EGRC-8/2017/INF.3
18 April 2017

Economic Commission for Europe

Committee on Sustainable Energy

Expert Group on Resource Classification

Eighth session

Geneva, 25–28 April 2017
Item 11(a) of the provisional agenda
Update on the applications of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009: Renewable energy resources

Solar Sub-group - Progress Report

Prepared by the Solar Sub-group of the Expert Group on Resource Classification

Introduction

1. As a result of industry and the United Nations Economic Commission for Europe (UNECE) interest in renewable energy resource classifications, the Task Force on Application of UNFC-2009 to Renewable Energy Resources was established in June 2013, under the Expert Group on Resource Classification (EGRC). Phase 1 of the Task Force's work was the production of generic Renewables Specifications for the UNFC-2009 to renewable energy. The Task Force, which has now been renamed the Renewable Working Group (RWG), is now in Phase 2 of its work, and has five sub-groups, working on the application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) to bioenergy, geothermal, hydro, solar and wind energy resources.

2. This report focuses on the Solar Sub-group (SSG) (previously known as the Solar Working Group) and provides an update and summary of progress establishing the SSG, holding meetings, preparing the Specifications for the Application of the UNFC-2009 to Solar Energy Projects and Resources (also known as Solar Specifications) as well as next steps towards preparing the first draft for review.

Establishment and membership of the SSG

3. The establishment of the SSG was initiated in May 2016 with the nomination of the SSG Lead. The Lead, with support from the Chair of the RWG, identified potential members and invited them to join the SSG. As members joined they also assisted in recruiting experienced people for the SSG. The first formal SSG conference call was held on 26 August 2016.

4. Members of the SSG include women and men with experience in solar resource assessments, solar project development, investment and financing of solar projects, and analysis of the solar energy sector. This includes members from academia, associations (notably the International Solar Energy Society), business, government, and international institutions including the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA).

5. As of 1 March 2017, the SSG had 18 Members from over twelve countries (see Annex 1).

Meetings

6. The main mode of meeting has been by teleconference including Skype and more recently GoToMeeting. There have been three meetings by teleconference and one virtual workshop. Meetings initially focused on introducing new members to the group and UNFC. However, as the drafting of the Zero Draft Solar Specifications was initiated and progressed, meetings included increasing discussion and feedback on technical issues including terms and definitions. There were also discussions on the application of the UNFC to solar energy projects and government assessments of solar energy resources, including assessments of the pipeline of potential solar projects.

7. The first virtual workshop was held in October 2016 with some members attending in person and others remotely. In addition to members of the SSG, several other UNFC and Expert Group on Resource Classification (EGRC) related people attended, specifically: David McDonald (Chair, EGRC), Alistair Jones (Member of the EGRC Technical Advisory Group), Frank Denelle (Chair of the Renewables Working Group), James Primrose (Chair of the Bioenergy Sub-group). For a summary of the virtual workshop see Annex 2.

Preparation of the Solar Specifications

8. The Solar Specifications are currently in the form of a zero draft. This means they are under preparation but are not yet sufficiently developed to share for the first round of review within the EGRC or internationally.

9. The approach taken to preparing the Solar Specifications has been to take what were the most advanced renewable specification at the time, the Geothermal Specifications, and adapt these to solar energy projects and resources. As the Bioenergy Specifications have progressed, these were increasingly used as a reference together with the Renewable Specifications and UNFC-2009. However, the most important information and feedback came from the SSG in the form of track changes, email and through SSG meetings and discussions.

