



**The Abdus Salam  
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**Joint ICTP-IAEA Workshop on Vulnerability of Energy Systems to  
Climate Change and Extreme Events**

*19 - 23 April 2010*

**Weather Extremes and Energy Systems: Workshop Introduction and Overview**

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# **Weather Extremes and Energy Systems: Workshop Introduction and Overview**

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**IAEA**

International Atomic Energy Agency

# Overview

- 1. IAEA Mandate and Work**
- 2. CC: Vulnerability, Impacts, Adaptation VIA**
- 3. CC - Weather Extremes - Energy Systems**

# 1. IAEA Mandate and Work

**"Atoms for Peace" to promote safe, secure and peaceful nuclear technologies:**

- **Safety and Security: Nuclear installations**
- **Safeguards and Verification: NPT**
- **Science and Technology - peaceful applications of N science and technology: Health, agriculture, water, ...**
- **Nuclear Energy: Efficient and Safe Use of Nuclear Power → Planning and Economic Studies**

# 1. IAEA Work in Energy Planning

## IAEA Mandate:

- **develop energy planning tools**
- **build capacity for applications**
- **training and technical support**

## For:

- **Energy system modeling**
- **Economic, financial and environmental assessments**
- **Analysis of options for energy strategies**

# 1. IAEA Work in Energy Planning

- **Transfer planning models tailored to developing countries**
- **Transfer data on technologies, resources and economics**
- **Train local experts**
- **Jointly analyze national options**
- **Help establish continuing local expertise**



# 1. IAEA Work in Energy Planning

- **Model for the Analysis of Energy Demand**



- **Model for Energy Supply System Alternatives and their General Environmental impacts**



- **Financial Analysis of Electric Sector Expansion Plans**



- **Simplified Approach for Estimating Impacts of Electricity Generation**



# 1. IAEA Work: Economic Studies

**Exploring issues of broad interest:**

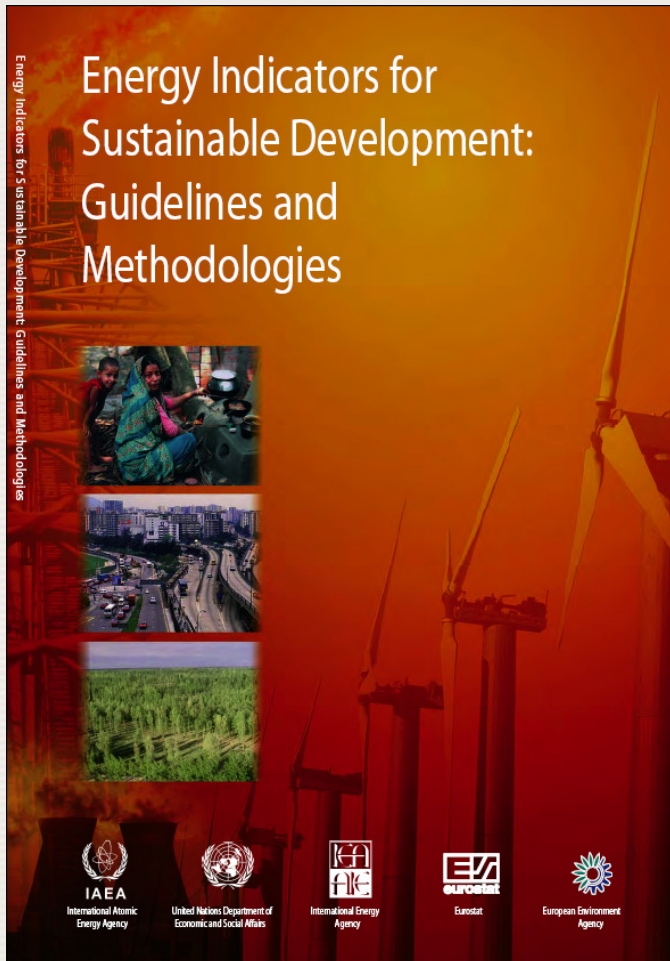
- **Climate change and nuclear power**
- **Nuclear energy and sustainable development**
- **Energy security**

**Developing tools:**

- **Energy Indicators for Sustainable Development  
EISD**



# 1. IAEA Work: Economic Studies - EISD



- Prepared by 5 agencies\*
- 3 Dimensions of SD (economic, social, environment)
- 30 Indicators
- Guidelines, caveats, methodology (data, construction)
- Important now is how to use the EISD
- \*UNDESA, IEA/OECD, IAEA, EUROSTAT, EEA

**Assessing Policy Options for Increasing  
the Use of Renewable Energy for  
Sustainable Development:  
Modelling Energy Scenarios for Ghana**



