**Response to Reviewers**

Paper No. ECM-D-18-05037, Energy Conversion and Management

Title: Performance analysis and optimization of a combined cooling and power system using low boiling point working fluid driven by engine waste heat

Dear editor & reviewers,

Thank you very much for your review of our paper entitled “Performance analysis and optimization of a combined cooling and power system using low boiling working fluid driven by engine waste heat”, and for your comments and recommendations. These commends and recommendations help us to make better modifications and improve the quality of the paper. We have modified the manuscript accordingly in the revised manuscript. Please find below our response and explanations for your comments and questions.

Editor Comments:

1. Avoid lumping references as in [2, 3] and all other. Instead summarize the main contribution of each referenced paper in a separate sentence. How each paper is related to the work presented in the manuscript? What is being challenged or extended?

We thank the editor for the suggestion. We have avoided the reference lumping in the revised manuscript. The lumping parts have been removed in the previous manuscript such as “~~waste heat recovery technology [2,3]~~”, “~~by many researchers [13-15]~~”, “~~avoid the decomposition [17,18]~~”, “~~simple layout [27,28],~~”.

Research work in references were summarized to descript the present research and existing questions. Ref. [1] descripted the widely use of internal combustion engines. Ref. [2] descripted the low fuel utilization efficiency of internal combustion engines. Ref. [3] descripted the advantages of organic Rankine cycle system. Ref. [4], [5] and [6] descripted the work of selecting suitable organic working fluids for organic Rankine cycle system by three different research groups. Ref. [7] and [8] descripted the configuration improving work in single-loop organic Rankine cycle system for internal combustion engine waste heat recovery. The maximum power output of single-loop organic Rankine cycle was challenged. Ref. [9] pointed out that maximum power output of a single-loop organic Rankine cycle system was lower than that of a dual-loop organic Rankine cycle. Ref. [10], [11] and [12] descripted the configuration improving work in dual-loop organic Rankine cycle system by three different research groups. But thermal stability of the organic working fluids in these systems was neglected. To avoid this issue, Ref. [17], [18] and [19] developed thermoelectric generator and steam Rankine cycle to address the decomposition issue of the high temperature heat transfer. But the energy conversion efficiency of the thermoelectric generator and component size of steam Rankine cycle in the references were challenged. Low thermal efficiency and large component bulk might limit their application. Thus, we provided our solution: a carbon dioxide Brayton cycle. For Ref. [20], the authors didn’t analysis the parameter variation of carbon dioxide Brayton cycle and they didn’t utilized the energy in the jacket water. Ref. [23], [24] and [25] descripted the utilization of jacket water in the organic Rankine cycle system for internal combustion engine waste heat recovery. But the utilization efficiency of jacket water is low. Thus, we designed a dual-pressure organic Rankine cycle to increase the mass flow rate of the working fluid preheated by jacket water. Ref. [27], [28] and [29] descripted the recent research work about multigeneration system driven by waste heat. They expressed the importance of the multigeneration. Ref. [30] and [31] descripted the combined cooling and power system driven by internal combustion engine. The authors used ammonia absorption refrigeration cycle in the systems to provide refrigeration. But the structure of the ammonia absorption refrigeration cycle is complex and it requires a relatively high driven temperature. Thus, we employed the ejector refrigeration cycle to provide refrigeration and further utilize the jacket water energy.

2. Please avoid having heading after heading with nothing in between, either merge your headings or provide a small paragraph in between.

We thank the editor for this suggestion. Heading after heading was avoided in the revised manuscript.

3. Avoid using abbreviations and acronyms in title, abstract, headings and highlights.

The first time you use a chemical formula in the text, please write the full compound name and the formula in parenthesis. Do not use chemical formula in the title, abstract, chapter headings and highlights.

We thank the editor for this suggestion. Abbreviations and acronyms in abstract and headings were removed and rewritten in the revised manuscript. (carbon dioxide) was used to explain CO2 the first time it appeared in the text in Line 106: “Brayton cycle with CO2 (carbon dioxide) as working fluid”

4. The first time you use an acronym in the text, please write the full name and the acronym in parenthesis. Do not use acronyms in the title, abstract, chapter headings and highlights.

We thank the editor for this suggestion. We have written a full name of the acronym in parenthesis the first time it appeared in the text in the revised manuscript.

