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An Exploratory Analysis of Public Perspectives towards Renewable Energy Sources in India

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The aim of this research paper is to study and investigate the public perspectives and awareness level towards the Renewable Energy Sources (RESs) in India. A comparative analysis between the Fossil Energy Sources (FESs) and the RESs on various aspects is discussed. The total power generation, growth rate, its requirement, availability and deficit position over the last decade are discussed. The need of transiting from the conventional to the RE-based economy is also highlighted. Moreover, the challenges and barriers in this transition are debated. The importance of awareness and public perspectives in adopting the RESs is further presented. For this plan, a questionnaire based study was conducted. 1025 participants from all over India participated in this study. In response to a question, 90%, 95% and 96% participants from rural, semi urban and urban background, respectively agree with the statement: 'switch to RE is urgent need'. Another question is posted to see how many people agree or disagree with the statement, "Climate change is a critical issue that must be addressed." This statement is supported by 95% of semi urban and urban respondents and 92% of rural respondents.The result analysis shows that the participants have a sound knowledge of problematic aspects related to the FESs and hence they prefer the RESs for its solution. In answer to a question, 35% of females and 47% of males say they are willing to pay more for energy that comes from green sources. Furthermore, the participants comprehensively think that use of the renewables is the best way to deal with global warming. Additionally, the results clearly acknowledge that the urban, male and post graduate (PG) participants have more positive perspectives towards issues such as renewables urgent need, energy independency and willingness to pay more bills for the renewables. The current study provides a data set to the researchers for future studies in this area.

Keywords: Climate change, FESs, Public perspectives, RESs, Willingness to pay

Introduction

All emerging and developed countries around the world prioritise RESs for safe and environment friendly economic growth and try to reduce carbon emissions to help the climate.[1] India along with the world is facing the twin problems of increasing environmental pollution and rising electricity consumption. Both these problems result in adverse climatic changes and fear of FESs supply interruption due to their presence in finite amount.[2] This alarming situation is compelling the governments and concerned authorities to take precautionary and corrective measures for reducing carbon and Greenhouse Gases (GHG) emissions. The RESs are capable and reliable alternate for countering these problems. So, expanding the proportion of the RESs is on top priority for policy makers across the world.[3] The implementation of RE transitions is important in order to achieve decarbonisation of the global economy and effectively address the challenges posed by global climate change.[4] There is widespread recognition among stakeholders, including politicians, business entities, and communities, that the development and implementation of Renewable Energy Technologies (RETs) necessitate consideration of elements beyond technical and economic aspects. The academic literature in the field of transdisciplinary studies has expanded to encompass several instances in which the deployment of RE faces challenges such as social resistance, limited knowledge about a particular technology, or the presence of harmful social or environmental consequences, whether actual or perceived.[5,6]

The transition from the FESs to the RESs is mandatory but this transition faces one major obstacle

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which is societal acceptance of the RESs. Societal acceptance directly links up and depends upon public perception and perspectives. In a broader sense, studies of social acceptability are mainly concerned with figuring out how various public actors, people, and authorities become supportive of RE to enable carbon reduction and environmental preservation.[7]

There are multiple factors that exert an influence on social acceptance. The existing body of literature examines several elements that shed light on possible "local externalities" associated with RE, such as appearance, noise, and effects on the surrounding ecosystems. These external factors all lead to resistance from local communities, sometimes referred to as the NIMBY (not in my backyard) phenomenon. However, the validity of this paradigm has been extensively discussed and analysed in various studies and locations. In addition to the NIMBY issues, a number of studies posit that the issue of acceptance is connected to a lack of adequate avenues for democratic participation, as well as the inability of strategists and legislators to recognise the supplementary environmental costs that come with RE.[8,9]

The factors mentioned above vary depending on the specific types of RETs being analysed. For instance, wind power has been extensively researched, whereas geothermal and other forms of RE have received comparatively less attention. Additionally, the geographic location and context in which different technologies and policies are proposed or implemented also play a role in influencing these factors.[10]

For the successful implementation of Renewable Energy Projects (REPs), it is necessary to study the public perspectives in this regard.

Literature Review

Here initially the problematic aspects of the FESs have been discussed followed by some remedial aspects of the RESs. Further, status of India's current energy generation mix is discussed along with production and growth of India's energy sector in the last decade. Moreover, power requirement and availability position in India over the last decade is presented along with considering transition's requirement (FESs to RESs) and presenting importance of public perspectives in adoption of the RESs.