10. Initially, the SWG was aiming to share a first draft of the Solar Specifications with the EGRC (after approval from the RWG and TAG) in April 2017. This has proved to be ambitious given the time required to draft the Solar Specifications and get feedback, guidance and consensus within the SSG. The members of the SSG are volunteers with demanding day jobs and have limited time available for providing feedback and building a consensus regarding the Solar Specifications. As a consequence, the SSG has revised the drafting process and timing for delivery of the first draft. The drafting process now includes a shift away from editing the zero draft Solar Specifications to the preparation of papers on specific issues consisting of:

(a) A discussion paper on possible applications of the Solar Specifications including:

(i) advantages and disadvantages of using the Solar Specifications

(ii) incentives and disincentives for using the Solar Specifications

(b) Working paper (or set of frequently asked questions) regarding similarities and differences between renewable solar resource reporting and non-renewable resource reporting

(c) A working paper on similarities and differences between project level and national level reporting of solar energy resources

(d) Case studies including hypothetical and real examples

(e) A working paper on the level of detail and information required for reporting, including the issues of whether proprietary and other confidential information should be addressed

(f) A short paper on what the Working Group is doing and will not be doing (at least in the short term)

(g) A working paper on the definitions of the E, F and G axes drawing from case studies

11. From these papers, the aim is to build a common understanding and consensus around the classification of solar energy projects and resources. However, the time required to prepare the documents is considerable, and there have been discussions about the possibility of raising funds so that the documents could be developed on a consultancy basis. In addition to this, there have also been discussions about the possibility of recruiting talented postgraduate students to undertake research on key elements of the Solar Specifications perhaps as part of a case study. At a minimum, a drafting team from within the SSG will prepare the working papers and share these with the wider SSG.

12. With regards to reviewing the draft Solar Specifications, the SSG believes that rapid progress could be made through an in-person meeting. However, this would require funds to pay for travel and accommodation as well as renting a venue. Virtual workshops or teleconferences can only secure everyone for a maximum of two hours due to the many time zones SSG members work in. An in-person meeting would allow greater interaction and concentration on the Solar Specifications, and as such, it is anticipated that rapid progress would be made on the Solar Specifications.

Next steps

Next steps include:

(a) Seeking funds for the SSG to hold a workshop and possibly recruit consultant(s)

(b) Preparing project brief(s) for post graduate student(s) to undertake research supporting the development of Solar Specifications

(c) SSG drafting team preparing working papers and case studies

(d) Postgraduate student(s) and possibly consultants progressing select working papers and case studies

(e) Holding a workshop to review working papers and draft solar specifications sometime in September or October of 2017

(f) Submit the first draft of the Solar Specifications to the RWG and TAG in November 2017, seeking approval for wider review by the EGRC/international community

(g) December 2017, make the first draft of the Solar Specifications available for review

(h) March 2018, collect and compile feedback on first draft Solar Specifications.

Annex 1

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Annex 2

Summary of SSG Virtual Workshop held 16-17 October 2016

Opening sessions

The Virtual Workshop started with a welcome from the Chair of the Solar Working Group. The Chair reiterated the origins of the UNFC as being a bridge between non-renewable resource classifications but noted that subsequently, the UNFC has served as a frame for renewable specifications and more recently the development of the geothermal specifications and bio-energy specifications. The TOR for the Solar Working Group shows the main task for the Group is the development of Solar Specifications.

The Chair thanked everyone for their feedback on the Zero Draft Solar Specifications, noted the agenda, then opened the floor to feedback from those that had provided feedback.

On the second day, the Chair of the Solar Working Group (SWG) welcomed everyone again and noted that the Chair of the Expert Group on Resource Classification (EGRC) and the Chair of the Task Force on the Application of the UNFC to Renewable Resources were participating. As such, the EGRC and Task Force Chairs were invited to provide an introduction to the EGRC and Task Force and provide some further context to the work of the SWG.

