

Forging a Dialogue Between the Energy Industry and the Meteorological Community

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Abstract The interplay between energy and meteorology (based on its broad meaning of weather, water and climate) has been steadily growing. For this relationship to continue flourishing, a formal structure for stakeholders to interact effectively is required. The process of formation of the World Energy & Meteorology Council (WEMC), an organisation aimed at promoting and strengthening such a relationship, is discussed in this chapter. Such a process involves building many diverse relationships, something which has been happening over several years, alongside the adoption of more formal practices such as stakeholder surveys. While the focus of this chapter is clearly on WEMC, this process could be used as a stimulus for analogous activities in the broader energy and meteorology area, specifically those at the national and regional levels, as well as similar activities straddling diverse disciplines, such as those promoted by the Global Framework for Climate Services (GFCS).

Keywords Meteorology • Climate services • Energy • Partnerships • Survey • Capacity building • Communication • Outreach • Stakeholder engagement • Education • Associations

INTRODUCTION TO THE WORLD ENERGY & METEOROLOGY COUNCIL

The World Energy & Meteorology Council (WEMC) is a non-profit organisation devoted to promoting and enhancing the interaction between the energy industry and the weather, climate and broader environmental sciences community. Its primary goal is to support improved sustainability, resilience and efficiency of energy systems under ever-changing weather and climate.

Formally established in 2015 as a Company Limited by Guarantee in the UK, WEMC has taken shape over several years. The initial seeds were sown with the 2008 NATO Advanced Workshop, *Weather/Climate Risk Management for the Energy Sector*, which was attended by nearly 30 very active participants who subsequently produced a report published in an international journal (Troccoli et al. 2010) as well as a book that has attracted the attention of thousands of practitioners (Troccoli 2010) and paved the way for more organised interactions between many stakeholders including but not limited to hydrometeorological science and energy sector communities. This start-up workshop was then followed by the more

formal and substantial International Conference on Energy & Meteorology (ICEM) series. Four ICEMs have been successfully held thus far—2011 in Australia, 2013 in France, 2015 in USA and 2017 in Italy—with a fifth one to be held in May 2018 in China, where increasing emphasis will be placed on developing world activities and requirements (plans for subsequent conferences are underway). During this period, the WEMC concept has developed substantially thanks to countless discussions amongst experts, the creation of new connections, the burgeoning of the literature in the area of weather, water and climate services as well as work in related international activities such as the International Energy Agency (IEA) Tasks 36 for wind energy, 46 for solar energy and so on. Moreover, the UN-led Global Framework for Climate Services (GFCS) has officially elected energy as a new (fifth) priority area in 2017 and developed a road-map for the implementation of climate services for the energy industry (WMO 2017, also Ebinger and Vergara 2011).

All of these activities have pointed to the growing interest in strengthening the relationship between energy and meteorology to ultimately help achieve the goals of sustainability, resilience and efficiency of energy systems. In a practical way, WEMC has been acting as the implementing agent for the ideas and recommendations emerging from the ICEMs and beyond (e.g. the GFCS-Energy Exemplar, the World Economic Forum, the United Nations Framework Convention on Climate Change [UNFCCC] Conference of the Parties [COP] 21–Paris Agreement in December 2015). With an average of 200 attendees at each ICEM, an edited book (Troccoli et al. 2014), two special issues in international journals—one in *Solar Energy* following ICEM 2011 (Troccoli 2013) and one in *MetZet* following ICEM 2015 (Troccoli and Schroedter-Homscheidt 2017)—and abundant discussions during ICEMs and at related events (e.g. Troccoli et al. 2013), there is a wide-ranging set of issues that naturally feeds into the WEMC concept and plan of action. The plan of action includes (1) the organisation of a series of institutional workshop presentations, webinars and capacity building activities (including internships); (2) the assessments about the significance of future climate projections on energy resource and their implications for energy system investments; (3) the documentation on meteorological and energy data/metadata quality to assist the energy sector to easily access and make optimal use of these data; (4) the formulation and implementation of projects and programmes. These are just some examples amongst the many topics germane to the energy and meteorology

intersection. A more comprehensive list of suggested planned activities is presented below, resulting from the WEMC survey.

Rationale for Creating the Organisation

The major ongoing transformation of energy systems worldwide is highlighting the intimate interplay between energy on the one side and weather, climate and water on the other (Green et al. 2016). Although this connection is self-evident in the case of renewable energy (RE), weather and climate information is also critical to a much wider range of energy industry activities, from managing of energy supply from broader energy sources (e.g. offshore oil operations), to the understanding and estimation of energy demand, to the assessment of meteorological impacts on energy extraction, transportation, transmission and distribution (see also Chap. 2).

