

“Case Study”

Application of UNFC-2009 to Solar Energy

Presented on behalf of the EGRC
and the Task Force on Application of UNFC-2009 to Renewable Energy

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SPE Swiss Section Lecture
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On the occasion of the
UNECE Expert Group on Resource Classification
Sixth Session, Geneva, April 2015



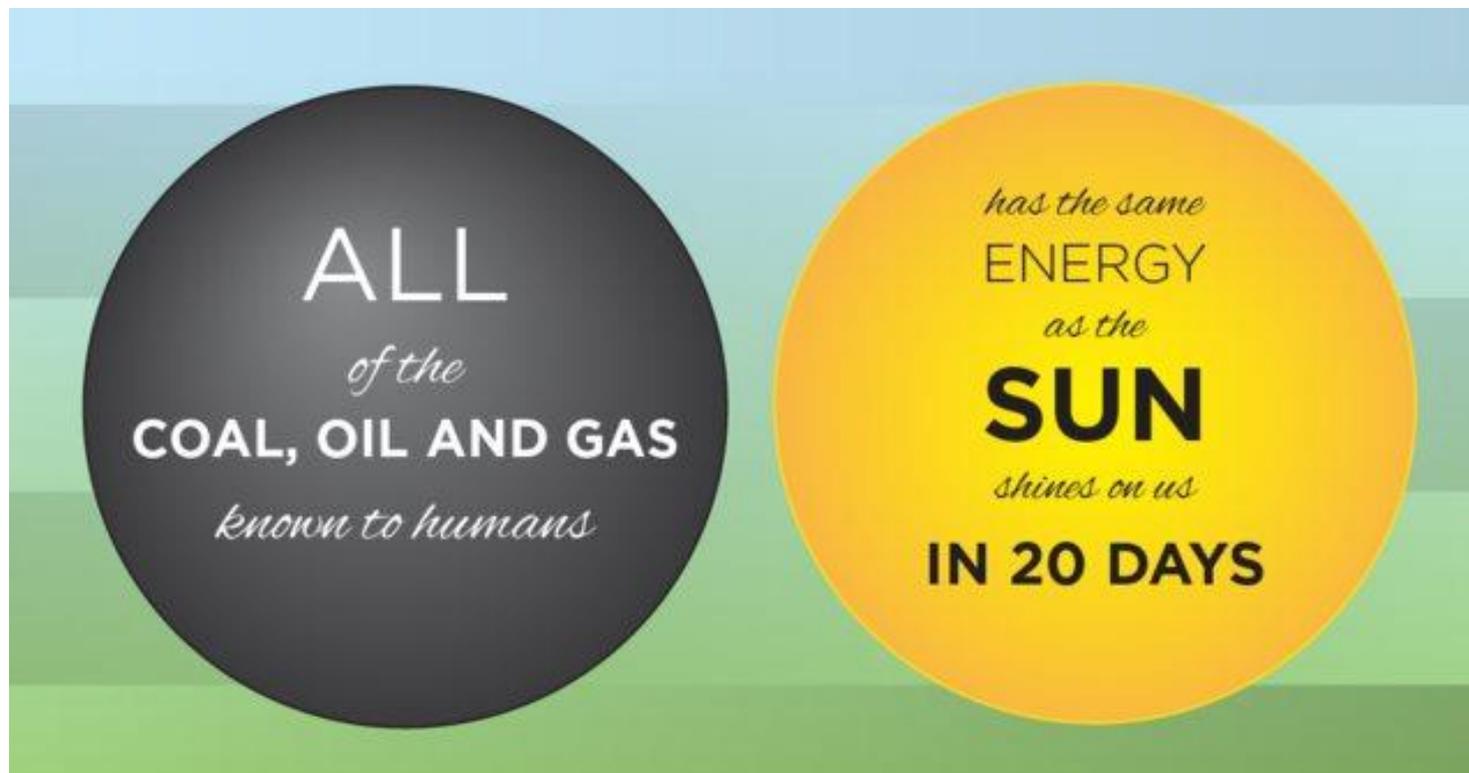
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Introduction