Introduction to the EGRC and Task Force

The Chair of EGRC noted that his role is to lead the Expert Group, and this includes extending the application of the UNFC to renewables including solar. The Chair of the EGRC noted that the Solar Specifications will not only facilitate the classification of solar energy resources but will allow comparison with other energy investment options. This was noted as being particularly important in the context of capital markets and the access to new capital. For example, those that have traditionally invested in non-renewable energy resources will be able to understand reporting that follows the Solar Specifications and as such will have greater confidence when it comes to understanding the information related to solar energy projects and investing. The work of the Solar Working Group will also contribute to the realisation of the SDGs, in particular SDG 7 which is to "ensure access to affordable, reliable, sustainable and modern energy for all".

The Chair of the EGRC encouraged the SWG to develop the Solar Specifications in the way most useful to classifying solar resources. As such, he encouraged the group to create definitions that address solar energy resources and then look at how these definitions compare with definitions used to classify other renewable and non-renewable resources. The Chair of the EGRC also noted that the UNFC is being revised over the next two years and as such, the Solar Specifications will be an important input to this revision. The Chair also noted that the UNFC will be removing reference to minerals and fossil energy from its title. He noted that these are only words but words are important.

Finally, the Chair of the EGRC noted the Expert Group works on other products including a competency framework for those applying the UNFC and related standards. In addition to having the UNFC this is an important part of helping ensure resource estimates are made consistently.

The Chair of the Task Force was then invited to speak. The Chair of the Task Force noted that the Task Force on the Application of the UNFC to Renewable Energy began its work in 2013. This included the development of Renewables Specifications as well as Working Groups on geothermal, bio-energy which are quite progressed, solar which has initiated its work, wind and hydro which are about to start. The Chair congratulated everyone on being part of the SWG and for the contributions so far towards the preparation of Solar Specifications.

The SWG noted that the openness to modification under the UNFC is very important. It was also noted that differences between renewable and non-renewable energy, such as solar energy being a flow rather than a stock will have a bearing on the Solar Specifications. It was noted by the SWG that it is very helpful to know the history of the UNFC and where it is from. As such, the Chairs of the EGRC and Task Force were thanked.

The Chair of the SWG then went through the agenda which included reviewing the revised zero draft Solar Specifications (which had been updated overnight) which was to be followed by a SWOT analysis for the Solar Specifications and the work of the SWG.

Updated Zero Draft Solar Specifications (Day two)

The Chair noted that in the previous session (the day before) the SWG had requested that the Zero Draft be updated so that there is more clarity regarding its contents. It was also requested that the next steps for each section be included in the document.

The Chair then invited Axel Gunaltun, who updated the Zero Draft, to elaborate on how the Zero Draft Solar Specifications were reviewed. Axel noted that wherever possible he had accepted track changes or comments. In some cases, the comments would require a deeper analysis and revision and in such cases the comments were left in the document. The Chair thanked Axel for the work he had done and in particular the very quick document turnaround.

The Chair then noted that for each section the immediate next steps for updated the Zero Draft were added in red based on the discussions from the previous day's SWG Virtual Workshop session. These red next steps were reviewed by the SWG section by section. As such, the summary follows these sections.

Feedback on the zero draft Solar Specifications

Note: the feedback below is not presented in chronological order, but rather according to the sections of the Zero Draft Solar Specifications they are most relevant to. In addition, the main actionable points from the Workshop are **highlighted in bold** at the end of each section.

A. Solar Energy, Products and Resources

Under the UNFC the solar energy from the sun is the "source" (i.e. the input), meanwhile, the "resource" is the output (i.e. the useful energy from the sun captured using technology). It was noted that for many involved in solar, the term "resource" refers to the solar energy from the sun and the useful energy is referred to as the "asset". As such there are differing terminologies. It was noted that only the asset is quantified and classified. This is why the concept of project is important as it is the project that makes an input into an output.

It was asked if the Solar Specifications should be restricted to only solar energy used for electricity generation. It was decided that in principle all types of solar related energy should be included, but only as far is practical. In some cases it may be possible to address certain types of solar energy using the UNFC while in other cases there may be practical limitations.

It was also noted that there is a need for consistency between the various UNFC related specifications and working groups.