Given this context, WEMC seeks to substantially contribute to increasing the productivity, resilience and efficiency of energy systems under the influence of ever changing weather and climate as well as to achieving more affordable and available energy, and thereby, foster sustainable and resilient energy systems.

Aims of the Organisation

WEMC aims to enhance productivity and policy formulation for the energy industry through a close collaboration between the energy sector and the weather, water and climate community and to achieve improved adoption of weather, water, climate and other environmental information by the energy industry towards more efficient, proactive and sustainable risk management practices. WEMC also aims to assist the energy industry in meeting the demand for energy while being mindful that there is a need for reducing harmful impacts on the natural environment, in line with international protocols such as the COP21 Paris Agreement.

These aims are tackled through the identification of top-class expertise in energy and meteorological sciences as well as through mobilisation of resources, with fund raising and facilitation of focussed programmes executed by an appropriate mix of energy industry, private service providers, government and international institutions and scientific organisations. Such activities are typically in line with, and in support of, existing relevant national and international efforts.

Ultimately, WEMC aims to create knowledge, critical thinking, experimental tools and funding platforms at the global level for a highly effective use of meteorological information within the energy sector, particularly through creative public–private–academic partnerships. For instance, WEMC supports the energy industry in more effectively utilising meteorological products and facilitating the integration of more appropriate services in a changing climate. Specifically, one key area where the energy sector can benefit from the interaction with the weather and climate community, and that WEMC is contributing to, is the use of meteorological forecasts for grid integration and related tasks such as dynamic line rating. A number of transmission system operators (TSOs) and market operators are already using weather and/or production forecasts for the integration of renewable electricity into the grid. However, this is particularly the case in countries where either RE penetration is important (typically larger than 10%) or use of RE forecasts is mandated (or both). In countries where RE production is still marginal, use of forecasts is not considered a priority. There are also indications that countries/organisations that have taken early action in RE forecasting, rather than to react to a sudden increase in RE production, integrate RE into the grid in a more managed and effective way. It is critical therefore to inform TSOs about the latest developments in meteorological forecasting and the benefits of using this information. Thus, by producing easily accessible, jargon-free and succinct publications, WEMC aims to assist, as in this specific case, with the adoption of meteorological forecasting tools to improve the integration of RE into the grid, and at the same time help control the cost of electricity for consumers.

Structure of WEMC

WEMC is structured around four programmes:

1. Communications and Services
2. Stakeholder Engagement
3. Research and Technology Transfer
4. Education

These programmes, which represent a mix of activities ranging from communication of technical information (programme 1) to a continuous engagement with an ever-widening base of stakeholders as well as the

strengthening of advisory bodies at the strategic (Advisory Board) and the technical (Technical Advisory Group) levels (programme 2); to the assistance in the uptake of meteorological tools for more efficient, resilient and sustainable energy systems (programme 3); to capacity building activities such as the ICEMs (programme 4), have clearly been constructed to target the goals of WEMC. Top level international experts are leading the efforts in each of these programmes, with the assistance of the WEMC secretariat, which although currently small and with limited resources, is in a growing phase. The WEMC secretariat is sited on the campus of the University of East Anglia (Norwich, UK).

Sustained input from international experts, particularly the ICEM Organising Committee and the WEMC Technical Advisory Group, is key to the success of the WEMC initiative, in a similar manner to the way that related international activities function (e.g. the above-mentioned IEA tasks). Indeed, assistance from a wide base of experts is essential to tackle prioritised activities aimed at improving the interaction between energy and meteorology (e.g. data exchange and their standardisation).

WEMC heavily relies on the expert guidance of its Advisory Board, which is drawn from as diverse a group of people as possible to cover the main international players in the energy sector and the meteorology community, both in the developed and developing countries and including related associations (e.g. the USA-based Utility Variable Integration Group, UVIG).

Also integral to the structure of WEMC are Special Interest Groups (SIGs). The growing WEMC membership is leading the work of the SIGs. The plan is to constitute several such SIGs, one for each identified main critical activity, with around a dozen experts participating in each. Initially WEMC will focus on three initial SIGs, one on Data Sharing and Standards, the second on Grid Integration and the third on Education. This choice has been informed by members and the interests of other experts' interest, as identified through the survey presented in the next section. WEMC will provide communication tools and assistance to facilitate the work of these groups. It will also horizon scan for funding opportunities and pursue the most relevant and promising ones so as to provide financial support to the activities of specific working groups (e.g. to hold physical meetings). These SIGs are tasked to produce output readily usable by the energy industry such as the aforementioned guidance document on grid integration (Fig. 5.1).

