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Committee on Sustainable Energy

Expert Group on Resource Classification

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Item 12 of the provisional agenda

Application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 to Renewable Energy Resources

Application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 to Renewable Energy Resources

Basis for establishing generic specifications for the application of UNFC-2009 to renewable energy resources

Report prepared by the Task Force on Application of UNFC-2009 to Renewable Energy Resources

I. Introduction

1. The draft Specifications for the Application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) to Renewable Energy Resources *as at 18 April 2014* (EGRC-5/2014/INF.1) were presented to the Expert Group on Resource Classification at its fifth session in April 2014.

2. The Expert Group requested the Task Force to finalize the draft generic specifications document following the document approval procedure outlined under the Conclusions and Recommendations for Item 24 “Other business” (ECE/ENERGY/GE.3/2014/2). The approval procedure is provided below for ease of reference:

“(a) Document approval procedure

The Expert Group recommended in the future that document approvals should conform to the following procedure:

- (i) Preparation of a draft document by “working group”. During preparation, the Technical Advisory Group should be involved in periodic review/consultation;
- (ii) The draft should be subject to a public comment period. Comments should be considered for possible inclusion and the draft modified as appropriate. Reasons for not acting on specific comments should be documented;
- (iii) The final draft should be presented to the Expert Group at its annual session. The Expert Group should request that the draft be submitted to the Technical Advisory Group for an appropriate level of review and for recommendation to the Bureau;
- (iv) Once agreed by the Bureau, any significant changes from the final draft will be sent to the Expert Group for agreement;
- (v) The agreed draft will be sent to the Committee on Sustainable Energy for endorsement.”

II. The process

3. In line with the aforementioned approval procedure, the draft generic Specifications for the Application of UNFC-2009 to Renewable Energy Resources were issued for public comment on the United Nations Economic Commission for Europe (ECE) website for a period of three months. The three month period ran from 12 June 2014 to 12 September 2014.
4. During the public comment period, fifteen responses were received, from both individual experts and organizations. All comments were carefully reviewed by the Task Force and incorporated as appropriate in the final draft of the specifications document. The public comments and the Task Force's response are detailed in Annex II.
5. The members of the Task Force are listed in Annex I.
6. This report summarizes all the comments received during the public comment period and how the comments were dealt with and considered by the Task Force.
7. The Technical Advisory Group has been fully involved during the preparation of the final draft text submitted for consideration to the Expert Group on Resource Classification at its sixth session (ECE/ENERGY/GE.3/2015/3). The Technical Advisory Group submitted its recommendation to the Bureau of the Expert Group on 27 January 2015. The Bureau reviewed the final draft of the specifications and approved the version submitted to the Expert Group at its sixth session.

III. Recommendations

8. The proposed draft generic specifications for application of UNFC-2009 to renewable energy resources, as presented to the sixth session of the Expert Group on Resource Classification, should be endorsed by the Expert Group and posted to the ECE website as soon as possible.
9. During the development of the commodity-specific specifications for application of UNFC-2009 bioenergy, geothermal, hydro, solar and wind any needed changes to the generic specifications for the application of UNFC-2009 to renewables should be documented. Depending on the nature of any such amendments a revised version of the generic specifications should be prepared for consideration by the Expert Group on Resource Classification.

Annex I

Task Force members

Raffaella Cristianetti

Frank Denelle (Chair)