The use of acronym in the text were “internal combustion engine (ICE)” in Line 44; “study of organic Rankine cycle (ORC)” in Line 51; “introduced thermoelectric generator (TEG) technology” in Line 96; “coupled with CO2 Brayton cycle (CBC)” in Line 108; “Combined cooling and power (CCP) systems” in Line 135; “Ammonia absorption refrigeration cycle (AARC)” in Line 143; “ejector refrigeration cycle (ERC)” in Line 146; “dual-pressure organic Rankine (DORC)” in Line 152; “genetic algorithm (GA)” in Line 164.

5. The introduction should include problem context, literature review and the hypothesis based on the gap analysis of the previously published research.

We thank the editor for this suggestion. Introduction was thoroughly rewritten in the revised manuscript. Problem context, literature review and hypothesis were included in the introduction.

6. The originality of the paper needs to be further clarified.

We thank the editor for this suggestion. Originality of the paper was further clarified in the revised manuscript.

There are three innovative features in this paper:

(1) We investigated a CO2 Brayton cycle to prevent the risk of the decomposition of organic working fluid and provide power with high efficiency.

Organic Rankine cycles are used by many researchers to recover waste heat from internal combustion engines. Refrigerants are widely used as working in organic Rankine cycles but their decomposition temperatures are relatively low (200-300 ℃). When the high-temperature (above 450 ℃) engine exhaust gas transfers heat with these organic working fluids, there is risk of decomposition of the organic working fluids. Though organic working fluids with high decomposition temperature were investigated researchers, their flammability hindered their further applications. Some high-temperature loops for waste heat recovery were proposed by some researchers such as thermoelectric generator, steam Rankine cycle. But the thermal efficiency of the thermoelectric generator is low and the bulk of components in steam Rankine cycle is large, which might limit their application. Thus, we use a CO2 Brayton cycle work as a high-temperature loop in the system to prevent the decomposition risks and provide power with high efficiency and compact structure.

(2) We developed a dual-pressure organic Rankine cycle to increase the utilization efficiency of the jacket water energy.

The previous internal combustion engine waste heat recovery systems, energy in jacket water was not fully utilized. In some studies, energy in jacket water was not utilized as all. Jacket water was mainly used to preheat the organic working fluid in the organic Rankine cycle based internal combustion engine waste heat recovery system. But there is mismatch of the mass flow rate of the organic working fluid in the preheater and evaporator. Thus, only a small part of the energy in jacket water was harnessed. We developed a dual-pressure organic Rankine cycle as a bottom cycle after the CO2 Brayton cycle. Dual-pressure organic Rankine cycle can provide a large amount of power output. Moreover, organic working fluid in both high-pressure and low-pressure are preheated by the jacket water, which increases the utilization rate of the jacket water.

(3) We developed an ejector refrigeration cycle to fully utilize the jacket water waste heat and provide refrigeration.

Combined cooling and power system driven by engine waste heat shows the advantages of high efficiency and multiple energy supply. Ammonia absorption refrigeration cycle are widely used for refrigeration in these systems. But the configuration of it is complex and it requires a high driven temperature. We coupled a ejector refrigeration cycle with the organic Rankine cycle system instead of ammonia absorption refrigeration cycle to provide refrigeration. The ejector refrigeration cycle has a simple structure and requires relatively low driven temperature. Thus, jacket water is used to drive the ejector refrigeration cycle to provide refrigeration and fully utilize the waste heat.

Reviewer #1:

This manuscript introduces the performance analysis and optimization of a combined cooling and power system using low boiling point working fluid driven by engine waste. The novelty and the impact of the present manuscript is limited and the relation to previous works is poor.

Thank the reviewer for pointing out the shortcomings of the paper. We have thoroughly rewritten the introduction section to further clarify the novelty and the relation to previous work of the paper.

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(1) We investigated a CO2 Brayton cycle to prevent the risk of the decomposition of organic working fluid and provide power with high efficiency.

Organic Rankine cycles are used by many researchers to recover waste heat from internal combustion engines. Refrigerants are widely used as working in organic Rankine cycles but their decomposition temperatures are relatively low (200-300 ℃). When the high-temperature (above 450 ℃) engine exhaust gas transfers heat with these organic working fluids, there are risks of decomposition of the organic working fluids. Though organic working fluids with high decomposition temperature were investigated researchers, their flammability hindered their further applications. Some high-temperature loops for waste heat recovery were proposed by some researchers such as thermoelectric generator, steam Rankine cycle. But the thermal efficiency of the thermoelectric generator is low and the bulk of components in steam Rankine cycle is large, which might limit their application. Thus, we use a CO2 Brayton cycle work as a high-temperature loop in the system to prevent the decomposition risks and provide power with high efficiency and compact structure.