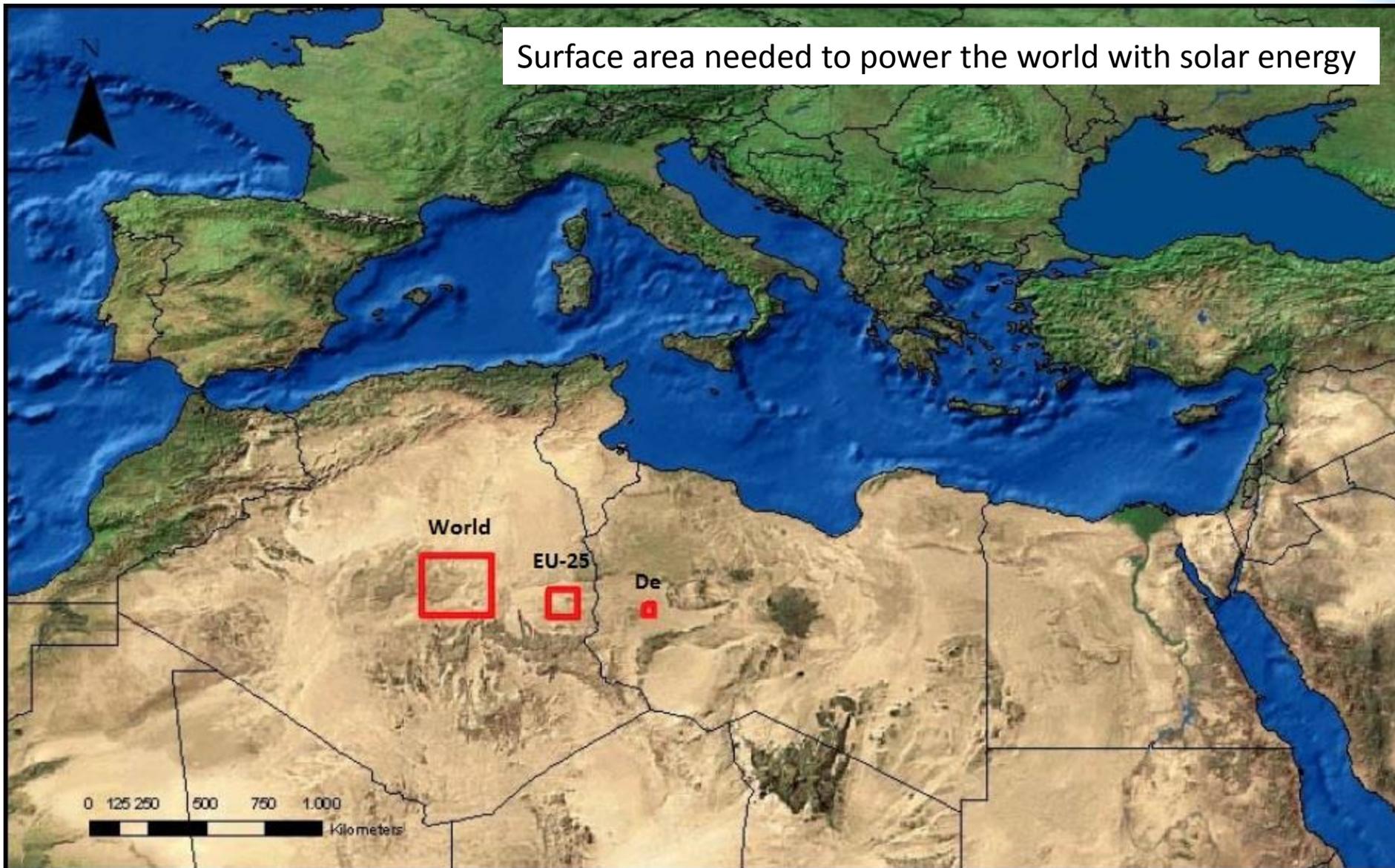
- Why would we want to classify Renewable Energy in the same consistent manner as Oil, Gas and Minerals?

Solar Energy



Source: ucsusa.org

Surface area needed to power the world with solar energy



What will we do in this session?

- Short summary of the work of the Task Force on application of the UNFC-2009 to Renewables
- Plenary discussion of a fictitious Solar Energy case
 - Trigger plenary discussion: classification may sometimes be subjective!
 - Gather feedback: where are the “rules of application” not clear?

Application of UNFC-2009 to Renewable Energy



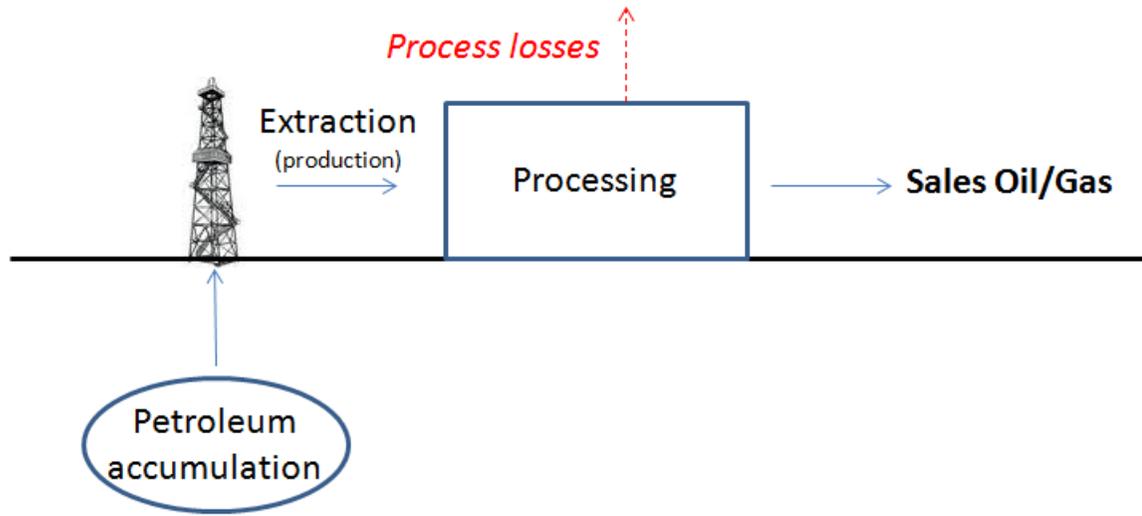
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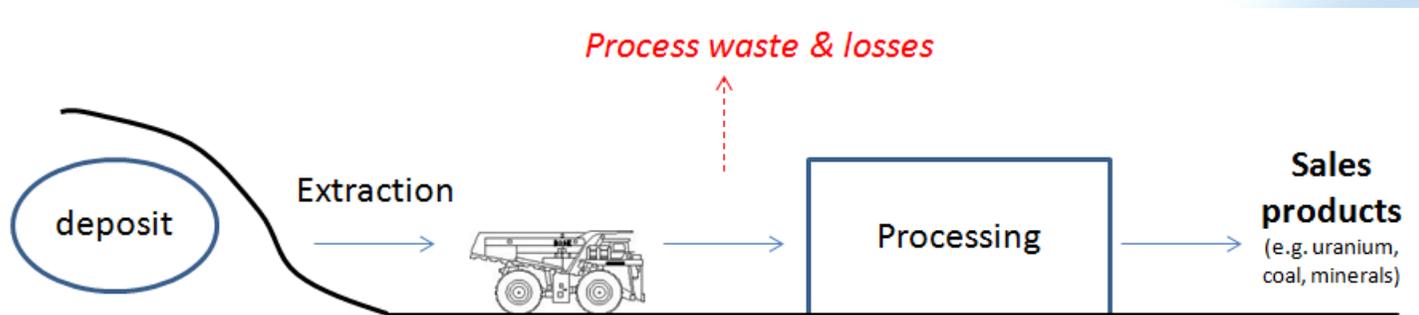
Background & progress