FESs Problematic Aspects

FESs, RESs and nuclear fuels are the fundamental sources of energy generation.[11] The carbon dioxide emission rate (gCO_2/kWh) of various energy sources is depicted in Fig. 1. Here it can be seen that coal is the leading carbon dioxide emitter followed by oil and natural gas, respectively. Comparatively RESs emit very low amount of CO_2 in the environment. Hydro power is the cleanest source followed by the RESs and nuclear fuel. There are several problematic facets associated with FESs like Greenhouse Gas (GHG) emissions, carbon emissions and other harmful pollutants. All these aspects cumulatively cause global warming.[12–15] Along with these constraints, the FESs have one more problematic aspect which is their limited availability and depleting nature.[16]

All these factors make a way for the replacement of the FESs with their counterpart i.e. the RESs (solar energy, wind energy, bio-energy and small hydro power). Each and every problem of the FESs are effectively countered by the RESs.

RESs Remedial Aspects

They can provide neat and clean energy with better air quality as they don't produce harmful pollutants and have negligible carbon emission during power generation.[17] In the last few decades it has been noted that the RESs have gained prominence due to their abundant availability and free cost. Also, they are so much diverse in nature and available for infinite time.[18–20] Sustainable energy sources are obligatory for economic and industrial development. The furtherance of RETs to minimize the environmental pollution is a main issue for governments all across the world.[21,22]

India's Current Energy Generation Mix

India emerges as a leader in developing economies as well as in population in the world. Large

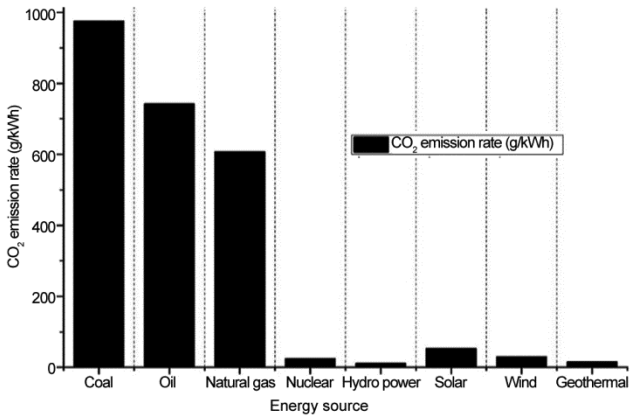

Fig. 1 — Carbon dioxide emission rate of energy sources in gCO_2/kWh[12–15]

population demands more energy requirements and it possesses a threat to energy security.[23]

The installed capacity of energy generation in India is shown source-by-source in Table 1. Coal is the leading energy source with 210699.5 MW capacity in India's total energy generation mix. Natural gas and oil contribute 24900 MW and 510 MW in total installed capacity, respectively. In this way, we see that the FESs contribute nearly 59% of share in the total installed capacity. Nuclear fuels contribute 6780 MW with 1.70 % of share.

Conventional hydro power accounts 11.65% of share with 46722.52 MW capacity. In the RESs, solar power is leading one with 55337.66 MW followed by wind power, bio power and SHP with 40528.08 MW, 10682.36 MW and 4850.90 MW, respectively.

The RESs along with conventional hydro power cumulatively account for 39.43% of share in the total installed capacity.[24,25]

India's Energy Sector: Production and Growth in the Last Decade

India's total energy production, measured in billion units (BU), is shown in Table 2 along with the percentage increase rate for the last ten years. In the year 2011–12 total energy production was 928 BU with 9.14% growth rate. This energy production ramps up to 1490 BU with 7.85% growth rate for the year 2021–22.

A steady growth is seen from 2012–13 to 2018–19 and then steep fall is observed in the next two years in the table (growth rate is 0.94% and −2.50%, respectively for the years 2019–20 and 2020–21). Corona pandemic engulfed the world in these two years. Due to it every kind of activities halted for a long period. Governments all across the world imposed various restrictions that harmed the import and export of goods.

India is heavily dependent upon the FESs for energy generation and a major flock of these sources is imported from other countries. So that's why particularly these two years (2019–20 to 2020–21) observed slowdown in production as well as in growth. From early 2022 when there is an ease in these restrictions we observe a visible growth of 7.85%.[26,27]

Power Requirement and Availability Position in India over the Last Decade

India's electricity availability and requirement during the previous ten years is displayed in Table 3. The table also includes a reference to the deficit, or the difference between availability and requirement. This table presents year wise comparative analysis between power requirement and availability in BU.