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The previous internal combustion engine waste heat recovery systems, energy in jacket water was not fully utilized. In some studies, energy in jacket water was not utilized as all. Jacket water was mainly used to preheat the organic working fluid in the organic Rankine cycle based internal combustion engine waste heat recovery system. But there is mismatch of the mass flow rate of the organic working fluid in the preheater and evaporator. Thus, only a small part of the energy in jacket water was harnessed. We developed a dual-pressure organic Rankine cycle as a bottom cycle after the CO2 Brayton cycle. Dual-pressure organic Rankine cycle can provide a large amount of power output. Moreover, organic working fluid in both high-pressure and low-pressure are preheated by the jacket water, which increases the utilization rate of the jacket water.

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About the impact of this paper:

There are two pathways to improve the performance of the organic Rankine cycle system for engine waste heat recovery. One will be selecting organic working fluids which are suitable for the system under certain conditions. Another is to optimize the system configuration to make full use of the waste heat. In this paper, we designed a combined cooling and power system with a novel configuration which prevents the decomposition risk of organic working fluid, fully utilizes the jacket water energy and provides power and refrigeration simultaneously.

About the relation of this paper to previous work:

We have thoroughly rewritten the introduction section of this paper. More recently published papers were added to descript research conditions and existing problems. We carried out our work based on the analysis of previous work.

Reviewer #2:

Corrections mainly involve formatting points, such as English grammar, citation of references, etc.; and insufficient information regarding some equipment used in the research. Concerning the formatting and methodology the points are as follows:

1. In Nomenclature, present separately the Latin symbols, Greek symbols, Acronyms, Subscripts and Superscripts, because of the form that is presented, it is confused; include the acronym TEG - Thermoelectric generator and GA - Genetic Algorithm; if the "K" of K$" is "kilo", must be represented by "k".

Thank the reviewer for the kind suggestion. The Nomenclature section was separated as Latin symbols, Acronyms, Greek symbols and Subscripts in the revised manuscript. TEG and GA were added to the list and "K$" was changed to "k$".

2. In lines 72, 96, 97 and 203, separate the temperature values of its units, for example, 90 ºC (line 72).

In the revised manuscript, temperature values were separated with their units.

In Line 87: “low (200-300 ℃) [13], while the temperature of exhaust gas is above 450 ℃”.

3. In line 104 change "to the utilize" by other word.

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

4. In line 126 put comma between gas and while, and after "But" in line 127.

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

5. In line 139 and 140 change the word "flew" by "flows".

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

6. In lines 148, 149 and 150 put "2" of "CO2" as subscript.

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

7. In line 166 change the word "consumption" by "combustion".

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

8. In line 174 put comma after "Meanwhile".

We have thoroughly rewritten the introduction section and the error was avoided in the revised manuscript.

9. From line 197 to 206 write "Several assumptions are made to simplify the simulation of the system, which are: (1) the system keeps a steady state; (2) the heat and friction ….are not considered; and so on.

We thank the reviewer for the suggestion. The system assumptions part was rewritten based on the suggestion in the revised manuscript from Line 206 to Line 213

“Several assumptions are made to simplify the simulation of the system, which are: (1) the system keeps a steady state; (2) the heat and frication in the system are not considered; (3) the pressure losses in the vapor generators, preheater, evaporator, condensers and pipes are neglected; (4) the gas temperature at the outlet of the vapor generator 1 is higher than 110 ℃ [35], considering the low gas dew point temperature; (5) the working fluids at the outlet of the condensers and the preheater are saturated liquids, and the evaporator outlet state is saturated vapor; (6) the process through the throttle valve is isenthalpic.”

10. In line 228 put a comma after "thermodynamic".

We have rewritten that paragraph in the revised manuscript from Line 230 to Line 235. The error was avoided.

11. Begin the sentence of the line 236 by "In this study, all components in the system …" and remove "in this study" of the end of the sentence.

The sentence was rewritten in the revised manuscript in Line 240 as following:

“In this study, all the components in the system are associated directly or indirectly with fuel of other heat sources, such as exhaust as and jacket water.”

12. In line 257 put comma between "expenses" and "etc."

A comma was put between "expenses" and "etc." in the revised manuscript in line 260 as following:

(like the taxes, insurance engineering expenses, etc.)

13. Indicate that equations from 11 to 21 are proposed in [33].

We have indicated in the revised manuscript as following:

Line 264: “In the following text, equations from Eq. (11) to Eq. (21) are proposed in Ref. [37].”

