



Achieving SDG7 – Application of UNFC-2009 to geothermal energy resources

Prof. Gioia Falcone

5th UK Deep Geothermal Symposium
London, 25 October 2016

My Service in relation to UNECE

- **United Nations Economic Commission for Europe (UNECE):** Member of the Expert Group on Resource Classification (2012 to present); Member of the Renewable Reserves Taskforce (2012 to present); Member of the Bureau of the Expert Group on Resource Classification (2014 to present).
- **International Geothermal Association (IGA):** Member (2011 to present); Member of the Resources and Reserves Committee (2013 to present); Initiator of the MoU between IGA and UNECE to develop a globally applicable harmonized standard for reporting geothermal resources (signed in September 2014); Leader of the Working Group to develop the geothermal specifications for the UNFC (2015-present).
- **Geothermal Resources Council (GRC):** Member (2013 to present).
- **European Geothermal Council (EGEC):** Member (2012 to present).

Need for Energy Classification Standards

Presented by Gioia Falcone on behalf of the Task Force on the
Application of the UNFC-2009 to Renewable Energy and the IGA
Resources and Reserves Committee

London, 25 October 2016



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Resource Classification: is it Possible to Enforce 'THE GOAL'?

Standards?

Rules?

Guidelines?

Codes?

Protocols?

Flexibility increases uncertainty



Greater uncertainty = greater risk to investor



Less confidence in development

A classification framework is key to describe resources in a representative way, reflecting their maturity and uncertainty, and capturing their present value vs. future potential.



Multiple End-Users ... Can They Agree?

- Governments
- Field Owners, Operators
- Investors
- Reserves Auditors
- Insurance Companies
- International Energy Associations, Agencies, Councils

Challenges Posed by Standardisation

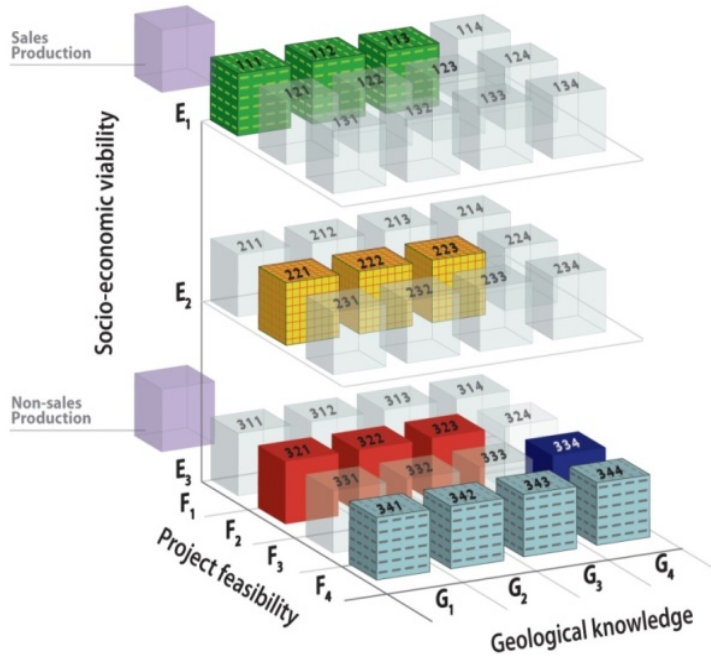
- Different types of resources & geographical distribution
- Different uses & associated economics
- Technology advances
- Impact of technology & economics on cut-offs
- Conventional vs. unconventional resources
- Varying environmental, policy & regulatory constraints
- Multiple end-users
- Reluctance to accept standardised workflows

UNFC-2009

1. What is it?

2. How it works

3. Specifications



UNFC-2009

United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources

- **Generic, principles-based system**

- Now applicable to solid minerals, fossil energy, renewables (geothermal) and to injection projects

- **Based on three criteria**

- **'E axis'** (*degree of favourability of social and economic conditions in establishing commercial viability of project*)
- **'F axis'** (*maturity of studies and commitments necessary to implement project*)
- **'G axis'** (*level of confidence in the geological knowledge and potential recoverability of the quantities*)

