited capacity to generate electricity at hydropower plants.

15. The seasonal drop in water flow in the Vakhsh river is only partially compensated by its advance accumulation in the Nurek reservoir.

[1] Mr. Ivan Khomutov, President, Petromarket RG

[2] Mr. Bahriddin Abdurahimzoda, Head, Department of New Technologies, Ministry of Industry and New Technologies of the Republic of Tajikistan

[3] Available in Russian at: https://medt.tj/documents/main/strategic_national_programm/ strategic_national_prog_ru.pdf

16. During the autumn and winter period, Dushanbe gas-fired Combined Heat and Power (CHP)-1 and coal-fired CHP-2 power plants are put in operation to provide additional electricity and heating to the country's capital.

B. Tajikistan's energy demand forecast

17. The forecast presented in the study is based on the methodology used to develop a baseline scenario for greenhouse gas (GHG) emissions of Tajikistan under the Fourth National Communication of the country to the UN Framework Convention on Climate Change.[4]

18. The methodology assumes that energy demand is linked to proxy variables. The following assumptions were made in the study: (i) household energy demand grows in proportion to the population, and (ii) other consumer demand grows in proportion to GDP growth, adjusted for the reduction in the energy intensity that was projected by extrapolating the historical development of this indicator for the years 2000-2020.

(a) The 2022 projection of the Population Division of the UN Department of Economic and Social Affairs was used as the basis for the population growth projection;

(b) The forecast of the Tajikistan's GDP was carried out by author of the study. The forecast for the period of 2022-2025 was based on the forecast of the Ministry of Economic Development and Trade of the Republic of Tajikistan, while for the period of 2025-2030 on the forecast from the industrial scenario of the National Development Strategy.

19. The study forecasts (i) electricity demand as well as (ii) demand for various energy sources, such as coal, natural gas, and petroleum products (not counting the demand for converting those fuels into electricity, which falls under the first category).

20. The forecast of energy demand presented in the study is a baseline scenario, i.e., a projection into the future of the current consumption patterns. As a result, it takes into account only the dynamics of the country's social and economic development indicators and does not reflect potential structural changes in fuel consumption.

C. Tajikistan's international climate commitments

21. In 2017, the Parliament of Tajikistan ratified the Paris Agreement to the United Nations Framework Convention on Climate Change.

22. The Tajikistan's most recent NDC (from 2021)[5] assumes an unconditional target of limiting GHG emissions (including land use, land-use change, and forestry - LULUCF) to 60-70% of the 1990 levels by 2030 (21.32–24.87 $MtCO_2Eq$), and a conditional target of limiting GHG emissions to 50-60% of the 1990 levels by 2030 (17.76–21.32 $MtCO_2Eq$).

23. In 2016 – the most recent year for which GHG emission data are available for the Republic of Tajikistan – the country's overall GHG emissions amounted to 13.75 $MtCO_2Eq$.[6]

24. As of 1 February 2022, the Republic of Tajikistan has not declared its carbon neutrality targets.

[4] Text of the document in Russian and English, URL: https://unfccc.int/documents/614376

[5] Text of the document in English, URL: https://unfccc.int/sites/default/files/NDC/2022-06/NDC_TAJIKISTAN_ENG.pdf

[6] Total GHG emissions are calculated by the international consultant on the basis of the GHG emissions and removals inventory tables for 1990-2016 from the Annex to the Fourth National Communication of the Republic of Tajikistan to the UN Framework Convention on Climate Change, using the global warming potential (GWP) values provided by the Intergovernmental Panel on Climate Change (IPCC) in the Fourth Assessment Report (25 to CH_4 and 298 for N_20)

D. Tajikistan's domestic coal market

25. The capacity of the domestic coal market in the Republic of Tajikistan in 2021 was 1,909 thousand tonnes, roughly the same as in 2019 and 2020.

26. The design capacity of the existing local coal mining enterprises in Tajikistan exceeds 3 million tonnes per year, which is one and a half times the country's current demand for coal.

27. There are 21 registered coal deposits and occurrences in Tajikistan with total resources of 3.6 billion tonnes.

28. The main coal deposits, as well as the operating coal producing enterprises are concentrated in the north-western part of the country. In 2021, 80.6% of the production in Tajikistan came from the Sughd Region and 19.4% from the Districts under the Central Government Jurisdiction.