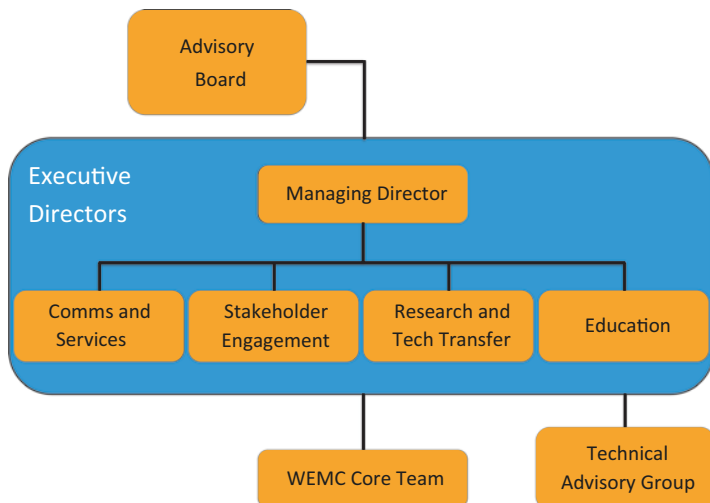


Fig. 5.1 The World Energy & Meteorology Council (WEMC) organigram

DEFINING PRIORITIES FOR WEMC: THE USERS' SURVEY

Rationale for Undertaking a Survey

Given the aim and nature of the WEMC activities, it was fundamental to define the next steps for the organisation based on the needs and requirements of the potential future users of those services. A survey was conducted with the target of engaging with as many potential users and organisations around the world as possible.

Methodology and Implementation of the WEMC Survey

The method selected to engage with potential users of WEMC was an online survey as it enabled the collation of the widest possible number of responses from around the world as possible in a relatively short amount of time (May 2011). The survey, developed using the software Survey Monkey, included four main sections¹:

- *Welcoming page*—This introductory page described WEMC and asked respondents to select their sector of activity: energy; weather and climate; or other.

- *Your organisation*—This section covered questions about the respondent’s organisation including the size and type of organisation, its geographical location, the scope of their activities and where it operates, as well as the respondent’s specific role. Some of the questions were tailored specifically to take into account the sector of activity (i.e. energy; weather and climate; or other sectors).
- *Future projects and initiatives*—This section included questions regarding the projects, initiatives and activities which WEMC should be focusing on in the future.
- *Next steps*—The final page asked participants if they would like to be involved and updated on future WEMC initiatives and, if so, to leave their contact details.

Given the importance of involving people from the energy and weather community worldwide, the survey was disseminated to participants at the 3rd ICEM in Boulder USA in 2015² as well as circulated to targeted mailing lists such as the Energy-L³ and Climate-L,⁴ mailing lists for energy policy issues and climate-related news, respectively. The survey was officially launched in June 2015 and closed in January 2016. The sections below describe some of the main findings from the survey and how it helped inform future activities within WEMC.

RESULTS FROM THE WEMC SURVEY

A total of 147 responses were received between June 2015 and January 2016. Almost half of the respondents worked in the energy sector (47%, $n = 69$), followed by those working on weather and climate related activities (33%, $n = 39$) and other sectors (20%, $n = 29$). The type of organisations also varied with private companies representing the large majority in the energy sector whilst research institutes were the most represented in the weather and climate sectors (Fig. 5.2).

The participants’ organisations also varied in size and between the sectors of analysis. The energy sector showed the highest number of large companies (with more than 5000 employees) followed by smaller organisations (with up to 100 employees). Conversely, the weather and climate sector showed the highest number of smaller companies (up to 100 employees) followed by those with between 1000 and 5000 employees (Fig. 5.3). Organisations in the ‘other’ sector had a fairly similar distribution

