HASIL CEK_Dissemination of technology information through YouTube: a case of renewable energy technology

by Muhammad Kunta Biddinika 60191235

Submission date: 22-Nov-2021 08:50AM (UTC+0700)
Submission ID: 1709560275
File name: 10124-32799-1-PB.pdf (584.61K)
Word count: 8246
Character count: 47701

TELKOMNIKA, Vol.17, No.3, June 2019, pp.1526~1538
ISSN: 1693-6930, accredited First Grade by Kemenristekdikti, Decree No: 21/E/KPT/2018
DOI: 10.12928/TELKOMNIKA.v17i3.10124

Dissemination of technology information through YouTube: a case of renewable energy technology

Muhammad Kunta Biddinika*[1], Mochamad Syamsiro[2], Srikandi Novianti[3], Bakhtiyor Nakhshiniev[4], Muhammad Aziz[5], Fumitake Takahashi[6]
[1,6]School of Environment and Society, Tokyo Institute of Technology, Kanagawa, Japan
[1]Center for Waste Management and Bioenergy, Universitas Janabadra, Yogyakarta , Indonesia
[2]Department of Mechanical Engineering, Universitas Janabadra, Yogyakarta, Indonesia
[3,4]Department of Environmental Science and Technology, Tokyo Institute of Technology, Japan
[5]Institute of Innovative Research, Tokyo Institute of Technology, Tokyo 152-8550, Japan
*Corresponding author, e-mail: mkuntab@gmail.com

Abstract

Internet video sharing has been used by scholars for two main purposes. First, it is for informal scholarly communication including teaching and academic conferences. Second, it is for engagement tool by contemporary society. Renewable energy technology has also been utilizing internet video sharing technology for those purposes. It is a promotional tool to disseminate information about the technology as well as a media for public engagement with renewable energy issues. This paper reviews how YouTube, the most popular internet video sharing website whose content is created and accessed publicly for free of charge, has been elaborated in scholarly publication in the various fields prior to showing how renewable energy is portrayed in YouTube. By using a hundred YouTube most viewed videos, this paper presents an in-depth and systematic measurement study on the characteristics of YouTube videos on renewable energy issues.

Keywords: *communication, energy education, renewable energy information, video sharing*

1. Introduction

Despite of well-known benefits and importance socially and environmentally, renewable energy still encounters challenges in the implementation. Besides technical obstacles, renewable energy also faces some non-technical barriers that are associated with the less smooth adoption of renewable energy technology into society. Previous studies have demonstrated how researchers argue on factors that influence adoption of renewable energy. Most studies in the implementation of renewable energy implicated with the information of renewable energy and the engagement between the information and stakeholders in the implementation of renewable energy.

Because of growing popularity of internet for the dissemination of information and for people engagement, this study focuses on the use of social media as it enables conversations beside sharing information, knowledge, and opinions among communities of people who gather in the internet (online) [1]. Internet provide a broad arena in which information can be disseminated directly to the internationally borderless audience from a wide range of background in comparison with traditional media such as newspaper, television, and magazine.

For the dissemination of information, there is growing interest in the use of social media, such as promoting public health and health care [2, 3], extending classroom learning beyond the walls of the school [4–6], making decision, operation, and searching travel information for tourism [7, 8], political campaign and movement [9–11], and improving brand and product marketing [12, 13]. Since direction of renewable energy information may flow only in one-way manner from “sponsor” (government and industry) to the public, it also important to observe the flow of renewable energy information occurring between the parties and how significant the parties in the renewable energy policy. Based on flow of information and significance in a policy, Rowe and Frewer distinguished three forms of engagement; communication, consultation, and participation [14]. Fair engagement between parties may help to build and to sustain society’s

Received May 31, 2018; Revised January 14, 2019; Accepted February 20, 2019

trust in renewable energy [15]. Therefore, engagement with the information also plays an important role in the study of renewable energy information.

However, most of the previous studies have elaborated renewable energy information in the text format [16, 17], considering the aforementioned instance. There are still quite a few studies elaborated other format of information in renewable energy, especially in the format of video sharing in internet. The available study on YouTube's renewable energy videos. Therefore, this study elaborates YouTube as a source of information on renewable energy as it is a free video-sharing website for public use. YouTube also adhere the user-generated content (UCG) where the videos are derived from YouTube users and consumers. YouTube also facilitates its users to give comments on the videos as well as to reply the comment. Besides, YouTube videos are also shareable by various social media network by which the users are able to engage with a certain video including the messages conveyed by the video.

This paper also shows how renewable energy information portrayed in YouTube by presenting an in-depth and systematic measurement study on the characteristics of YouTube videos on renewable energy. This study contributes to elaborate how feasible YouTube videos play a role as information source of renewable energy by some indicators; i.e. what contents of the videos, which renewable energy sources are most featured in the videos, and so on. This study also encourages researchers and engineers working in the renewable energy research and development to utilize YouTube as an information dissemination tool. In addition, this study assists them during preparation of information regarding research and development of renewable energy to the public.

As YouTube delivers information in video format, it is indicated that the use of a video is more effective rather than in written format for comprehension of information [18]. Information in video format also more helpful for improving people understanding the information which is presented in the written format [19]. Even for scientific publication, Journal of Visualized Experiments (JoVE; jove.com), a video-based peer-reviewed scientific journal, believes that "written word and static picture-based traditional print journals are no longer sufficient to accurately transmit the intricacies of modern research [20]. YouTube is also capable of facilitating visualization of renewable energy technology since it helps researchers to describe how the technology works and to deliver message to the public [21]. In addition, utilization of YouTube in science communication has also been suggested by a review on previous studies [22].

Hence, structure of this paper begins by revisiting factors which affect adoption of renewable energy as discussed by previous researchers. The next section focuses on the barrier of implementation especially that relates to renewable energy information and facilitating public in understanding the information. The third part of the introduction revisits scholarly publication of YouTube as a social media. The second section describes methodology of this study including the data of the video, and then the third section delivers results and discussion. Finally, some conclusions and lesson-learned from this study are withdrawn.

