

# **“Case Study”**

## **Application of UNFC-2009 to Solar/Wind/Hydro**

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# What will we do in this session?

- Plenary discussion of a fictitious Solar Energy case
- Session Objectives:
  - Trigger plenary discussion: classification may sometimes be subjective!
  - Gather feedback: where are the “rules of application” not clear?
  - Identify critical issues and answer key questions to capture in the commodity specifications, not only for Solar but also for Wind and Hydro

# There are a number of key questions that we would like to have your opinion about

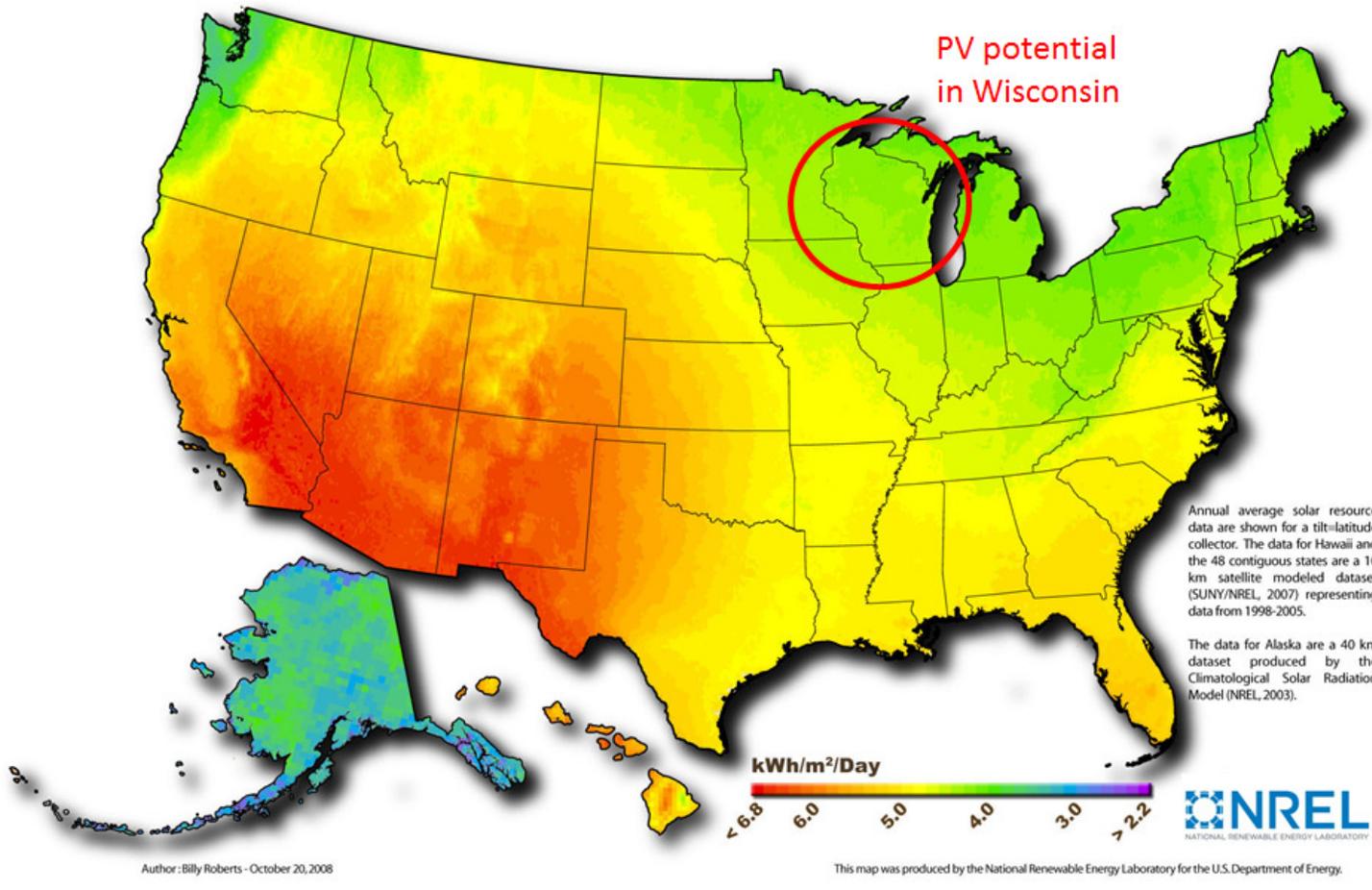
1. Can the UNFC-2009 be usefully applied to Solar projects?
  - Clear criteria for moving along the E- and F-axis?
  - What is a useful project life time to apply?
  - What uncertainties to be taken into account under the G-axis?
  - Is using the UNFC-2009 an opportunity compared to existing methods?
2. Are there any fundamental differences and/or challenges when applying the UNFC-2009 to Wind/Hydro projects?
  - One set of specifications for Solar/Wind/Hydro or three different ones?
3. Are there any natural “owners” for the Solar/Wind/Hydro specifications?