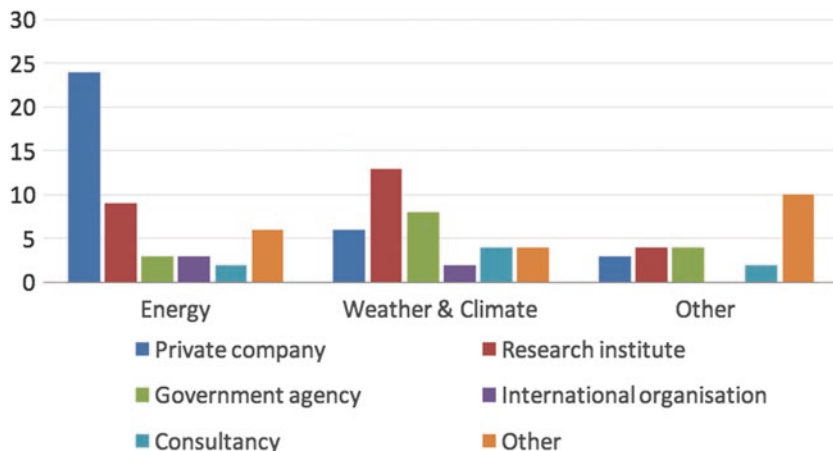


Fig. 5.2 Type of organisations per sector of activity

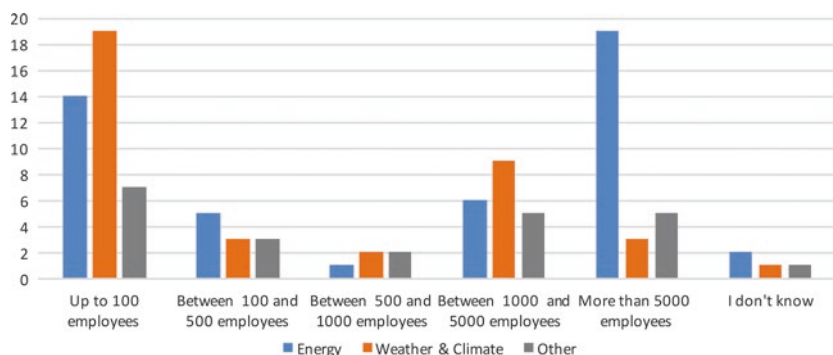


Fig. 5.3 Size of the responding organisations per sector

with regard to the size of the companies who responded to the survey (Fig. 5.3).

The respondents from the energy sector were mainly based in Europe (France, Germany, Denmark, Spain) as well as the USA; whilst those working in the weather and climate sector were mostly based in the USA followed by France and the UK (Fig. 5.4).

With regard to the scope of the organisations' activities, these were predominantly worldwide for both the energy and the weather and climate

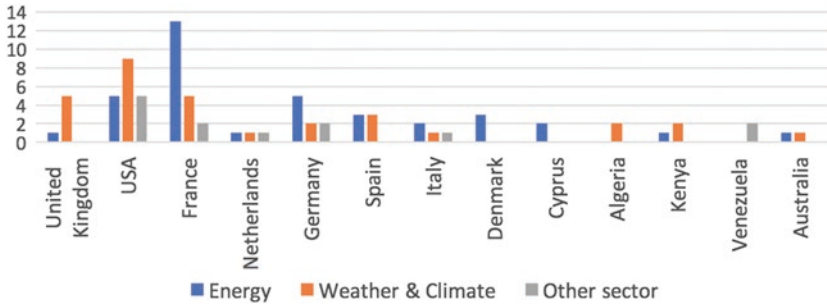


Fig. 5.4 Countries where survey respondents are based. Countries selected by only one respondent were excluded from this chart. These included Brazil, Austria, Vietnam, Costa Rica, Namibia, South Africa, New Zealand, Mexico, Zambia, Greece, Indonesia, Argentina, Malaysia, Bosnia and Herzegovina, India, Finland and Guatemala, Ghana, Morocco, Chad, United Arab Emirates and Mauritania

sector followed by those operating across Europe and in specific countries worldwide for the energy sector and those operating in specific European countries for the weather and climate sector (Fig. 5.5). Those in the other sectors operated across the range of geographical areas as identified in Fig. 5.5.

Activities Across Sectors

The main activities pursued in the energy sector were distribution/transmission, technology development, and power development (Fig. 5.6), although approximately half of the organisations in the energy sector ($n = 25$) worked in two or more activities.

Similarly, more than half of the organisations ($n = 27$) operated in two or more areas within the renewables (i.e. solar, wind and hydroelectric power) which was the sub-sector most strongly represented amongst the surveyed organisations (Fig. 5.7). Given renewables are, amongst the energy systems, the most impacted by weather and climate events, this result was not unexpected; however, this also reflects the backgrounds and interests of the respondents.