14. In line 265 write "where Ki,turb are the constants corresponding to the turbine type; and W is the power …."; and in similar manner in lines 276, 282 and 286.

We have rewritten the sentences in the revised manuscript in Line 269 “Ki, turb are constants corresponding to”, Line 280 “Ki, pump are the constants corresponding to”, Line 286 “Bi, pump are the constants corresponding to”, Line 290 “Ci, pump are the constants corresponding to”, Line 295 “Ki,comp are the constants corresponding to”, Line 305 “Ki,he are the constants corresponding to”, Line 312 “Bi,he are the constants corresponding to” and Line 316 “Ci,he are the constants corresponding to”.

15. In lines 297 and 784 I suggest to change the word "Tube-and-shell heat exchangers" to "Shell-and-tube heat exchangers".

It was corrected in the revised manuscript in Lines 301 and 741.

16. Verify in the equation (23) if the exponent of the term in brackets of the numerator is "n - 1".

Thank the reviewer for the kind suggestion. We have verified the equation. It was "n".

17. In line 336 add the word "years" after 30.

It was corrected in the revised manuscript in Line 339 as following: “being assumed as 30 years”

18. In lines 340 and 348 change the word "steams" by "streams"; and in lines 342, 343 and 349 change the word "steam" by "stream".

We have changed the expression in the revised manuscript in Lines 343, 345, 346, 351 and 352 as following:

“In a steady system, there are a number of entering and outing working fluid streams and heat and work interactions with the surroundings. In exergoeconomic analysis, each flowing stream is associated with a levelized exergy cost. The equations to calculate the cost of the stream product are given as:”

“where c denotes levelized exergy cost of the streams; Ey,in and Ey,out are the exergy transfer rate of the stream flowing in and out of a component;”

19. In line 348 remove the space before "where" and verify if the variable "c" is the "levelized exergy cost of the system" or is the "average cost per unit of exergy" according to the Nomenclature.

Thank the reviewer for the kind suggestion. "c" is the "levelized exergy cost of the system". We have corrected the error in the Nomenclatureand remove the space in Line 351.

20. In line 349 add "of" after out.

We have corrected the error in the revised manuscript in Line 352 as following: “flowing in and out of a component”

21. In line 360 and 363 add the word "where" before "cfuel" and "cBt", respectively; and remove the initial space.

We have corrected the error in the revised manuscript in Lines 364 and 367.

22. In line 365 add "… and the fuel-cost-related part, given by Eq. (32) and (33).

We have corrected the error in the revised manuscript in lines 369 and 370. “capital-cost-related part and the fuel-cost-related part, given by Eq. (32) and Eq. (33).”

23. I suggest that sections 4.1.1, 4.1.2 and 4.2 are inserted at the end of section 3, because they represent materials and methods and not results and discussion.

Thank the reviewer for the kind suggestion. We have put sections 4.1.1, 4.1.2 and 4.2 to the end of section 3 from Line 397 to Line 402.

24. In line 380 remove the word "gas" and maintain only "… supercharger engine."; in line 382 replace "The heat load capacity" by "The thermal load of the …" and deleted "when cooled down to the acid dew temperature".

We have rewritten the sentences in the revised manuscript in Line 380.

“In this study, the engine selected [7] is a 12-cylinder 4-stroke supercharged engine. The main designed parameters of the engine are listed in Table 3. The composition of the engine exhaust gas is presented in Table 4. The thermal load of the engine exhaust gas is about 1700 kW and 1000 kW can be obtained from the engine jacket water.”

25. In line 386 express the seven key parameters by its symbols.

We have added the symbols of the key parameters in the revised manuscript from Line 388 to 392 as following:

“Seven key parameters : BC turbine inlet temperature (TBt,in), BC turbine inlet pressure (PBt, in), inlet temperature at the high-pressure side of ORC turbine (TOt, in, h), inlet pressure at the high-pressure side of ORC turbine (POt, in, h), inlet temperature at the low-pressure side of ORC turbine (TOt, in, l), inlet pressure at the low-pressure side of ORC turbine (POt, in, l) and the ejector primary inlet pressure (Pej, in),”

26. In lines 392, 393, 395 and 396 express the variables "W", "Q" and "c" in italics.

We have corrected the error in the revised manuscript from Line 396 to Line 402.

“In the thermodynamic aspect, the net power output of the CO2 Brayton cycle (W BC), net power output of the DORC (W ORC), net power of the whole system (W net), cooling capacity of the system (Qcool) and the exergy efficiency of the system () are selected to reflect the system performance. Levelized exergy cost for the BC turbine power output (cBt), levelized exergy cost for the ORC turbine power output (cOt), levelized exergy cost the system product (cproduct) and the system capital cost (zcapital) are chosen to represent the exergoeconomic performance.”