Adoption of renewable energy: Influencing factors

In the earlier literature overview on non-technical barriers to the diffusion of renewable energy sources in agriculture [23], they are identified as the negative factor that relates to the economic and commercial, operative and maintenance, social, institutional and environmental factors. Economic and commercial factors include plant costs, competitiveness compared to conventional (fossil) sources, etc. Operative and maintenance factors include any problem in plant operation. Problems originated from human being were included into social factors such as information and its understanding, technical training, willingness to invest in new technologies; willingness to pay higher cost of newly developed technologies, etc. Institutional factors include laws or regulations affecting a technology, bureaucratic procedures, etc. Environmental factors come from the potential pollution resulting from use of the technology.

In an earlier overview of the renewable energy situation European Union countries, there were 5 (five) factors which influence renewable energy development in EU; factor of geography, economic environment, politics, technology, and cognitive environment. Cognitive environment involves public beliefs, awareness and understanding on the renewable energy [24]. In another review of biomass processing by thermal conversion for fuels and chemicals production, technical and non-technical barriers to implementation were explained. Non-technical barriers were identified and classified into economics, perception, politics, scale,

risk, and vested interests. Dealing with perception barrier, increasing attention will need to be placed on understanding the idea to the public where the plant is to be built [25].

Since China has an ambitious renewable energy development for rural areas where up to 70% of rural households should have adopted renewable energy in their daily lives by 2020, a study on general local acceptance of renewable energy deployment in rural areas of China was conducted. It identified some possible factors influencing adoption of renewable energy. Intention of rural dwellers to be generally supportive renewable energy development was found to increase with household income, individual knowledge level and belief about cost of renewable energy use but decrease with individual age. The study argued that propaganda and popularization of knowledge about renewable energy use would be conducive to win local public support [26]. Another study on implementation of solar water heater in China also indicated that income, age, and education of residents play an important role in the adoption of solar energy technologies for households [27].

From the experience of renewable energy application in the organization of Islamic conference (OIC) countries, Sopian and his colleagues suggested some strategies in implementation effort of renewable energy [28]. The strategies included establishing education and capacity building programs, creating renewable energy market and financing mechanism, improving appropriate energy policies, establishing database, as well as international collaboration to promote renewable energy technologies. In view of the strategies in education and capacity building, the review also suggested some educational programs such as providing technical knowledge and improving competency level of service providers, engineers, architects, technicians, and academia. For capacity building program, there are some programs Sopian and his colleagues suggested, such as enhancing awareness level of the rationales for renewable energy technology among public, policy makers, investors, and financial institution. Furthermore, the reviewer argued that educational programs should be integrated in the education system in all levels such as including a chapter on renewable energy within science or physics subject at school textbooks. It is hope to raise public understanding on renewable energy to certain point that public understand the technology, benefits, ecological significances, purpose, and functions of the technology [28].

Case studies from commercial wind turbines in Denmark and India as well as residential solar panels in Germany and the United States have been presented by Sovacool and Ratan [29]. They tested nine factors playing an important role in the diffusion of renewable energy against those four case studies. The factors are (1) strong institutional capacity, (2) political commitment, (3) favorable legal and regulatory framework, (4) competitive installation/production costs, (5) mechanisms for information and feedback in which public engagement focusing, (6) access to financing, (7) prolific community/individual ownership and use, (8) participatory project siting, and (9) recognition of externalities or positive public image.

In a case study of biofuels implementation in Malaysian transportation sector, Lim and Lee explored 6 (six) key factors by which the success on the implementation is dependent on [30]. The factors are (1) supply, (2) technology, (3) infrastructure which arguably dependent on mutualistic symbiosis between government and industry, (4) cost, (5) policy from government, and (6) public acceptance by increasing citizens' knowledge for biofuels. Taking the acceptance factor into account, Lim and Lee argued that public reluctance in adopting state-of-the-art transportation fuels were usually originated form lack of information pertaining to the suddenly radical changes the public might take. Moreover, Lim and Lee also noted that number of citizens in developing countries with low environmental awareness and no familiarity with biofuels operation is relatively high. These are the vivid starting points for the research on renewable energy information and the mechanism of its dissemination. Given the variety of factors contributing to the adoption of renewable energy as explained by this section, attention of this study is focused on the contribution to resolving social barriers related to renewable energy information and its understanding by public.

Public understanding: Impediment of renewable energy implementation

Most of studies on the barrier of renewable energy implementation implicated insufficiency of information and its engagement which incurred low understanding and awareness. Since the previous section collects selected studies highlighting factors which influence implementation of renewable energy, this section focuses on the barrier of implementation especially that relates to renewable energy information and facilitating public in understanding the information.

In a comprehensive review of barriers to renewable/sustainable energy technologies adoption in India, Luthra et al. revealed twenty-eight barriers categorized into seven dimensions [31]. The dimensions are Economical and Financial; Market; Awareness and Information; Technical; Ecological and Geographical; Cultural and Behavioral; and Political and Government Issues. Three barriers within three different dimensions reflected barriers that relates to renewable energy information and public understanding. First barrier is lack of consumer awareness to technology. This is the most important barrier in the market dimension by which indicating relatively poor access to information compared to the conventional energy technologies. Information on renewable energy technologies were primarily sourced from newspaper and magazines which are also lack of distribution given large population of electricity consumers in India. This situation results in uncertainty on the quality of renewable/sustainable energy technologies. Second barrier is lack of information technology resources which is categorized into awareness and information dimension. This barrier is indicated by poor information flow and communication so that complicates technology transfer experiences in an industry. Third barrier is lack of awareness of technology especially among rural people. In order to cope with this barrier, the review revealed to incorporating from resource and various renewable energy technologies study to information on available government incentives and support systems within education and information dissemination related to renewable energy.

As Malaysia's experiences on biofuels implementation described in the previous section, public willingness in switching from fossil-based fuels to biofuels blends in transportation sector is important to ensure the success of the implementation whilst the willingness is originated from sufficient information related to the radical changes which might take public by surprise [30]. Lim and Lee argued "low uptakes amongst the public (due to their lack of information) can snowball into a chain reaction with refueling station operators refusing to sell or store biofuels due to low demand. This will then further reduce the uptakes of biofuels due to insufficient refueling stations." Furthermore, Lim and Lee warned that low awareness on renewable energy caused by lack of information induces complication amongst public when they need to spend additional transportation cost in consequence of more expensive biofuels. This complication possibly leading to public unrest may tarnish the image of biofuels accordingly. Therefore, Lim and Lee urged to disseminate information regarding merit and demerit of biofuels to the public by extensive campaigns, promotions and publicity through various mass media and communication channels for public to understand background and purpose of the implementation of biofuels in transportation sector.