Another interesting aspect was the fact that 75% of these organisations ($n = 35$) were involved in the energy and meteorology nexus (i.e. working in areas linking energy and meteorology). The organisations working with

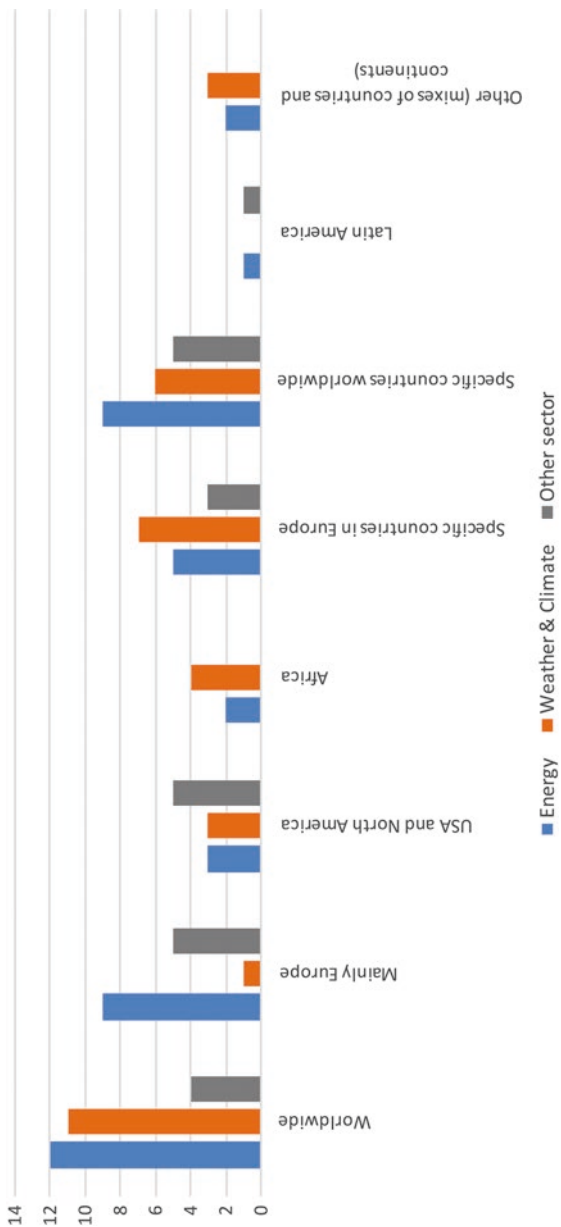


Fig. 5.5 Organisations scope of operations and activities

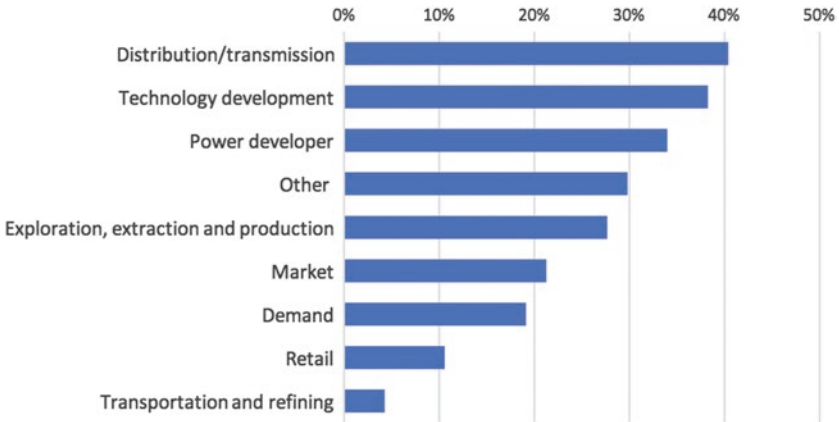


Fig. 5.6 Scope of responding organisations’ activities in the energy sector (total per cent of $n = 47$; note that this was a multi-answer question)

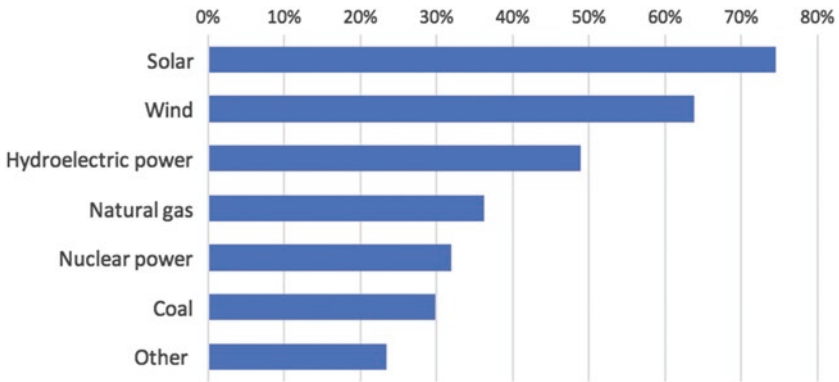


Fig. 5.7 Area of the energy sector in which the organisations operate (note that this was a multi-answer question)

weather and climate were fairly homogenous with regard to the provision of different weather and climate information (Fig. 5.8).

