Dear reviewer,

Thank you very much for your affirmation of our work as well as your valuable comments.

Here are our responses and potential modifications based on your comments. The text in bold and italics is our response.

General comment of appreciation

This paper is not only documenting timely information but entails also important messages for policymakers to understand different options to address the current energy crisis with options at a given cost, also in terms of GHGs. This paper is recommended to receive extra advertisement of ESSD for two reasons. Firstly, it illustrates the importance of data and observation-based evidence for informed decision making. Substitutes for Russian gas supply are needed now and this paper comes with very timely advice. Secondly, science and data sharing can help to keep an open dialogue between many countries in troubled times. It is remarkable how much regional data has been taken up in this exercise.

Thanks again for your affirmation of our work. With your valuable suggestions, we can deliver a better dataset and information on the EU gas supply-consumption and potential solutions for the current gas crisis related to the Russian supply.

Comment on the data used for section 2.3.3:

It is difficult to assess if the data and information collection is complete for Europe, given the very different approaches in the different EU27 MS. Import from North Africa might benefit extra attention. As an example, ENI Italy was already end April seeking to untap North-Africa's potential for gas supply, getting deals with Algeria and Egypt.

Ref: https://www.al-monitor.com/originals/2022/04/italys-eni-tap-north-african-gas-europe

This is an important suggestion, we will add one overview figure that summarizes the potential increases of international gas supply to EU to supplementary information or manuscript. And, indeed, the North African countries play important roles (potentially filling about 6~15% of the Russian gas gap) to alleviate the Russian gas deficit by increasing their exports to the EU. Egypt was not fully considered in our current analysis, and we will add Egypt data and discussions to our revised version based on the reference.

Comment on the substitution discussed in section 2.3.2:

Why is biogas production within EU27 not taken up? Even if the source is small, a little upscaling is still possible and all small bits help.

Ref: https://www.euronews.com/green/2022/03/30/biogas-made-from-farm-waste-could-replace-russian-fossil-fuels-in-germany#:~:text=Biogas%20made%20from%20farm%20waste%20could%20replace%20R

We do evaluate the potential capacity from power generated from the biomass sector. But for more detailed sector categories, such as biogas, although they might be alternatives for natural gas, we did not find a solid dataset (also see our response below for the EuroStat) or approach to evaluate their capacity for now. Those might be a topic for our future works. We will add some discussions about those promising alternatives to our paper.

Comment on Supplementary Information – gas network simulation

The total amount of the gas pipelines from North Africa seems reduced. This might be acceptable, if the total volumetric flow rate is fully taken up. In fact, there are three pipelines available from North Africa to Italy: the Transmediterranian (via Tunesia – El Haouaria), the Greenstream (Libya – Mellitah) and the Galsi (Algeria – Koudiet Draoucha) and there are two pipelines available from Algeria to Spain: the Medgaz (Algeria – Beni Saf) and Maghreb-Europe gas (via Morocco – Gibraltar)

Ref: doi:10.1007/s10479-020-03659-9

We manually collected all the importing points from the ENTSOG map. The following is a table that compares the ENTSOG points from North Africa we used for collecting gas transmission data with the pipelines you suggested. The data for Koudiet Draoucha is currently unavailable from ENTSOG, which might cause the underestimation. Please check more information here:
https://transparency.entsog.eu/#/map

	ENTSOG Point Name	Point EicCode
Tunesia – El Haouaria	MAZARA DEL VALLO	21Z000000000080V
Libya – Mellitah	GELA	21Z000000000149L
Algeria – Beni Saf	ALMERÍA	21Z0000000002131
Morocco – Gibraltar	TARIFA	21Z000000000045X
Algeria – Koudiet Draoucha	KOUDIET EDDRAOUCH	Planned

Comment on Supplementary Information – sectoral splitting validation

It would benefit the transparency, if EuroSTAT sectors 4 "Industry – E and NE" and sector 5 "sum of the other four sectors" could be described shortly. It would be interesting to understand if "fertiliser production" is part of sector 4 as Industry NE or of sector 5.

Those terms are directly from EuroStat dataset, we will add explanations for them. In brief, "FC" refers to the final consumption, "Industry – E and NE" refers to the energy and non-energy (used as raw material) consumption in the industrial sector. And the other sectors mainly include energy and non-energy consumption in transport, agriculture, and fisheries. It would be interesting to add discussion on biogas,

unfortunately, we did not find any sector directly related to biogas from the gas energy balance dataset (EuroStat, nrg_cb_gas).

Minor editorial comments:

l.2 + l.36: please replace "dramatically" by "drastically"

Thanks. We will replace "dramatically" with "drastically".

l.35: More countries saw a sudden decrease and this sentence might be completed with a date and a reference.

This is background information for 2020 (before the war) which has been noted at the beginning of the sentence.

l.25 + l.62: when mentioning USA, Australia and Norway, adding North Africa could be appropriate

We will add more discussion about North Africa as discussed in the previous response.

l.179: please specify the reason why gas consumption for Latvia and Estonia are underestimated.

This refers to lines 168-171, the data comparisons among our dataset, Eurostat, and Bp report. For the country-based comparisons (Fig 3e), we find a large underestimate for Latvia-Estonia (-153%) probably due to the incomplete consumption data in ENTSOG for the two countries.

l.246: adding North Africa could be appropriate.

We will add North Africa as discussed in the previous response.

l.264: first verb "could" seems too much for good reading

We will delete the first "could".

fig.1: the "legend" figures for input dataset, output dataset and model estimation is not needed and could be deleted, if the first green box reads "Open input dataset"

Good suggestions. We will edit the title for each box and delete the legend to simplify the figure, i.e., "Open Dataset" to "Open Input Dataset", "Gas Supply Source" to "Gas Supply Source (EUGasSC dataset)", "Potential Solutions" to "Potential Solutions (EUGasRP dataset)".

fig.2: a) I would prefer to read "annual consumption" instead of "total consumption"

We did not use "total consumption" for fig.2, are you referring the fig.3a?

If so, we will change the "total consumption" to "annual consumption" in fig.3a.

Fig.5: please write TTF in full

We will add the full name for TTF, which is Title Transfer Facility.

Fig.6: this is the difference of two shares, but for which the total maximum is different because of different years. I would prefer to see the difference between 2021 and 2020 (in absolute terms of Russian gas supplied) divided by the total in 2021 (of gas supplied). This would present the change in Russian supply share for 2021 compared to a previous year in a cleaner way. And since 2020 is a special COVID year, a fourth row would be welcome, where also the difference between 2021 and 2019(in absolute) divided by the total in 2021 is also presented.

Yes, it would be interesting to separate the comparisons for the COVID period. We will replace the third row with two new rows that compare the difference between 2021 and 2020, 2021 and 2019, respectively.

Fig.7: excellent graph!

Thanks!