Another study toward general renewable energy perception of Peninsular Malaysian citizens by Kardooni et al. also raised important issues about knowledge of renewable energy and its comprehension [32]. The study found that due to a lack of knowledge, people may feel the use of renewable energy would involve a high level of effort. It also found three indicators why public knowledge does not support renewable energy application; (1) the lack of appropriate programs in the educational system, (2) the absence of the role of mass media, and (3) the absence of a government policy implemented through one agency.

Furthermore, Lim and Lee also became aware of a challenge in biofuels implementation that many citizens in developing countries had low environmental awareness and are not familiar enough with the operation of biofuels whilst the countries had considerably potential of biofuels sources. To cope with the challenges, they recommended adequate communications and interactions amongst parties by which biofuels information and engagement on the issue play an important role. Although some previous studies, as described above, revealed the significance of information regarding renewable energy as well as its engagement by public, to the best of the author's knowledge, there is still a little study on the characteristic of renewable energy information available in internet.

YouTube videos in academic works

YouTube, launched in 2005, is the third most frequently visited website and free video sharing online platform whose contents are generated or created by the user itself [33, 34]. In one minute, totally 100 hours long of video is uploaded into YouTube and within one month, approximately one billion unique visitors watching videos on YouTube [35]. There is growing number of academic studies on YouTube videos as they have capabilities as information sources, learning tools, and engagement tools. In the academic field, YouTube has also been utilized for publication of activities related with scholarly purpose such as scientific experiments, conference presentations, or course lectures [36]. Even some papers cite YouTube video as

one of the reference [37]. Liikkanen and Salovaara also noted that as of May 2014, citation report for publication including “YouTube” in the title inclines to increase by over 100 papers recorded for 2013 and 492 papers by 2014 [38]. As a research environment, Konijn et al described YouTube by three approaches [39]. First approach, YouTube acts as an environment to present manipulated media materials in controlled experimental designs; second, as an environment to study effects of peer feedback on various media contents; and third, as a format to design a media-based questionnaire.

YouTube as information source

Studies on YouTube related with comprehension of information are mostly contributed by medical science, mainly in patients understanding of medical knowledge, such as assessment of YouTube videos as an information source in pregnancy [40], hypertension [41], H1N1 influenza pandemic [42], and kidney stone disease [43]. Misleading anorexia information disseminated through YouTube were also investigated in order to raise awareness about trustworthiness of health-related information [44]. Some links to YouTube videos were also presented in a review of *Curcuma longa* for health [45].

YouTube as learning tool

Study on YouTube as a learning tool has been demonstrated by development of YouTube channel designed to provide educational material for student of chemistry [5] and delivery of a module to undergraduate student in nursing [46]. Those studies found that YouTube videos may increase student engagement, critical awareness and facilitate deep learning. YouTube videos have also been evaluated for clinical skills education for nurses in the first year of their university diploma program [47], for stimulating discussion about what statistics are and why statistics matter in the statistics classroom [48], and as a platform to support classroom teaching on anatomy education for medical student [49]. By involving 20 instructors and lecturers in the area of music, creative writing, theater, television and film, dance, animation, and fine arts, YouTube videos were also studied as a tool for teaching and learning performing arts [50]. Since visiting industrial plants have a great importance and interest in the field of technical education, the University of Jaén developed a learning innovation project for renewable energy based on videocast techniques using YouTube as the platform. This project gave students a chance to obtain a real vision of the industrial plant whereby renewable energy is used as the energy source. Visiting industrial plants relates with problems of resource availability, time consuming, and access permission due to the on-going industrial processes [51].

YouTube as engagement tool

Research on YouTube videos as an engagement tool has used comments feature of the video along with the commenters and the discussions [52], such as a study on comments from YouTube videos related to the 2012 mass shootings and catastrophic hurricane in the United States [53]. That study highlighted differing online contexts in showing grief and emotions following man-made and natural calamities. Given music videos as the most popular genre in YouTube, Liikkanen and Salovaara examined how people interact with music videos [38]. They engage through commenting and voting (also well-known as liking). Voting is clicking thumb-up symbol instead of thumb-down of a video in YouTube. YouTube has also been elaborated as a medium to foster political expression by examining typology of discussions in YouTube channel managed by the White House [54]. A study on YouTube videos’ comments were also performed to examine engagement with “new age” spirituality [55]. YouTube videos’ comments on meditation were sorted into three main groups; remark about the video, reports of subjective experience, and responses to other comments.

Most of studies highlighted YouTube videos as a source of information while as an engagement tool was not elaborated deeper yet. Buie and Blythe also noted that as of July 2013, a search of the Association for Computing Machinery (ACM) Digital Library returned more that 7500 works for YouTube and only 65 for YouTube comments [55].

2. Method and Data

The 691100 videos were found in the search results by querying “renewable energy” terms by using search bar facility on the top of the YouTube webpage. The videos search results were sorted in descending order by video view count. A hundred most viewed YouTube videos were retrieved from the search result for further analysis.

From analyzing 100 videos, videos that met any of the exclusion criteria were eliminated for further analysis. First, videos which were not in the English language were excluded. Second, duplicate videos were also excluded, including the videos whose different title, yet the content is similar. Third, videos containing hoax, myth and pseudoscience including videos without any correlation with renewable energy issues were also excluded. Pseudoscience refers to a claim, belief, or practice which selectively uses scientific facts and so fosters misleading images about the nature of science [56]. As YouTube randomly assigns each video an eleven-digit distinct characters, numbers and symbols as video identity [57] denoted after equal symbol of the unique web address, or uniform resource locator (URL) of the video. For example, the URL of wind turbine video is www.youtube.com/watch?v=AS74oAmjpxU; this paper then names the video as ID: AS74oAmjpxU. The similar labelling on YouTube videos was also performed by previous research [36].

