Renewable Energy: Underwriting and engineering assessment of Wind Farms and Solar Plants

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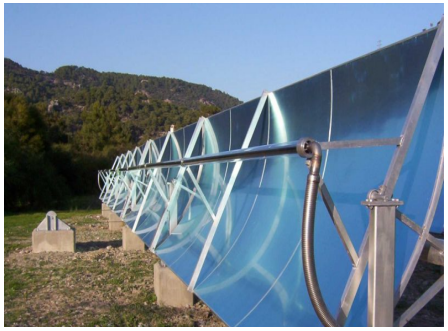
AIG

ACE insured.

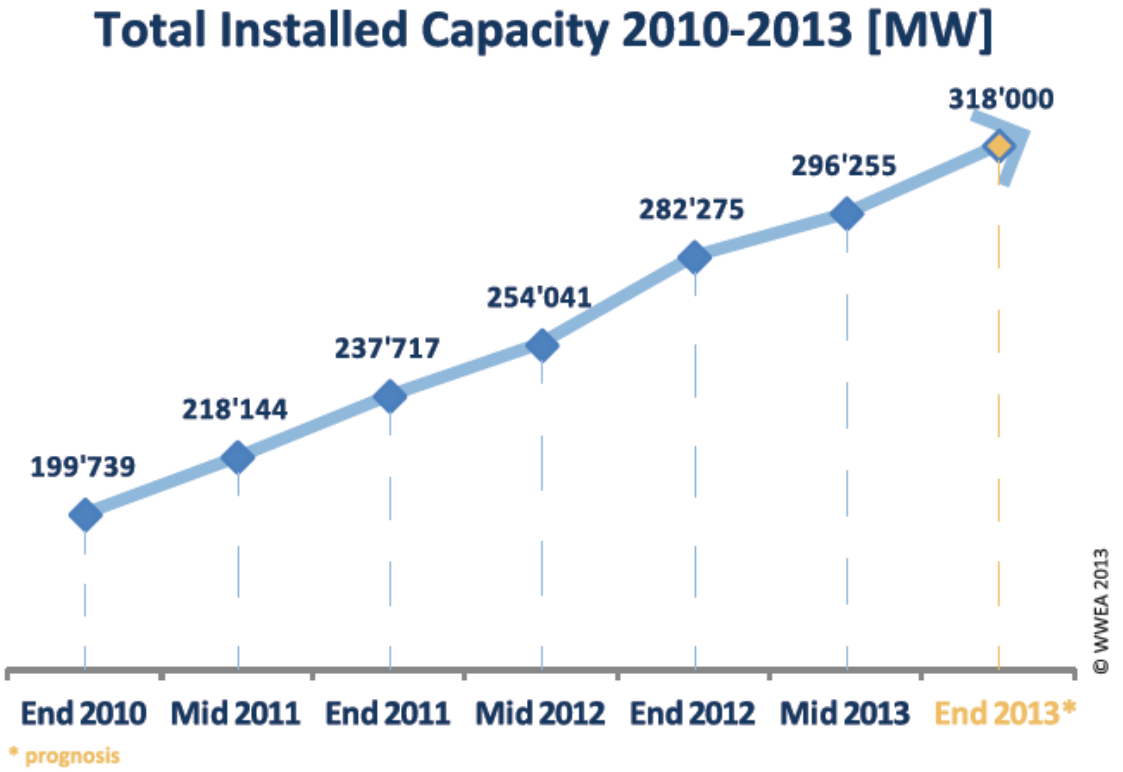
Renewable Energy

- Wind power
- Solar power
- Geothermal energy
- Hydropower
- Biomass
- Biogas
- Waste to energy