The remainder of the organisations ($n = 29$) operating in other sectors was mainly constituted by those working in academic research, government and public administration, forestry, media, biodiversity and ecology and coastal activities.

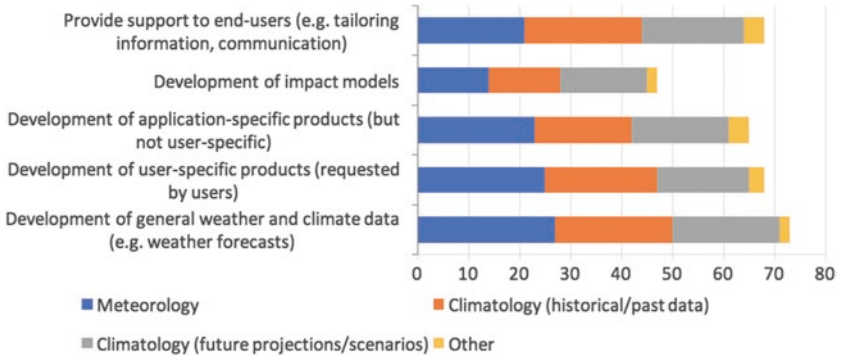


Fig. 5.8 Scope of activities in the responding organisations operating in meteorology and climate (note that this was a multi-answer question)

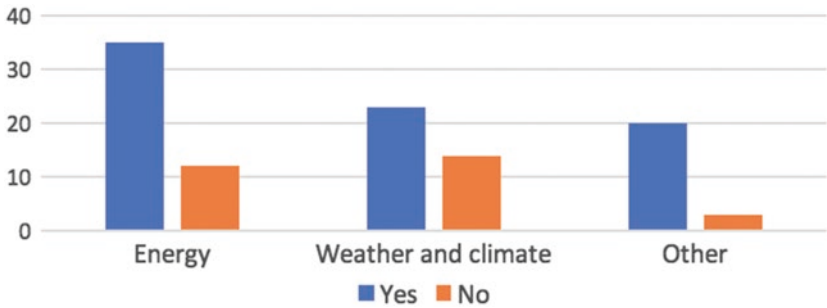


Fig. 5.9 Number of organisations surveyed interested in the energy and meteorology nexus

Nexus Between Energy and Meteorology

Survey participants were also asked about the interest of their organisation in the energy and meteorology nexus. The large majority of respondents confirmed the interest in this nexus with approximately 75%, 62% and 87% of the respondents in the energy, weather and climate and other sectors agreeing, respectively (Fig. 5.9).

Future WEMC Projects and Initiatives

Survey participants were provided with a list of options of potential policy and services initiatives that could be pursued by WEMC (Fig. 5.10). Of those, the three main aspects that respondents (across all sectors of analysis) preferred to have available from WEMC were the ‘Development of codes, standards and guidelines for meteorological information’, ‘Position papers’ and ‘Reports on resilience and sustainable energy systems and links to emission reduction requirements’. Conversely, the least preferred option was ‘Recommendations on data/metadata quality to assist the energy sector’ (Fig. 5.10).

It should be noted, however, that the range of scores between the most and least popular suggested policy/services initiatives is relatively small, and their differences are likely within the sample error. In addition, given this is an evolving area we expect these responses to vary over time. Therefore, it is not straightforward to clearly pinpoint which activities are deemed as critical to the extent that they should be prioritised.

Participants were also asked about their preferences regarding research and technology transfer initiatives that should be pursued by WEMC. The ‘Development of methodologies for analysing the linkages between

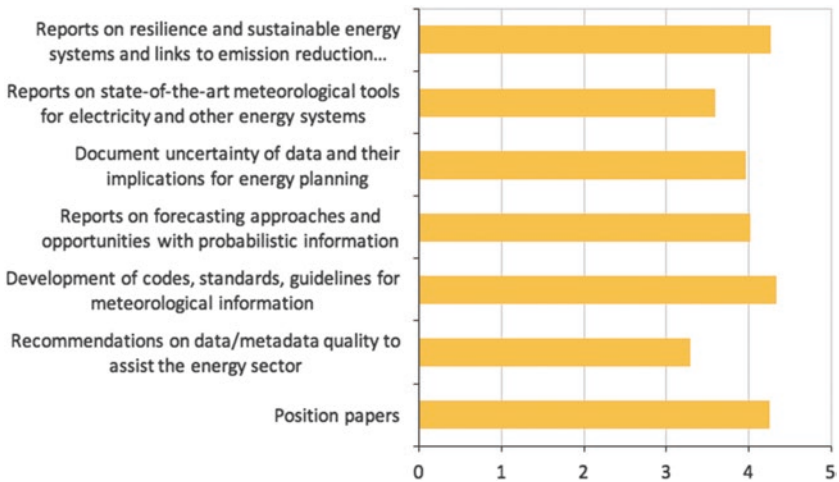


Fig. 5.10 Preferences from survey respondents regarding policy/services initiatives to be pursued by WEMC (based on rating average of ranked preferences)