Based on the data presented in the table, it is evident that there exists a substantial disparity between the stated requirements and the actual availability during the initial years. However, as time progresses, this discrepancy gradually diminishes, ultimately resulting in a convergence between the current requirement and availability figures in the last part of the table. Also, this table specifically presents year wise deficit between requirement and availability.

Table 1 — India's Energy generation mix (in MW) [24,25]

Category	Energy sources	Installed capacity	% share
	Coal	210699.5	52.54%
FESs	Natural gas	24900	6.20%
	Oil	510	0.12%
Nuclear	Nuclear fuels	6780	1.70%
	Hydro	46722.52	11.65%
	Small hydro power (SHP)	4850.90	1.20%
RESs	Wind power	40528.08	10.12%
	Bio-power	10682.36	2.66%
	Solar power	55337.66	13.80%
Total	FESs + RESs + Nuclear	401010.23	100%

Table 2 — India's total energy production (in Billion Units) and growth over last decade[26,27]

Year	Total energy production (Including FESs, RESs & Nuclear sources)	% Growth
2011–12	928	9.14
2012–13	970	4.47
2013–14	1020	5.24
2014–15	1110	8.85
2015–16	1174	5.69
2016–17	1242	5.80
2017–18	1308	5.35
2018–19	1376	5.19
2019–20	1389	0.94
2020–21	1382	−2.50
2021–22	1490	7.85

Table 3 — Power requirement and availability position in India over last decade (in Billion Units)[28,29]

Year	Requirement (BU)	Availability (IN BU)	Deficit (BU)	Deficit (%)
2011–12	937.199	857.886	−79.313	−8.5
2012–13	995.557	908.652	−86.905	−8.7
2013–14	1002.257	959.829	−42.428	−4.2
2014–15	1068.923	1030.785	−38.138	−3.6
2015–16	1114.408	1090.850	−23.558	−2.1
2016–17	1142.929	1135.334	−7.595	−0.7
2017–18	1213.326	1204.697	−8.629	−0.7
2018–19	1274.395	1267.626	−7.070	−0.6
2019–20	1291.010	1284.444	−6.566	−0.5
2020–21	1275.534	1270.663	−4.871	−0.4
2021–22	1375.663	1369.818	−5.845	−0.4

The deficit which was 79.313 BU in 2011–12, now reduces to 5.845 BU for the year 2021–22. So, in the last decade the mismatching between requirement and availability is reduced by a large extent. The main reason behind this is a significant contribution of the RESs in energy generation basket during the last decade.[28,29]

Transition's Requirement (FESs to RESs)

The problematic aspects of FESs are forced us to look out for an alternate which provides an amicable solution. Also the goal of decreasing the carbon footprints all across the world is fulfilled by this transition. In today's time, one of the most important sustainability goals to be achieved is in transiting from the conventional to the renewable energy-based economy.[30,31] The more dependence of countries on the FESs makes this changeover very tough and challenging. This changeover requires serious and continuing efforts as every aspect of daily routine like social and economic activities are largely regulated by energy.[32–35]

Public Perspectives Importance in Adoption of RESs

The active cooperation of the public that would be affected through these changeovers is a necessary condition for fruitful energy transition.[36,37] Non-support of the native inhabitants in REPs is a prime reason for their suspension and failure. The various studies show that for the successful implementation of the REPs, consent of natives and all stakeholders is necessary. Also issues around this changeover must be sensitive to public perspectives.[38–40]

There are a lot of barriers that restricts the acceptance of the REPs. These include legal framework barriers, economic barriers, technical and infrastructure barriers and public awareness barriers. All these barriers cumulatively disrupt the progress of the renewables.[41,42] Among these barriers, lack of citizen's awareness is a major one.

The inadequate knowledge of public perspectives towards renewables is the main hindrance in their deployment.[43,44] The REPs are largely funded by public funds, so their consent and approval becomes important for successful implementation of these programs. The various studies show that, adequate knowledge of public perspectives towards the RESs helps in adapting these new RETs.[45–47] To examine the public perspectives and awareness towards the RESs, it is imperative to conduct a survey.

Methodology

The Questionnaire Design & Data Collection

To measure the public perspectives and awareness towards the RESs in India, we have conducted a survey for this research. To make this study more reliable and effective, the participants from different localities from all over India have been incorporated.

For this study, we framed a questionnaire consisting of two parts. The first part consists a brief preface to the research and participant's complete background data. The second part contains eleven questions related to the public awareness and perspectives regarding the RESs. A total of 1025 respondents participated in this research study. To strengthen the study, we have done analysis on three parameters which are as follows: on the basis of localities, gender group and educational qualification.