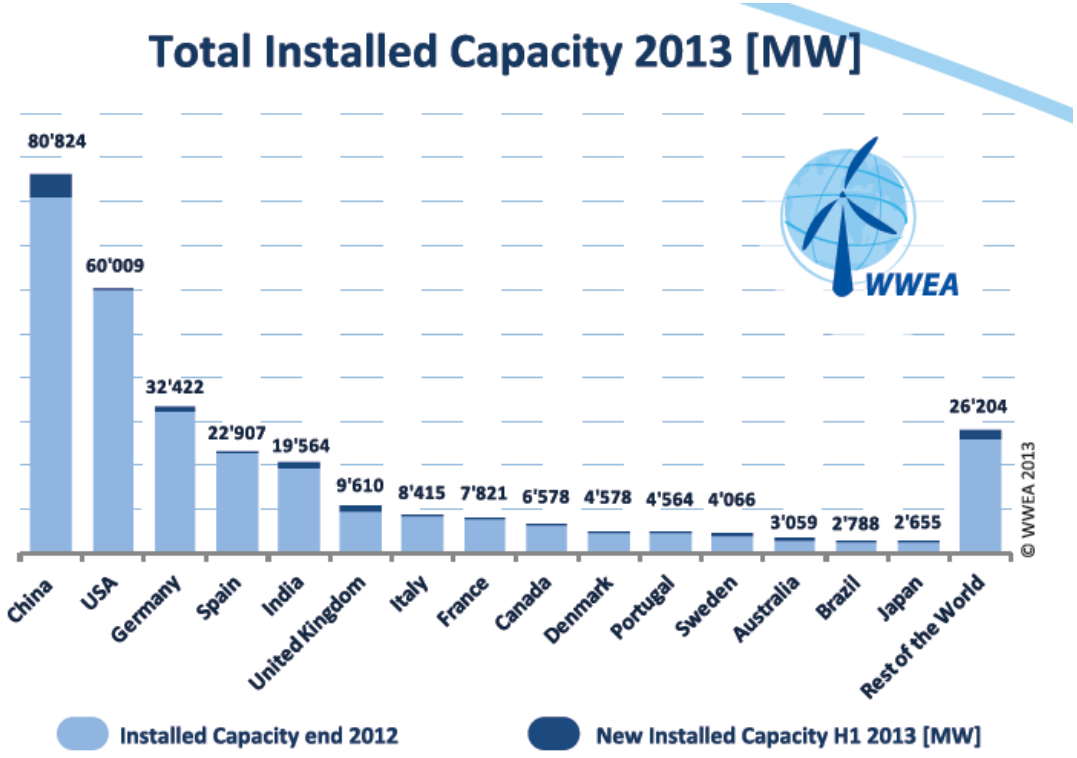
Wind Industry

- Worldwide wind capacity has reached 296 GW, 318 GW expected for full year (2013)
- 14 GW of new installations in the 1H13 after 16.5 GW in 2013
- 5 countries (USA / China / Germany / Spain / India) represents 73% of the global wind capacity



Wind Industry

- Top wind Market in 2013: China / UK / India / Germany
- Europe is still the continent with the largest capacity.
- Top 2 European producer : Germany and Spain
- In 2013, China accounted for 39% of the total new wind capacity



Solar and Wind Industry

Position	Country	Total Capacity by June 2013 [MW]	Added Capacity first half 2013 [MW]	Total Capacity end 2012 [MW]	Added Capacity first half 2012 [MW]	Total Capacity end 2011 [MW]	Added Capacity first half 2011 [MW]	Total Capacity end 2010 [MW]
1	China	80'824	5'500	75'324	5'410	62'364	8'000	44'733
2	USA	60'009	1,6	60'007	2'883	46'919	2'252	40'180
3	Germany	32'422	1'143	31'308	941	29'075	766	27'215
4	Spain	22'907	122	22'785	414	21'673	480	20'676
5	India	19'564	1'243	18'321	1'471	15'880	1'480	13'065
6	United Kingdom	9'610	1'331	8'228	822	6'018	504	5'203
7	Italy	8'415	273	8'152	320	6'877	460	5'797
8	France	7'821	198	7'623	650	6'640	400	5'660
9	Canada	6'578	377	6'201	246	5'265	603	4'008
10	Denmark	4'578	416	4'162	56	3'927	-	3'734
11	Portugal	4'564	22	4'542	19	4'379	260	3'702
12	Sweden	4'066	526	3'743	-	2'798	-	2'052
13	Australia	3'059	475	2'584	-	2'226	-	1'880
14	Brazil	2'788	281	2'507	118	1'429	-	930
15	Japan	2'655	41	2'614	-	2'501	-	2'304
	Rest of the World	26'204	2'030	24'174	3'026*	18'778	3'200*	15'805
	Total	296'255	13'980	282'275	16'376	237'717	18'405	199'739

* includes (-)

Due diligence for Wind/ Solar Plant – Insured's Perspective

Energy Yield Assessment / Technical Expertise

- Solar irradiation assessment/ wind expertise
- Other expertise necessary for the permitting process (e.g. environmental impact assessment etc.)