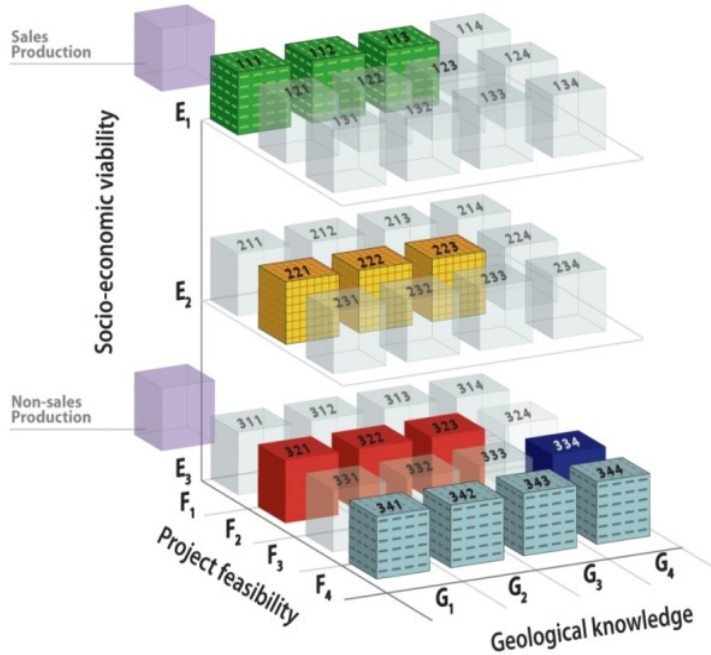


UNFC-2009

1. What is it?

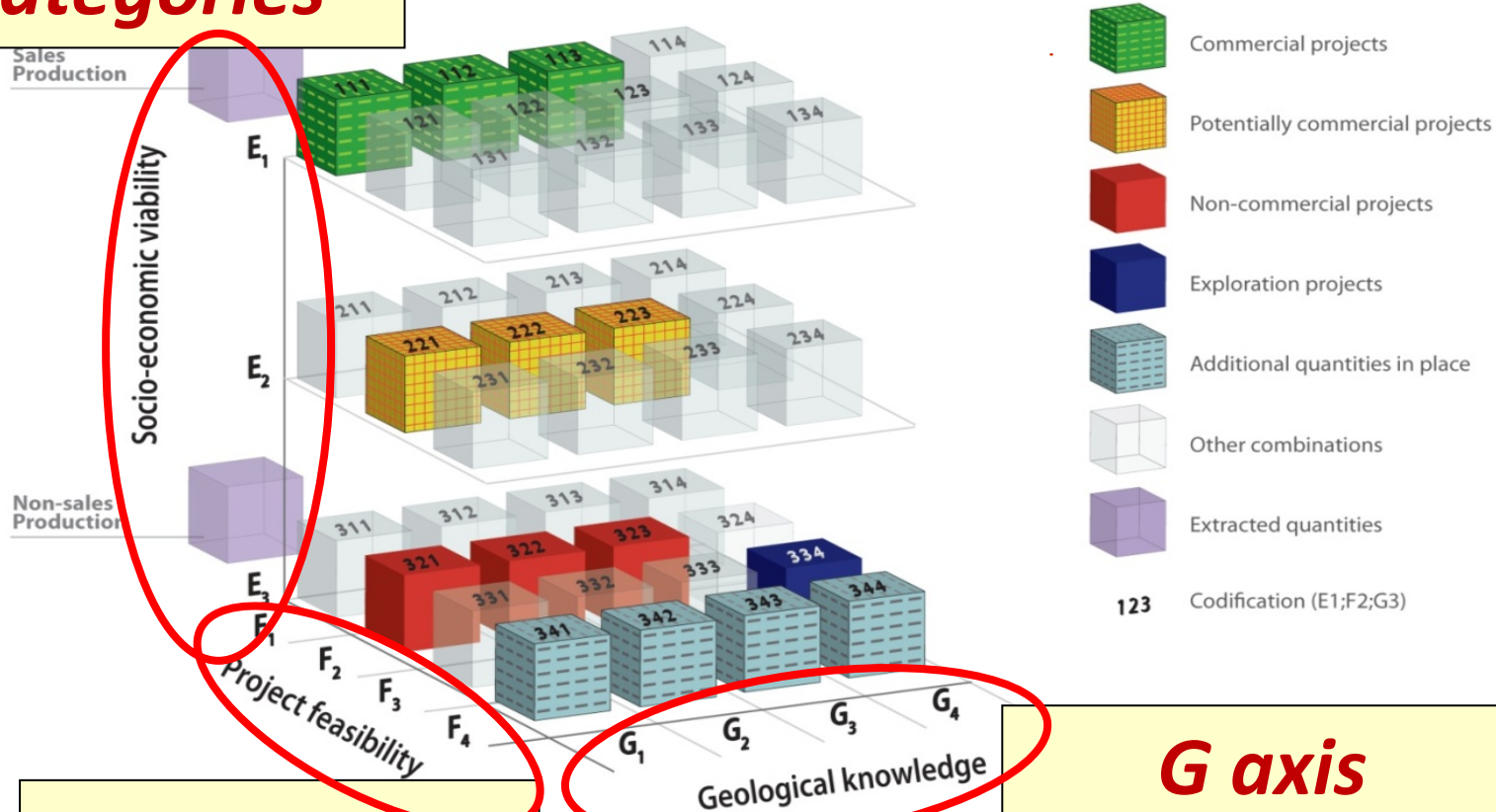
2. How it works

3. Specifications



UNFC – How it works

E axis categories

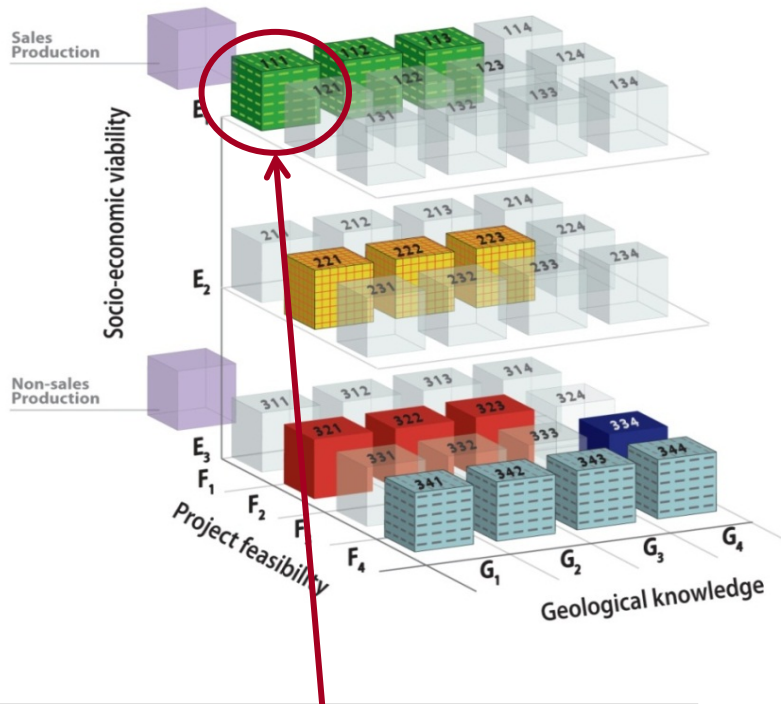