29. Most of the coal in Tajikistan is extracted from open-pit mines.

30. The domestic market for coal in Tajikistan is isolated from the world market. Export of coal to the international market is hindered by the lack of access to the sea and very high transportation costs. There is also no need to import coal. As a result, coal prices in the country are not linked to the world prices but are determined by the local production costs.

31. In recent years, development of the cement industry in Tajikistan has been the main driver of coal demand in the country. From 2010 to 2021, local cement production increased 15-fold, and since 2016, Tajikistan has become a net cement exporter. Cement plants currently account for more than 90% of coal consumption by Tajikistan's industrial enterprises. In 2020, the production capacity of cement plants in the country reached 5.6 million tonnes/year. According to the "Programme for Accelerated Industrialisation of the Republic of Tajikistan in 2020-2025" the local cement production in 2025 is set to reach 7.0 million tonnes.

32. Due to the growth of the cement industry, the demand for coal in Tajikistan's industrial sector in general will also increase, despite the fact that since the resumption of natural gas supplies from Uzbekistan that took place in 2018, the demand for coal in other industries has decreased.

33. Household demand for coal varies markedly from year to year, depending on weather conditions. In 2018, it amounted to 139 thousand tonnes.

E. Options for additional power generation in the country

34. For the purpose of the study the following potential additional power generation options have been considered:

(a) Coal-fired Thermal Power Plant (TPP) is a power generation only facility located near the Fon-Yaghnob coal deposit;

(b) High Efficiency, Low Emissions Coal-fired TPP (HELE-TPP) utilizing supercritical steam conditions located near the Fon-Yaghnob coal deposit;

(c) HELE+CO_2 capture and storage (CCS) TPP Coal-fired TPP utilising supercritical steam conditions and technology located near the Fon-Yaghnob coal deposit ;

(d) Coal-fired CHP (power and heat generation) located in Dushanbe;

(e) Gas-fired CHP located in Dushanbe;

(f) Solar power plant (SPP);

(g) Wind power plant (WPP);

(h) Rogun Hydropower Plant (HPP) completion project. Additional investments of 4.2 billion USD are required to expand the plant from the current 240 MW to the planned 3,600 MW;

(i) HPP greenfield project (GHPP).

35. To choose the most efficient option, the alternatives were compared in terms of levelized cost of electricity (LCOE).[7]

36. According to the results of the analysis, the cheapest power generation option for Tajikistan is a conventional coal-fired TPP (LCOE = 36 USD/MWh), and the cheapest "clean" option is the Rogun HPP completion project, which is, however, 90% more expensive than coal-fired TPPs (LCOE = 68 USD/MWh).

37. According to the forecast, in the spring and summer period the requirement for additional power generation will emerge no earlier than in 2035. Until then the growing power demand in the domestic market during the period in question can be met by simply reducing power export.

38. In the autumn and winter period power shortages are recurrent. This means that power plants commissioned before 2035 shall either operate in autumn and winter only (which is possible for coal-fired and gas-fired power plants), or, if they operate all year round, export the surplus of the electricity generated in spring and summer.

39. The LCOE for season-oriented (autumn and winter) generation is higher than for the continued whole-year production.

40. In the case of season-oriented generation, the increase in the LCOE does not affect the above-mentioned results: a coal-fired TPP remains the cheapest option (LCOE = 51 USD/MWh), and its nearest competitor among the "clean" energy sources, which is the Rogun HPP, turns out to be more than twice as expensive (LCOE = 115 USD/MWh).

41. However, the selection of the energy production technology cannot be based on a simple arithmetic comparison of the LCOE. Consideration should also be given to factors such as public health and climate costs associated with the different power plants' operations. Moreover, potential funding sources for construction of various types of power plants need to be considered as well. While those matters are analysed by the study in detail, the sections below constitute a brief summary of the relevant content of the study.

F. Impact on health and environment

42. The study assesses the expected effect that additional coal-fired power plants (and associated additional coal extraction) would have on the health of Tajikistan's citizens. The two separate situations are considered in that context: (i) utilizing coal-based generation to eliminate the existing power shortage, and (ii) utilizing coal-based generation to meet the growing power demand in the future.

43. In the case of power shortage elimination, the adverse health impact from increasing coal-based generation is estimated to be fully compensated by the simultaneous reduction of emissions of particulate matter (PM) 2.5 originating from the combustion of solid biofuels and coal by households.

44. In that case, the same reduction of the death rate from household air pollution would occur regardless of which type of plant, whether coal-fired or based on renewable energy sources (RES), is constructed. In both cases the result would be the same: due to the additional supply of electricity, households would discontinue burning solid biofuels and coal.