Permits

- Watertight permits for construction / operation / grid connection
- Timely achievement of permits

Tariff / Grid Connection

- Confirmation of grid connection from local grid operator.
- Feed-in tariff regime or limited exposure to merchant risk
- Tenor of tariff drive maximum tenor financing available

We recommend the Insurance Industry is involved early on in the due diligence process to advise on the above parameters

Due diligence for Wind/ Solar Plant – Insured's Perspective

Construction

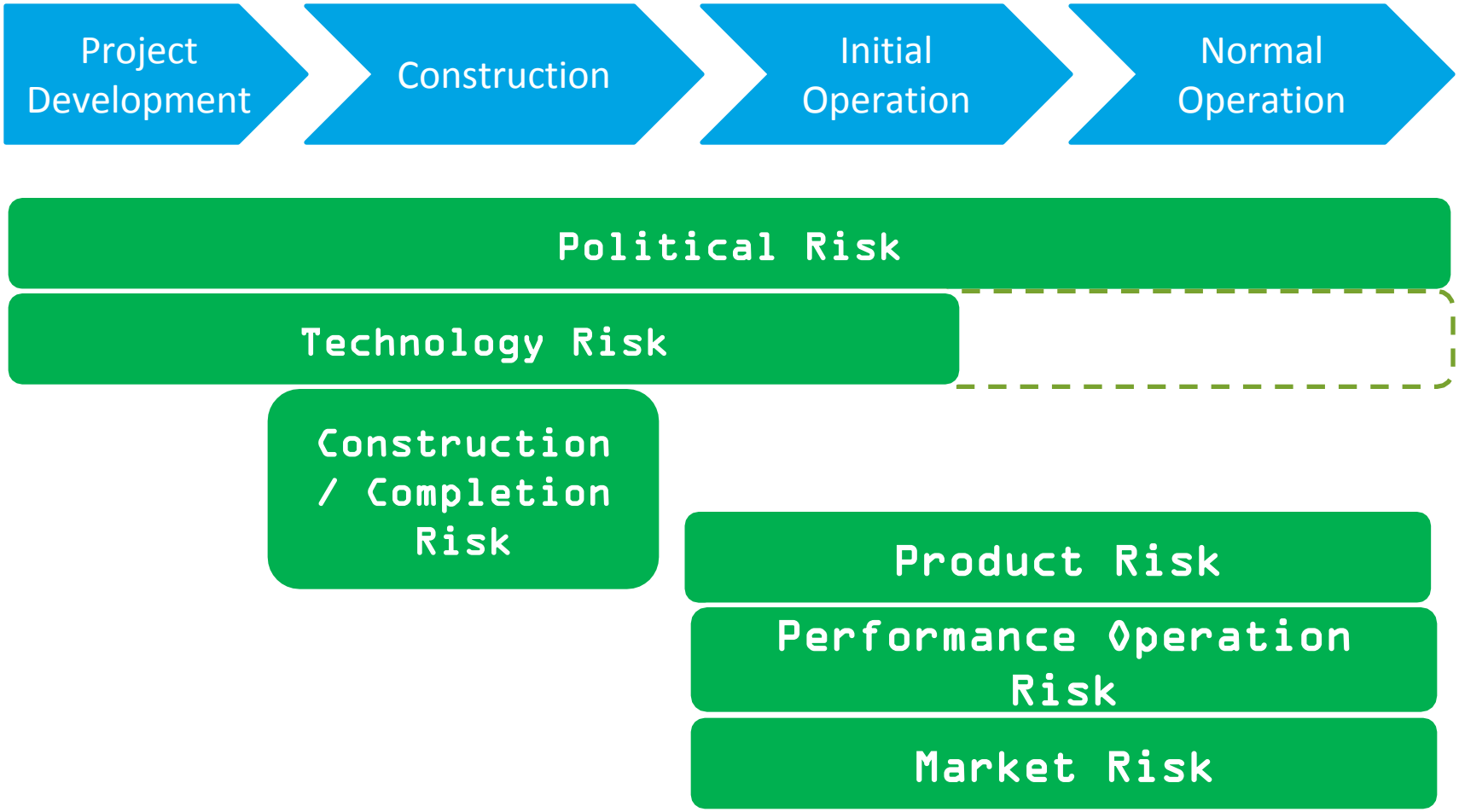
-Use of proven technology / equipment from experienced suppliers
- EPC guarantees to cover delays and/or cost overruns