F axis categories

G axis categories



UNFC – How it works



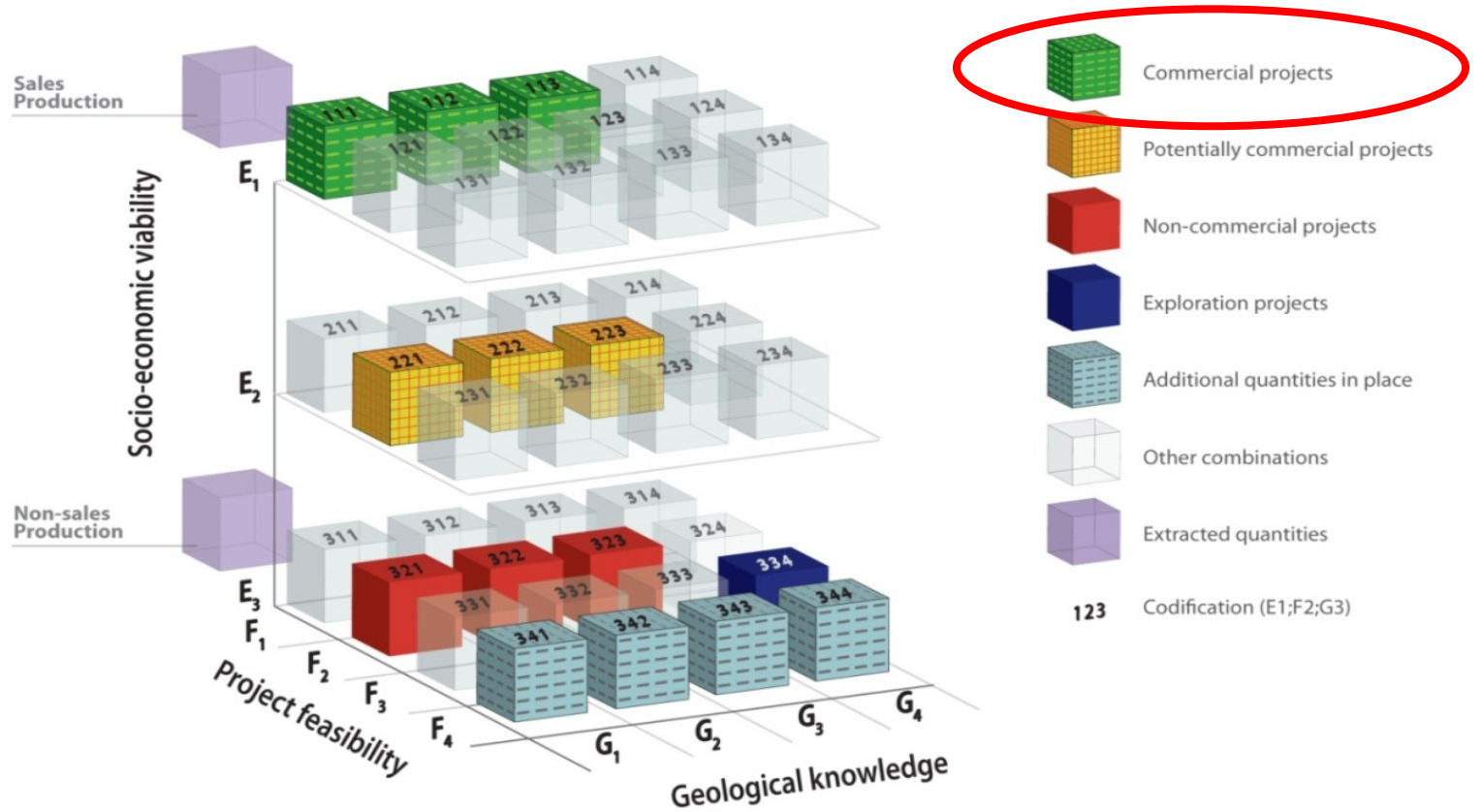
UNFC Class: 111

Category	Definition
E1	Extraction and sale has been confirmed to be economically viable.