The analysis was conducted by two of the authors (MKB and MS) in order to understand typical energy sources commonly mentioned and discussed in YouTube videos. In addition, the initial analysis was required to define classification of video content. The two authors as the coders viewed and discussed each video simultaneously to reach agreement on the classification procedure of content analysis. Content analysis of the videos was conducted subsequently in order to categorize the videos into five classifications; [1] policy and concept explanation, [2] description on how a technology works (how-to), [3] description of technology innovation especially in comparison with the available technology, [4] commercial or advertisement, and [5] case study.

3. Results and Discussion

Due to the exclusion criteria, 90 out of 100 unique YouTube videos on renewable energy were discovered for further analysis. From 100 videos in search results, by reason of non-English language criterion, a video in the Spanish language (ID: cfwHoRptPCs) was excluded (n=1). The video has also similar content with another video presenting the concept of ocean thermal energy conversion technology in English language (ID: x59MptHscxY). Although this video was excluded from the analysis, the practice of inserting or adding either audible or written narration which is translated from the original narration into a video is worth emulating especially for the dissemination of renewable energy technology information. Since the aforementioned studies revealed that countries with potential renewable energy source are not English-speaking countries whilst most of information resources on renewable energy technology are in English language, it is still required to translate English materials on renewable energy technology into languages other than English in order to provide more access to non-English speaking countries toward renewable energy information. An example of this practice is found in a video describing Japanese innovation on solar energy system (ID: lmdLwTe-rqw). The video is narrated in audible Japanese language; however, the narration is sub-titled in English. It makes the video still understandable by people who are illiterate in Japanese language.

A video was dropped by duplication criterion (n = 1), that is ID: 1AsANZBIHeI due to similar content with ID: Hy88ylRx-6o. Although ID: 1AsANZBIHeI has longer video duration, yet the content is merely repetition of certain parts from the other one. In addition, ID: Hy88ylRx-6o was uploaded earlier than ID: 1AsANZBIHeI. In the two cases of nearly similar commercials videos (ID: mjwCWGOil1Y with ID: Ragy23vW8so and ID: sIhYPIBVPHQ with ID: VJF7QZ-QeZk), both of them were not excluded. It is because each video emphasizes different points, such as creating jobs, helping local community, and continuously available renewable energy source, although both videos in the first case advertise wind power system produced by Siemens in the United States of Amerika (www.usa.siemens.com). Alike with the first case, each video in the second case emphasizes different points, such as growing new frontier of renewable energy, nature of renewable energy, revolution toward clean energy, and how the people required to power the revolution.

Most eliminated videos were because of the third criterion (n=8), such as ID: l4QwWnqQE5w and ID: wdodjuVC45k which show how free and renewable energy produced from neodymium magnets, ID: cmnHeBD-5GU which shows clean and renewable energy from melanin which is found in areas of human body, and ID: nidJnqgP9ro which explains renewable internal energy self-massage by Russian martial arts. Some other videos which are not included

in this study are ID: 7Uy6L8I1Hrw showing how rants of American actor Charlie Sheen were found as secret code for producing renewable energy, ID: 4cKgKSj112M playing instrumental music titled "100% Renewable Energy", ID: K-_S30AqkMA showing that pyramid in Egypt as a renewable energy source, and ID: LXCibbfQG0M which is a video of Austrian Domino Art presenting dominoes themed renewable energy. The complete exclusion criteria including the videos are listed in Table 1.

Table 1. Exclusion Criteria of Renewable Energy (RE) YouTube Videos Found in Search Results

Criteria	Video ID	Remark
Non-English language	cfwHoRptPCs	in Spanish language
Duplicate	1AsANZBIHeI	N/A
Containing hoax, myths, pseudoscience and irrelevance	I4QwWnqQE5w	Neodymium magnet as RE source
	wdodjuVC45k	Neodymium magnet as RE source
	cmnHeBD-5GU	Melanin as RE source
	nidJnqgP9ro	Russian martial arts
	7Uy6L8I1Hrw	Rants as RE source
	4cKgKSj112M	Instrumental music
	K-_S30AqkMA	Pyramid as RE source
	LXCibbfQG0M	Dominoes about RE

The uncovering of the videos containing hoax, myths and pseudoscience gives urgency to the renewable energy scientists to join education efforts including spreading the information, so that public are liberated from misleading understanding on renewable energy. Since most of the videos mentioned more than one renewable energy source, the distribution of energy sources is depicted as shown in Figure 1. Among renewable energy sources, wind and solar are predominantly mentioned and discussed in YouTube videos since more that a half of analyzed videos mention wind and solar energy. Wind energy and solar energy may be regarded as the most popular sources across renewable energy sources. Both wind energy and solar energy are also relatively simple to indicate compared with other renewable energy sources. A single tower of wind turbine easily indicates wind power and a single solar panel attached on the rooftop or some panels that cover land also easily indicate solar power.

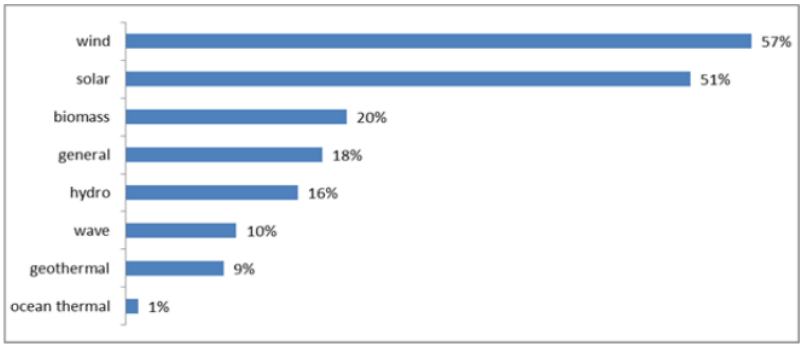

Figure 1. Distribution of renewable energy sources mentioned in YouTube videos

Renewable energy as the general term is commonly mentioned in the explanation of policy and concept, for example in a learning material about energy for middle school students answering the question what makes an energy source renewable or non-renewable (ID: pBTnVoEIb98), and in explaining concept of plug-in hybrids for electric vehicle (ID: pSdnycHfLnQ). In addition, renewable energy is also mentioned generally as a background

or motivation of technology innovation, for example in the innovation of liquid metal batteries (ID: Sddb0Khx0yA).