45. However, there is a difference between coal-fired and RES-based plants, in terms of their contribution to ambient air pollution since expansion of the former will result in greater PM 2.5 emissions from power generation and coal extraction facilities.

46. By burning solid biofuels and coal, households are not only the source of household air pollution, but contribute a significant share (24%) to ambient air pollution.[8] Therefore,

[7] The levelized cost of electricity represents the average revenue per unit of electricity generated that would be required to recover the costs of building and operating a generating plant during the assumed financial life and duty cycle

[8] Text of the document in English, URL: https://www.nature.com/articles/s41467-021-23853-y#MOESM4

eliminating power shortages by increasing coal-based power generation capacity will, on the one hand, lead to greater ambient air pollution from coal extraction and power production facilities, and, on the other hand, help to reduce the pollution originating from households.

47. At the same time, eliminating power shortages by providing additional clean energy generation capacities would result in an even greater emission reduction, since, like TPPs, such facilities would allow elimination of certain amounts of emissions from households, but, contrary to TPPs, they would not account for any additional emissions from power generation and coal extraction.

48. In monetary terms, the difference between coal-based and RES-based generation costs of annual public health damage by 2050 is estimated to amount to 205 million USD. Taken per 1 MWh of additional generation, the damage is estimated at about 11 USD/MWh, which is a significant amount, but still many times lower that the difference in LCOE between a coal-fired TPP and Rogun HPP.

49. Tajikistan does not employ any explicit pricing mechanisms applicable to the emissions of CO_2 and other GHGs and no such mechanisms are expected to be adopted in the foreseeable future.

50. The potential growth of coal-based generation would not jeopardise achievement of Tajikistan's absolute Nationally Determined Contribution (NDC) goal. In the baseline scenario assuming that no efforts will be made to reduce emissions and that the existing fuel profile will remain unchanged in the power and heat generation sector, between 2021 and 2030 the emissions from the latter will increase in total by 1.5 $MtCO_2eq$.

51. In the scenario assuming a high coal consumption by the power generation sector, in which the additional power demand not covered by the ongoing projects is fully met by coal-fired TPPs (being the cheapest power generation option), generation-specific emissions will grow by 2 $MtCO_2eq$ by 2030, which is only 500 $ktCO_2eq$. more than in the baseline scenario.

52. In the latter scenario, the increase in fugitive emissions from coal extraction is also insignificant (by 20 $ktCO_2eq$). According to the calculations presented by the study, the cumulative net GHG emissions in 2030 are expected to amount to 22.9 $MtCO_2eq$, which stays within Tajikistan's established 2030 unconditional NDC target of 21.32 to 24.87 $MtCO_2eq$. Furthermore, if certain efforts to cut emissions in the sectors other than power are undertaken, construction of coal-fired power plants will be aligned even with the conditional country's NDC target of 17.76 to 21.32 $MtCO_2eq$.

53. If the additional power demand in Tajikistan is fully met by renewable energy power plants or HPPs, by 2030 the GHG emissions from the power sector will not grow above the 2021 level, and the country's cumulative emissions (amounting to 20.9 $MtCO_2eq$) will fall within the conditional target range, even without any efforts for emissions reductions in other sectors of the economy.

54. Fully covering the Tajikistan's additional power demand by 2050 by using only coal-fired TPPs is estimated to result in the increase in GHG emissions from the power generation sector by 19.8 MtCO2eq, which is almost 1.5 times greater than the cumulative emissions from all sectors in 2016.

55. Such an increase in emissions will prevent the country from achieving its carbon neutrality goal, which at the moment, has not been officially set yet and is discussed in Tajikistan only as a concept.

56. The absence of short-term (no carbon emission fee) and medium-term (possibility to achieve NDC goals) obstacles to development of coal-based generation does not actually mean that a Tajikistan's greater turn towards coal will not have adverse effects in the long-term. If the country's trading partners introduce at any point a Carbon Border Adjustment Mechanism (CBAM), Tajikistan's products will become less competitive on those markets. In addition, given a long service life of coal-fired power plants (approx. 30 years) and the trends in the international climate policy (increasing international pressure on countries to commit to climate neutrality, and promotion of Corporate Climate Responsibility mechanisms), current investments in the coal-based generation are likely to entail challenging and expensive future efforts to reduce GHG emissions and maintain competitiveness.

Therefore, such investments are very likely not to pay out due to highly probable necessity of early decommissioning.