Category	Definition
F1	Feasibility of extraction by a defined development project or mining operation has been confirmed.

Category	Definition
G1	Quantities associated with a known deposit that can be estimated with a high level of confidence.

UNFC – Examples of classes



Alignment of systems (schematic)

UNFC-2009

PRMS

CRIRSCO

Total commodity initially in place	Sales Production
	Non-sales Production
	<u>Class</u>
	Commercial Projects
	Potentially Commercial Projects
	Non-Commercial Projects
	Additional quantities in place
	Exploration Projects
	Additional quantities in place

Production
<u>Class</u>
Reserves
Contingent Resources
Unrecoverable
Prospective Resources
Unrecoverable

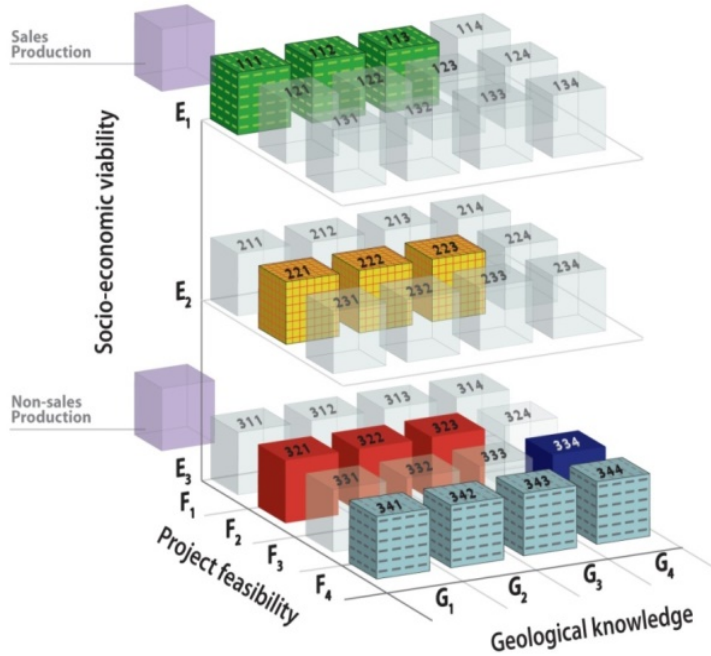
Extracted
<u>Class</u>
Mineral Reserves
Mineral Resources
Not reported
Not reported
Exploration Results
Not reported

UNFC-2009

1. What is it?

2. How it works

3. Specifications



What are specifications?

Definitions

Classification
Framework

Specifications

Application
Rules

Guidelines

Non-
Mandatory
Guidance



Further Bridging Documents, Specifications & Guidelines

- Red Book and UNFC Bridging Document
- Guidelines for the application of the UNFC-2009 to uranium and thorium resources
- Guidelines on Project Definition
- Draft Bridging Document between the Oil and Fuel Gas Reserves and Resources Classification of the Russian Federation of 2013 and the UNFC-2009
- Draft Specifications for Application of UNFC-2009 to Injection Projects for the purpose of geological storage
- **Draft Specifications for Application of UNFC-2009 to Renewable Energy Resources (approved 30-Sep-2016)**
- **Draft Specifications for Application of UNFC-2009 to Geothermal Energy Resources (approved 30-Sep-2016)**



Is it feasible to apply resource classification to renewable projects?