Regarding the content of YouTube videos on renewable energy, some videos may share some different contents as shown in Figure 2. Most of them explain policy and concept such as explanation of the Europenan Enion (EU)'s energy policy which mixes energy sources including renewable sources (ID: 1cysaOnlv_E), description of the ocean turbine for electricity generation in Norway and Scotland (ID: JKbfkfDumRo), and explanation of an involvement of a family farm as a part of a sustainable renewable energy pipeline by producing ethanol and other biofuels (ID: 7VyxctmL9RI). Videos on policy or concept explanation are predominantly less-technical compared with videos on how-to and innovation.

Most of videos on technology innovation also include content of how-to something works. Hence, almost all of how-to videos are more technical compared with that of other video contents. Not all innovation shown in the videos are sophisticated technology. Some technology innovations are indeed sophisticated as well as costly, such as offshore windfarm including smart grid and technology for transmitting produced its electricity (ID: tPOivsKavQo). The video is produced and owned by a German company, Infineon Technologies AG (www.infineon.com), which designs, manufactures and markets semiconductors, including power semiconductors. A video of giant sea-snake-shaped machine for producing electricity by harnessing ocean wave is also an example of sophisticated innovative renewable energy technology presented in YouTube (ID: mcTNkoyvLFs). Since both videos shows innovative and sophisticated technology, they also include explanation how the technologies work. This is the reason why videos on technology innovation mainly also include content of how-to something works.

In contrast to sophisticated technologies, a video of simple technology innovation also appears. The video shows homemade parabolic mirror for reflecting solar power in order to obtain thermal solar energy (ID: 4nGheClD-IY). The video also shows how the mirror burning a piece of wood by collecting and reflecting sunlight. The video owner even mentioned that the mirror is considered as do-it-yourself (DIY) renewable energy technology.

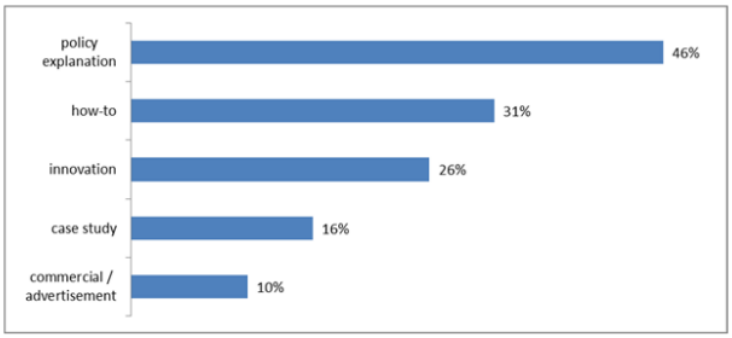

Figure 2. Content distribution of renewable energy videos in YouTube

Commercial videos on renewable energy business also appear in YouTube. They are from the simple format such as photo compilation until complex format in motion picture as if they are short movies in cinema. An advertisement of Brazilian biomass wood chips pellet briquetting is an example of commercial of renewable energy business in simple format as photo compilation (ID: mhT9cdTsqnA), and commercials from relatively large companies are examples of commercials in the complex format of motion picture, such as ID: mjwCWGOil1Y and ID: Ragy23vW8so by Siemens of the United States of America, as well as ID: VJF7QZ-QeZk and ID: slhYPIBVPHQ by Ecotech Institute. The products advertised in the videos are various from parts and whole system of home renewable energy system, such as home solar and wind power system for residential purpose (ID: Hy88ylRx-6o and ID: F3TUTfy1n60) until large-scale renewable energy system (ID: Ragy23vW8so). It is also not

only in the form of goods but also human resource development such as training and education (ID: VJF7QZ-QeZk and ID: slhYPIBVPHQ).

Considering the energy sources in the commercials of renewable energy business, seven out of nine videos mention wind power; five out of nine videos mention solar energy, and only two out of nine commercial videos mention biomass energy as shown in the Table 2. This tendency is similar with distribution of energy sources mentioned in YouTube videos as shown in Figure 1. It also may emphasize that wind and solar energy are regarded as the most popular sources across renewable energy sources. This tendency is profound in content category of advertisement compared with the other. This tendency also could be used to understand investor involvement in the renewable energy business by which leading to the market acceptance as one of the dimensions of social acceptance introduced by Wustenhagen et al. [58]. Wustenhagen and his colleagues suggested further research "in understanding of the current rethinking process in large energy companies toward taking a more or less proactive approach to renewables".

Renewable energy videos in YouTube also show practices or actual application of its technologies. Not all video shows success story of renewable energy application, such as a video showing demonstration outside the Public Service Commission in the United States of America (ID: 2Fs5v6NHTHg). During the action, protesters run a fan powered by batteries which were charged by wind turbine and solar panel. However, before the protest was over, the batteries went out because wind turbine and solar panel could not produce enough electricity. Some videos show country-specific practices by which the development of renewable energy from the particular countries could also be observed. The difference between Germany and Philippines in the renewable energy application is obvious by watching video of German solar power plant (ID: p2hU17p2xjU), Japanese solar system (ID: lmdLwTe-rqw), and solar power plant in a city of a gulf country, Masdar (ID: NIaz61zpLfs) compared with low hydro power in Philippines (ID: BULXLaM4NmE) and utilization of biogas in the Himalaya (ID: GQrr4KhP4Dc). The list of video content including some selected renewable energy videos is presented in the Table 2.

In addition to the aforementioned discussions, the following videos attracted more authors' attention by which some lesson-learned and conclusions are drawn. An interesting video (ID: mlj8EuEJ8FY) describing how different types of renewable energy work does not spark lively discussion although the content is quite interesting and explaining some energy sources. The video also does not collect many views despite appealing content since the explanation video is easy to understand. It is probably because the video was not shared through others social media in order to extend video exposure to the public. Although some interesting videos also did not attract many views due to some other reasons, however, sharing through others social media might become one of solution to reach more viewers.