- UNECE called upon the EGRC to “*develop ideas on how the UNFC could apply to and integrate renewable energy by December 2013*”
- The EGRC established a Task Force on the Application of UNFC-2009 to Renewable Energy Resources
- The Task Force presented draft Specifications on the application of the UNFC-2009 to Renewable Energy at the 5th session of the EGRC in 2014 and a final draft at the 6th session in 2015
- Established 2 working groups to develop commodity Specifications for Geothermal (through MoU with IGA) and Bioenergy
- Work on Solar/Wind/Hydro temporarily on hold, until key stakeholder support and active involvement is secured

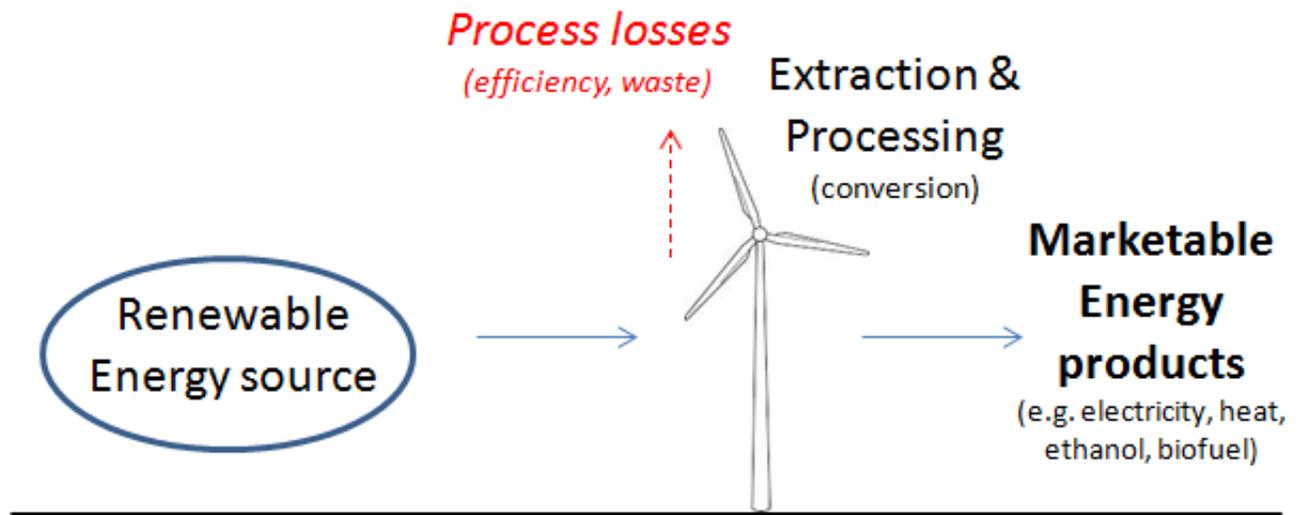
The concept: UNFC-2009 is “project-based”



The **project** generally represents the level at which a decision is made whether or not to proceed (i.e., spend more money)



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 and provides the basis for economic evaluation and decision-making

Main challenges

- Many different stakeholders, relatively fragmented, and limited global consolidation yet
 - How to get input and support from full spectrum of stakeholders?
 - Who will “own” and “maintain” the Specifications?
 - Is this initiative too early or right on time?
- Common practice of using “Annual Capacity” and “Potential” is not aligned with UNFC-2009 project-based approach
 - Is there sufficient incentive among stakeholders to define a Project and Project Life Time
- UNFC is based on finite quantities with associated geological uncertainties
 - Some confusion among Renewable Energy stakeholders about the application of E, F and G-axis categories and how to effectively use for Renewable Energies