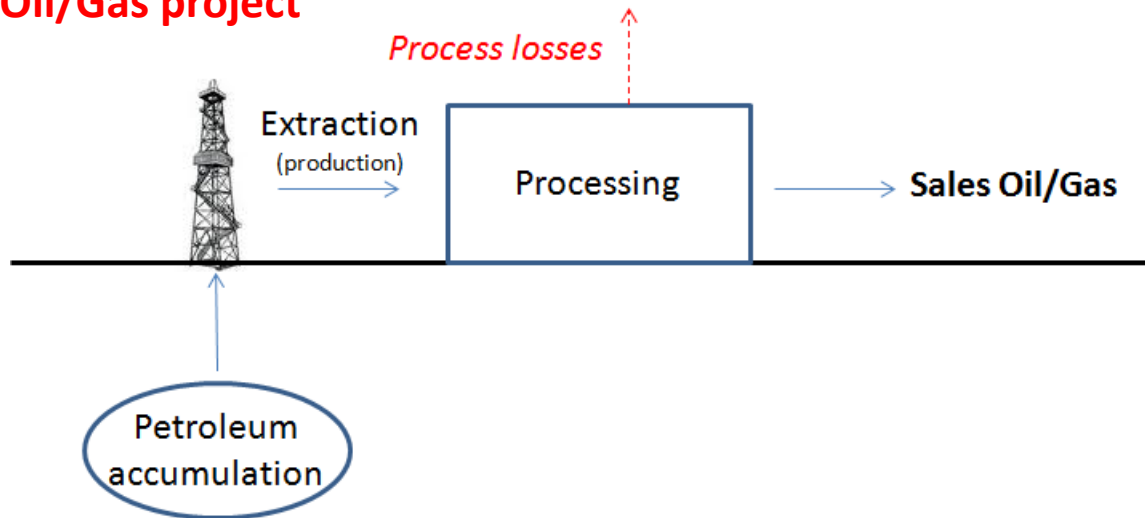
- Most renewable projects are not subject to depletion, as for fossil fuels and minerals
- However, they can be considered in the same way: in terms of future cumulative energy production under a prescribed set of conditions
- Renewable projects are similar to fossil and mineral projects:
 - a project has a fixed level of investment, with an expected production profile
 - they progress through stages
 - they have similar prerequisites such as gaining access to the resource and market, receiving authorisation, and validation of the economic case
 - as the project develops, risk declines and certainty of returns improves
- This means they can be evaluated and classified into categories depending on their technical, commercial and socio-economic viability



The Concept

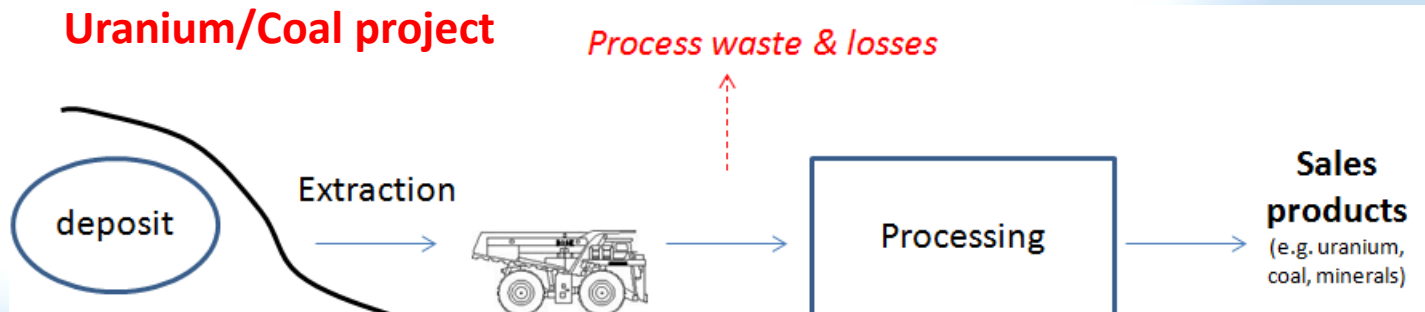
A “Project-Based” Classification

Oil/Gas project

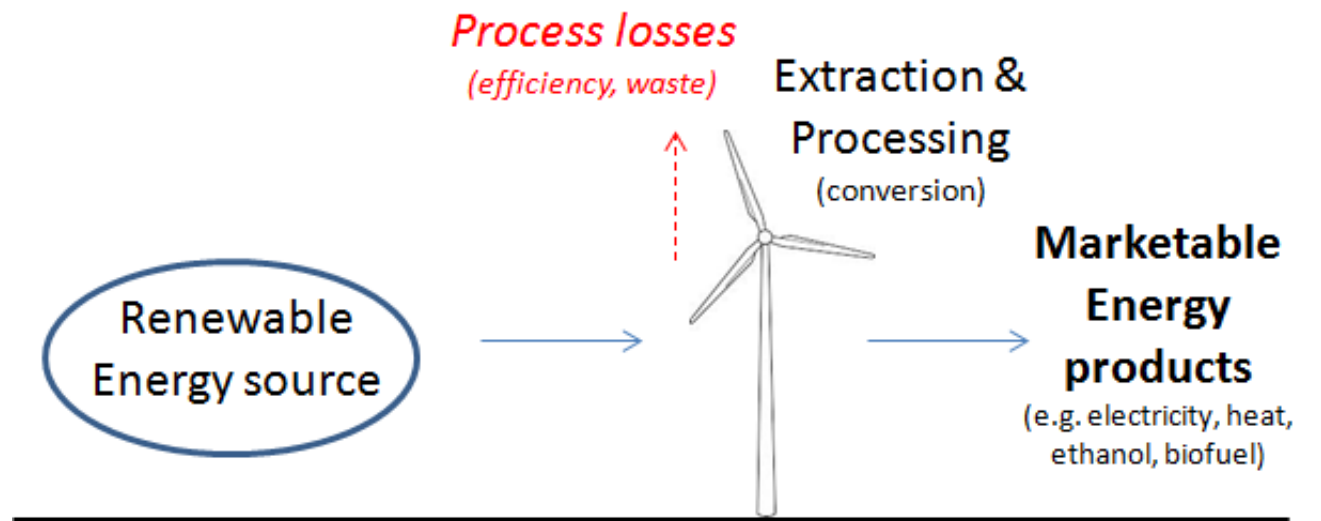


The **project** represents the level where a decision is made to proceed (i.e., spend money or not)

