

Vulnerability–Adaptation– Energy Resilience (VAR):

Indicators as a way of improving
communication on energy systems
vulnerability, resilience and adaptation to
climate change

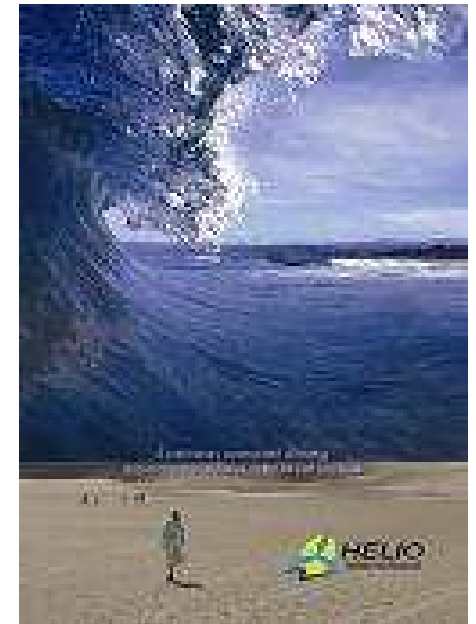
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NATO Advanced Research Workshop:
Weather/Climate Risk Management for the Energy Sector
S. Maria di Leuca (Lecce, Italy), 6 - 10 October 2008



What is HELIO?

- Non-profit, based in Paris, France
- It has:
 - a small secretariat
 - an independent, international network of leading of leading energy analysts
- It works on ecodevelopment and
- climate stabilisation/energy issues
 - SEW report series (since 1997)
 - 2006: *The Ultimate Challenge*
 - 2007 report
 - *A preliminary assessment of energy and ecosystem resilience in ten African countries*





Development of Indicators

- Selection of criteria for each aspect of ecocodevelopment with stakeholders input
- Choice of indicators which are:
 - meaningful
 - relevant to the local context
 - specific, clear and simple
 - measurable; monitorable
 - policy oriented
- Validation and local pilot testing



Policy Pre-conditions

- Analysis of the local context
- Study of local policies and trends
- Impacts of climate change to be taken into account
 - need for adaptation as well as mitigation measures



Assessing the Sustainability of Climate Projects

- 1999: Presentation of a matrix to screen MDP projects at COP5
- Creation of SouthSouthNorth (SSN)
- Matrix SSN
 - eligibility tests (with thresholds)
 - additionnality filters
 - indicators for viability and assessment
 - feasibility indicators: ranking; selection
 - → creation of the Gold Standard (COP9)



Other Quantified Assessments by HELIO International

- Project VAR: *Assessing the vulnerability adaptation and resilience of energy systems in ten African countries*
 - presentation and methodological workshop in Bali (COP13)
- Project MEDRES with ADEME: *Assessing the impact of renewable energy electrification in rural regions of the Southern Mediterranean*



Weather/Climate Risk Management: Energy sector

- Energy systems are both the **key** tool and the **Achille's heel** of our modern societies
- In unstable times / wars, they are a favorite target and require special protection
- Unconsciously humankind has been at war with its own environment for a long time. Large energy installations have been a major contributor to:
 - destruction of habitats (biodiversity)
 - soil degradation and loss (desertification, nuclear and other wastelands)
 - air and water pollution
 - disruptions of natural cycles (carbon) and genetic patrimony
 - ...

Weather/Climate Risk Management: Energy sector

Now nature retaliates visibly and in no uncertain terms to preserve its own balance...





Weather/Climate Risk Management: Energy sector

- Interference with the carbon cycle and resultant greenhouse effect had been suspected early XIXth century by Joseph Fourier and was denounced early XXth by Svante Arrhenius
- The first scientific conference on the climate took place in 1988 in Toronto. The UNFCCC was established and the IPCC shortly after
- The **mitigation** approach adopted by industrialised countries, didn't lower our global carbon budget
- Time has come to **adapt**. Humankind has definitively lost the upper hand.
- We need better tools to measure the vulnerability of energy systems and improve their resilience to climate perturbations



Climate-proofing Energy Supply Systems

- But the period of denial isn't over...
 - war-oriented decisions are still being made and financed (by IFIs in particular)
 - energy plants are still creating major externalities which are increasing the **ecological debt** that we have started repaying unwittingly with climate change
- And those who pay the most are also the poorest
- We have to communicate to decision-makers in clear/simple terms, ie. using indicators that:
 - identify the vulnerability of existing energy systems
 - select resilient systems for adaptation strategies
 - implement specific capacity and institution-building measures