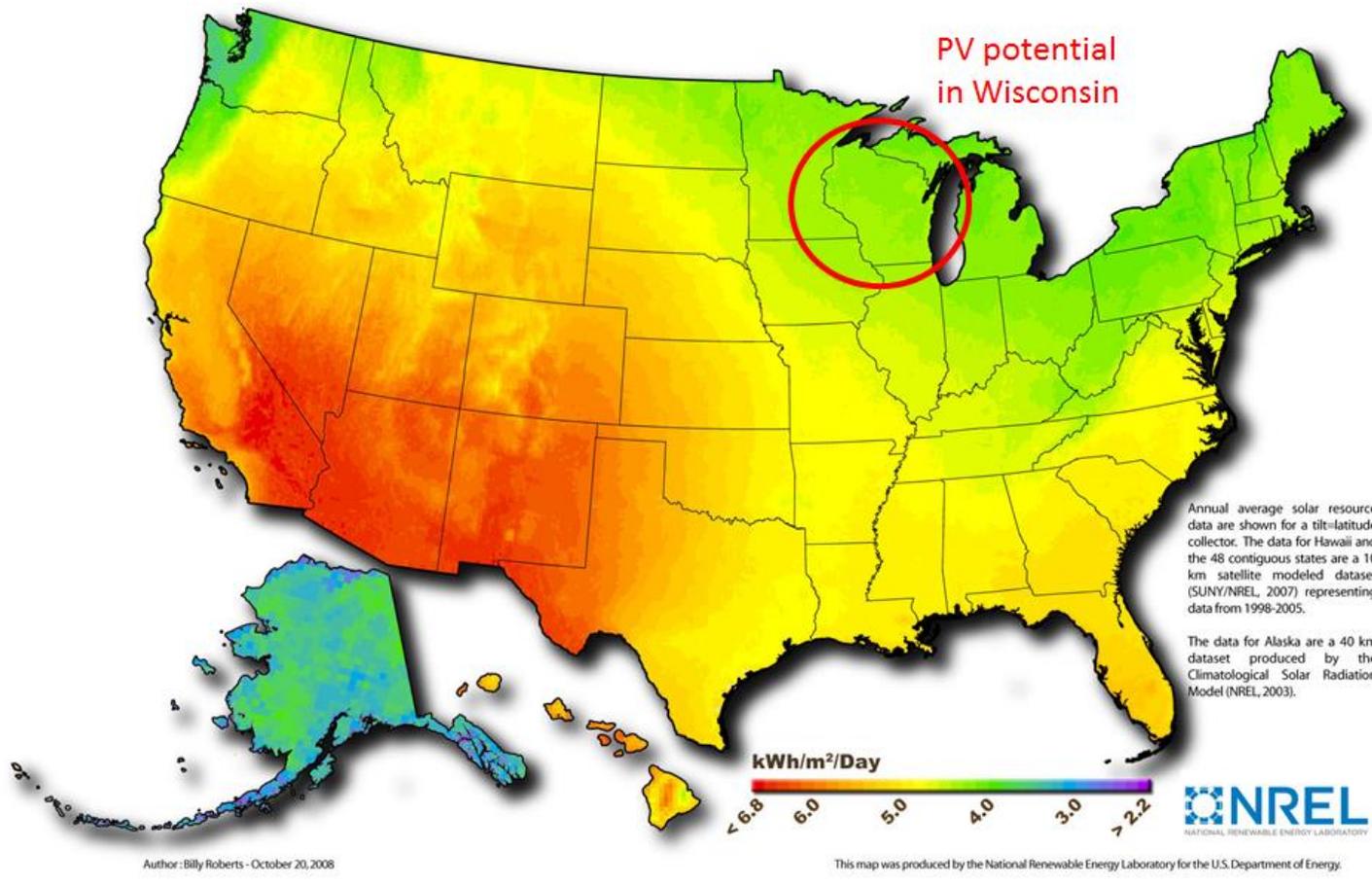
Case Study: Solar Energy in Wisconsin



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PV potential in state of Wisconsin

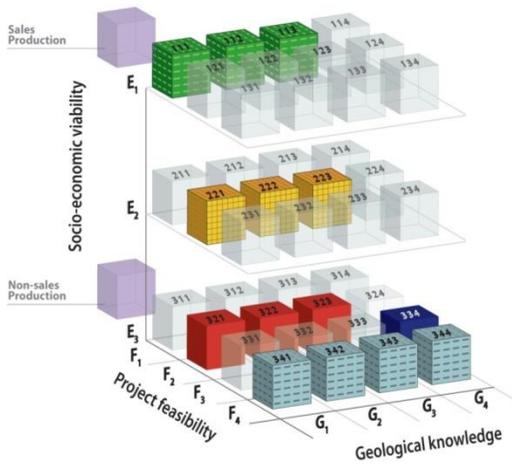


- Estimates of potentials assumed to be unconstrained by grid limitations such as lack of storage or transmission capacity.
- Utility scale PV in rural areas was restricted by excluding federal protected lands, water features and wetlands, and allowing installations only where land surface slopes are $\leq 3\%$. Resulting areas must be $\geq 1 \text{ km}^2$ to be included in the potential. Installed capacity for utility scale PV assumes an installation density of 48 MW/km^2 .