G. Future demand

57. For all but cement industries in Tajikistan, gas is a more cost-effective fuel option than coal. Therefore, future demand for coal is estimated to grow only in the cement sector, whereas in all other industries in the country it is predicted to remain at the level of 2021.

58. A more intensive growth of cement production through emergence of new export routes is unlikely, as cement has a high weight/price ratio. This means that the future competitiveness of Tajikistan's cement on external markets will depend on availability of cheap means of transportation, which in Tajikistan's case, given its geography, implies the availability of rail. For the moment, Tajikistan has a railroad connection only with Uzbekistan. Any development of the national network allowing for rail connections with other neighbour states is in the short- and mid-term perspective unlikely.

59. Apart from using coal as a fuel, the industry may require coal as feedstock for e.g., production of coke in the iron and steel industry, synthetic gas or synthetic petroleum products, and petrochemical products.

60. While coking coal is being extracted in Tajikistan (from the Fon-Yaghnob deposit), it is currently used solely as a fuel. Its use for other purposes would be possible if there were any iron and steel industry facilities in the country, which at the moment is not the case. According to the forecast presented in the study, it is also very unlikely that demand for coking coal to supply Tajikistan's domestic iron and steel industry will emerge in the short- or a mid-term perspective.

61. Based on the calculations used in the forecast, coal-to-gas and coal-to-petroleum conversions are likely to be price-wise uncompetitive with direct gas and petroleum imports.

62. By 2025, the yearly coal demand from households will decrease from 273 thousand tonnes recorded in 2021 to 185 thousand tonnes. Then it will increase again to 268 thousand tonnes by 2050, almost returning to its 2021 level.

63. The demand for coal by the public sector (including schools, hospitals, as well as the security, defence, and law enforcement agencies) will increase within the forecast period in proportion to the growth in the number of public organizations, which will, in turn, correspond to the population growth.

64. Despite the soaring coal exports from Tajikistan in 2022 (328 thousand tonnes of coal exported in 9 months of 2022 versus a total of 34 thousand tonnes in 2021), there are no long-term prospects for Tajikistan coal exports in the future.

65. According to the study, Tajikistan's cumulative demand for coal will be only 1.5 times higher by 2050 than it is in 2021.

H. Potential for coal demand reduction

66. After covering the current seasonal electricity shortages in the autumn and winter period and lowering the resulting households' coal demand, a further coal demand reduction may potentially occur in the power sector, provided that the Dushanbe CHP-2 plant is decommissioned.

67. In all other segments, the presented forecast does not envisage any possibility for cuts in coal demand.

68. The study observes that in order to determine whether coal demand in Tajikistan will decrease during the forecast period it is necessary to evaluate if there is a possibility that the cost of electricity generation by a potential new non-coal-fired power plant would at any point in the future become lower than the cost of electricity production at the existing coal-fired CHP plant.

69. While the cost of the coal-based generation is to grow due to increasing coal prices and the maintenance costs of the ageing existing plants, the cost of solar- and wind-based generation will continue to decrease due to the constantly growing scale of their uptake worldwide.

70. Coal price increases will result from a steady decrease of the local extraction in open-pit mines and the simultaneous growing reliance on the more expensive underground mining. This change will occur due to the fact that the opportunities for open-pit coal mining in Tajikistan are already exhausted by almost 80%.

71. Despite the growth of coal prices and the decline of the costs of generation at SPPs and WPPs, if the funds for development of future generation capacities are raised without engaging international development partners[9] (at a discount rate of 10%[10]), a coal-fired CHP plant is estimated to remain the most cost-effective option throughout the forecast period.[11]

72. At the same time, if in the calculation a discount rate of 3% is utilized, which is the estimated rate if that funding is allocated by international development partners, then decommissioning Dushanbe CHP-2 and its replacement with a new HPP would be immediately cost-effective (especially taking into account also negative health impacts related to the operation of the CHP-2 plant), and its substitution with SPP will become cost-effective approximately in 2050.

I. Set objectives

73. When Uzbekistan discontinued its natural gas supplies to Tajikistan in 2012 - 2018, the coal-fired Dushanbe CHP-2 plant was built, and a number of industrial facilities shifted from natural gas to coal. As a result, over that time coal demand demonstrated a 7-fold growth from 253 thousand tonnes in 2011 to 1,741 thousand tonnes in 2018.

74. Tajikistan adopted its National Development Strategy in 2016, i.e., during the above-mentioned period of interrupted gas supplies.