Vulnerability to Climate Change

| Threats | Impacts: environmental | Impacts: human |
|---|--|---|
| <ul style="list-style-type: none">■ sun / heat■ precipitations■ wind speed■ glacier / ice cover■ ecosystem modification | <ul style="list-style-type: none">■ drought■ heat waves■ increase in cloud cover■ flooding■ landslide/earthquake■ siltation■ sea-level rise■ salinisation■ desertification■ storms/cyclones■ loss of biodiversity■ changes in biomass■ species migration | <ul style="list-style-type: none">■ disease/epidemics■ famine■ population displacement■ livelihoods threatened■ humans rights and justice |



Indicators of Vulnerability: Transmission systems

- VT1: Length of above-ground transmission lines (km)

Decentralised systems are much less vulnerable to failures in the transmission systems than centralised ones



Indicators of Vulnerability: Wind systems

- VW1: Number of wind turbines at less than 1 m above sea level
- VW2: Projected change of average windspeed in the next 20 years based on regional climate models (%)
- VW3: Projected share of windspeeds over 25 m/s in average annual windspeed 20 years from now based on regional climate models
- VW4: Projected likelihood of a storm with gusts over 70 m/s reaching areas where wind turbines are located (% over 20 years)

VW4 should be based on past experiences coupled with regional climate models



Indicators of Vulnerability: Solar systems

- VS1: Expected temperature increase in the next 20 years (°C)
- VS2: Projected change in cloudiness in the next 20 years based on regional climate models (%)
- VS3: Projected likelihood of a storm with gusts over 70 m/s reaching areas where solar power plants are located (% over 20 years)
VS3 should be based on past experiences coupled with regional climate models

Indicators of Vulnerability: Hydro systems

- VH1: Expected precipitation change in the next 50 years, differentiated by watersheds (%)
If runoff forecasts are available, VH1 should use runoff instead of precipitation.
- VH2: Projected additional runoff due to glacier melting in the next 50 years based on regional climate models, differentiated by watersheds (million m³)
- VH3: Projected flood frequency in the next 50 years (number of floods that would be more intense than a flood currently having a 100 year recurrence time)

Indicators of Vulnerability: Fuel from biomass

- VB1: Probability of temperature increase beyond biological heat tolerance of relevant crop within the next 20 years (%)
- VB2: Expected precipitation change during the growth season in the next 20 years, differentiated by crop regions (%)
- VB3: Projected drought frequency in the next 20 years (number of droughts that would lead to a reduction of crop yield by more than 20%)
- VB4: Projected flood frequency in the next 20 years (number of floods that would lead to a reduction of crop yield by more than 20%)
- VB5: Number of biomass power plants located at less than 1 m above sea level and within the area that would be flooded by a flood with a current recurrence period of 100 years

Indicators should be calculated for each crop that generates residues used for energetic purposes



Indicators of Vulnerability: Fuel from mined resources

- VF1: Expected temperature increase of cooling water for thermal power plants within the next 30 years (°C)
- VF2: Expected number of droughts that lead to a capacity decrease of thermal power plants by more than 10% within the next 30 years
- VF3: Number of thermal power plants located at a river fed by glacial melt where the glaciers are likely to vanish in the next 30 years
- VF4: Share of offshore oil and gas installations likely to be hit by a storm of more than 70 m/s gusts within the next 20 years (%)
- VF5: Number of coal mines plants located at less than 1 m above sea level and within the area that would be flooded by a flood with a current recurrence period of 100 years
- VF6: Number of thermal power plants located at less than 1 m above sea level and within the area that would be flooded by a flood with a current recurrence period of 100 years

Implementation Indicators





Implementation Indicators: Monetary capacity

- CM 1: Domestic capital formation (million €/year)
- CM 2: Domestic investment into the energy sector (million €/year)
- CM 3: Domestic investment into renewable energy (million €/year)
- CM 4: Capital of domestic insurance companies (million €)



Implementation Indicators: Technological capacity

- CT 1: Degree of energy supply diversification
- CT 2: Domestic graduation of engineers (100/year)
- CT 3: Domestic engineers specialised in renewable energy technology (100)
- CT 4: Number of domestic companies able to construct renewable energy plants
- CT 5: Availability of hazard maps for droughts
- CT 6: Availability of hazard maps for floods
- CT 7: Availability of coastal maps with a 1 metre altitude contour