O&M

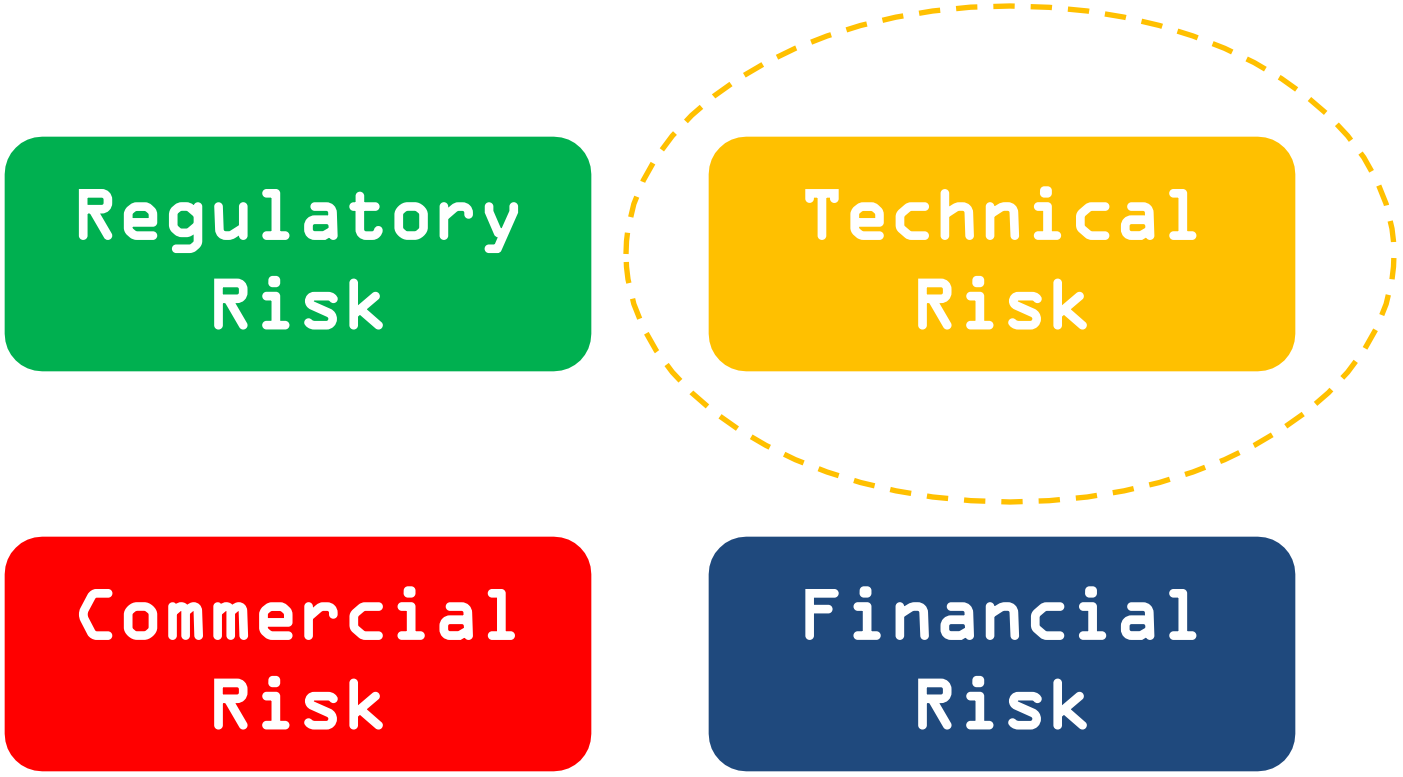
- O&M contract with minimum availability guarantee
- Linkage of O&M fee to revenues
- Availability of appropriate insurance

We recommend the Insurance Industry is involved early on in the due diligence process to advise on the above parameters

Risk profile from the Insured perspective



Key risks of Renewable Projects



Solar and Wind Industry

Both Solar and Wind Industry offers the same Risk Management issues to insurers with a few exceptions. Overall compared to other Power risks these have been looked at less favorably due to:

- Lack of numbers of projects means few insurers have experience in this technology.

- Historically there have been issues with technology – Wind Farms suffered from generator failures and failures in support structures (lattice) / Solar have suffered from design flaws.

- Large values but lower PML's mean some insurers have targeted these risks and achieved a sizeable market share.

- A limited operating environment limits the numbers. Also tied to this is the large footprint needed to establish a meaningful plant.