Uranium/Coal project



Renewable Energy Projects are Very Similar to Fossil Energy or Mineral Projects



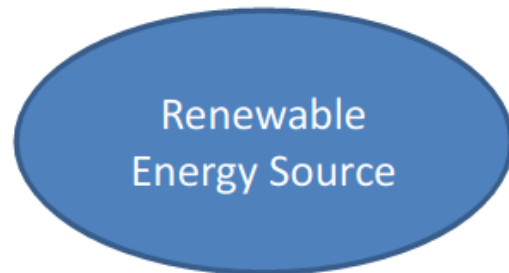
The **Project** is the link between the Renewable Energy Source and sales quantities of Energy Products.

The **Project** provides the basis for economic evaluation and decision-making

What are “Renewable Energy Resources”?

Renewable Energy Source:

The primary energy available for extraction/conversion



Examples: sun, wind, bio mass, earth heat, river flow, tides etc

Extraction / Conversion



Process/project:
Wind park, solar park, hydro power plant, sugar cane mill, geothermal

Renewable Energy Resources:

cumulative quantities of extracted and marketable Energy Products from the Renewable Energy Source, measured at a Reference Point



Examples:
Electricity

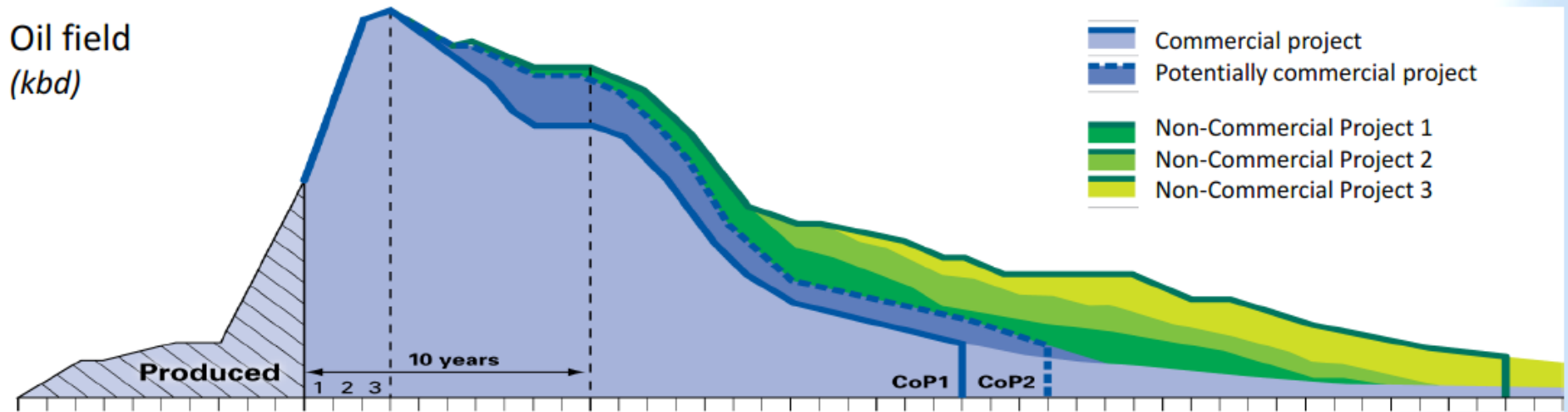
Heat

Biofuel



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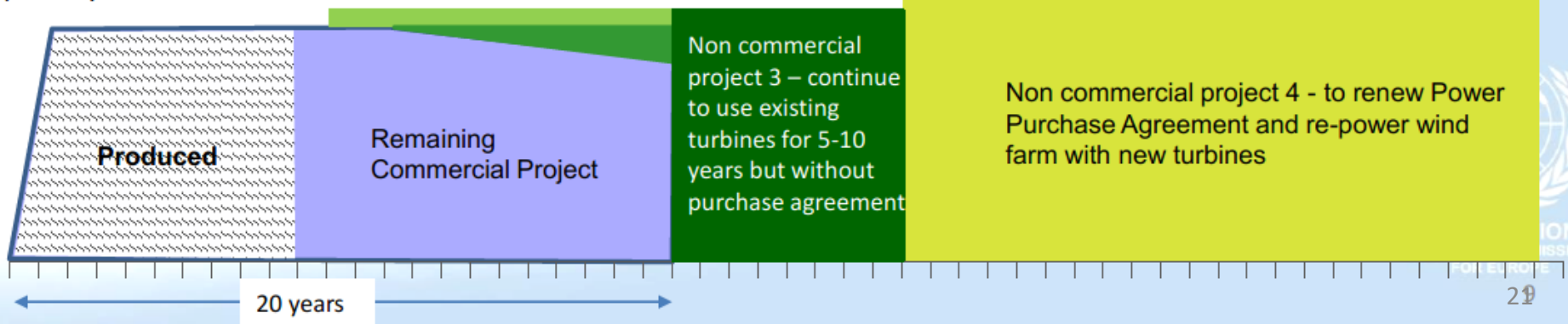
Illustration: oil field vs wind farm