# Case Study: Solar Energy in Wisconsin



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# PV potential in state of Wisconsin



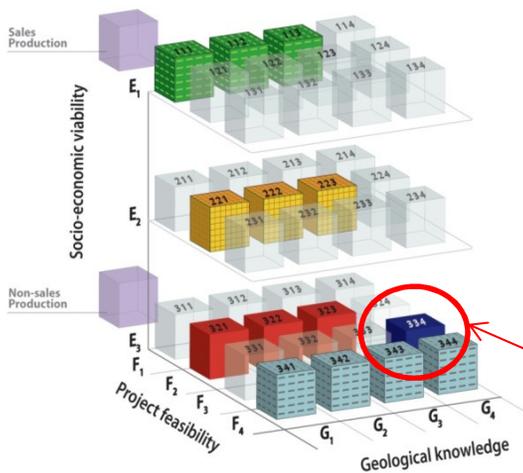
- Estimates of potentials assumed to be unconstrained by grid limitations such as lack of storage or transmission capacity.
- Utility scale PV in rural areas was restricted by excluding federal protected lands, water features and wetlands, and allowing installations only where land surface slopes are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



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# Plenary discussion (1)

- How to classify the estimated PV potential in the Wisconsin?



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.	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.	G4	Estimated quantities associated with a potential Deposit, based primarily on indirect evidence.	Quantities that are estimated during the initial assessment phase are subject to a substantial range of uncertainty as well as a major risk that no development Project or mining operation may subsequently be implemented to extract the estimated quantities. Where a single estimate is provided, it should be the expected outcome but, where possible, a full range of uncertainty in the size of the potential deposit should be documented (e.g. in the form of a probability distribution). In addition, it is recommended that the chance (probability) that the potential deposit will become a deposit of any commercial significance is also documented.
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.	F3	Feasibility of production by a defined development Project or mining operation cannot be evaluated due to limited technical data.	Very preliminary studies (e.g. during the assessment phase), which may be based on a defined (at least in conceptual terms) development Project or mining operation, indicate the need for further data acquisition in order to confirm the existence of a Project in such form, quality and quantity that the feasibility of production can be evaluated.			

## Category E3F3G4 ?

- Resources are cumulative quantities of energy over a certain time period. What time period to use?
- Potential Deposit (G4 = "exploration projects") vs. Known Deposit In-situ measurements required?