Norbert Dolle

Gioia Falcone

James Primrose

Bernard Seiller

Jean-Alain Taupy

Daniel Trotman

Secretary, Expert Group on Resource Classification

Annex II

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
Radoslav Vukas, Ministry of Natural Resources, Mining and Spatial Planning, Serbia	1.1	In footnote 6 (page 5) in parentheses after the word Geothermal, you may need to add the following: petro and hydro; shallow and deep in accordance with the law).	The footnote only aims to indicate that uncertainties captured under the G-axis are, in general, different for Renewables compared to fossil fuels and minerals. Only Geothermal, given the same subsurface context, has similar "geological" uncertainties. The geothermal "law" is not the same around the world (and sometimes there isn't one - geothermal often falls under water resources). In some countries, "deep" geothermal refers to systems deeper than 400m; in other countries, different criteria are adopted. A classification approach by "petro" (petrothermal) and "hydro" (hydrothermal) is also not standardised, and there are still internal debates within the geothermal community. These considerations will have to be addressed in the development of the geothermal specifications.
	1.2	In the Table (category F), for F 4, the end of a sentence may be added in parentheses (natural geological conditions explored for construction, etc.).	The text in the table reflects the UNFC-2009 definition of F4, which is a given. Furthermore, the G-axis represents uncertainty in the estimated quantity of the resource. Geological risks that could impact construction should be captured in, for example, project costs and/or feasibility (E and/or F categories).
	1.3	In Table (category G), column - Additional /Renewables Energy context, in parentheses (for Geothermal Projects, add: or geological conditions for the construction of other projects/facilities).	The G-axis represents uncertainty in the estimated quantity of the resource. Geological risks that could impact construction of the project should be captured in, for example, project costs and/or feasibility (E and/or F categories).
	1.4	Bridging document; part: Renewables - additional guidance, it says for Bioenergy?-(need clarification of this term?!).	Added to the specifications document: (Energy (e.g. liquid, gaseous, power or heat) from Biomass) to clarify the term "Bioenergy".
	1.5	Footnote 8, these minerals are: Si, Li, Mn, Zn and S... It may be necessary to clarify whether the water and some general/statistical records of the quantities of minerals (state balance, i.e. who, where and how), should represent the economic evaluation of the project.	The footnote already describes: "... may be included in the economic evaluation of the project" when these are sales products of the project. Water, which is not reinjected back into the reservoir, that is representing a value could equally be included in the economic evaluation of the project.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	1.6	(M. Evaluator qualifications) in the first sentence, after the word...level of expertise; perhaps add:...adequate academic qualifications.	The text under M. reflects the UNFC-2009 specifications, which is a given. No additional Renewables context has been added here. Further requirements concerning "competent persons" may be added to the commodity specifications.
Valérie Issumo, Prana Sustainable Water	2.1	Renewable energy from wastewater should be taken into consideration although about 80% of wastewater is untreated in the world and on the opposite energy is needed to supply clean water. In case of interest we can help you for this matter.	Commodity specifications will provide additional guidance for cases/situations in which waste water can be a source of renewable energy.
John Etherington, PRA International Ltd, Canada	3.1	Geothermal energy projects may not provide replacement at a higher rate than consumed as the heat may dissipate after significant production – it is not infinitely renewable. The same may apply to biomass sources.	Referring to existing footnote 3, in which it is recognized that alternative definitions exist: <i>The SE4ALL definition uses "replenished at a higher rate than consumed", but it is noted that alternative definitions describe renewable energy as being replenished at an equal or higher rate than consumed or that the replenishment rate may vary seasonally or depending on the type of project.</i>
	3.2	The Term Renewable Energy Resources may better be described as Ultimate Recoverable Renewable Energy Resources to align with the term Estimated Ultimate Recoverable (EUR) as used in the petroleum industry being the sum of prior production and remaining recoverable.	Renewable Energy Resources reflect the remaining quantities of the project, similar as used in Petroleum Industry (e.g. PRMS). The term Estimated Ultimate Recovery (EUR) or Ultimate Recoverable Renewable Energy Resources is indeed equally applicable to Renewable energy project but represents a different quantity not defined in the specifications. These terms are, however, not used in UNFC-2009 and therefore not adopted in the Renewable Specifications.
	3.3	One of the costs not discussed under Section B under risks and uncertainties is the mitigation of social/economic impact (killing birds by wind farms, using large areas of arable land for solar farms, etc.) The use of corn for ethanol is an example of poorly defined consequences in reducing food sources.	Section B only aims to describe the project in general terms. Social/economic considerations are indeed equally applicable to Renewable energy projects and covered under the UNFC-2009 E-axis. Footnote (d) to the E-axis in UNFC-2009 has been repeated in these specifications. This is the text that defines the E-axis to include all economic and social contingencies affecting a project.
Graeme Beardsmore, Hot Dry Rocks, Australia	4.1	Indirect evidence' of geothermal energy might have to be clearly defined. For example, there might be differences of opinion over whether geochemical indicators of resource temperature provide 'direct' or 'indirect' evidence.	Thank you for your comment; we anticipate guidance on this subject in the Geothermal specifications.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	4.2	Heat in place' and 'heat recharge' make up two distinct components of a geothermal resource, and these two components will almost always be associated with different levels of confidence. This should be manageable under the RE specifications.	Thank you for your comment; we anticipate guidance on this subject in the applicable commodity specifications.
	4.3	Similarly, increasing numbers of geothermal projects provide both heat and electricity as 'energy products'. Electricity generation is sometimes sacrificed for increase heat provision during peak seasons. Again, estimating resources/reserves for such projects should be possible under UNFC-2009 but will require clear guidelines.	Thank you for your comment; we anticipate guidance on this subject in the applicable commodity specifications.
	4.4	Commodity specific Geothermal Specifications might have to be far more explicit than these RE specification about allowable types of 'energy products', default 'recovery factors', requirements for 'competent persons', definitions of 'direct evidence', and potentially other parameters. The range of ways these and other parameters are addressed at present accounts for the current wide variance in resource estimates	Thank you for your comment; we anticipate guidance on this subject in the Geothermal specifications.
Anthony Budd, Geoscience Australia	5.1	The proposed application of UNFC-2009 to renewable energy resources should work for geothermal energy. It should be noted that lower grade geothermal resources will generally be extracted at rates higher than they are replenished, but that with time after extraction the temperature will rebound. This may impact considerations on resource and project extent. Exact definitions and/or guidelines will be required for the application of the scheme to geothermal projects, including bridging documents to existing resource classification schemes. This includes what should be reported - energy in place, recoverable energy, converted energy.	The first point should be addressed by the geothermal specifications. Regarding bridging to existing geothermal classification schemes, the EGRC feels that the geothermal community does not have existing schemes that are as widely accepted as - for example - PRMS for the oil & gas. Neither is there one scheme that encompasses all different types of geothermal resources. On the last comment, the UNFC already offers the opportunity to separate potential vs. known deposits, exploration projects and additional quantities in place. Only F4 can accommodate "in place". The different levels of project maturity will dictate the rest. When talking about in-situ with reference to geothermal, one can only talk about the initial volume of water/steam, and/or the initial quantity of heat in place. Knowing that the water is the necessary carrier for the heat, but not the ultimate energy product.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
Professor Marinela Panayotova, University of Mining and Geology, Department of Chemistry, Bulgaria	6.1	Consider replacing p3, par4: "The main difference with fossil fuels or solid minerals is that, during the life time of the project, the renewable energy source is being replenished" with "The main difference with fossil fuels or solid minerals is that, during the life time of the project, the renewable energy source is being replenished at an average annual rate equal or higher than consumed"	Suggested addition is already described in existing footnote 3. This does not include reference to "at an average <u>annual</u> rate" as this additional guidance may wrongly exclude certain renewable energy projects.