Plenary discussion (1)

- How to classify the estimated PV potential in the UNFC-2009?



G4 (exploration project)?

- UNFC-2009: "Estimated quantities associated with a potential deposit, based primarily on indirect evidence"
- But ... we know that the sun is shining in Wisconsin and that energy can be extracted from the sun at any place ...

F4 (in situ/in-place quantities)?

- UNFC-2009: "No development project or mining operation has been identified"
- But ... without a time-bound limit the solar energy at any particular location in Wisconsin is infinite ...

Without definition of (notional) project(s) there is no place for "potentials" in the UNFC?

Solar Energy Project: Helios

Sunshine Ltd has taken an option for a 35 year lease of a 23-acre site in Wisconsin to build a PV Solar Park, project "Helios"

The electricity generated by Helios will be fed into the local grid and used to offset non-renewable energy use in a nearby city

Sunshine Ltd has not yet made an investment decision but is in the process of completing a feasibility study



Solar Energy Project: Helios (2)

Project facts used in feasibility study:

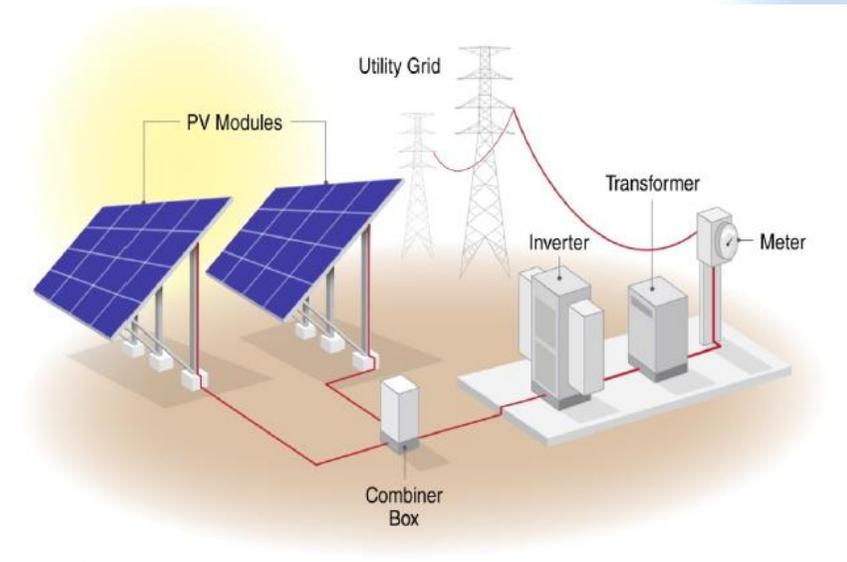
- PV module warranty 25 yrs (guaranteed system performance)
- PV efficiency 0.5% degradation/yr (0.4 – 0.7% range)
- Inverter warranty 10 yrs, two replacements in project
- Project electricity output calculated based on preliminary estimate of average solar radiation
- Still awaiting completion of Solar Resource Assessment (data from Satellite model and local ground measurements)

Economic conditions:

- Federal tax credit (~ 45%) available for initial investment
- Commercial electric rate 0.08 \$/kWh, 2% increase/yr
- Local feed-in tariff for renewable energy 0.02 \$/kWh
- Power Purchase Agreement not yet agreed

Investment criteria:

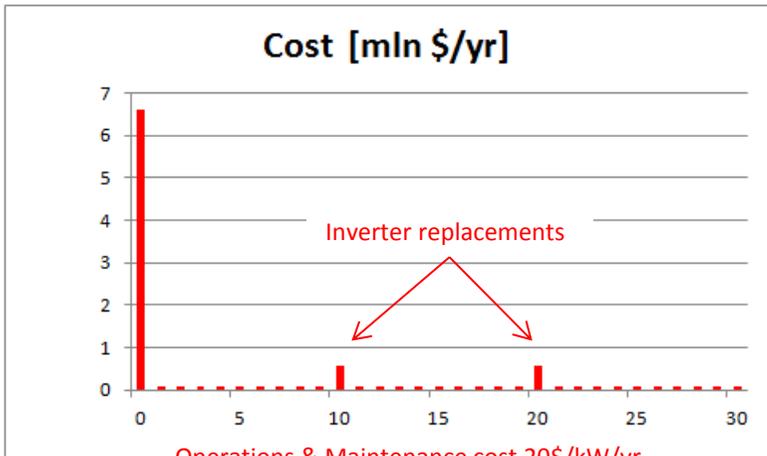
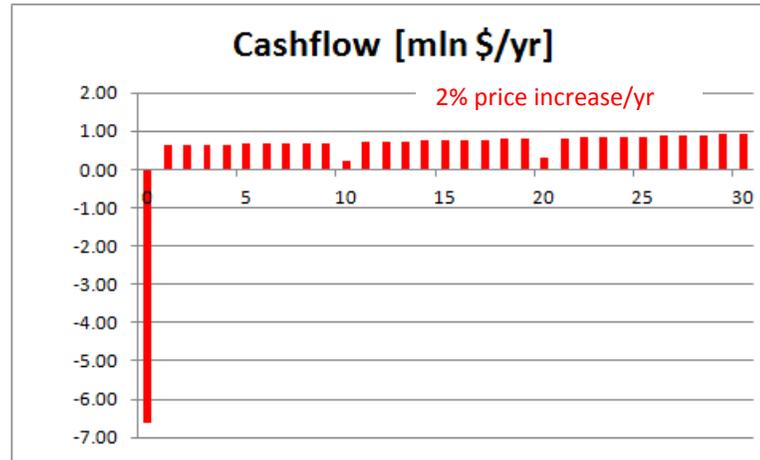
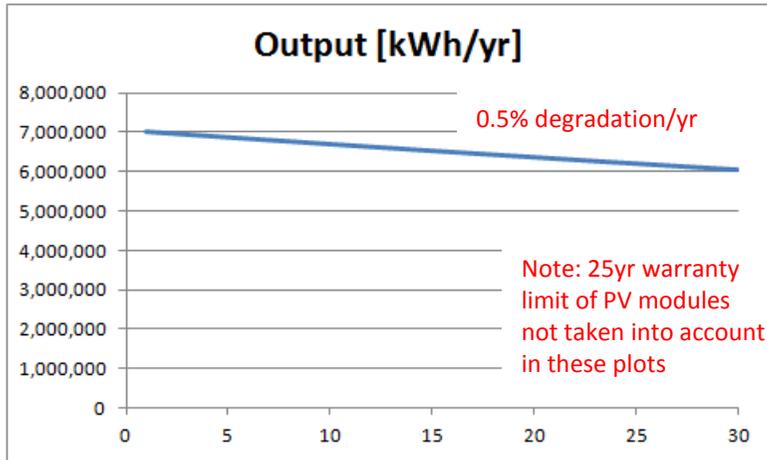
- Sunshine uses 8% IRR as investment criteria for its projects



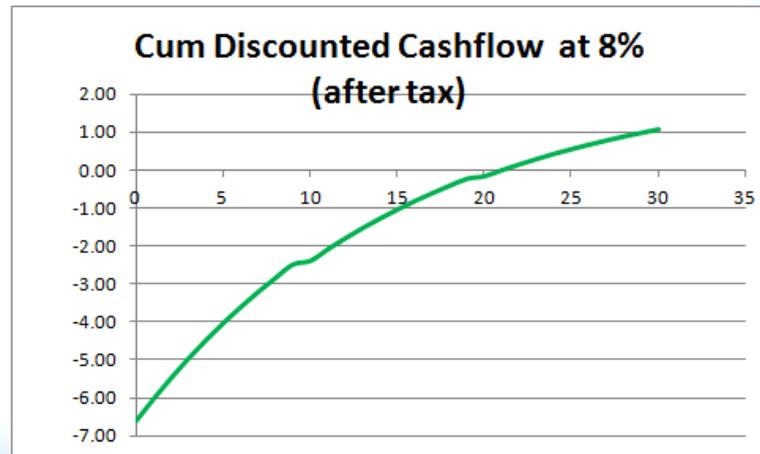
Permitting:

- Number of permits required for the projects:
 - Site preparation (removal of vegetation)
 - Water usage for cleaning of PV panels
 - Connection to the grid
- Local community is not yet in full support

Solar Energy Project: Helios (2)