# 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:

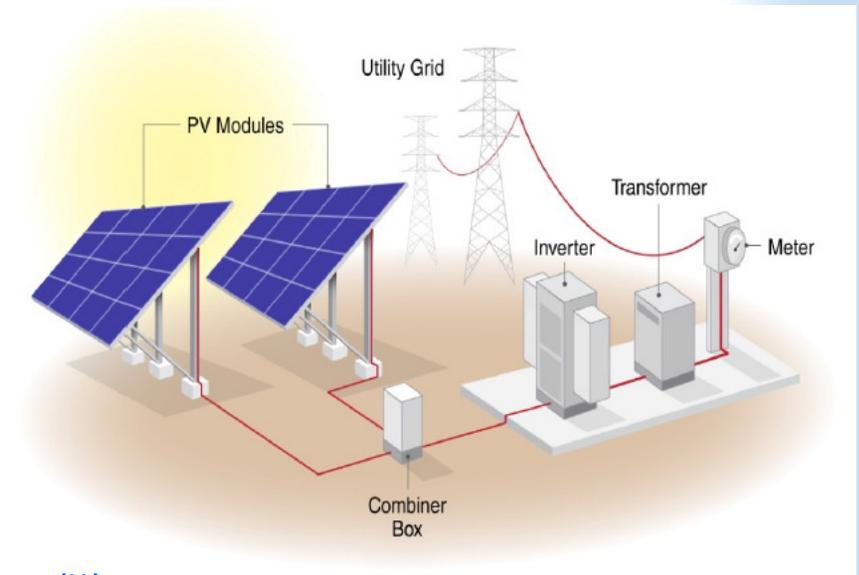
- PV module warranty 25 yrs (guaranteed system performance)
- PV efficiency 0.5% degradation/yr (0.4 – 0.7% range)
- Inverter warranty 10 yrs, two replacements in project
- Project electricity output calculated based on preliminary estimate of average solar radiation
- Still awaiting completion of Solar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



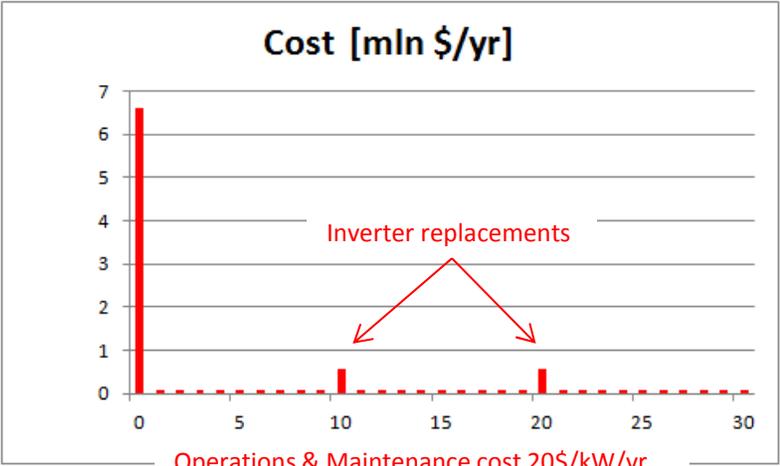
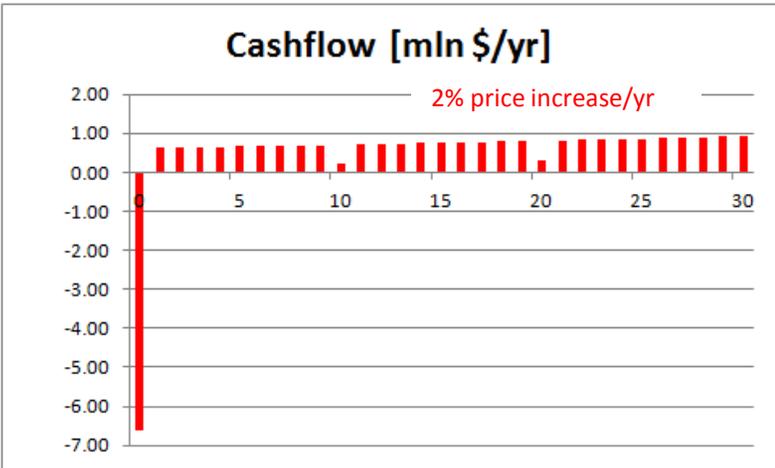
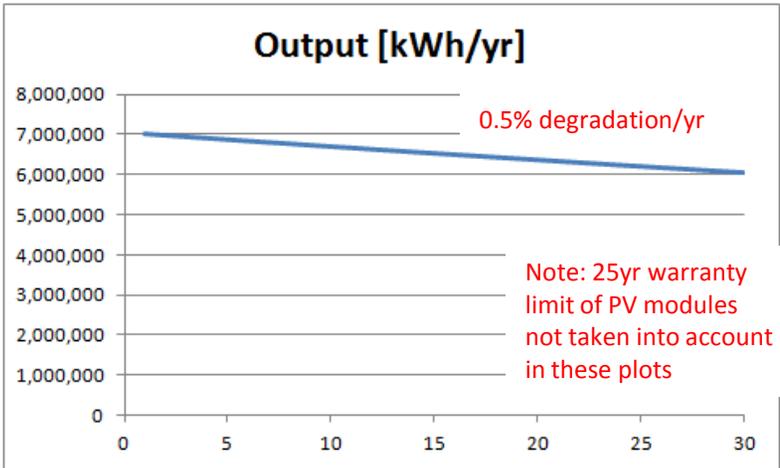
## Permitting:

- 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

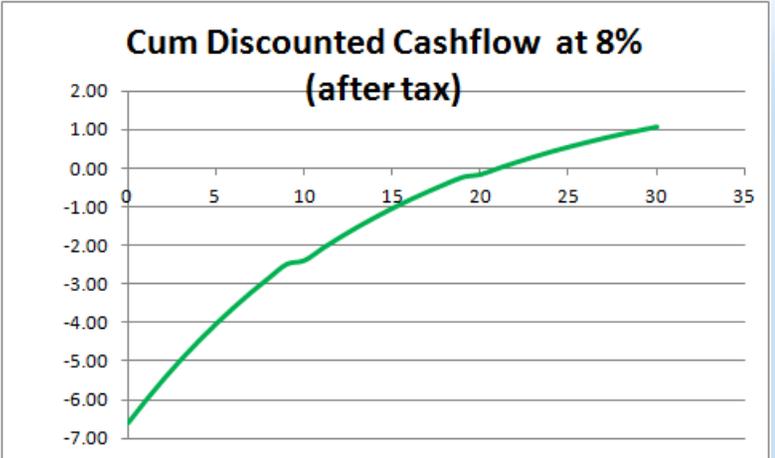


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# Solar Energy Project: Helios (2)

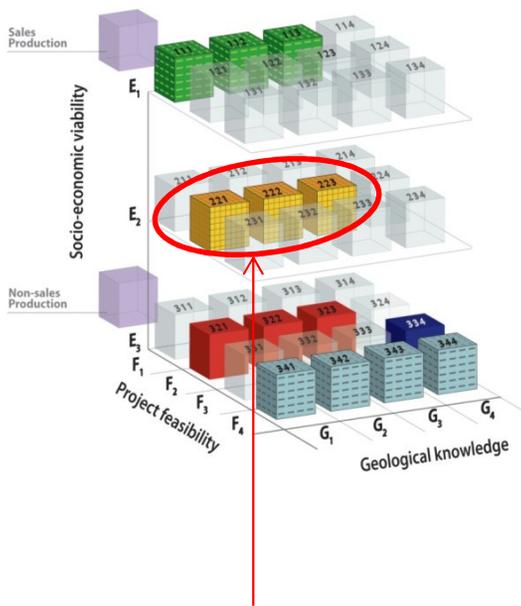


Operations & Maintenance cost 20\$/kW/yr is minor compared to initial investment



# Plenary discussion (2)

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



Category E2F2?  
With associated range in level of confidence (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 (3)

- 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?