	6.2	Consider replacing p5, footnote 6: "In the renewable context, the G set of categories does not necessarily represent the level of confidence in the geological knowledge and potential recoverability (except for Geothermal) but in other factors that play a role in the uncertainty in the quantity of Renewable Energy Source that may be available for extraction via the Project." with "In the renewable context, the G set of categories does not necessarily represent the level of confidence in the geological knowledge and potential recoverability (except for Geothermal) but in other factors that play a role in the uncertainty in the quantity of Renewable Energy Resource that may be available for extraction via the Project. "	The G axis in the UNFC indeed designates the level of confidence in the geological knowledge and potential recoverability of the quantities. This covers both the <i>Source</i> (equivalent to the Hydrocarbons in Place or the deposit) and the <i>Resources</i> (the recoverable quantities). The text of the Specifications is updated to reflect both the Source and the recoverability of Resources.
	6.3	Consider replacing "Renewable Energy Project" on p7, column 3 with "development project" to remain consistent with UNFC-2009 (in italics).	Correct comment: the text in grey should reflect the UNFC. Second column of F1 category has been corrected.
	6.4	Consider replacing "...such as meteorology, climatology, ecology, geography and geology " on p8, column 4 with "...such as meteorology, climatology, topography and other branches of geography, ecology, and geology"	Good comment; specifications text has been updated.
	6.5	Consider additional context on p10 (Effective date): "Reported quantities are estimates of those energy quantities that are potentially recoverable from renewable sources on the basis of existing technology or technology currently under development, and are associated with actual or possible future Projects development."	Thank you; However, the comment is not considered relevant in the context of Effective Date.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	6.6	Consider replacing ".. minerals such as silica, lithium, manganese, zinc and sulphur" on p11, footnote 8 with ".. Inorganic materials such as silica, lithium, manganese, zinc and sulphur". For the sake of clarity - actually metals are extracted mainly under the form of minerals from the geothermal fluids; however the metals lithium, manganese, zinc are too broadly classified as minerals.	Good comment; text has been updated accordingly.
	6.7	Consider replacing p12 "Typical uncertainties that impact the level of confidence in the estimated quantities of Renewable Energy Resources are meteorology, climatology, ecology, geography and geology (for Geothermal Projects)" with "Typical uncertainties that impact the level of confidence in the estimated quantities of Renewable Energy Resources are related to meteorology, climatology, ecology, geography and geology (for Geothermal Projects)"	Good comment; text has been updated accordingly.
	6.8	Consider additional context on p14 (Exploration Projects): "Instead of site-specific geological studies and exploration activities, site-specific studies, relevant to the corresponding RES are meant; Instead of deposit, renewable energy resource is meant; Instead of drilling or testing, relevant to the corresponding RES measurements and testing methods are meant; Instead of geological province, geographic area is meant;	The UNFC term "deposit" is clarified in section A. Additional context is indeed relevant for Renewable Energy commodities (except of Geothermal for which the original text already applies). Updated the specifications accordingly.
	6.9	Consider additional context on p15 (Additional Quantities in Place): "Instead of deposit, renewable energy resource is meant"	The UNFC-2009 term "deposit" is clarified in section A.
	6.10	Page 16, table row 7: Evaluator and the terms description has to be moved on another raw of the Table	Good comment; Evaluator should be a separate row. Glossary table has been updated accordingly.
	6.11	Consider adding to Glossary of Terms: "Energy extraction and conversion - Technological processes where energy is recovered from RES - the equivalent of the term development or mining operation in the Project description."	Agreed with the comment, but the UNFC-2009 term "development" is also equally applicable to Renewable projects. "Conversion" has been added to footnote 4, also as response to another comments received.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
Chris Bromley, Chairman, IEA-GIA (Geothermal Implementing Agreement)	7.1	Check consistency with existing country-specific geothermal resource assessment codes (e.g. Australia and Canada).	We are not aiming to write a new version UNFC-2009 for the existing geothermal code. We need to write geothermal specifications for UNFC-2009, trying to take the best ideas from classification schemes already proposed by the geothermal community worldwide, including the Australian/Canadian Code. This work will be carried out by the International Geothermal Association.
	7.2	The main issue is really fundamental to all renewable energy resource assessments, that is, they are very difficult to quantify. If, as suggested in the draft specifications, one uses project economic design life as a limit to resource potential, there are wide ranges. For example turbines might have a design life of 25 years, but some Wairakei geothermal turbines have lasted 56 years and are not expected to be de-commissioned for another 10 years, Some wells corrode and fail in a few months or years, others (such as a bore drilled in 1928 in Kamojang, Indonesia) might have a discharge or injection lifetime of 100 years or more.	Indeed, project life time is one of the key parameters. This requires additional guidance in each of the commodity specifications.
	7.3	The report uses the term 'geology' in a generic sense with respect to information required to constrain geothermal resource assessments. In fact, what is really needed for an economic and sustainable development strategy is a site-specific, mathematical reservoir simulation model, populated by rock properties (such as permeability and porosity), boundary conditions, and heat sources, that predicts energy extraction performance under different scenarios, and recharge/recovery rates from adjacent or deeper heat/fluid resources outside of the drilled volume. With development history, the models get better (through performance calibration), the rock properties change, and the sustainable energy extraction estimates get better. This, in a way, sets geothermal apart from the other renewables, as well as from hydrocarbon resource assessments. From a resource management point of view, geothermal is probably	Thank you for your comment. Whether or not additional guidance is required on this subject will be part of the considerations when developing the Geothermal specifications.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
		somewhere in between.	
Sigurd Heiberg, Petronavitas	8.1	The title should refer renewable projects, not resources. This reflects the text and the underlying thinking behind the UNFC much better. The title will then also resonate better with many who identify reserves and resources with something finite, and therefore will view (rightly or wrongly) a classification of resources as foreign and irrelevant for renewable resources. This change is likely to increase the acceptability of the specifications.	While UNFC-2009 is a project-based system, UNFC-2009 itself refers to Fossil Fuels and Mineral Resources and not to projects. Similarly for the SPE-PRMS.
	8.2	Footnote (d) to the E-axis in UNFC 2009 should be repeated in these specifications. This is the text that redefines the E-axis to include all economic and social contingencies affecting a project. Many renewable projects are blocked or delayed by hindrances in this space beyond the stricto sensu economic ones. Including this is important for the use of the classification for all the four purposes it is designed to serve.	Good comment; UNFC-2009 Footnote (d) from E-axis has been added.
Sigurd Heiberg, Petronavitas	8.3	Propose to change definition of Renewable Energy to "Renewable energy is energy that is derived from radiation from the sun or the earth's interior and naturally occurring chemical potentials, excluding hydrocarbons and coal (e.g. sunlight and wind) that are replenished at a higher rate than they are consumed. Solar, wind, geothermal, hydropower, and biomass are common sources of renewable energy".	The Task Force agrees that the proposed definition may be more extensive and possibly more complete. The Task Force, however, has adopted the SE4ALL definition but recognizes that there are many alternative definitions possible.
	8.4.	Propose to change Renewable Energy Product to Renewable Energy quantity	For application of UNFC-2009 to Renewable Energy it is important that the term "resources" is defined in a consistent manner as fossil fuel and mineral resources. The term resources is consistently used throughout these specifications to indicate the quantities potentially recoverable/extractable/convertible from the energy source by the Project. In the context of Renewables and application of the UNFC to Renewables, the Task Force considers it critical to distinguish between the Source (potentially infinite) and the Resources associated with the Project (finite).
	8.5.	Propose to remove the definition of Renewable Energy Resources. This is redundant, and may give rise to unclarity, as the term resources is used both for naturally occurring and recoverable quantities in the next sentence and in some extractive activities.	