27. Start the Results and discussion section from section 4.2.1.

We have put that section at the beginning of Results and discussion in the revised manuscript from Line 404.

28. In all results shown from Fig. 2 to Fig. 15 only one parameter at a time was varied, while the others were maintained constants? Clear this in the text.

We have explained this in the revised manuscript from Line 393 to Line 395 as following: “When one parameter is investigated to analyze the system performance, other parameters are maintained constants based on the conditions in Table 5.”

29. In line 552 change "The can be explained …" by "This can be explained …".

The sentence was rewritten in the revised manuscript from Line 521 to Line 522 as following: “The reason is that the two related parts of cOt increase with the drop of the ORC turbine power output.”

30. Seems incomplete to me the sentence of the line 612 "Thus, the capita-cost-related …".

We have rewritten the sentence in the revised manuscript from Line 555 to Line 558 as following: “The impact of cOt and cBt is greater than that of the system capital cost which would result in the increase of the capital-cost-related part of cproduct. Thus, the levelized exergy cost of the system product (cproduct) shows a descending trend.”

31. In line 641 remove the word "vapor" after "… vapor generator 2".

We have rewritten the sentence in the revised manuscript from Line 594 to Line 596 as following: “The levelized exergy cost for vapor in vapor generator 2, which is the equal to that of the vapor in vapor generator 1, increases as a result, causing the increase of the levelized exergy cost of the exhaust CO2 after the BC turbine.”

32. In line 658 add "of" after "Though".

We have added an “of” after “Though” in the revised manuscript in Line 608.

33. In the sentence of line 676 I suggest to write "The cooling capacity (Qcool) increases slightly with the …" because by Figure 12 the increase is very small and, hence, should also be corrected at the end of line 680.

We have rewritten the sentence in the revised manuscript in Lines 625 and 628.

34. In line 709 add a "t" after "can'".

The error was corrected in the revised manuscript in Line 653.

35. Rewrite the two sentences from line 713 to 715.

We have rewritten the two sentences in the revised manuscript from Line 657 to Line 659 as following:

“The increase of the ejector primary inlet pressure causes the increase of the entrainment ratio of the ejector. Thus, more secondary flow is entrained to the ejector from the evaporation, leading to the increase of the cooling capacity.”

36. In the paragraph from line 751 to line 753 I suggest to refer to Fig. 8 and 9 where are evidenced the highest output power, exergy efficiency and the lowest levelized exergy cost (but not the cooling capacity) at the highest inlet pressure at the high-pressure side ORC turbine.

We thank the reviewer for this kind suggestion. We compared the results of the genetic algorithm optimization results with the parameter trend in Fig. 8 and 9. The value of net power output, exergy efficiency, levelized exergy cost and the inlet pressure at the high-pressure side ORC turbine in the two parts were nearly the same. The inlet pressure at the high-pressure side ORC turbine is varied while other six parameters are kept as constants in Fig. 8 and 9. Thus, the inlet pressure at the high-pressure side ORC turbine plays a more important other six parameters. When the inlet pressure at the high-pressure side ORC turbine is close to the highest permitted pressure, the system performance is close to the optimization performance.

Note that: When the inlet pressure at the high-pressure side ORC turbine increases, the pinch point temperature difference in vapor generator 2 decreases. Thus, there would be temperature cross in the vapor generator when inlet pressure at the high-pressure side ORC turbine is larger than critical value. That’s why the optimization results shows that the value of the inlet pressure at the high-pressure side ORC turbine is 1.85 MPa in stead of the maximum value 2 MPa.

We have rewritten the paragraph from Line 698 to Line 707 as following:

“The optimization results of GA are listed in Table 8. It can be obtained that the minimum levelized exergy cost for the system product cproduct is 53.25 $(MWh)-1. The net power output, exergy efficiency of the CCP system are 374.37 kW, 37.31% respectively. The inlet pressure at the high-pressure side of ORC turbine is 1.85 MPa. Meanwhile, it can be evidenced from Fig. 8 and 9 that the highest output power (about 374.37 kW), exergy efficiency (about 37.31%) and the lowest levelized exergy cost (about 53.25 $(MWh)-1) at the highest inlet pressure at the high-pressure side ORC turbine (about 1.85 MPa). The results shown in Fig. 8 and 9 are close to the optimization results. The inlet pressure at the high-pressure side ORC turbine is varied while other six parameters are kept as constants in Fig. 8 and 9. Thus, inlet pressure at the high-pressure side ORC turbine plays a more important role than other six parameters when determining the performance of the system. When the inlet pressure at the high-pressure side ORC turbine is close to the highest permitted pressure, the system performance is close to the optimization performance.”