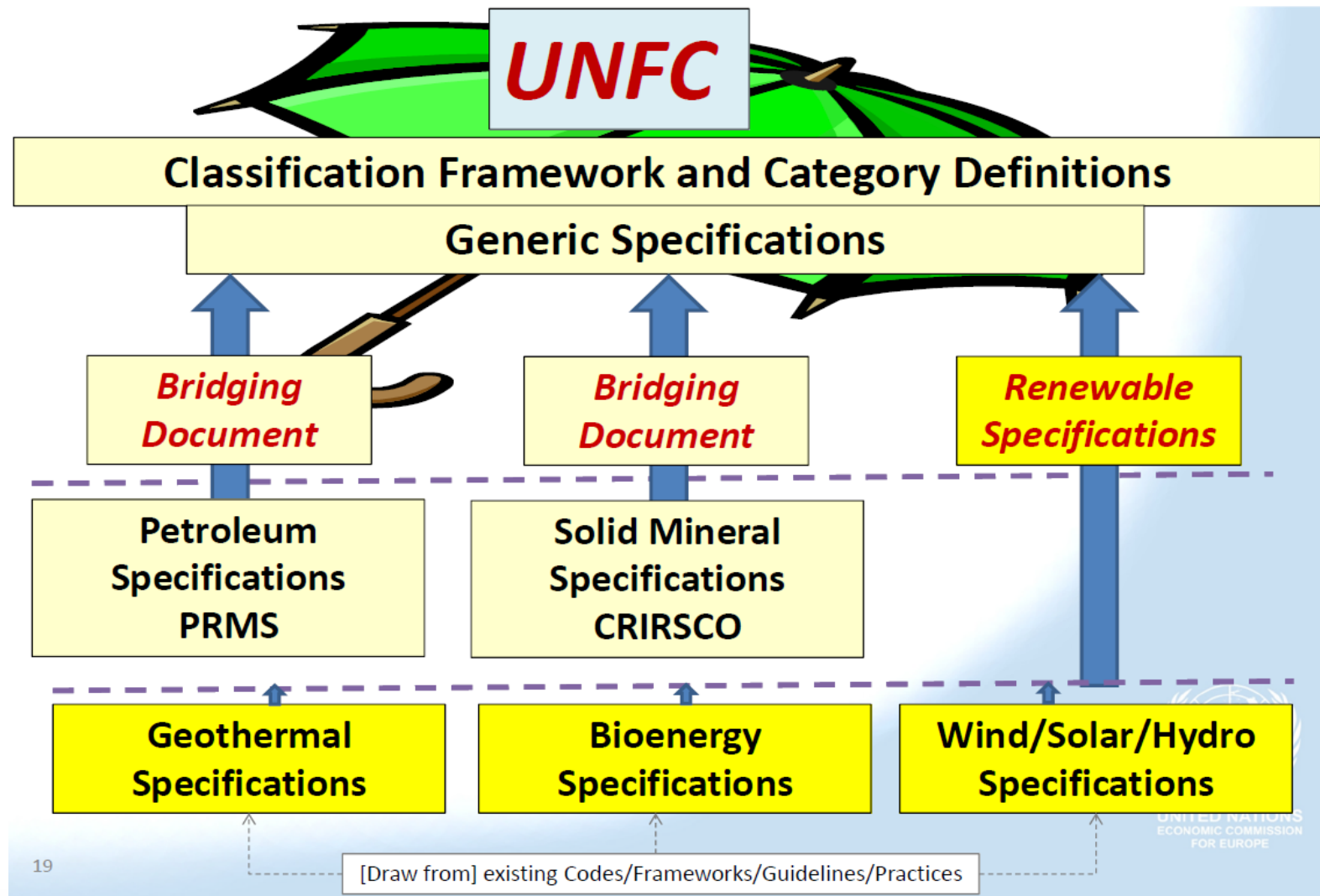
Non commercial project 1 - to invest in plant efficiency to retain same throughput over lifetime of the plant

Non commercial project 2 - to increase turbine efficiency and decrease downtime on maintenance, resulting in higher throughput

Wind Farm (MWh)



Including Renewables



19

No bridging to existing REN codes or specifications

UNECE-IGA



- In **September 2014**, the IGA and the UNECE signed a MoU to develop a globally applicable harmonized standard for reporting geothermal resources.
http://www.unece.org/fileadmin/DAM/oes/MOU/2014/MoU-UNECE_IGA.pdf
- On **15 January 2015**, the IGA appointed a voluntary Working Group to draft 'Geothermal Specifications' for the UNFC.
- Subsequent 20-month period of teleconferences, drafting, workshops, presentations, white papers, expert reviews, public comments and refinement of the documents.
- On **30 Sept 2016** The UNECE Committee on Sustainable Energy endorsed the Geothermal Specifications.