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	8.6.	Section B: Propose to update "classifying the Project(s) based on project maturity or chance of commerciality" to "classifying the Project(s) based on project (technical) status and feasibility and on economic and social viability"	Thank you for this suggestion. The text of the specifications has been updated accordingly.
	8.7.	Section B: suggest to add "and social acceptability" as one of the risks and uncertainties	Thank you for this suggestion. The text of the specifications has been updated accordingly.
	8.8.	Section C: Suggest changing "The forecasted Renewable Energy Resources for a Project are constrained by the economic limit, Project lifetime or by entitlement" to "... the economic limit and Project lifetime. Entitlement defines the quantities that accrue to project participants."	Thank you for this suggestion. The text of the specifications has been updated accordingly.
	8.9	Section D: This text may be expanded to address non-linear contracts, that could lead to the view that entitlement should not be part of the classification, but dealt with as a separate issue, based on the project classification and the contracts and other (fiscal and other) framework conditions. Ref. text in the specifications	Thank you. We envisage that the commodity specifications will include additional guidance about entitlement and contract structures.
Serge van Gessel, Vice-Chair of the Geo-Energy Expert Group, EuroGeoSurveys	9.1	In theory most renewable primary energy sources represent an infinite "in-place" (or "in-situ") quantity whereas fossil/mineral resources are finite and physically constrained to accumulations and rock volumes. This has the following implications for production strategy: <ul style="list-style-type: none"> o Production development of fossil/mineral resources is typically limited by the outlines of an accumulation or a rock volume and strives for an optimal recovery of "in-place" resources. o Production development of renewable energy is less influenced by geographical occurrence (i.e. the required primary conditions such as sun and wind are less strictly limited to specific locations) and strives for an optimal and cost-effective capturing of power/energy generated at a location. 	Thank you for your comment. The purpose of the renewable specifications is precisely to clarify such differences, and these specific points are already addressed.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	9.2	Although geothermal energy is considered to be a renewable resource, it actually represents a finite resource at the timescale of the project. The rate of subsurface reheating of cold injected water is generally much slower than the production rate the hot water.	Thank you for your comment. The purpose of the renewable specifications is precisely to clarify such differences, and these specific points are already addressed.
	9.3	Part II, Section C, Page 4, Second paragraph: an economic limit will be appropriate for geothermal doublets as the cooled injected water will eventually reach the hot water production well which will result in a decrease of performance.	Thank you; this will be considered in the Geothermal Specifications.
	9.4	Part II, Section E, Page 4 and Table for F-classes, Page 7: - Class F4 raises the question “how to provide a reasonable resource estimation for undeveloped renewables?”. Renewable resources typically represent an infinite quantity. What methodology and further assumptions can be used best for objectively quantifying these classes (e.g. a single notional development plan, an estimate of energy that can be recovered over a fixed period of time)? How to define the recovery factor?	Good comment. Additional guidance on use of category F4 will be provided in each commodity specific specification. Note that UNFC-2009 already offers the opportunity to separate potential versus known deposits, exploration projects and additional quantities in place. Only F4 can accommodate "in place". The different levels of project maturity will dictate the rest. The details for renewable energy commodities will be handled by the commodity specifications.
	9.5	Table for F-classes, page 7: The term “renewable project” has been used in the “grey” text but this is not consistently done throughout the table. It seems that this adjustment should belong to the right column.	Correct; the table has been corrected accordingly.
	9.6	Part IV, Section C, Page 10: What assumptions/criteria are used to estimate/determine remaining quantities that could potentially be produced by future projects? (e.g. re-investments for replacing infrastructure in order to extend production, etc.).	This depends on the commodity/project and whether, at the effective date, those future projects have been identified/defined and the degree of maturity and estimated associated resource quantities for those projects.
Paolo Conti, PhD, DESTEC Department of University of Pisa and Italian Geothermal Union (UGI)	10.1	COMMENT #1 (P3 – Definition of renewable energy) In the current definition, the term “renewable” is related to exploitation conditions of a generic energetic source. Therefore, “renewable” does not regard only the specific source (solar, hydro,...), but it depends mainly on the conversion process operated by the so- called “project” (Part. II letter B).	The definition of Renewable Energy is consistent with SE4ALL and not defined by the Task Force. The Specifications recognize that alternative definitions exists and are used elsewhere. The conversion process forms indeed an integral part of the Renewable project. The way in which a geothermal source is exploited and its energy converted from one form into another will indeed affect the recharge (hence the sustainability - or not -