37. The sentence of conclusion (2) is very extensive and I suggest ending it in "… for the system product.", beginning the next sentence such as, "Meanwhile, the increase of the ORC …".

We have rewritten the sentence in the revised manuscript in line 727 as following: “In the DORC, the increase of TOt, in and TOt, in, l would cause the decrease of the system exergy efficiency and the increase of the levelized exergy cost for the system product. Meanwhile, the increase of POt, in, h and POt, in, l would result in the increase of the exergy efficiency and the decrease of the levelized exergy cost.”

38. In line 810 replace the word "frication" by "friction".

The error was corrected in the revised manuscript in line 767 as following: “the Darcy friction factor,”

39. In the "References" use the abbreviation names of the Journals, such as, Energy Convers Manage and the number of pages as 201-14, instead of using 201-214, for example; in the reference [14] line 863 change the number of the pages to 215-32 to differentiate from reference [12];

Thank the reviewer for the suggestion. We have rewritten the abbreviation names of Journals and the page number in the revised manuscript.

40. in reference [16] correct the names of authors to Rajabloo T, Bonalumi D, Lora P; in reference [17] add at the end of the author names, the author Zhu W; in reference [31] add at the end of the author names, the authors Liu H, Wang E, Yao B; in reference [32] correct the author names to Bejan A, Tsatsaronis G, Moran M and the first name of the publisher to John; in reference [33] add other authors, i.e., Turton R, Bailie RC, Whiting WB, Shaeiwitz JA;

We have corrected the errors in the revised manuscript in Lines 877, 880, 884 and 885 as following:

[34] Shu G, Zhao M, Tian H, Huo Y, Zhu W. Experimental comparison of R123 and R245fa as working fluids for waste heat recovery from heavy-duty diesel engine. Energy 2016; 115:756-69.

[35] Zhang J, Zhang H, Yang K, Yang F, Wang Z, Zhao G, Liu H, Wang E, Yao B. Performance analysis of regenerative organic Rankine cycle (RORC) using the pure working fluid and the zeotropic mixture over the whole operating range of a diesel engine. Energy Convers Manage 2014; 84:282-94.

[36] Bejan A, Tsatsaronis G, Moran M. Thermal design and optimization. New York: John Wiley & Sons; 1996.

41. What is the reference [35]?

That reference was a website for the CEPCI. We have removed it.

42. In table 3 replace the word "Term" by "Parameter" and the same in Table 8; in this table I suggest that the values presented be limited in two digits after comma to standardize all.

We have replaced the expression in Table 5 (Table 3 in the previous manuscript) and Table 8 and in Line 957 and Line 960. The values in Table 8 were limited to two digits.

43. In Table 6 replace "Ranges of the decision variables" by only "Parameters or Variables" and add "Operation" before "Range".

We have replaced the expression in Table 6 in the revised manuscript in Line 958.

44.In Table B1 the source is [33} and not [32].

Thank the reviewer for helping us find the error. It was corrected in the revised manuscript.

Reviewer #3:

The authors have conducted a study that covers a topic of great interest: "Performance analysis and optimization of a combined cooling and power system using low boiling point working fluid driven by engine waste heat". This very important topic deserved a great deal of attention. However, many shortcomings can be identified. Therefore, I recommend that these shortcomings, as listed in the following, should be addressed before it can be considered for publication;

1. Abstract section, present in more detail and clarity

Thanks for the reviewer’s kind suggestion. The abstract section was thoroughly rewritten in the revised manuscript. More details were added in the abstract.

“This paper develops a combined cooling and power system, which consists of a carbon dioxide Brayton cycle, a dual-pressure organic Rankine cycle and an ejector refrigeration cycle, to recover waste heat from exhaust gas and jacket water in internal combustion engines. Thermodynamic models of the system are performed and exergoeconomic methods are used to calculate the levelized exergy cost of the component products. Effects of seven parameters, including temperature and pressure at the Brayton cycle turbine inlet, temperature and pressure at the high-pressure and low-pressure side of the organic Rankine cycle turbine inlet and pressure at the ejector primary inlet, are evaluated. Single-objective optimization is carried out by means of genetic algorithm to obtain the minimum levelized exergy cost of system product. Results show that the increase of pressure at Brayton cycle turbine inlet and high-pressure and low-pressure side of the organic Rankine cycle turbine inlet contributes to the decrease of levelized exergy cost of the system product. Optimization results show that minimum levelized exergy cost for system product is 53.25 $ (MWh)-1. When levelized exergy cost is minimum, system net power output, cooling capacity and exergy efficiency are 374.37 kW, 188.63 kW and 37.31%, respectively.”