Geothermal WG Members



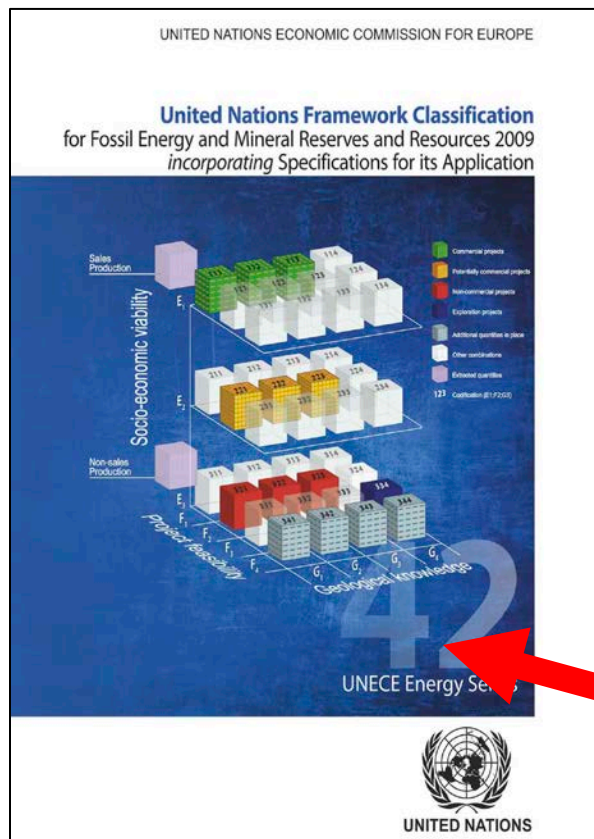
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Roy Baria	UK	Mil-Tech UK Ltd.
Larry Bayrante	Philippines	Energy Development Corporation
Paolo Conti	Italy	University of Pisa (endorsed by UGI)
Malcolm Grant	New Zealand	MAGAK (endorsed by NZGA)
Robert Hogarth	Australia	Hogarth Energy Resources
Egill Juliusson	Iceland	Landsvirkjun
Harmen F. Mijnlieff	Netherlands	TNO (endorsed by Dutch Geothermal Platform)
Annamaria Nádor	Hungary	Geological and Geophysical Institute of Hungary
Greg Ussher	New Zealand	Jacobs
Kate Young	USA	National Renewable Energy Laboratory

(*) Now at Cranfield University, UK

Observers: Graeme Beardsmore, Chair, IGA R&R
Horst Rüter, Director, IGA Service Company



UNFC-2009 hierarchy



UNECE

Specifications

for the application

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

to Renewable Energy Resources

Done in Geneva, 30 September 2016

UNECE

Specifications

for the application of the

United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009)

to

Geothermal Energy Resources

Done in Geneva on 30 September 2016

Geothermal Specifications linked to Renewable Specifications and Generic Specifications

Case Studies (coming soon!)



1	Ngatamariki	New Zealand
2	Habanero	Australia
3	Insheim	Germany
4	Rotliegend-3	The Netherlands
5	Dutch Rotliegend Play Area	The Netherlands
6	Hódmezővásárhely	Hungary
7	Alto Peak	Philippines
8	Baslay-Dauin	Philippines
9	Canavese	Italy
10	Vertical Ground-Coupled Heat Pump	Italy
11	North Rhine Westphalia	Germany
12	Pauzhetsky	Russia

Widespread geographical representation

Encompassing hydrothermal, EGS, GSHP

Electricity and heat

Single project and aggregation

FOCUS ON CLASSIFICATION



Summary

- Renewable Energies form a rapidly growing (all be it from a small base) proportion of the world's primary energy supply.
- The Paris agreement on the limitation to global temperature increase is likely to require further significant renewable energy development and growth.
- Considering environmental and societal pressures, they should be developed and implemented in the most effective & efficient way
- Such development will take place only if there is a business case for investors to finance this development
- This business case demands a representative evaluation of the uncertainty, maturity and value of the resources to develop
- The application of the UNFC-2009 to Renewable Energies provides a universally recognized system to help conduct this evaluation



Acknowledgements



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 - In kind support from the International Renewable Energy Agency (IRENA) and the Geothermal Resource Council (GRC)
 - Expert input by the International Energy Agency Geothermal Implementing Agreement (IEA-GIA), the Geothermal Energy Association (GEA), the European Geothermal Energy Council (EGEC), the l'Unione Geotermica Italiana (UGI) and authors of submissions during the public comment period





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