The questionnaire was made in google doc sheet and shared with participants through various modes like e-mail and WhatsApp. The replies and feedback were recorded in a google doc sheet. Then, analysis work was done with the help of MS Excel and Origin software.

Results and Discussion

This segment contains received responses of questionnaire. There are eleven research questions in Table 4 and codes Q1 to Q11 are allocated to each research question respectively.

Public Awareness and Perspectives Related Results

Locality wise Received Results

The questionnaire responses that were received in terms of "agreement," "disagreement," and "don't know" are listed in Table 5.

Table 4 — Code table (codes assign to research questions)

Codes	Please state your level of agreement or disagreement to the following statements:
Q1	Fossil fuels are polluting the environment.
Q2	Renewable energy is unlimited.
Q3	Not enough is being done to reduce climate change.
Q4	Better incentives/subsidies should be given for consumption of Renewable energy.
Q5	Switch to Renewable energy is urgent need.
Q6	Energy conservation and efficiency are very common topics of talk among my family and friends.
Q7	Climate change is a vital issue that must be addressed.
Q8	As a country, we need to invest more money and effort into becoming energy independent as soon as possible.
Q9	Governments provide many energy saving/conservation schemes.
Q10	Are you ready to pay more bills for getting energy through renewables?
Q11	The best way to deal with global warming is use of renewables & cut down electricity consumption.

Table 5 — Locality wise responses to research questions

Locality	Statements	Q1 %	Q2 %	Q3 %	Q4 %	Q5 %	Q6 %	Q7 %	Q8 %	Q9 %	Q10 %	Q11 %
	Agree	94	89	86	93	90	84	92	90	27	12	72
Rural	Don't know	2	6	9	6	6	5	5	8	9	5	9
	Disagree	4	5	5	2	4	11	8	1	64	83	19
	Agree	87	88	86	91	95	86	95	94	35	14	76
Semi urban	Don't know	5	5	8	5	5	8	3	4	4	3	10
	Disagree	8	7	6	4	0	7	2	3	61	83	14
	Agree	93	91	88	91	96	82	95	96	54	37	92
Urban	Don't know	3	5	9	7	2	7	4	3	4	3	2
	Disagree	4	4	3	2	2	11	1	1	42	60	6

The initial inquiry is posed in order to assess the participant's degree of concurrence or dissent with respect to the assertion that fossil fuels are causing pollution in the environment. About 94% of participants from rural localities, 87% from semi-urban localities, and 93% from urban localities concur with the aforementioned statement.

In regard to the second query, a significant proportion of respondents from various geographical areas hold the belief that renewable energy possesses an inexhaustible nature. A minority of participants, specifically 5% from rural areas, 7% from semi-urban areas, and 4% from metropolitan areas, expressed disagreement with the aforementioned assertion.

The replies received for the third question exhibit a consistent trend, with a significant majority of participants (about 86%) from various locales expressing agreement with the assertion posed in the question.

The fourth inquiry pertains to the exploration of enhanced incentives and subsidies aimed at promoting the consumption of renewable energy sources. The findings indicate that a significant majority of participants from rural areas (93%), semi-urban areas (91%), and urban areas (91%) are in favour of providing enhanced incentives or subsidies to promote the consumption of renewable energy. Conversely, a mere 2% of participants from both rural and urban areas expressed disagreement with this proposition. A total of 6%, 5%, and 7% of participants from rural, semi-urban, and metropolitan regions, respectively, expressed uncertainty regarding the provision of subsidies or incentives for the adoption of renewable energy consumption.

The subsequent four inquiries aim to explore the viewpoints of the participants regarding the pressing necessity of renewable energy, energy conservation, climate change, and energy independence.

In relation to the fifth query, it was found that a significant majority of participants, specifically 90% from rural areas, 95% from semi-urban areas, and 96% from urban areas, expressed agreement with the assertion that the transition to renewable energy is an imperative requirement. A mere 2% of urban participants and 4% of rural participant’s express disagreement with the aforementioned assertion. Remarkably, no participant residing in a semi-urban area expressed disagreement with the aforementioned assertion.

The sixth inquiry aims to assess the extent of agreement or disagreement among respondents on the statement: "Energy conservation and efficiency are frequently discussed topics among my family and friends." The statement in question received agreement from a significant majority of participants, with 84% of those from rural backgrounds, 86% from semi-urban backgrounds, and 82% from urban backgrounds expressing agreement. A total of 11% of respondents, comprising individuals from both rural and urban backgrounds, expressed disagreement with the aforementioned assertion. A notable proportion of semi-urban respondents, specifically 7%, express disagreement with the aforementioned notion.