Construction Risk

Risk Taker	Supplier	Plant Operator	Sponsor	Insurer

Risk	Activity	Risk Mitigation
Natural Catastrophes	Assessment of Seismic Activity / Flooding exposure Lightning Protection / Wind Assessment	Build to relevant codes and Ensure design is appropriate Add in protections (Berms/Barriers), Lightning Poles, breakers, structural integrity
Technology	Proven Technology / No Prototype (equipment defects / performance / financial strength of supplies)	Track record of at least 8,000 trouble free hours / # of units Proven Design Manufacturer Support by manufacturer (LTSA)
Suppliers / Manufacturers	Warranties Financial strength	In Business for a long time Experts in field Open and transparent dialogue with insurers /insureds

Construction Risk

Risk Taker | Supplier | Plant Operator | Sponsor | Insurer

Risk	Activity	Risk Mitigation
Geology & Environment	Soil Investigation Report EQ and Flood Assessments Dust/Atmospheric Conditions	Full assessment of all environmental conditions - Proof no Sinkhole/Flood/Dust/Freezing conditions will affect build
Contractor / Sub -Contractor	Prior Builds of similar plants. Operating in similar environment in the past Labor Skills /Risk Management/Site Management	Has Contractor/Sub-Contractor done this before/if so where and degree of success Contractors relationship to OEM etc.
Construction / Design	Transportation/Access Availability of resources Fire protection	Is the design and implementation of the construction contract robust and have all risk issues been taken into consideration
Business Income	Understanding of Revenue/Profits Flow Risk Management / Financed Project	The earnings (BI or DSU/ALOP) at this stage are crucial. Does the insured know the full effects of the Contingent Coverage

Operational Risk

Risk Taker | Supplier | Plant Operator | Sponsor | Insurer

Risk	Activity	Risk Mitigation
Catastrophes	Contingency Plan for Flooding/Fire/EQ/Wind etc. In place plan involving training and remedial action	Can the insured prevent flooding/fire losses or reduce the effects of Wind/EQ losses through DRP
Technology	The equipment is fully supported by O&M and the operators are aware of all risks involved with the Machinery. Risk control measures are trained for and responded to	Operators/Maintenance teams trained and capable of running and maintaining the plant IAW manufacturers standards. Supplies/Techniques/Risk Control
Suppliers / Manufacturers	Warranties LTSA Financial Strength	Fully supported program by OEM and other suppliers. LTSA and parts contract. No obsolete equipment

Operational Risk

Risk Taker	Supplier	Plant Operator	Sponsor	Insurer

Risk	Activity	Risk Mitigation
Environment	Machinery and Plant are designed for operating environment	Filters regularly changed (dust), chemicals in atmosphere monitored/general upkeep of all plant and buildings - in code
Operator (owner contractor)	Training and experience in plant Operations. Labor Skills /Risk Management/Site Management/Maintenance/DRP	Does the O&M/Owner employees know the plant and equipment operational parameters - Risk Control/Disaster Control/Maintenance, etc
Procedures	Transportation/Access Availability of resources Fire protection	Is the design and implementation of the operational regime robust and have all risk issues been taken into consideration
Business Income	Understanding of Revenue/Profits Flow Risk Management / Financed Project	The earnings (BI) at this stage are crucial. Does the insured know the full effects of the Contingent Coverage

Operational Risk

NAT CAT Controls and Considerations

EQ Design caters for the level of Earthquake resident in that area

Wind Turbines – Foundation and Mounting are reinforced
Sufficient resilience built into the turbine/generator
Disconnects from electrical (loading) if EQ detected
Prefer separation between units equal to height plus

Solar - Foundation and mountings reinforced
Sufficient resilience built into mirrors (shock resistant)
Towers (if designed) are reinforced
Disconnects from grid (loading)
Liquid spills (oil/brine) are contained or not able to cause more damage

Operational Risk

Windstorm

Design caters for the level of Earthquake resident in that area

Wind Turbines –	Units are disconnected during storm (rotors locked or in idle depending on manufacturers recommendations) Sufficient resilience built into the turbine/generator Prefer separation between units equal to height plus No lattice mounting – solid only
Solar -	Foundation and mountings reinforced Sufficient resilience built into mirrors (shock resistant) Towers (if designed) are reinforced Disconnects from grid (loading) Police area for movable objects (missile hazard)


Daily Mail, Monday, October 28, 2013
VON
Twisted and broken: A huge wind turbine lies destroyed in a field near Teignmouth after blowing over in severe winds