The SWG noted that more thought needs to be given to the different products included in the Solar Specifications as well as services and consideration of capacity. There was a question as to whether the use of electricity would be considered. This was noted as essentially being a question of how far the Solar Specifications should go beyond energy supply, and is linked to the issue of where the reference point should be for counting energy resources. It was also noted that there may be insights to be drawn from the boundaries used in the UNFC.

The SWG agreed that Section A should include: a review of terminology used in the UNFC and in the solar energy industry, and at a minimum any differences should be highlighted and usage within the Solar Specifications noted; and a note that in principle all types of solar energy uses are covered, but in practice, it may be difficult to apply the UNFC.

B. Corporate versus National Resource Reporting

There was some concern regarding the term "project" and its use at all stages of assessment. It was noted that wider resource assessments would seem to extend beyond the boundaries of what would normally be considered a project, especially at an early stage (or maturity) of assessment. It was suggested that a modifier could be used such as potential project. It was also noted that sometimes the expression pipeline is used to refer to potential solar energy resources that may or may not be developed. The Chair of the EGRC noted that there are different project stages in the UNFC under the F axis reflecting the maturity of the assessment. These can include modifiers, and the Chair of the EGRC brought the SWGs attention to Annex 4 on page 42 of the UNFC.

The possibility of using a term other than project was discussed. However, it was noted that in many cases countries use projects as a basis for understanding what they can do, to utilise solar energy. As such, the project is a useful concept. Ultimately it would be ideal to see more projects, and projects bring a focus to resource assessments.

It was noted that project reporting should be considered within a wider context. The analogy of an iceberg was used, with projects being the visible tip of the ice berg. However, projects make up only a fraction of potential solar resources, specifically the faction that is actually going to be used. The UNFC covers the entire iceberg, from the tip to the base. Importantly, the UNFC can highlight gaps and impediments to the creation of projects, including what needs to be done for solar energy resources to be realised through a project. In this context the SWG was comfortable with the project approach as it is coupled with wider national reporting.

It was noted that there is always a chance that a solar energy resource may not be utilised.

There was a question as to whether a project should be assessed and valued from the perspective of an individual investor or from the perspective of society as a whole. This presumably would depend on the purpose of assessment and would require the underlying assumptions to be stated with regards to how the resource was classified. As such the Solar Specifications can help ensure the transparency of assessments in either case. The UNFC has provision for both corporate (project) level reporting as well as wider national resource reporting.

It was noted that projects are based on markets which in turn are based on policies. This is an essential point, and one that the UNFC addresses along the EFG axes. It was also noted that projects rely on a set of assumptions and risks. The UNFC is a useful frame for explicitly identifying the underlying assumptions and risks as indicated using the E, F and G axes. Similarly, it was noted that regulations cannot create solar panels but can change the

conditions they operate under. The Chair of EGC noted that the important thing is identifying the barriers between boxes (i.e. categories under the UNFC) rather than the boxes themselves.

It was noted that assessments can only be made armed with the information at hand. If situations change then assessments need to be revised and updated. As such, the classification of resources depends on the information available at the time of assessment. If policies, markets or other circumstances change, then project assessments and wider national assessments need to be updated. There was a suggestion to look into policy parameters and policy areas elated to solar energy.

It was noted that in South Australia, a lack of auxiliary generation led to blackouts. There was a question as to how such events might relate to the UNFC or the Solar Specifications. It was noted that such situations might lead to changes in management of systems or could affect access to markets or the contractual arrangements of existing or planned projects. As such, it could lead to the need for reassessment of projects.

Examples of solar energy resource projects should help identify gaps and inform the classification.

It was brought to the attention of the SWG that there is an IEA document that attempted to classify the theoretical, technical and economic solar energy resources. Dave Renee will attempt to find this document and share it with the SWG.

Manajit Sengupta noted that he might be able to provide resource assessment examples to the SWG to assist in understanding the how the Sola Specifications should be developed and could be applied.