The seventh inquiry is administered to assess the respondents' degree of concurrence or discord about the statement: "climate change is a crucial matter that necessitates attention." The statement in question received agreement from a significant majority of respondents, with approximately 95% of both semi-urban and urban participants, and slightly less than 92% of rural participants expressing agreement. The findings indicate that a significant proportion of participants express a high level of concern regarding climate change.

The eighth query is posed to assess the degree of concurrence or discord among the participants regarding the statement: "As a country, we need to invest more money and effort into becoming energy independent as soon as possible". The results indicate that a majority of participants from urban (96%), semi-

urban (94%), and rural (90%) backgrounds chose the choice of agreement with the aforementioned statement. Conversely, a small percentage of participants from each background (1% urban, 3% semi-urban, and 1% rural) chose the option of disagreement. The findings of this study demonstrate that a significant proportion of participants, regardless of their geographical location, express a willingness to endorse and aspire to the expeditious realisation of an energy independent nation.

The purpose of the ninth question is to assess the participants' level of knowledge and understanding on government initiatives aimed at promoting energy conservation. The findings indicate that 27% of participants from rural backgrounds, 35% from semi-urban backgrounds, and 54% from urban backgrounds agree with the assertion that governments offer several energy-saving and conservation programmes.

The tenth inquiry investigates the extent to which individuals are ready to allocate additional financial resources towards the adoption of renewable energy sources. The survey results indicate that a mere 12% of participants residing in rural areas and 14% of participants residing in semi-urban areas expressed their willingness to pay a higher price for accessing energy derived from renewable sources. In contrast, a significantly higher proportion of urban participants, namely 37%, demonstrated their readiness to pay a premium for the same renewable energy. This finding indicates that individuals residing in urban areas exhibit a higher level of enthusiasm for the adoption of renewable energy sources compared to their counterparts in non-urban areas.

The final query is posed to inquire about the perspectives of the participants regarding the strategies employed in addressing the issue of global warming. A majority of participants, specifically 72% from rural backgrounds, 76% from semi-urban backgrounds, and 92% from urban backgrounds, expressed agreement with the statement that the most effective approach to addressing global warming involves the utilisation of renewable energy sources and reducing electricity usage.

Gender-wise Distribution of Results

The data presented in Table 6 illustrates the replies obtained from the administered questionnaire, categorized into three distinct categories: agreement, disagreement, and uncertainty. In relation to the initial two inquiries pertaining to fossil fuels and renewable energies, it has been noted that male participants exhibit a slightly higher level of awareness compared to their female counterparts. The subsequent inquiries pertain to the subject matter of climate change, the provision of incentives for renewable energy sources, and the transition towards the utilization of renewable energy. Both male and female individuals exhibit nearly identical levels of agreement in response to similar inquiries.

The next three inquiries specifically inquire about the respondent's attitudes regarding energy conservation, climate change, and energy independence. The responses provided by male and female participants are identical in relation to these inquiries.

In relation to the ninth inquiry pertaining to the government's energy saving initiative, it is seen that male participants exhibit a somewhat higher level of awareness compared to their female counterparts.

In relation to the subsequent inquiry, it was found that 35% of female participants and 47% of male participants expressed their willingness to incur additional expenses in order to obtain energy from renewable sources. This finding indicates a higher level of interest in renewable energy adoption among male participants compared to their female counterparts.

In relation to the last inquiry, it was found that 58% of male participants and 54% of female participants hold the belief that the most effective approach to address the issue of global warming involves the utilization of renewable energy sources and the reduction of electricity use.

Educational Qualification wise Received Results

The collected results from the questionnaire are presented in Table 7, which organizes the data into three unique categories: agreement, disagreement, and

Table 6 — Gender-wise responses to research questions

Gender	Statements	Q1 %	Q2 %	Q3 %	Q4 %	Q5 %	Q6 %	Q7 %	Q8 %	Q9 %	Q10 %	Q11 %
	Agree	91	85	87	91	93	84	94	94	77	35	54
Female	Don't know	5	5	8	2	4	5	3	4	7	5	6
	Disagree	4	10	5	7	3	11	3	2	16	60	40
	Agree	95	93	87	92	95	84	94	95	79	47	58
Male	Don't know	2	5	9	6	4	6	5	4	5	4	19
	Disagree	3	2	4	2	1	9	1	1	16	49	23