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
		<p>The wording “.. energy that is derived from natural processes (...) that are replenished at a higher rate than they are consumed” does not suit well with biomass and geothermal applications (and maybe hydro), as there cannot be a perfect synchronism between exploitation and replenish rate. E.g. when we use trees or crops, we have to wait for new plants: biomass can be considered renewable only respecting the growing time of new plants. Geothermal energy is analogous. Thus, the conditions “at a higher rate than they are consumed” seems too strict to me, unless a proper integral time-scale is defined for the conversion process.</p> <p>The actual discriminant factor to consider an energetic conversion process “renewable” (or not) is the level of alteration of the primary source. As other comments say, one source is renewable if its replenishment rate is similar or higher than utilization one. We can discuss on what “similar” stands for, or about a proper reference time scales for each source, but, in my opinion, a suitable definition should be focused on the sustainability of the conversion process. It could read: “Renewable energy is energy that is derived from natural processes (...) that are exploited with a sustainable average rate (during the life time of the project), without significantly affecting the original availability of the source”. At the end of the project lifetime, we have to stand sufficiently close to the conditions that occurred at the beginning of the operation.</p> <p>The use of terms like “similar”, “sufficiently close”, “significantly” seems necessary in order to avoid too strict definitions resulting inapplicable to actual renewable energy systems.</p>	<p>of the resource). The Task Force therefore fully agrees that "replenishment" is time-dependent. Again, the existing SE4ALL definition is used in these specifications. However, geothermal and hydro are generally considered as Renewable energy irrespective of the exact definition that is used.</p> <p>Your comments about the definition of Renewable Energy will be passed on to SE4ALL.</p>