2. Please, Give more numerical results about the study results in the abstract section.

Thank the reviewer for the suggestion. The abstract section was rewritten in the revised manuscript and more numerical results were put in the abstract section.

3. Analysis of the state of the art in the introduction is insufficient, which undermines novelty of this work. An updated and complete literature review should be conducted.

The introduction section was thoroughly rewritten in the revised manuscript. More recent references were discussed and some old references were removed. The novelty of this work was further clarified.

4. Literature section should be given current papers after 2017.

We thank the reviewer for the kind suggestion. References in 2017 and 2018 were put in the introduction sections and some old references were removed in the revised manuscript.

[5] Rijpkema J, Munch K, Andersson S. Thermodynamic potential of twelve working fluids in Rankine and flash cycles for waste heat recovery in heavy duty diesel engines. Energy 2018; 160:996-1007.

[6] Su X, Shedd T A. Towards working fluid properties and selection of Rankine cycle based waste heat recovery (WHR) systems for internal combustion engines – A fundamental analysis. Appl Therm Eng 2018; 142:502-10.

[10] Wang X, Shu G, Tian H, Liu P, Jing D, Li X. Dynamic analysis of the dual-loop Organic Rankine Cycle for waste heat recovery of a natural gas engine. Energy Convers Manage 2017; 148:724-736.

[11] Wang E, Yu Z, Zhang H, Yang F. A regenerative supercritical dual-loop organic Rankine cycle system for energy recovery from the waste heat of internal combustion engines. Appl Energy 2017; 190:574-90.

[12] Huang H, Zhu J, Deng W, Ouyang T, Yan B, Yang X. Influence of exhaust heat distribution on the performance of dual-loop organic Rankine Cycle (DORC) for waste heat recovery. Energy 2018; 151:54-65.

[13] Rajabloo T, Bonalumi D, Lora P. Effect of a partial thermal decomposition of the working fluid on the performances of ORC power plants. Energy 2017; 133:1013-26.

[14] Shi L, Shu G, Tian H, Deng S. A review of modified Organic Rankine cycles (ORCs) for internal combustion engine waste heat recovery (ICE-WHR). Renew Sustain Energy Rev 2018; 92:95-110.

5. How were reference conditions (environmental pressure and temperature) considered?

In this paper, environment temperature is 20 ℃ and environment pressure is 101.3 kPa. They are based on the following reference:

Yang X, Zheng N, Zhao L, Deng S, Li H, Yu Z. Analysis of a novel combined power and ejector refrigeration cycle. Energy Convers Manage; 2016; 108:266-74.

6. The level of English throughout the manuscript does not meet the journal's desired standard. There are a number of grammatical errors.

Thank the reviewer for the kind suggestion. We have checked the grammatical errors and thoroughly rewrote the paper in the revised manuscript.

7. Introduction part needs to be extended by some of the recently published papers to show the importance of multigeneration systems in high-quality journals

We thank the reviewer for the kind suggestion. We have expressed the importance of the multigeneration systems with three recently published paper in the introduction section of the revised manuscript.

[27] Li Fan, Sun Bo, Zhang C, Zhang L. Operation optimization for combined cooling, heating, and power system with condensation heat recovery. Appl Energy 2018; 230:305-16.

[28] Yari Mortaza, Ariyanfar Leyli, Aghdam EA. Analysis and performance assessment of a novel ORC based multigeneration system for power, distilled water and heat. Renew Energy 2018; 119:262-81.

[29] Bai Z, Liu T, Liu Q, Lei J, Gong L, Jin H. Performance investigation of a new cooling, heating and power system with methanol decomposition based chemical recuperation process. Appl Energy 2018; 229: 1152-63.

8. Originality of the paper should be emphasized clearly. How this study differs from related published papers?

The introduction section was rewritten in the revised manuscript. We analyzed the gaps existing in the published papers and provided our original solutions. The innovative features of the paper were summarized at the end of the introduction section.

There are three innovative features in this paper:

(1) We investigated a CO2 Brayton cycle to prevent the risk of the decomposition of organic working fluid and provide power with high efficiency.