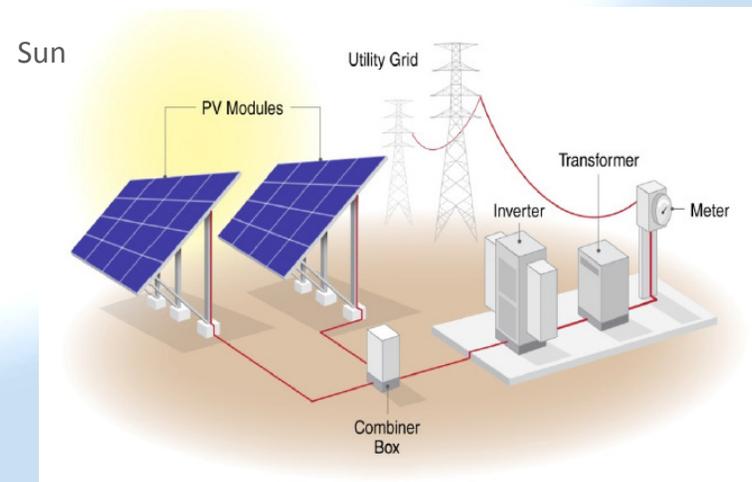
What project life times are generally used in commercial investment or policy decisions?

# Plenary discussion (4)

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

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

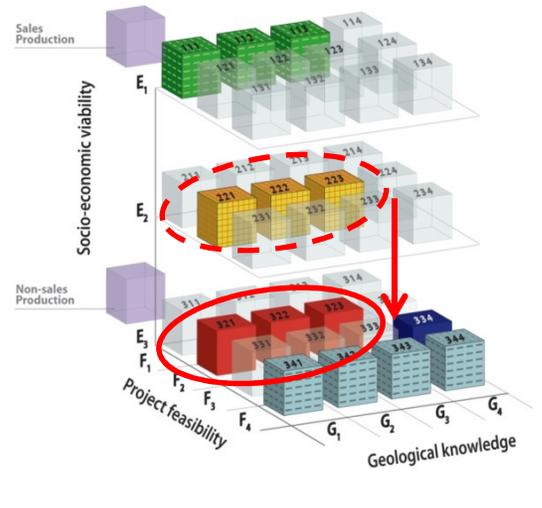
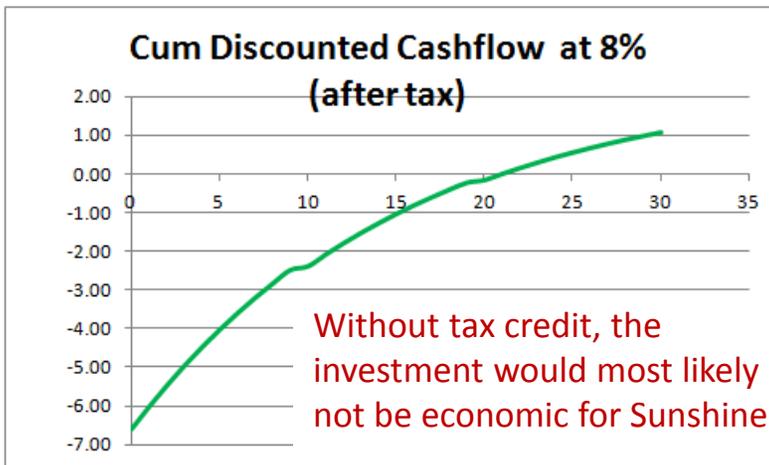
- Uncertainty in the 20-30 yr forecast due to possible variations in solar intensity at the project location?
- Uncertainty in actual PV and inversion System Efficiency?
- Wind speed variations that may impact the electricity generation (trackers in stow position)?
- ...



# Plenary discussion (5)

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?



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From E2 to E3

# Plenary discussion (6)

Are there any key differences for wind or hydro?

- Very long project life times for **hydro-electricity** (100+ yrs). What would be a sensible life time to use for estimating the resource quantities?
- **Wind** turbine parts are generally designed for circa 20 yrs. Following that lifespan, the turbines are generally replaced by new, more efficient, ones. Should this replacement be classified as a *new project*?
- What are the key uncertainties for wind/hydro that should be captured under the G-axis?
- Are there any fundamental differences between solar and wind/hydro that should be taken into account in energy resource classification using the UNFC?

# Key questions (recap)

1. Can the UNFC-2009 be usefully applied to Solar projects?
  - Clear criteria for moving along the E- and F-axis?
  - What is a useful project life time to apply?
  - What uncertainties to be taken into account under the G-axis?
  - Is using the UNFC-2009 an opportunity compared to existing methods?
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