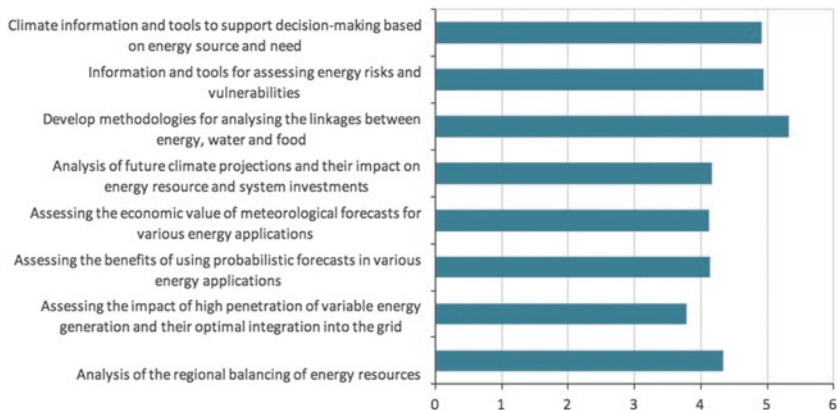


Fig. 5.11 Preferences from survey respondents regarding research and technology transfer initiatives to be pursued by WEMC (based on rating average of ranked preferences)

energy, water and food’ ranked the highest of all the options given (Fig. 5.11). This was followed by ‘Information and tools for assessing energy risks and vulnerabilities’ and ‘Climate information and tools to support decision-making based on energy source and need’. The least preferred option was ‘Assessing the impact of high penetration of variable energy generation and their optimal integration into the grid’ (Fig. 5.11).

Finally, participants were asked about their preferences regarding outreach and training activities. The main priority for respondents is the creation of a ‘WEMC mailing list and newsletter’ (Fig. 5.12). Following from that, respondents were also interested in ‘Targeted schools on particular topics within the energy and meteorology nexus’ and ‘A series of online webinars on the energy and meteorology nexus’. The least preferred option was ‘Creation of a database of organisations, projects, events, and best practices to support potential collaborations’ (Fig. 5.12).

Paying for WEMC Services

Participants were also asked about their willingness to pay for WEMC services. Of those who responded to this question ($n = 88$), 47% agreed that they would be willing to pay for those services whilst 53% disagreed. Those who indicated they would be willing to pay were then asked about

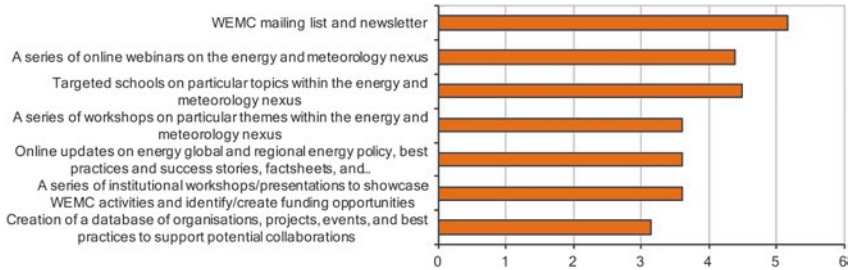


Fig. 5.12 Preferences from survey respondents regarding outreach and training activities to be pursued by WEMC (based on rating average of ranked preferences)