Table 7 — Education qualification-wise responses to research questions

Educational qualification	Statements	Q1 %	Q2 %	Q3 %	Q4 %	Q5 %	Q6 %	Q7 %	Q8 %	Q9 %	Q10 %	Q11 %
	Agree	56	47	35	41	53	14	42	65	35	43	36
Below UG	Don't know	15	19	8	31	24	6	5	26	22	5	3
	Disagree	29	34	57	28	23	80	53	9	43	52	61
	Agree	59	60	52	47	64	36	50	67	44	50	44
UG	Don't know	14	12	8	25	8	11	9	20	13	5	17
	Disagree	27	28	40	28	28	53	41	13	43	45	39
	Agree	90	87	59	88	77	65	84	77	72	68	91
PG	Don't know	3	1	5	9	6	9	5	6	22	10	5
	Disagree	7	12	36	3	17	26	11	17	6	22	4

uncertainty. The participants have been classified into three distinct subcategories, namely "Below undergraduate," "Undergraduate," and "Postgraduate," based on their educational levels.

Based on the findings of the questionnaire, it is evident that postgraduate (PG) participants exhibit a higher level of awareness and possess a greater depth of knowledge compared to undergraduate (UG) and below-UG participants. The survey indicates that participants below the undergraduate level possess the least amount of information.

Willingness to Pay for Renewables

The tenth inquiry examines whether people are willing to spend more on RE. Only 12% of rural and 14% of semi-urban respondents were willing to pay more for RE. Urban participants were 37% more willing to pay more for RE. This suggests that urbanites are more enthusiastic about RE than non-urbanites. In the same survey, 35% of women and 47% of men were willing to pay more for RE. This suggests that men are more interested in RE than women. In response to same question, 68% PG, 50% UG, and 43% below UG were willing to pay more for renewables. This suggests that high-educated people are more interested in RE than their peers.

The findings of this inquiry indicate that there is a lack of enthusiasm and a certain degree of reluctance among individuals to incur more expenses for the purpose of obtaining RE, with the exception of those belonging to the highly educated demographic.

The propensity to allocate financial resources towards RESs is influenced by individuals' attitudes and prior experiences. Hence, a recommended approach to enhance the propensity to pay should involve the integration of educational initiatives and the promotion of awareness. Attitude has been demonstrated to have an impact on individuals' willingness to pay. A marketing plan is thus more inclined to achieve success when implemented within an educational effort.

Conclusions

A comparison study was performed to compare participants' regions, genders, and educational qualifications to the identical questions. The results of this analysis were useful and insightful. One interesting finding is that rural male postgraduate students are more aware and appreciative of FESs pollution and RE incentive programmes than other groups. The responses to a question about energy conservation and efficiency discussions among family and friends show that semi-urban and PG participants report more such discussions. The second noteworthy conclusion shows that urban male PG students had a stronger knowledge of climate change and government energy conservation programmes than their colleagues. Urban, male, and PG participants also have more positive views on RE, energy independence, and spending more on RE. The present study emphasises the qualitative feedback from a technology-friendly class, leaving out those without technology. Thus, non-technology-friendly class input might be obtained, and the questionnaire could be modified more specifically for each RESs.

References

1 Baloch Z A, Tan Q, Kamran H W, Nawaz M A, Albashar G & Hameed Z, A multi-perspective assessment approach of renewable energy production: Policy perspective analysis, *Environ Dev Sustain*, **24** (2021) 1–29, https://doi.org/10.1007/s10668-021-01524-8.

2 Bene D D, Scheidel A & Temper L, More dams, more violence? A global analysis on resistances and repression around conflictive dams through co-produced knowledge, *Sustain Sci*, **13** (2018) 617–633, https://doi.org/10.1007/s11625-018-0558-1.

3 Fraune C & Knodt M, Sustainable energy transformations in an age of populism, post-truth politics, and local resistance, *Energy Res Social Sci*, **43** (2018) 1–7, https://doi.org/10.1016/j.erss.2018.05.029.

4 Levenda A M, Behrsin I & Disano F, Renewable energy for whom? A global systematic review of the environmental justice implications of renewable energy technologies, *Energy Research Soc Sci*, **71** (2021) 101837, https://doi.org/10.1016/j.erss.2020.101837.

5 Fast S, Social acceptance of renewable energy: Trends, concepts, and geographies, *Geogr Compass*, **7** (2013) 853–866, https://doi.org/10.1111/gec3.12086.

6 Bronfman N C, Jim´enez R B, Ar´evalo P C & Cifuentes L A, Understanding social acceptance of electricity generation sources, *Energy Policy*, **46** (2012) 246–252, https://doi.org/10.1016/j.enpol.2012.03.057.