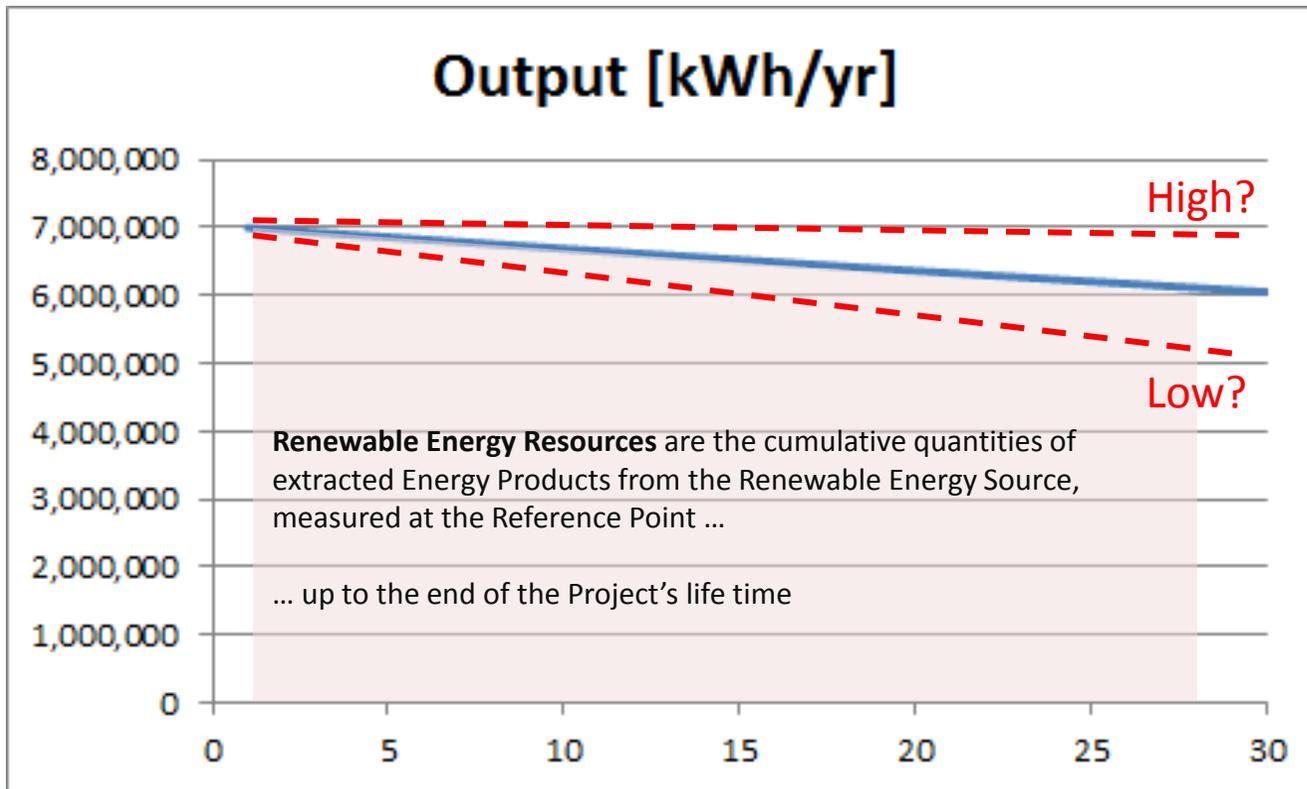


Operations & Maintenance cost 20\$/kW/yr is minor compared to initial investment



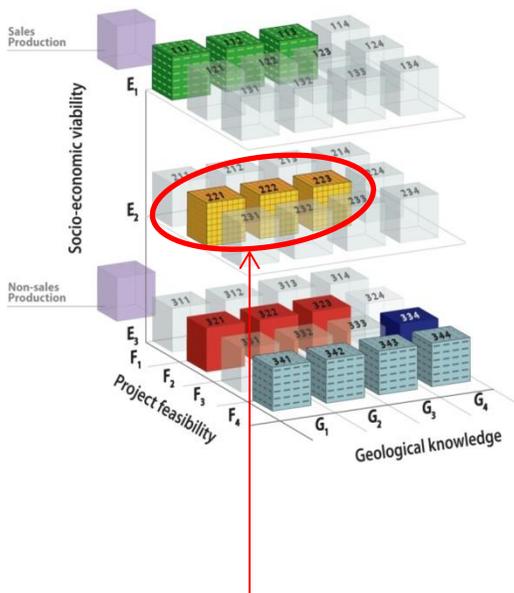
Plenary discussion (2)

- How to estimate the quantities of Renewable Resources for Project Helios?



Plenary discussion (3)

- How to classify the Renewable Resources for Project Helios in terms of E- and F-axis?



Category E2F2?
With associated range of quantities (G1-G3)

Category	Definition	Supporting Explanation (UNFC-2009 ANNEX I)
E1	Extraction and sale has been confirmed to be economically viable	Extraction and sale is economic on the basis of current market conditions and realistic assumptions of future market conditions. All necessary approvals/ contracts have been confirmed or there are reasonable expectations that all such approvals/contracts will be obtained within a reasonable timeframe. Economic viability is not affected by short-term adverse market conditions provided that longer-term forecasts remain positive.
E2	Extraction and sale is expected to become economically viable in the foreseeable future.	Extraction and sale has not yet been confirmed to be economic but, on the basis of realistic assumptions of future market conditions, there are reasonable prospects for economic extraction and sale in the foreseeable future.

Approvals and contracts not yet confirmed and some risk that lack of local community support may impact approval of permits

Category	Definition	Supporting Explanation (UNFC-2009 ANNEX I)
F1	Feasibility of extraction by a defined development Project or mining operation has been confirmed.	Extraction is currently taking place; or, implementation of the Renewable energy Project is underway; or, sufficiently detailed studies have been completed to demonstrate the feasibility of extraction by implementing a development Project or mining operation.
F2	Feasibility of Extraction by a defined development Project or mining operation is subject to further evaluation.	Preliminary studies demonstrate the existence of a Project in such form, quality and quantity that the feasibility of extraction by a defined (at least in broad terms) development Project or mining operation can be evaluated. Further data acquisition and/or studies may be required to confirm the feasibility of extraction.

"...Still awaiting completion of Solar Resource Assessment (data from Satellite model and local ground measurements)"

Will this data be critical to establish the feasibility of the project...?

Plenary discussion (4)

- What time limit to assume for the calculation of the quantity of renewable energy resources associated with the project?
 - 10 yrs based on inverter life time?
 - 25 yrs based on PV module life time?
 - End of 35 years lease period?
 - When project cash flows go negative (when is this?)
 - Duration of the PPA?