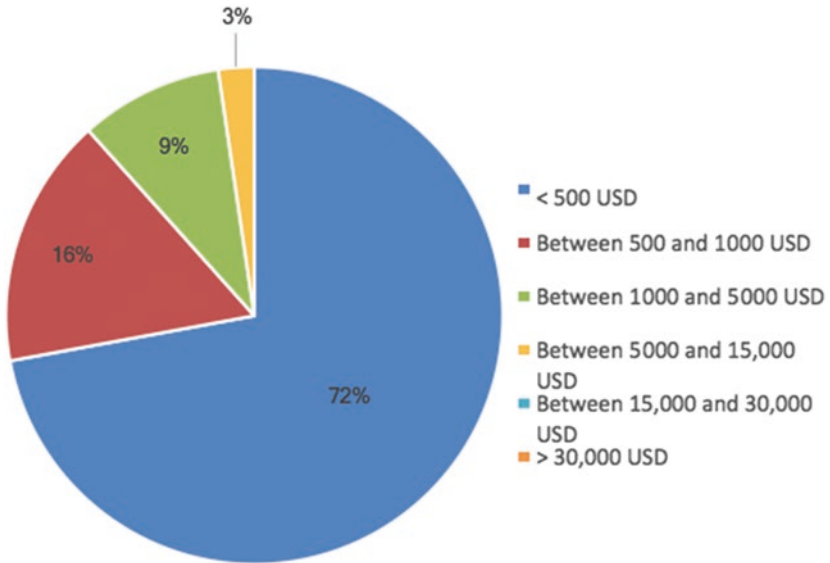


Fig. 5.13 Respondents' willingness to pay for WEMC services, per year

how much they would pay per year for the WEMC services. Around 72% of the respondents would be willing to pay less than 500 US dollars per year, whilst only 16% would pay between 500 and 1000 US dollars, 9% between 1000 and 5000 US dollars and only 3% said they would be willing to pay between 5000 and 15,000 US dollars (Fig. 5.13).

Of the total number of respondents, 46% agreed to continue being involved and updated regarding future WEMC activities (including those both willing and not willing to pay for the services). These mainly included respondents from Europe (56%) followed by those from the USA (21%), Africa (14%), South America and the Caribbean (6%) and Asia (3%).

NEXT STEPS FOR WEMC

The results of the survey have been very useful in shaping and guiding WEMC activities thus far, and for the immediate future. Specifically, the results of the survey have been useful to highlight:

- (a) The interest of survey respondents in WEMC pursuing a number of activities such as ‘Development of codes, standards and guidelines for meteorological information’ or ‘Development of methodologies for analysing the linkages between energy, water and food’;
- (b) The indication from nearly 50% of the respondents of their interest to remain engaged in and informed about future activities in the energy and meteorology nexus;
- (c) The willingness of a comparable percentage of respondents to pay for services provided by WEMC, a clear indication that these services are deemed important and valuable.

It is also important to note that the results of the survey were written up nearly a year after it was closed. Having had this additional period to see the evolution of the sector, particularly in terms of stakeholders’ requirements, it is apparent that some of the priorities have somewhat shifted since then. For instance, the optimal integration of RE into the grid was given as a low priority by the respondents (Fig. 5.11), while there is evidence (as highlighted earlier in this chapter and also through the work of, e.g., the UVIG⁵) that this is now higher in experts’ agendas. This apparent shift may also be indicative of the fact that our survey sample, although reasonably large, was not robust enough to clearly discriminate amongst priorities areas. It may also simply be a reflection of the fact that preferences regarding policy/services initiatives (Fig. 5.10) cannot capture the nuances in the response choices available. In all, stakeholder consultations, through surveys similar to the one presented here or via other processes (e.g. workshops), will need to be an integral component of WEMC activities so that new ideas, needs and other information from stakeholders are taken into consideration in a timely fashion.

Partnerships with analogous organisations (e.g. the International Solar Energy Society, ISES) are also key to the success of WEMC, and these are being actively pursued, for instance, via the co-organisation of webinars, a communication tool that is proving very popular or the involvement of key people (e.g. ISES president) in the WEMC Advisory Board.

Another important aspect of the WEMC activities is to provide a blueprint, and ideally an international reference, for national and regional activities in the area of energy and meteorology. A few such activities have already been initiated, with the USA (e.g. American Meteorological Society's annual Conference on Weather, Climate, Water and the New Energy Economy, which started in 2009) and the EU (the Energy Meteorology session at the European Meteorological Society annual conference, which also started in 2009) leading the way. More recently, a meeting on energy and meteorology was held in China in 2016 for the first time, for which ICEM was taken as a reference for the organisation of the event (Dr Rong Zhu, China Meteorological Administration, personal communication).

Overall, what is clear is that a continuous, adaptable and proactive interaction will be required in order to make WEMC's activities valuable to a wide range of stakeholders in this relatively fast evolving interdisciplinary area. Further discussion about next steps in the area of energy and meteorology is presented in the final chapter of this book.

NOTES

1. The survey questions are available at: http://www.wemcouncil.org/MEMBERS/WEMC_Survey_Qs_2015.pdf.
2. <http://www.wemcouncil.org/wp/conferences/icem2015/>.
3. <https://lists.iisd.ca/read/?forum=energy-l>.
4. <https://lists.iisd.ca/read/?forum=climate-l>.
5. <https://www.uvig.org/>.

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