Another inspiring video (ID: UZol5vMDhe4) shows a creative educational tool produced by a teacher, named Mr. Parr as his YouTube account name, to help his 6th grade student (usually 11–13 years old) understanding renewable energy. Mr. Parr creates science songs, records them, and uploads them on his YouTube channel. Besides the audio, the video also includes lyrics of the song and some necessary figures explaining the concept conveyed by the song. This typical video format corresponds with a solution of SDCF framework, that is diversity in presentation format and tone, as proposed by Barrios-O'Neill and Schuitema [59].

A video (ID: Sddb0Khx0yA) presents an inspiring talk by Donald Sadoway, a professor in materials chemistry at Massachusetts Institute of Technology (MIT), about the future of large-scale batteries that store renewable energy. The talk is interesting since it discussed an innovation on energy storage from present battery technology invented by Alessandro Volta to future utilization of liquid metal for the battery. In addition, the talk was arranged in such a way that resembled a lecture complete with a blackboard by which Professor Sadoway explained his innovation in a simple manner. The simplicity of the video, both content and method in particular, should inspire renewable energy scientists, including lecturers, to create similar video, i.e. by recording their lecture in a class and uploading on YouTube.

A similar idea with the lecture video, an interesting technical video (ID: a6e3CprVTi8) shows how a renewable energy technology works. The technology is biomass gasifier using wood pellets as the fuel. The gasifier produced flammable mixture for the purpose of running electricity generator in the absence of gasoline. The screenshot of the video is presented in Figure 3. The video production was quite simple since it was produced by using a handy video

camera and a tripod in order to make the camera standing still. The creator seemed to make a self-recording since the gasifier operator who appeared in the video also acted simultaneously as the presenter as well as camera operator. In addition, the video creator might have used additional high-quality microphone so that the recorded sound was sufficiently clear although he stood rather far from the camera. However, the video was not probably touched by sound processing software for editing process so that undesired sound from surrounding (e.g. cars passing-by) was also clearly included although he might have edited the video in order to insert some detailed still image inside the gasifier (e.g. fire-tube inside the barrel before the top lid welded).

Table 2. Content and Energy Source Mentioned in Some YouTube Videos on Renewable Energy

Content	Video ID	Energy source
Policy/concept explanation	Q7T_TmMjRr8	wind, solar, biomass
	1cmaLd-j8Wg	N/A (general renewable energy)
	Fep4CSRoreE	wind
	t5QxsZRKqls	N/A (general renewable energy)
	99p55moV8kw	N/A (general renewable energy)
	Fc01HalhoNc	N/A (general renewable energy)
	Qw59JqqELIs	wind, solar, general renewable energy
	05CJ2R88AZM	wind, solar
	kVskMh0Etcs	wind, solar, biomass, geothermal, hydropower, sea wave
	aNZgjEDPe24	wind, solar, biomass
Technology / how-to work	mIj8EuEJ8FY	wind, solar, geothermal, hydropower
	llHhaL6Hf7E	solar
	kIFoqqgLHCA	wind
	a6e3CprVTi8	biomass
	tm7y10rGXu0	biomass
	LMWIgwvbrcM	solar
	NDZzAIcCQLQ	solar
	Oh37m6tFydc	wind, solar, geothermal, hydro, wave
	cgjdIafNbaw	wind, solar
	Ib_Tur3Cc-A	wind, solar
Innovation	YQBam7ASoro	wind, wave
	Sddb0Khx0yA	N/A (general renewable energy)
	C-EvV90MeDY	solar, wind
	lmdLwTe-rqw	solar
	8FZPeQZIQE8	N/A (general renewable energy)
	x59MptHscxY	ocean thermal
	YHldwuCnCxg	solar
	mcTNkoyvLFs	wave
	tPOivsKavQo	wind
	4nGheCID-IY	solar
Commercial / Advertisement	Hy88ylRx-6o	wind, solar
	mjwCWGOil1Y	wind
	mhT9cdTsqnA	biomass
	Ragy23vW8so	wind
	dc2uBqQYrS0	solar, wind
	VJF7QZ-QeZk	solar wind
	F3TUTfy1n60	solar, wind
	sIhYPIBVPHQ	solar, wind
	tm7y10rGXu0	biomass
Case study	p2hU17p2xjU	solar, wind
	GQrr4KhP4Dc	biomass
	BULXLaM4NmE	hydro
	-mNrHcFEohA	hydro
	2Fs5v6NHTHg	solar, wind
	F3TUTfy1n60	solar, wind
	lmdLwTe-rqw	solar
	NIaz61zpLfs	solar
	7VyxctmL9RI	biomass
	aansFzgV1SQ	solar, wind

Figure 3. Typical YouTube video with the views count and like-dislike expression

Nevertheless, such an informative and communicative video was not necessarily created in a well-equipped studio where every single detail of the recording process is professionally well-prepared. As the engagement performance, the video was viewed more than 900,000 times and attracted more than 900 comments (as of May, 2018). Some of the comments contained technical discussions, suggestions related with the know-how, criticism on the selection of technology, as well as appreciation for creating and sharing the video including the detail explanation. The video and question or comment in the comment list has both a thumb up (meaning of I like this) and a thumb down (meaning I dislike this) signs adjacent to Reply sign to facilitate the simplest form of engagement on YouTube. As the video received more than 7,000 thumbs up and only less than 250 thumbs down (as of May, 2018), the was assumed to attract more positive impressions rather than negative ones. Moreover, following the people engagement in the comment list of the video may also enrich public knowledge on the renewable energy technology, particularly biomass gasification technology.

4. Conclusions

This study indicated YouTube as a potential tool to fulfil lack of information on renewable energy technology. It also fulfills all aspect of public knowledge vehicle; free, easy to access, user generated content, and able to play on-demand. It also satisfies all aspect of comprehensive definition of public engagement by Rowe and Frewer [14]. This study also highlighted that renewable energy information needs to be in the various languages depending on the public understandability. This study also found that information on renewable energy includes some hoaxes, pseudosciences, and myths. Those may lead to misleading information of renewable energy. In this regard, involvement of renewable energy scientists is necessary to purify the information. This current work has also shown that wind and solar energy is the most popular compared with that of other renewable energy sources. It means that the other renewable energy sources still need more promotion into the public.