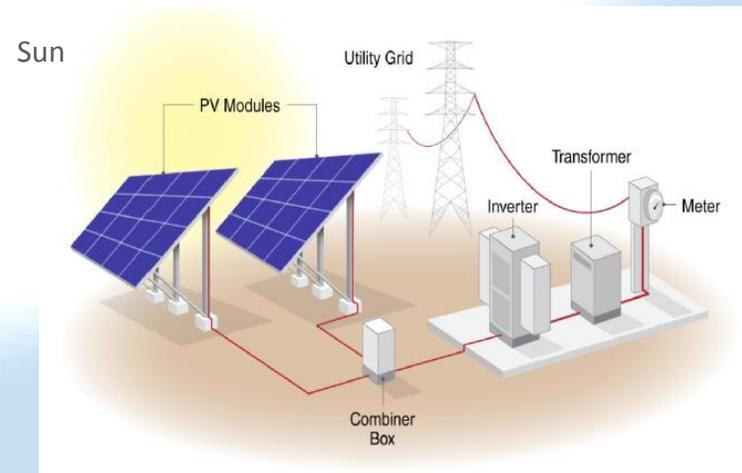
What project life times are generally used in commercial investment or policy decisions?

Plenary discussion (5)

- What uncertainties to take into account under the G-axis?

The G axis in the UNFC designates the level of confidence in the geological knowledge (i.e. the energy source) and potential recoverability (i.e. the conversion) of the quantities

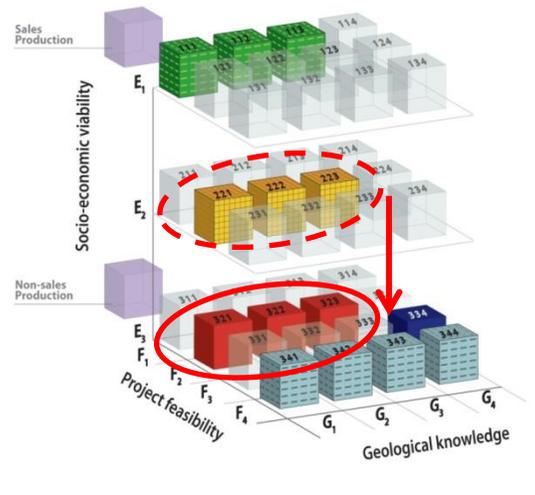
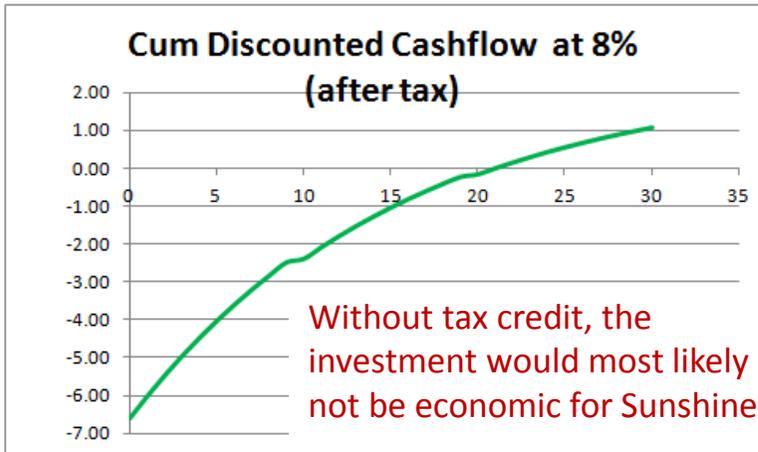
- **Uncertainty in the 20-30 yr forecast due to possible variations in solar intensity at the project location?**
- Uncertainty in actual PV and inversion System Efficiency?
- Wind speed variations that may impact the electricity generation (trackers in stow position)?



Plenary discussion (6)

Just after completing the feasibility study, the federal government decides that the 45% tax credit for initial investments in renewable energy no longer applies

- How does this decision change the classification of the resources?



E2	Extraction and sale is expected to become economically viable in the foreseeable future.	Extraction and sale has not yet been confirmed to be economic but, on the basis of realistic assumptions of future market conditions, there are reasonable prospects for economic extraction and sale in the foreseeable future.
E3	Extraction and sale is not expected to become economically viable in the foreseeable future or evaluation is at too early a stage to determine economic viability	On the basis of realistic assumptions of future market conditions, it is currently considered that there are not reasonable prospects for economic extraction and sale in the foreseeable future, or, economic viability of extraction cannot yet be determined due to insufficient information (e.g. during the assessment phase). Also included are quantities that are forecast to be converted, but which will not be available for sale.

From E2 to E3

Key topics for applying UNFC-2009 to Renewables

- Project definition vs. “Potentials”
 - Application of (notional) projects for country-based estimates
 - Reference point definition (Bioenergy)
 - Sales/Energy products
 - Time limit/technical cut-off
- G-axis
 - General understanding of level of confidence / uncertainties
 - Application of G4 (Exploration projects)
- “In place” estimates (F4)

Closing discussion

- Drawing from SPE experience, what benefits can the Renewable Energy sector expect from using a common and consistent classification framework?
- Will there be a time when energy companies start reporting “renewable reserves” in their Annual Reports?

Thank You