The SWG agreed that Section B should: highlight that the Solar Specifications can be used for project and national reporting, but perhaps more importantly can be used to identify the challenges, uncertainty and risks that have to be addressed to go from a potential to an actual project; and, highlight that the UNFC makes assumptions behind either project or national resource assessments clear.

It was suggested that the SWG could possibly form a sub-group to work on definitions[2].

C. Project and Reference Point Definition

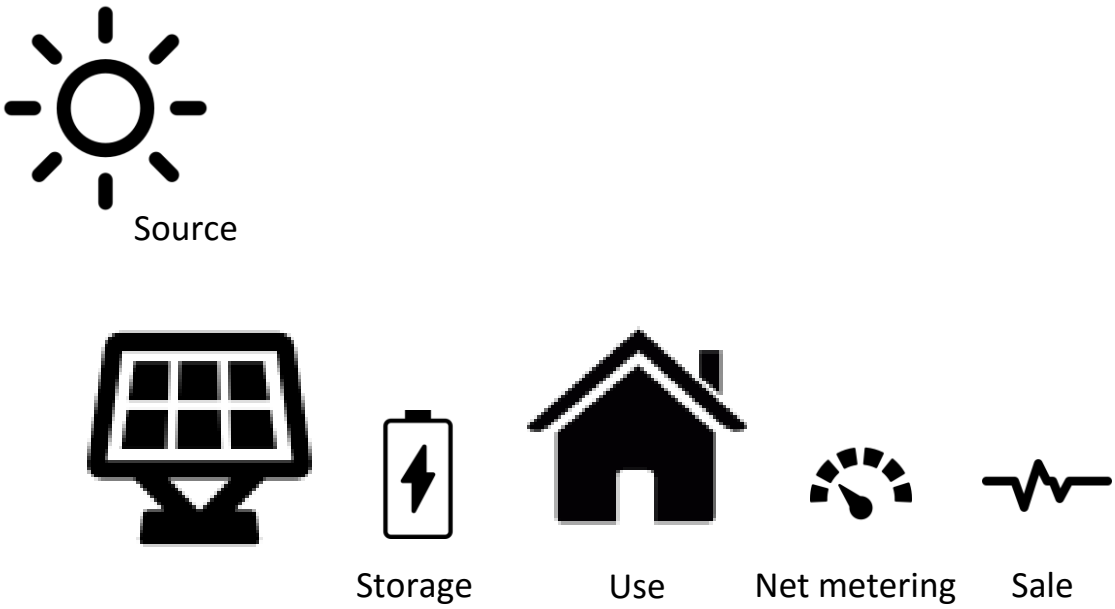
The reference point was noted as being the point at which the energy product is sold. In many cases this is the meter. In some cases, not all the energy is sold and this is classified separately (in E3.1.). There is a need for principles and perhaps guidance on point of sale and point of use and how estimates should be made in such cases. Hypothetical case studies would be useful in this regards. This could also include storage and other possible configurations of technology, metering and use. Importantly, the reference point or point of sale should not be over specified or underspecified. As such, there needs to be a balance between principles and guidelines. The Chair noted that the Solar Specifications should first focus on general principles then look into what level of guidance and specific examples should be included in the Solar Specifications.

A question was asked if multiple solar energy uses would be covered. It was generally agreed that in principle multiple uses should be included but at the same time there may be practical limits to the assessment of multiple uses in some cases.

2 It was not mentioned during the virtual workshop, but the Solar Working Group website includes a glossary that might be a useful reference and location to progress such definitions through a sub-group.

It was noted that some projects may have own use or net metering (**Error! Reference source not found.**). Virtual net metering was briefly discussed as well.

Figure 1
Illustration based on the discussion of net metering



The issue of storage arose, and was noted as not being restricted to solar, and thus it may be worthwhile looking at how storage is treated in other situations including renewable and non-renewable examples. It was noted that solar storage is analogous to a tank with fuel.