Most content of the video is explaining policy and less-technical concept while technical know-how is still a few in utilizing YouTube for distribution of technical information. By observing advertisement videos on renewable energy business, YouTube also has a potential to understand tendency to which extent investment in renewable energy business heading. Not only success story of renewable energy practice is available in YouTube videos, but also failure practice. In addition, country-specific practices on renewable energy are also shown in YouTube. Hence, the development of renewable energy from the particular countries could also be observed. In order to reach more viewers, this study suggests that renewable energy videos in YouTube need to be shared across others social media platform. Many of us, researcher and engineer in the renewable energy field, are assumed to be familiar with the creation a video, including the use of modern digital video camera at least in their private life (e.g. documenting wedding ceremonies, vacation at the beach, or birthday party of a family member). It makes no reasonable reason for us to create a documentation video showing us explaining at a simple

way how our experiments work, or how our experiments contribute to the development of renewable energy technology.

References

[1] Safko L, Brake DK. *T*he Social Media Bible: Tactics, Tools, and Strategies for Business Success. John Wiley & Sons. *Epub ahead of print*. 2009.
[2] Mandeville KL, Harris M, Thomas HL, et al. Using Social Networking Sites for Communicable Disease Control: Innovative Contact Tracing or Breach of Confidentiality? *Public Health Ethics.* 2014; 7(1): 47–50.
[3] Antheunis ML, Tates K, Nieboer TE. Patients' and health professionals' use of social media in health care: motives, barriers and expectations. *Patient Educ Couns.* 2013; 92(3): 426–31.
[4] Nowell SD. Using disruptive technologies to make digital connections: stories of media use and digital literacy in secondary classrooms. *EMI Educ Media Int*. 2014; 51(2): 109–123.
[5] Smith DK iTube, YouTube, WeTube: Social Media Videos in Chemistry Education and Outreach. *J Chem Educ.* 2014; 140604143525006.
[6] Tess PA. The role of social media in higher education classes (real and virtual) – A literature review. *Comput Human Behav*. 2013; 29: A60–A68.
[7] Xiang Z, Gretzel U. Role of social media in online travel information search. *Tour Manag.* 2010; 31: 179–188.
[8] Leung D, Law R, van Hoof H, et al. Social Media in Tourism and Hospitality: A Literature Review. *J Travel Tour Mark*. 2013; 30(1-2): 3–22.
[9] Xenos M, Vromen A, Loader BD. The great equalizer? Patterns of social media use and youth political engagement in three advanced democracies. *Information, Commun Soc.* 2014; 17(2): 151–167.
[10] Bimber B. Digital Media in the Obama Campaigns of 2008 and 2012: Adaptation to the Personalized Political Communication Environment. *J Inf Technol Polit*. 2014; 11(2): 130-150.
[11] Larsson AO, Moe H. Triumph of the Underdogs? Comparing Twitter Use by Political Actors During Two Norwegian Election Campaigns. *SAGE Open*. 2014; 4(4): 2158244014559015.
[12] Labrecque LI. Fostering Consumer–Brand Relationships in Social Media Environments: The Role of Parasocial Interaction. *Journal of Interactive Marketing.* 2014; 28(2): 134–148.
[13] Gensler S, Völckner F, Liu-Thompkins Y, et al. Managing Brands in the Social Media Environment. *J Interact Mark Journal of Interactive Marketing.* 2013; 27(4): 242–256.
[14] Rowe G, Frewer LJ. A Typology of Public Engagement Mechanisms. *Sci Technol Human Values.* 2005; 30(2): 251–290.
[15] Wallquist L, Holenstein M. *Engaging the Public on Geothermal Energy*. World Geotherm Congr Melbourne, Aust. 2015; 4.
[16] Biddinika MK, Lestari RP, Indrawan B, et al. Measuring the readability of Indonesian biomass websites: The ease of understanding biomass energy information on websites in the Indonesian language. *Renew Sustain Energy Rev*. 2016; 59: 1349–1357.
[17] Biddinika MK, Diponegoro AM, Ali RM, et al. Survey on readability of online information for upgrading understandability of biomass energy technology. *J Mater Cycles Waste Manag.* 2017; 19(3): 1069–1076.
[18] Ali Batel E. The Effectiveness of Video vs. Written Text in English Comprehension and Acquisition of ESL Students. *Arab World English J.* 2014; 5(4): 326–335.
[19] Sonne SC, Andrews JO, Gentilin SM, et al. Development and pilot testing of a video-assisted informed consent process. *Contemp Clin Trials.* 2013; 36(1): 25–31.
[20] Stern D. The Future of Peer-Reviewed Scientific Video Journals. *Online Search.* 2013; 37(3): 28–32.
[21] Biddinika MK, Syamsiro M, Hadiyanto AN, et al. Technology for public outreach of fuel oil production from municipal plastic wastes. *Energy Procedia.* 2017; 142: 2797–2801.
[22] Welbourne DJ, Grant WJ. Science communication on YouTube: Factors that affect channel and video popularity. *Public Underst Sci.* 2015; 25(6): 706-18.
[23] Jarach M. An overview of the literature on barriers to the diffusion of renewable energy sources in agriculture. *Appl Energy*. 1989; 32(2): 117–131.
[24] Reiche D, Bechberger M. Policy differences in the promotion of renewable energies in the EU member states. *Energy Policy.* 2004; 32(7): 843–849.
[25] Bridgwater A. Renewable fuels and chemicals by thermal processing of biomass. *Chem Eng J.* 2003; 91(2-3): 87–102.
[26] Liu W, Wang C, Mol APJ. Rural public acceptance of renewable energy deployment: The case of Shandong in China. *Appl Energy.* 2013; 102: 1187–1196.
[27] Yuan X, Zuo J, Ma C. Social acceptance of solar energy technologies in China—End users' perspective. *Energy Policy.* 2011; 39(3): 1031–1036.
[28] Sopian K, Ali B, Asim N. Strategies for renewable energy applications in the organization of Islamic conference (OIC) countries. *Renew Sustain Energy Rev.* 2011; 15(9): 4706–4725.