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	10.2	COMMENT #2 (P2 – the use of the term “extraction”) I do not think that the term “extraction” suits well with energetic processes and sustainability concept: the term “conversion” seems more appropriate	The term "extraction" is used in the specifications for consistency with the UNFC. Footnote 4 specifies that this term is equivalent to "production" and "recovery". "Conversion" equally applies to Renewables and has been added to the footnote.
Paolo Conti, PhD, DESTEC Department of University of Pisa and Italian Geothermal Union (UGI)	10.3	COMMENT #4 (P2 – “Renewable Energy Sources and Resources” definitions) The two proposed definitions do not seem totally clear and coherent with the standard terminology of energetic matters. In particular, the term “source” is generally used with a too generic meaning. The application of these guidelines will be probably more effective if established terminology is adopted, i.e. “Resource” and “Reserve”. These two terms have been widely discussed during the past decades and their definitions have reached a sufficient level of spread worldwide (e.g. McKelvey diagram or Muffler and Cataldi, 1978). The concepts of “marketable product”, “reference point”, “available technology” (and others) have been already included in energetic jargon, therefore, I think that the document should be based on the established terminology as it is appropriate also for renewable energy matters (with minor adjustments).	Terminology and definitions used in these specifications is generally in line with IPCC and SE4ALL and "translated" to UNFC-2009 terminology. Resources and reserves are both "recoverable" quantities, but at different degrees of maturity. Note that UNFC-2009 deliberately avoids the use of the term "reserves". The commodity specifications will, where needed, further translate current commodity jargon into UNFC-2009 jargon.
	10.4	COMMENT #5 (General consideration about (F) and (G) axes for renewable energy assessment) A clear evaluation of the “sustainability” of the project should be included in the reporting code. As mentioned in comment #1, the concept of “renewably” is strictly related to a sustainable operation. Therefore, the F-axis should be clearly focused on the feasibility and sustainability of the project. Thus, F1 category should include also an evaluation of the operational strategy of the plant, analyzing the whole conversion process from primary sources to marketable energetic products. G-axis is focused on the description of source characteristics and its energetic potential. The terms “Geological knowledge” (deriving from UNFC-2009) can be replaced with: “Resource base knowledge” (letter R)	UNFC-2009 is not a reporting code. Feasibility can be taken as inclusive of sustainability, with commodity specifications providing more detailed rules of application and guidance. Thank you for your suggestion to replace G by R but we cannot change the existing UNFC-2009 definitions and terminology.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
Professor Ånund Killingtveit, Norwegian University of Science and Technology (NTNU), Norway	11.1	<p>Seen from the "Renewable side" this document can be a little bit confusing, because people are used to defining Energy Resources as Annual averages, and therefore the summation to "cumulative quantities", which can be compared to oil or coal resources is not very easy to accept.</p> <p>The central concept in this document is the Project, because it is the possible extraction of energy during the lifetime of a project that is measured. For non-renewables the project will usually cover a lifetime long enough to extract all the economical useful resource, but for renewables this is of course not so. The resource is still there for further use, and not reduced, even after the project has been closed down. It is not very meaningful to sum up energy from a renewable source and compare to stored resources with limited quantity, like oil or coal. Important questions will be type of technology, lifetime of projects and discounting.</p> <p>(1) If we change the view from comparing energy resources to comparing energy projects, things becomes more logical. I will therefore suggest a slight, but important, modification of the Title for the report, replacing "Renewable Energy Resources" with "Renewable Energy Projects" to make this clear. Now we can compare the cumulative energy produced during the typical lifetime of projects, which may be what an investor needs in order to use the classification.</p> <p>(2) I will also suggest to delete the two last lines in Part II Section A, "Renewable Energy Resources are the cumulative ...". This sentence is not needed, it only adds to the confusion. Also the definition of Renewable Energy Resources in Annex 1 should be deleted for the same reason.</p>	<p>Thank you for the useful comment. The Task Force agrees that there is a fundamental difference between using Annual Capacity or Average versus using Cumulative Quantities associated with a project. Additional context has been added to the introduction of the Specifications document to explain this.</p> <p>UNFC-2009 is already a project-based classification system. We therefore see no need to change the title of the report, but have added additional information in the introduction to make this clear. For that same reason we consider the two last lines in Part II Section A relevant to actually avoid potential confusion between Annual Capacity or Average versus Cumulative Project-based Quantities.</p>