Organic Rankine cycles are used by many researchers to recover waste heat from internal combustion engines. Refrigerants are widely used as working in organic Rankine cycles but their decomposition temperatures are relatively low (200-300 ℃). When the high-temperature (above 450 ℃) engine exhaust gas transfers heat with these organic working fluids, there are risks of decomposition of the organic working fluids. Though organic working fluids with high decomposition temperature were investigated researchers, their flammability hindered their further applications. Some high-temperature loops for waste heat recovery were proposed by some researchers such as thermoelectric generator, steam Rankine cycle. But the thermal efficiency of the thermoelectric generator is low and the bulk of components in steam Rankine cycle is large, which might limit their application. Thus, we use a CO2 Brayton cycle work as a high-temperature loop in the system to prevent the decomposition risks and provide power with high efficiency and compact structure.

(2) We developed a dual-pressure organic Rankine cycle to increase the utilization efficiency of the jacket water energy.

The previous internal combustion engine waste heat recovery systems, energy in jacket water was not fully utilized. In some studies, energy in jacket water was not utilized as all. Jacket water was mainly used to preheat the organic working fluid in the organic Rankine cycle based internal combustion engine waste heat recovery system. But there is mismatch of the mass flow rate of the organic working fluid in the preheater and evaporator. Thus, only a small part of the energy in jacket water was harnessed. We developed a dual-pressure organic Rankine cycle as a bottom cycle after the CO2 Brayton cycle. Dual-pressure organic Rankine cycle can provide a large amount of power output. Moreover, organic working fluid in both high-pressure and low-pressure are preheated by the jacket water, which increases the utilization rate of the jacket water.

(3) We developed an ejector refrigeration cycle to fully utilize the jacket water waste heat and provide refrigeration.

Combined cooling and power system driven by engine waste heat shows the advantages of high efficiency and multiple energy supply. Ammonia absorption refrigeration cycle are widely used for refrigeration in these systems. But the configuration of it is complex and it requires a high driven temperature. We coupled an ejector refrigeration cycle with the organic Rankine cycle system instead of ammonia absorption refrigeration cycle to provide refrigeration. The ejector refrigeration cycle has a simple structure and requires relatively low driven temperature. Thus, jacket water is used to drive the ejector refrigeration cycle to provide refrigeration and fully utilize the waste heat.

This paper differs from the previous paper mainly in the following four point:

(1) We used a CO2 Brayton cycle to prevent the risk of decomposition of the organic working fluid and comprehensively analyzed its performance.

(2) We designed a dual-pressure organic Rankine cycle as a bottom cycle to increase the utilization efficiency of the jacket water.

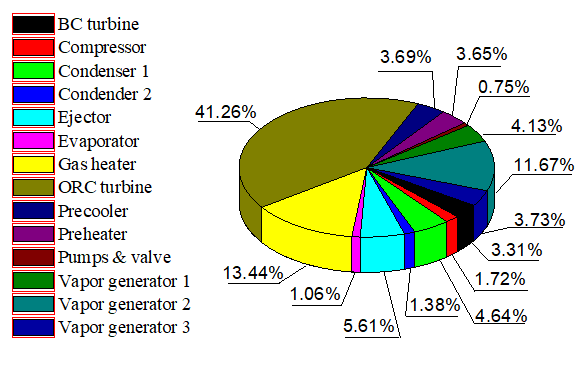
(3) We used jacket water to drive the ejector refrigeration cycle to fully utilize the jacket water energy and provide refrigeration.

(4) We used exergoeconomic method to analyze the system performance.

9. Discuss and elaborate more on the exergy destruction rates of system and sub-systems. They were not written in the text.

Exergy destruction rates of the components in the system were calculated and presented in the revised manuscript from line 708 to 716 as following:

“Fig. 16 shows the exergy destruction of different components of the system under the optimization conditions. The largest exergy destruction takes place in the ORC turbine (41.26%), which is mainly caused by the mixing of the high-pressure working fluid and the low-pressure working fluid. Gas heater contributes 13.44% of the total exergy destruction. Three vapor generators take up 4.13%, 11.67% and 3.73% of the exergy destruction, respectively. The exergy destruction for the ejector is 5.61%, which is also caused by the working fluid mixing. For BC turbine, condenser 1, precooler and preheater, the exergy destruction are 3.31%, 4.64%, 3.69% and 3.65%, respectively. Other components contribute to the rest 4.87% of the exergy destruction.”



**Fig. 16.** Exergy destruction of different components