[29] Sovacool BK, Lakshmi Ratan P. Conceptualizing the acceptance of wind and solar electricity. *Renew Sustain Energy Rev.* 2012; 16(7): 5268–5279.
[30] Lim S, Lee KT. Implementation of biofuels in Malaysian transportation sector towards sustainable development: A case study of international cooperation between Malaysia and Japan. *Renew Sustain Energy Rev.* 2012; 16(4): 1790–1800.
[31] Luthra S, Kumar S, Garg D, et al. Barriers to renewable/sustainable energy technologies adoption: Indian perspective. *Renew Sustain Energy Rev.* 2015; 41: 762–776.
[32] Kardooni R, Binti S, Binti F. Renewable energy technology acceptance in Peninsular Malaysia. *Energy Policy.* 2016; 88: 1–10.
[33] Ryu M-H, Kim S, Lee E. Understanding the factors affecting online elderly user's participation in video UCC services. *Comput Human Behav.* 2009; 25(3): 619–632.
[34] Alexa Top 500 Global Sites, http://www.alexa.com/topsites. Aaccessed 15 January 2016.
[35] Warman M. YouTube at 8: 100 hours uploaded every minute. *The Telegraph.* 2013.
[36] Kousha K, Thelwall M, Abdoli M. The role of online videos in research communication: A content analysis of YouTube videos cited in academic publications. *J Am Soc Inf Sci Technol.* 2012; 63(9): 1710–1727.
[37] Chun Hou T, Nurshazwani Wan Zakaria W, Sue Jing T, et al. Vision Based Human Decoy System for Spot Cooling. *TELKOMNIKA Telecommunication Computing Electronics and Control.* 2017; 15: 1512–1519.
[38] Liikkanen LA, Salovaara A. Music on YouTube: User engagement with traditional, user-appropriated and derivative videos. *Comput Human Behav.* 2015; 50: 108–124.
[39] Konijn E a, Veldhuis J, Plaisier XS. YouTube as a research tool: three approaches. *Cyberpsychol Behav Soc Netw.* 2013; 16(9): 695–701.
[40] Hansen C, Interrante JD, Ailes EC, et al. Assessment of YouTube videos as a source of information on medication use in pregnancy. *Pharmacoepidemiol Drug Saf.* 2016; 25(1): 35–44.
[41] Kumar N, Pandey A, Venkatraman A, et al. Are video sharing web sites a useful source of information on hypertension? *J Am Soc Hypertens.* 2014; 8(7): 481–90.
[42] Pandey A, Patni N, Singh M, et al. YouTube as a source of information on the H1N1 influenza pandemic. *Am J Prev Med.* 2010; 38(3): e1-3.
[43] Sood A, Sarangi S, Pandey A, et al. YouTube as a source of information on kidney stone disease. *Urology.* 2011; 77(3): 558–62.
[44] Syed-Abdul S, Fernandez-Luque L, Jian W-S, et al. Misleading health-related information promoted through video-based social media: anorexia on YouTube. *J Med Internet Res.* 2013; 15: e30.
[45] Prasad S, Gupta SC, Tyagi AK, et al. Curcumin, a component of golden spice: from bedside to bench and back. *Biotechnol Adv.* 2014; 32(2): 1053–64.
[46] Clifton A, Mann C. Can YouTube enhance student nurse learning? *Nurse Educ Today.* 2011; 31(4): 311–3.
[47] Duncan I, Yarwood-Ross L, Haigh C. YouTube as a source of clinical skills education. *Nurse Educ Today.* 2013; 33(12): 1576–80.
[48] Everson M, Gundlach E, Miller J. Social media and the introductory statistics course. *Comput Human Behav.* 2013; 29(5): A69–A81.
[49] Jaffar AA. YouTube: An emerging tool in anatomy education. *Anat Sci Educ.* 2012; 5(3): 158–64.
[50] DeWitt D, Alias N, Siraj S, et al. The Potential of Youtube for Teaching and Learning in the Performing Arts. *Procedia - Soc Behav Sci.* 2013; 103: 1118–1126.
[51] Torres-Ramírez M, García-Domingo B, Aguilera J, et al. Video-sharing educational tool applied to the teaching in renewable energy subjects. *Comput Educ.* 2014; 73: 160–177.
[52] Thelwall M, Sud P, Vis F. Commenting on YouTube videos: From Guatemalan Rock to El Big Bang. *J Am Soc Inf Sci Technol.* 2012; 63(3): 616–629.
[53] Miller ED. Content Analysis of Select YouTube Postings: Comparisons of Reactions to the Sandy Hook and Aurora Shootings and Hurricane Sandy. *Cyberpsychology, Behav Soc Netw.* 2015; 18(11): cyber.2015.0045.
[54] Halpern D, Gibbs J. Social media as a catalyst for online deliberation? Exploring the affordances of Facebook and YouTube for political expression. *Comput Human Behav.* 2013; 29(3): 1159–1168.
[55] Buie E, Blythe M. *Meditations on YouTube.* In: Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces - DPPI '13. New York, New York, USA: ACM Press. 2013: 41.
[56] Allchin D. Pseudohistory and Pseudoscience. *Sci Educ.* 2004; 13: 179–195.
[57] Cheng X, Liu J, Dale C. Understanding the Characteristics of Internet Short Video Sharing: A YouTube-Based Measurement Study. *IEEE Trans Multimed.* 2013; 15: 1184–1194.
[58] Wüstenhagen R, Wolsink M, Bürer MJ. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy.* 2007; 35(5): 2683–2691.
[59] Barrios-O'Neill D, Schuitema G. Online engagement for sustainable energy projects: A systematic review and framework for integration. *Renew Sustain Energy Rev.* 2016; 54(C): 1611–1621.

HASIL CEK_Dissemination of technology information through YouTube: a case of renewable energy technology

ORIGINALITY REPORT

4%	3%	5%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	s3.amazonaws.com Internet Source	3%
2	Luthra, Sunil, Sanjay Kumar, Dixit Garg, and Abid Haleem. "Barriers to renewable/sustainable energy technologies adoption: Indian perspective", Renewable and Sustainable Energy Reviews, 2015. Publication	2%

Exclude quotes	On	Exclude matches	< 2%
Exclude bibliography	On		