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
		<p>(3) In Part III the two lines below the grayed out text (with quotes from UNFC-2009), I will suggest to change to: "Additional context is added to the tables below, where deemed necessary for the application of the UNFC-2009 to Renewable Energy quantities" Same change should be made in Part IV B. Bridging document in the Box Renewables - additional guidance: Replace "Resources" with "Quantities".</p>	
	11.2	<p>Then, I have some problems with the statement on top of Page 11 under D. Commodity or product type. In the Box it is stated that "For Renewable Projects producing multiple sales products, the non-energy commodity output shall be excluded from the Renewable Resource quantity. This could be a problem for Multi-purpose projects where other "non-energy commodities" could be a major part of the output, but I am not sure how to include this. It will not be energy, but still an important contribution from the project, increasing its value and viability. This is mostly a problem for Hydropower, where Multi-purpose projects are very common, and energy generation is only one of the outputs from the project.</p>	<p>Good comment; Refer to footnote 8 - non-energy commodities can be valuable contributors to the economic value of the project but are not reported as resources. The commodity specification will consider the details of cases where non-energy commodities are a major part of the economic value of the project.</p>
	11.3	<p>Finally, in the Table for Category E1-E3 I have some problems with the use of "...economically viable". We need to include a wider view on viability, not only the economical but also include legal, environmental and social factors that could have a big impact on viability. I am not quite sure how this could be formulated in good English, but I think it is important in some way to make clear that Economical in a narrow sense is not enough, maybe this could be explained in a foot-note?</p>	<p>Good comment: the footnote from UNFC has been added to highlight socio-economic factors/component. The introduction does already state that the Renewable Specifications should be used in conjunction with the UNFC-2009 and its Generic Specifications.</p>