7 Langer K, Decker T & Menrad K, Public participation in wind energy projects located in Germany: Which form of participation is the key to acceptance?, *Renewable Energy*, **112** (2017) 63–73, https://doi.org/10.1016/j.renene.2017.05.021.

8 Pasqualetti M J, Opposing wind energy landscapes: A search for common cause, *Ann Assoc Am Geogr*, **101** (2011) 907–917, https://doi.org/10.1080/00045608.2011.568879.

9 Michaud K, Carlisle J E & Smith E R A N, Nimbyism vs. environmentalism in attitudes toward energy development, *Env Polit*, **17**(2008) 20–39, https://doi.org/10.1080/09644010701811459.

10 Burningham K, Barnett J &Walker G, An array of deficits: Unpacking NIMBY discourses in wind energy developers' conceptualizations of their local opponents, *Soc Nat Resour*, **28** (2015) 246–260, https://doi.org/10.1080/08941920.2014.933923.

11 Raheem A, Abbasi S A, Memon A, Samo S R, Taufiq-Yap Y H, Danquah M K & Harun R, Renewable energy deployment to combat energy crisis in Pakistan, *Energy Sustain Soc*, **6(16) (**2016) 1–13, https://doi.org/10.1186/s13705-016-0082-z.

12 Panwar N L, Kaushik S C & Kothari S, Role of renewable energy sources in environmental protection: A review, *Renew Sustain Energ Rev*, **15(3)** (2011) 1513–1524, https://doi.org/10.1016/j.rser.2010.11.037.

13 Hall D O, Mynick H E & Williams R H, Cooling the greenhouse with bioenergy, *Nature*, **353(6339)** (1991) 11, doi:10.1038/353011a0.

14 Dincer I, Energy and environmental impacts: Present and future perspectives, *Energy Source Part A*, **20(4)** (1998) 427, https://doi.org/10.1080/00908319808970070.

15 Kumar A & Choudhary S, Energy requirement, resources and future management: A review, *Indian J Pure Appl Phys*, **59(11)** (2021) 779–784, https://doi.org/10.56042/ijpap.v59i11.48505.

16 Kumar A, Kumar K, Kaushik N, Sharma S & Mishra S, Renewable energy in India: Current status and future potentials, *Renew Sustain Energ Rev*, **14** (2010) 2434–2442, https://doi.org/10.1016/j.rser.2010.04.003.

17 Gielen D, Boshell F, Saygin D, Bazilian M D & Wagner N, The role of renewable energy in the global energy transformation, *Energy Strategy Rev*, **24** (2019) 38–50, https://doi.org/10.1016/j.esr.2019.01.006.

18 Rizzi F, Eck N J V & Frey M, The production of scientific knowledge on renewable energies: Worldwide trends, dynamics and challenges and implications for management, *Renew Energ*, **62** (2014) 657–671, https://doi.org/10.1016/j.renene.2013.08.030.

19 Majid L H, Majid H H & Hussein H F, Analysis of renewable energy sources, aspects of sustainability and attempts of climate change, *American Sci Res J Eng Technol Sci*, **43(1)** (2018) 22–32.

20 Kumar A & Choudhary S, Renewable energy in India: Assessment of public understanding, social acceptance and attitude, *Indian J Eng Mater Sci*, **29** (2022) 201–210, https://doi.org/10.56042/ijems.v29i2.59587.

21 Batel S & Devine-Wright P, My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure, *Glob Environ Chang*, **47** (2017) 110–120, https://doi.org/10.1016/j.gloenvcha.2017.08.003.

22 Lucas H, Carbajo R, Machiba T, Zhukov E & Cabeja L F, Improving public attitude towards renewable energy, *Energies*, **14** (2021) 4521, https://doi.org/10.3390/en14154521.

23 Chabhadiya K, Srivastava R R & Pathak P, Growth projections against set-target of renewable energy and resultant impact on emissions reduction in India, *Environ Eng Res*, **26(2)** (2021) 200083, https://doi.org/10.4491/eer.2020.083.

24 Central Electricity Authority (CEA), *All India Installed Capacity (in MW) of Power Stations*, (2021) 1–7.

25 Ministry of Power (MoP), *Annual Report 2020-21 (Energizing India Enriching Lives)*, (2021) 1–248.

26 Central Electricity Authority (CEA), *Executive Summary Power Sector*, (2021) 1–64.

27 Central Electricity Authority (CEA), *Executive Summary Power Sector*, (2022) 1–63.

28 Ministry of Statistics and Program Implementation (MoSPI), *Annual Report 2021 (Installed Capacity and Capacity Utilization, Chapter 2)*, (2021) 1–14.