75. Based on the conditions governing at that time, the Government assumed that the coal sector would continue growing in the future. Coal extraction was expected to grow to 10.4 million tonnes by 2030 in the more conservative scenario, and to 15.1 million tonnes in the more optimistic one.

76. Once the natural gas supplies from Uzbekistan were resumed in 2019, industrial facilities in most sectors (except the cement industry) returned to using natural gas, and thus since then coal demand growth decelerated drastically.

77. As a result, the prospects for growth of the coal-fired power industry were reduced as they proved to be incompatible with the country's new climate agenda.

78. What further exacerbated the situation of the coal-fired power industry, was the fact that the international development partners, also driven by climate change considerations, committed to stop funding projects for unabated coal-based power generation.

[9] In practice, mobilising resources without engaging international development partners is virtually impossible. The state-owned power holding OSHC "Barki Tojik" is unable to obtain loans from private banks due to the company's high debt burden, which as of 31 December 2020 amounted to 32.6 billion Tajikistani Somoni (approx. 3.05 billion USD) vs. only 3.3 billion Somoni (approx. 0.31 billion USD) of 2020 gross annual revenue and 6.6 billion Somoni (approx. 0.62 billion USD) of net losses before tax. Further financial assistance from China, which previously was Tajikistan's main supporter in that field, cannot be expected for the development of coal-based generation capacity in the country (see para. 79).

[10] For the purpose of the study, it is assumed that for the Government of Tajikistan a discount rate and an interest rate are equal.

[11] Cost-effective in terms of the cost of pure energy generation without taking into account any other associated costs, such as public health costs and climate costs related to operations of the power generation plants and fuel supplying facilities or mines.

79. Finally, China, which had previously contributed to the development and execution of the Dushanbe CHP-2 construction project, also made a commitment to not fund any additional coal-fired power projects abroad.

80. Considering the above, the forecast presented in the study does not see a possibility for Tajikistan to meet the coal production goals set out in its National Development Strategy.

VI. Conclusions and recommendations

81. The power sector development in Tajikistan should be based on the construction of power plants using renewable energy sources (sun and wind) and HPP, as such projects are aligned with the country's and the international climate agenda and as such can be developed and executed in cooperation with, and with the support of, the international development partners.

82. While substituting RES for coal in power generation will reduce the value and benefit of Tajikistan's abundant coal reserves, in the long-term perspective it will improve the competitiveness of the country's products on the international markets, facilitate achievement of Tajikistan's climate neutrality, and allow the Government to avoid significant public health-related costs.

83. In the manufacturing industry, provision of any support for coal utilization in lieu of gas would be counterproductive, as it would add to the cost of final products and thus undermine their competitiveness. At the same time, where the use of coal is currently dictated by the economic calculation (as it is the case e.g., in the cement industry) it should not be immediately and arbitrarily prevented by any prescriptive measures, but the incentives for searching for alternative solutions should be created. In the long-term, any companies whose products are currently based on power or heat generated by coal are likely to become uncompetitive if they do not modernize their mode of production, so that it aligns with the principles of the green economy (see para. 56).

84. The situation that occurred on the global markets in 2022 was extremely favourable for Tajikistan's coal exports, but by no means it should be assumed to become a "new normal". As long as the price situation permits, coal exports could continue, but the decisions to invest into any additional export facilitating infrastructure (such as e.g., construction of new railroads particularly for that purpose) or expansion of the extraction capacities will be made within the context of the real prospects for the global coal market development, which strongly indicate the future continuous decrease in both prices and demand.

85. Tajikistan's goals to increase coal extraction stipulated in Governmental strategic documents should be deemed outdated. Due to the rapidly changing global situation, the goals set in 2016 are now unrealistic.

86. A new coal sector development strategy should not be focused on achieving record-high extraction levels, but rather on fair distribution of the natural resource rent obtained from coal exports in the framework of decreasing demand, ensuring a safe working environment, strongly pursuing mitigation of environmental damage (e.g., through decommissioning of exhausted mines), and monitoring and minimizing methane emissions along the whole coal value chain. Provisions for the transformation and adaptation of local communities, jobs and economic activities dependent on coal extraction should be considered at the outset so as to mitigate the economic and social impacts of mine closure.

VII. Next steps

87. The Group of Experts on Coal Mine Methane and Just Transition stands ready to support Tajikistan's efforts related to decarbonization of its energy sector, and welcomes any opportunity to cooperate with the Government and other local stakeholders on other projects addressing that matter.