The case was made that solar energy storage should be addressed within the Solar Specifications. It was noted that solar energy is in some cases to produce liquid fuel or hydrogen. These technologies are some way off from becoming commercially viable. There was a debate about whether such examples should be included in the Solar Specifications. In principle they should but only if it is practical to do so.

It was agreed by the SWG that Section C should: highlight the situation of net metering where there is both sale and use of solar energy; develop hypothetical cases to explore the issues of reference points; propose principles and perhaps guidance for review by the SWG on point of sale and point of use; and, explore the issue of storage and how this affects the classification of solar energy resources.

D. Project Lifetime/Limit

The terms lifetime and limit were noted as being a bit counter-intuitive in the context of solar energy. However, projects have limits but instead of being defined by the resource it is defined by technology, regulatory or other risks and changes. For example, solar might compete with other uses of land for example, limiting opportunities to utilise the energy. Markets may change affecting the viability of project. If a grid reaches an area a project lifespan for an off-grid project may be affected.

The lifetime should take into account the various factors affecting a project. Regulatory support will affect the economic viability of a project. It was noted that changes in policies

and markets can modify how resources are classified in relation to the E and F axes. The UNFC takes into account policy, and policies directly affect how energy resources are classified.

When it comes to the project lifetime, it was noted that numbers are important. In many cases the period of a contract is less than the lifespan of solar energy technology which could last up to 40 years for example. These things might be addressed by classifying the project under contact in one box (i.e. category) and the remaining period following the contract period in another box - with less confidence around the economic, social, environmental, regulatory or other conditions under which the project might continue.

The SWG noted that markets forces, and markets can change and that it would be useful to explore, through hypothetical case studies, how markets affect the classification of resources using the UNFC.

The SWG agreed that Section D should: clarify the use of the term lifetime in the context of solar energy as a renewable resource; and, highlight that the main limitation to the lifetime of a solar energy project is not solar energy but rather technical, social, economic, environmental, regulatory and other issues.

E. Access to Source

It was noted that regulation is important with regards to access to sources and access to markets. Furthermore, access to source and access to market are linked. This should be explained in the Solar Specifications.

The SWG agreed that Section E should: highlight the ways in which technical, social, economic, environmental considerations along with policies and plans, affect access to solar energy sources.

F. Access to Market

It was noted that there is powerful link between how policies affect markets and the projects that are viable. It was suggested that policies, including regulation, are perhaps the most important factors for access to source and access to markets.

The SWG agreed that Section F should: highlight the importance of access to markets, how this affects the classification of solar energy resources, policies create / shape markets.

G. Intermittent or Variable Extraction

The intermittent nature of renewables was discussed. Increasingly solar energy will constitute 100% of generation with periods of no or low generation. This will have a bearing on planning, management and access to markets, in addition to policy.

There was a discussion around intermittency and how this affects the system differently at different levels. These were noted as tough and complex things to consider. It was suggested that solar energy could draw lessons from other renewable and non-renewable classifications.

Intermittency needs to be addressed carefully and storage has an essential role here. It was noted that the SWG should also look into the issue of storage. Case studies could be important in this regards, for example hypothetical case studies could look at situations that include and excluding storage. It was noted that curtailment is an important issue linked to storage.

Curtailment was another issue discussed and is related to the wider energy system and the contractual arrangements related to specific solar energy projects. This raised the question of boundaries and whether these things should be considered. If storage is located between energy capture and the reference point, then presumably it will influence resource estimates and their classification using the Solar Specifications. However, if storage is after the reference point, then presumably it will fall outside the assessment boundary.

It was noted that market demand affects prices and as such impacts saleable resources. As such, changes in market conditions can create the need to re-assess resources in some cases. The confidence of making money is very important and decides whether further effort is put into an assessment. Important consideration includes contractual arrangements at each site. Risks ultimately present themselves in the contractual agreements.