Operational Risk

Flood

Design caters for the level of Flooding predicted in that area

Wind Turbines –	Units are disconnected during flooding Sufficient protections for the Transformers/Substation
Solar -	Not advisable to build in known flood area Foundation and mountings reinforced Sufficient resilience built into mirrors (shock resistant) Sufficient protections for the Transformers/Substation

Operational Risk

Lightning and Hail

Assessment of the Lightning/Hail Exposure

Wind Turbines –	Arrestors/Grounding/Breakers on Transformers & Substation – Materials (non-conducting – Blades) Static Guarding Hail less of a threat but care taken re exposed items
Solar -	Same Arrestors/Grounding/Breakers for Lightning as above. Hail a significant threat and avoidance of known high hail areas is recommended. Mirrors significantly exposed

Operational Risk

Fire and Other Perils

- Fire Protections in Place and Operational
- Local Fire Departments (& on site response team) are involved in emergency response actions and plans
- Sprinkler/CO2/Suppressant on unattended locations (Wind) transformer/switch rooms
- Alarms (local/remote) for smoke and IR detection in enclosed rooms and critical areas
- IR scanning of critical electrical components / Megga Testing of cables
- Stack temperature alarm on any economizer/outlet of the boilers (Solar Tower)

Operational Risk

Mechanical and Electrical

- Oil (Lube and Cooling) analysis (Viscosity/DGA/Contaminants) on Turbine/Gen/Transformer
- IR scanning of critical electrical components / Megga Testing of cables
- Turbine/Generator – Vibration/Overspeed/High and Low L/O trips (Solar and Wind)
- Operators and Maintenance Staff – Qualified by OEM
- Spares – Sufficient and critical use spares to reduce downtimes (mirrors/boiler tubes/piping and materials) / (blades/turbine/generator)
- LTSA / Spares agreement

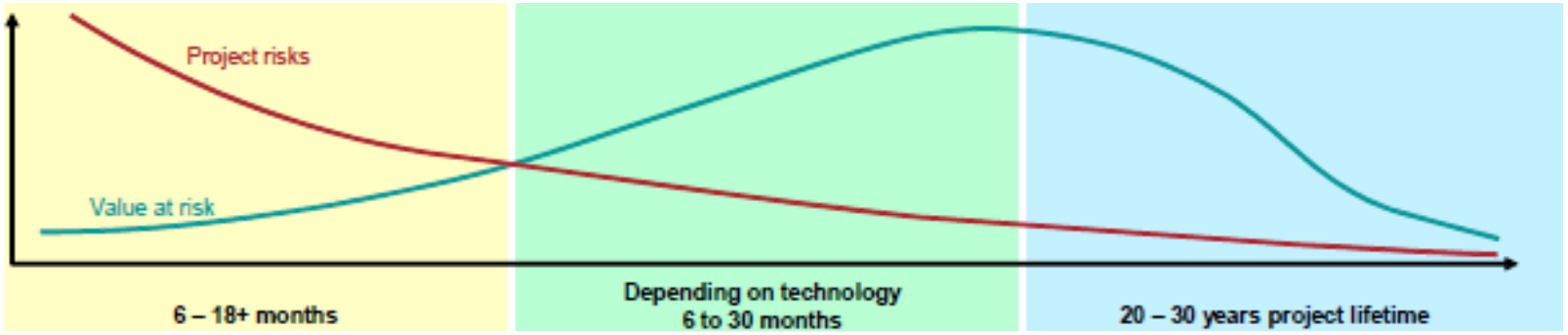
Operational Risk

Business Interruption

- Owner/Operator understands the revenue flow and expense base
- Review of BI potentials based on environmental conditions (Wind/Solar)
- PPA –There is no guarantee the wind will blow enough or the sun will shine enough to ensure adequate revenue is generated – Do not overcommit
- Most Renewable Plants do not make money despite not having to purchase a fuel source
- Therefore is insurance a Profits Based Coverage or a Revenue Based Coverage? Is it worth
- Insuring profits/revenue over and above Standing Charges?

Project Cycle – Risks Summary

Developmental	Construction	Operation



Delayed / denied permits Land rights Regulatory uncertainty	Construction delays Costs overrun Contractors performance Manufacturers delays Financing Tariff changes Grid connection	Defects / Material deterioration Spares O&M Vandalism Regulatory changes Financing

Overall Risks

Summary - Underwriting Considerations

- Technology is proven
- Geographical Risks (NAT CAT) are controlled
- Operators are capable
- Replacements are available
- Risk Management is in place and well thought out
- Exposures are understood and controlled