Implementation Indicators: Human and administrative capacity

- CH 1: Number of domestic mechanics trained in repairing of renewable energy systems
- CH 2: Number of domestic companies specialised in servicing renewable energy systems
- CH 3: Availability of early warning systems for meteorological extreme events
- CH 4: Existence of plans to react on meteorological extreme events and of mobile repair teams for power plants and transmission infrastructure
- CH 5: Existence of siting guidelines for new power plants taking into account climate change impacts
- CH 6: Existence of guidelines for power plant robustness with regards to storms

Indicators of Improved Resilience



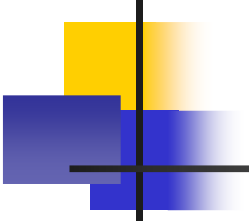
Improve Resilience to Climate-proof our Energy Systems

- An energy system can be made resilient in several ways:
 - good siting
 - diversification
 - better design and manufacturing
 - closeness of supply and demand → decentralisation
- But it must first be part of a genuine strategy of ecodevelopment:
 - devised and adopted by citizens living in the area
 - environmentally sane
 - economically sustainable



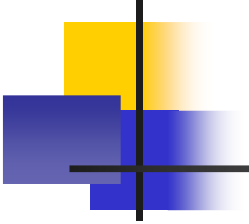
Indicators of Increased Resilience: Wind systems

- EW 1: Domestic regulation for storm proof wind power plants is enacted and enforced.
 - the regulation ensures that during the technical lifetime of the wind turbines, they withstand the highest windspeed that is likely to occur in the area during that period
- EW 2: A siting map for wind power plants has been developed taking into account projected changes in windspeeds, floodplains and area impacted by sea level rise
- EW3: An insurer offers an insurance against wind turbine storm damage



Indicators of Increased Resilience: Solar systems

- ES1: A siting map for solar power plants has been developed taking into account projected changes in cloud cover
- ES2: Domestic regulation for storm proof concentrating solar power plants has been enacted, which ensures that during the technical lifetime of the CSP plant it withstands the highest windspeed that is likely to occur in the area during that period



Indicators of Increased Resilience: Hydro systems

- EH1: All new dams are equipped with desilting gates
- EH2: It has been mapped which hydro plants should expand their capacity due to projected improvements in river flow regime
- EH3: A siting map for new hydro power plants has been developed taking into account projected changes in river flow
- EH4: A plan for optimised operation of hydro plants under projected flow regimes has been developed

Indicators of Increased Resilience: Biomass systems

- EB1: An irrigation masterplan has been developed taking into account projected changes in drought occurrence
- EB2: A research budget for heat and drought resistant crops has been allocated and a realistic plan for this research has been drafted (for small countries: participation in CGIAR activities for crop improvement research has been organized)
- EB3: A siting map for biomass power plants has been developed to prevent siting in floodplains and areas impacted by sea-level rise
- EB4: Domestic regulation for storm proof biomass power plants has been enacted, which ensures that during the technical lifetime of the biomass plant it withstands the highest windspeed that is likely to occur in the area during that period

Indicators of Increased Resilience: Mined resources systems

- EM1: A siting map for coal / oil sands / oil shale/uranium mines has been developed taking into account projected flooding and drought-prone areas
- EM 2: Domestic regulation for storm proofing mining operation offshore has been enacted, ensuring that the installations withstand the highest windspeed likely to occur in the area during that period, over its technical lifetime
- EM3: Domestic regulation for siting of thermal power plants at sites with sufficient cooling water availability in the next 50 years has been enacted

Indicators of Increased Resilience: Civic involvement

Energy systems are a strategic good put under the care of citizens and responsible authorities. They require:

- **Balanced energy governance**
 - participatory energy decision-making with accountability
 - public awareness, skills and means (Councils of Users-CUBEs)
 - free and early access to relevant information

- **Integration with ecodevelopment planning and policies**
 - institutional mechanisms, capacities and structures (Agenda 21)
 - sustainable livelihoods to reduce overall vulnerability

- **Preparedness: Organisational capacities and coordination**
 - early warning systems and trained emergency teams
 - collective contingency planning

THANK YOU FOR YOUR ATTENTION!

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