29 National Statistical Office (NSO), *Energy Statistics India*, (2022) 1–124.

30 Markard J, The next phase of the energy transition and its implications for research and policy, *Nat Energy*, **3** (2018) 628–633, https://doi.org/10.1038/s41560-018-0171-7.

31 Hansen K, Mathiesen B V & Skov I R, Full energy system transition towards 100% renewable energy in Germany in 2050, *Renew Sustain Energ Rev*, **102** (2019) 1–13, https://doi.org/10.1016/j.rser.2018.11.038.

32 Solomon B D & Krishna K, The coming sustainable energy transition: History, strategies, and outlook. *Energy Policy*, **39** (2011) 7422–7431, https://doi.org/10.1016/j.enpol.2011.09.009.

33 Rogge K S, Kern F & Howlett M, Conceptual and empirical advances in analyzing policy mixes for energy transitions, *Energy Res Soc Sci*, **33** (2017) 1–10, https://doi.org/10.1016/j.erss.2017.09.025.

34 Osunmuyiwa O & Kalfagianni A, Transitions in unlikely places: Exploring the conditions for renewable energy adoption in Nigeria, *Environ Innov Soc Transit*, **22** (2017) 26–40, https://doi.org/10.1016/j.eist.2016.07.002.

35 Munro F R, Renewable energy and transition-periphery dynamics in Scotland, *Environ Innov Soc Transit*, **31** (2019) 273–281, https://doi.org/10.1016/j.eist.2018.09.001.

36 Moss T, Becker S & Naumann M, Whose energy transition is it, anyway? Organization and ownership of the energiewende in villages, cities and regions, *Local Environ*, **20(12)** (2014) 1547–1563, https://doi.org/10.1080/13549839.2014.915799.

37 Burke M J &Stephens J C, Energy democracy: Goals and policy instruments for socio technical transitions. *Energy Res Soc Sci*, **33** (2017) 35–48, https://doi.org/10.1016/j.erss.2017.09.024.

38 Kumar A, Justice and politics in energy access for education, livelihoods and health: How socio-cultural processes mediate

the winners and losers, *Energy Res Soc Sci*, **40** (2018) 3–13, https://doi.org/10.1016/j.erss.2017.11.029.

39 Jenkins K, McCauley D, Heffron R, Stephan H & Rehner R, Energy justice: A conceptual review, *Energy Res Soc Sci*, **11** (2016) 174–182, https://doi.org/10.1016/j.erss.2015.10.004.

40 Pandey P & Sharma A, Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India, *Energy Res Soc Sci*, **71** (2021) 101824, https://doi.org/10.1016/j.erss.2020.101824.

41 Foxon T J, Gross R, Chase A, Howes J, Arnall A & Anderson D, UK innovation systems for new and renewable energy technologies: drivers, barriers and systems failures, *Energy Policy*, **33(16)** (2005) 2123–2137, https://doi.org/10.1016/j.enpol.2004.04.011.

42 Owen A D, Renewable energy: Externality costs as market barriers, *Energy Policy*, **34(5)** (2006) 632–642, https://doi.org/10.1016/j.enpol.2005.11.017.

43 Sovacool B K, The cultural barriers to renewable energy and energy efficiency in the United States, *Technol Soc*, **31** (2009) 365-373, https://doi.org/10.1016/j.techsoc.2009.10.009.

44 Zografakis N, Sifaki E, Pagalou M, Nikitagi G & Psarakis V, Assessment of public acceptance and willingness to pay for renewable energy sources in Crete, *Renew Sust Energ Rev*, **14** (2010) 1088–1095, https://doi.org/10.1016/j.rser.2009.11.009.

45 Chen D, Cheng C-Y & Urpelainen J, Support for renewable energy in China: A survey experiment with internet users, *J Clean Prod*, **112(5)** (2016) 3750–3758, https://doi.org/10.1016/j.jclepro.2015.08.109.

46 Karytsas S & Theodoropoulou H, Socioeconomic and demographic factors that influence publics' awareness on the different forms of renewable energy sources, *Renew Energ*, **71** (2014) 480–485, https://doi.org/10.1016/j.renene.2014.05.059.

47 Ediger V S, Kirkil G, Celebi E, Ucal M & Kentmen-Cin C, Turkish public preferences for energy, *Energy Policy*, **120** (2018) 492–502, https://doi.org/10.1016/j.enpol.2018.05.043.