It was noted that precedent and that status quo is usually considered a better basis for making resource assessments compared to anticipation of future changes which may or may not eventuate.

It was highlighted that there are significant levels of judgement involved in resource assessments. It was noted that for less mature resources the less important errors in judgement are, meanwhile a project that is about to be invested in requires greater information and competence. Hence the EGRC is working on Competence.

Energy management may change and hence contingent resources should be considered (i.e. resources contingent of some specific change). It requires more subjective judgement but less financial risk.

The SWG agreed that Section G should: highlight the issue of intermittent energy, the role of solar in such situations, and the ways this affects classification under the UNFC, taking into account policies, plans and energy management regimes.

Furthermore, hypothetical case studies could be used to assess how intermittency, curtailment and contractual arrangements affect the classification of solar energy resources.

H. Projects with Multiple Energy Products

In some cases, a project may have more than one energy product. In such cases, each energy project should be classified.

The SWG agreed that Section H should explore the issue of multiple energy products related to solar energy.

E – Axis

The E-axis covers economic, social, environmental and legal considerations.

Feedback on the zero draft had noted that need to define the E-axis along with the F and G axes. The lack of a definition was explained as being a result of using the Geothermal Specifications as a basis for the zero draft Solar Specifications. This is because the Geothermal Specifications were designed to be used in conjunction with the Renewables Specifications and the UNFC, they didn't repeat or revise the definitions for the E, F or G axes. However, the Solar Specifications, like the Bio-Energy Specifications, is being prepared as a stand-alone document (i.e. it should be possible to use the document without referring to the UNFC or Renewables Specifications). As such, the Zero Draft needs to include definitions for the E, F and G axes.

The SWG Virtual Workshop agreed that the E-Axis section should: clarify the definition of the E axis in the context of solar energy drawing from the UNFC and the Renewable Specifications; and, highlight the social, economic, and environmental considerations that need to be taken into account along with regulatory and other considerations.

F – Axis

The F-axis covers the maturity of a project; i.e. how close a project is to being ready for investment.

The definition of project maturity was discussed. **Fred Morse volunteered to provide a specific project case example demonstrating the development of a project and the various stages and process the project went through. The purpose of the example will be to practically illustrate the levels of maturity, including key assessment stages that a resource must pass through to become a project with solar energy production.**

The SWG Virtual Workshop that the F-Axis section should: clarify the definition of the F axis in the context of solar energy project maturity, drawing from the UNFC and the Renewable Specifications; and, highlight the typical stages of development that a solar energy project goes through before becoming a reality.

G - Axis

The G-axis covers the generalised physical confidence of a resource, i.e. the confidence that a cumulative amount of useful energy will be realised over the lifespan of the project.

The SWG noted that the uncertainty related to an energy resource is based on the uncertainty around the quantity of energy that will come from the source as well as the efficiency and effectiveness of the technology in capturing the energy. As such, these uncertainties combine to form the uncertainty around the resource (i.e. the uncertainty around how much useful energy will be realised over the life of the project).

It was noted that the lifetime of a solar farm can be long in many cases and as such should affect the G-axis, especially since it is the cumulative useful energy that is estimated.

The SWG agreed that Section G should: clarify the definition of the G axis (generalised physical confidence) in the context of solar energy drawing from the UNFC and the Renewable Specifications; and, highlight physical and technological information required to assess and classify the resource (i.e. the output or useful energy).

UNFC

There was a concern that because the UNFC is inherited from oil, gas and minerals there may be a bias towards practices from the oil, gas and minerals industries. However, it was also noted that the solar specifications would feed into a revision of the UNFC and as such, may influence the overarching framework and the way in which different energy resources are compared in the future.

The Solar Specifications should be developed according to what makes sense for solar while at the same time allowing comparison with other types of energy projects.

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