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
	11.4	In footnote 2 on page 3, please add current ("... generated from waves, currents and tides")	Good comment; footnote text has been updated accordingly
	11.5	"Renewable energy resources" should be replaced with "Renewable energy quantities" throughout the report.	Use of the term "resources" is consistent with the UNFC-2009. The definition of resources already describes that these are quantities (but with a number of additional qualifiers).
Vitor Correia, President, European Federation of Geologists	12.1	According with Dr. Szanyi János, Chair of EFG's Panel of Experts on Geothermal Energy, the extension of the UN resource classification to geothermal sources faces a difficulty that should be considered: geothermal energy use is highly dependent on its vehicle. But calculation of groundwater resources varies considerably from hydrocarbon resources. Additionally, in the three fundamental criteria that shape the three-dimensional system, the capacity factor isn't considered. This is relevant since neither heat nor electricity storage is simple. And, because the energy content of geothermal sources isn't considered, comparison between different energy sources remains difficult. To conclude, we consider that the extension of UNFC classification to renewable is an important achievement, that poses relevant challenges, and we remain available to cooperate with UNECE in this task.	Thank you for your comment and kind offer to support and join the effort. Please note that the UNFC is project-based and therefore indeed recognizes that the energy quantity is dependent on its "vehicle".
Doug MacDonald, Schlumberger Information Solutions, Canada	13.1	Annex 1 - Glossary - Renewable Energy Source Quantifying the Renewable Energy Source the same way one might estimate the size of a "deposit" may be difficult. The sun, for example, would require considerations at the level of the Kardashev scale.	Thank you for your useful comment.
Jeremy Webb, Geology and Minerals Information Systems Specialist African Minerals Development Centre (AMDC)	14.1	Ref. Part II - Section B: "The cumulative quantity of Energy Products taken to the Project's economic, contractual or other time limit defines the Renewable Energy Resource quantity" This definition is practical and very useful at the project level.	Thank you for your useful comment.

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
		<p>Another application of renewable resource assessments might be to compare renewable resources with non-renewable resources. In such cases it might be better to simply compare the amount of electricity that could be produced from a renewable energy source over the theoretical lifespan of the non-renewable energy resource. This allows a fair comparison of competing non-renewable and renewable energy resources, for example as part of policy analyses. Note: Such an approach assumes that there will be reinvestment over time in capital related to renewable energy production and permits will be extended, however the same assumptions can be said to be made for non-renewable energy resources (for example when undertaking policy analyses).</p> <p>Policy analyses may need to use different approaches to assessing renewable energy resources relative to non-renewable energy resources.</p>	
	14.2	<p>Ref. Part IV - Section B: "The application of the UNFC-2009 to Renewable Energy Resources will be supported by a set of commodity-specific specifications and/or bridging documents for Bioenergy, Solar/Wind/Hydro and Geothermal energies"</p> <p>If it would help the work of the UNFC, I may be able to help organise and prepare case studies from New Zealand.</p>	Thank your for your offer to help - we will certainly make use of that.
	14.3	<p>Ref. Part IV - Section F (Reference Point): "... at which the reported sales quantities..."</p> <p>This coincides with the measurement point of product flows in national accounts and as such is a very practical reference point. It also means that the UNFC can potentially be used as a basis environmental economic accounts for renewable energy resources.</p>	Thank you for your useful comment

<i>Comment from</i>	<i>Item</i>	<i>Comment</i>	<i>Task Force Response</i>
F. Michael McCurdy, Senior Project Manager, Renewable Energy Generation Leidos Engineering, LLC (formerly RW Beck)	15.1	In reviewing the Part IV, Generic Specifications, part D. Commodity or product type, the draft specification includes the statement "For Renewable Projects producing multiple sales products, the non-energy commodity shall be excluded from the Renewable Energy Resource quantity". Many biomass technologies upgrade the Renewable Energy Source producing a co-product suitable for sale as food for people or livestock feed. My concern is that by establishing an economic value of the Resource based solely on the energy content as liquid fuel or electricity, the specification could create an economic incentive to destroy food or feed to produce energy. It may be worth considering food or feed to be an energy commodity on the basis of the energy that could be recovered by an end user. For example, sugar produced during ethanol production could be valued on a kJ/g basis depending on how much of the sugar is consumed by the human body."	Thank you for your comment and concern. Although the quantities of non-energy products cannot be classified and reported as Resources, footnote 8 clearly describes that the economic value of these non-energy products may be taken into account as part of the economic evaluation of the Project. The specifications therefore certainly do not provide an economic incentive to destroy food. Note that any social-environmental concerns beyond purely market-driven incentives are also taken into account as part of the E-axis classification. The footnote has been moved to the body of the document, to further clarify this. The specifications aim to apply the UNFC to Renewable Energy and not energy-equivalence. Including non-energy products on the basis of energy equivalence would significantly reduce the value and applicability of the UNFC in terms of providing a consistent framework classification across renewable and non-renewable energies.