UNITED NATIONS



Preprint Copy

UN-Energy

**A UN-ENERGY Demonstration  
Study**

**conducted by**

- **Department of Economic and Social Affairs (DESA)**
- **Food and Agriculture Organization (FAO)**
- **International Atomic Energy Agency (IAEA)**
- **United Nations Environment Programme (UNEP)**
- **United Nations Industrial Development Organization (UNIDO)**

**with assistance from the  
Ghana Energy Commission**

# 1. IAEA Work: Economic Studies - UN Energy

Assessing Policy Options for Increasing  
the Use of Renewable Energy for  
Sustainable Development:  
Modelling Energy Scenarios for Sichuan, China



UNITED NATIONS



# 1. Summary IAEA

**IAEA: *not only***

- ***atomic***: SED, 3E analysis, national energy planning – full set of resources and technologies
- ***energy***: nuclear applications in many areas – medicine, agriculture, water mgmt, ...

***Capacity building***: energy planning, 3E analysis – models, methods, indicators, data + training

***UN Energy***: joint projects; case studies: thematic (energy efficiency w/ UNIDO), national (Ghana):  
to demonstrate SED concepts, applicability,  
implementation

## 2. CC: Vulnerability, Impacts, Adaptation VIA

**Adaptation:** *Adjustment* in natural or human systems in response to actual or expected *climatic stimuli* or their *effects*, which *moderates* harm or *exploits* beneficial opportunities (TAR)

**WG II Ch 17:** explored adaptation in the context of vulnerability and adaptive capacity

**Vulnerability – adaptive capacity to CC:**

- V: propensity of human and ecological systems to suffer harm
- AC: ability to respond to stresses imposed as a result of climate change effects

## 2. CC – VIA

**Vulnerability** of a society to climate change is influenced by:

- development
  - physical exposures
  - distribution of resources
  - non-climate stresses
  - social and government institutions
- ➔ V determined by a combination of exposure and response capacity

## 2. CC - VIA

### Adaptation to climate variability + change

Adaptation to [current] climate change is *already* taking place, but on a limited basis

- long history of adaptation to *prevailing* climate and *variability*: crop diversification, flood control, irrigation, air conditioning
- *newly* emerging risks: droughts, heatwaves, hurricanes

## 2. CC - VIA

### Adaptation measures:

Adaptation *considering* [future] climate *change* are being implemented, on a limited basis

- increase water buffer capacity (Tsho Rolpa lake in Nepal: 0.23 km<sup>2</sup> 1957 to 1.65 km<sup>2</sup> 1997)
- snow-making (Alpine ski industry)
- infrastructure (transport, coastal defence)  
== Confederation Bridge (Canada): 13 km mainland to Prince Edward Island; ocean-going vessels 50m clearance → built 1m higher



## 2. CC - VIA

### Adaptation in a broader context:

Adaptation measures are seldom undertaken in response to climate change *alone*

- response to *current extreme* events (heatwaves, cyclones)
- broader *sectoral policies* (water, coastal areas: NL: next 20-30 years major renewal; or - development → upgrade to higher protection: Malaysia)
- many *other* things change: incomes, lifestyles, preferences, technologies → producers adjust

## 2. CC - VIA

### Adaptation costs:

Many adaptations can be implemented at *low cost*, but comprehensive estimates of adaptation costs and benefits are currently lacking

CCIA: from 2\*CO<sub>2</sub> to more sophisticated  
increasing use of scenarios (exposure Us)  
monetary damage estimates fewer  
costing A options or C/BA even less

So far: mainly in OECD regional/project level for  
SLR, Ag, energy, water, infrastructure:

Many low-cost measures, high NPV, no-regret A

## 2. CC - VIA

### Adaptive capacity:

Adaptive capacity is *uneven* across and within societies – *Determinants* (recall vulnerability):

- economic resources (no malaria >3K\$ GDP/c)
  - natural resources
  - human resources
  - institutions (prop.rights, legal, market)
- == also determinants and results of development

So: improve these factors →

develop = will reduce vulnerability to CC

## 2. CC - VIA

### Limits to adaptation:

There are substantial limits and barriers to adaptation

- when factors of adaptive capacity obstructed:

eg: water scarcity – market – ancient w rights

Key: information: adapt to what, how, when

Devg countries: Adapt cap low; impacts severe

+ barriers → need special assistance:

NAPAs: Nat. Adapt. Programmes of Action

## 2. CC - VIA

### Examples – Adaptation initiatives, activities

Sudan – Drought:

Expanded use of traditional rainwater harvesting and water conserving techniques;

building of shelter-belts and wind-breaks to improve resilience of rangelands;

monitoring of the number of grazing animals and cut trees;

set-up of revolving credit funds

## 2. CC - VIA

Examples – Adaptation initiatives, activities

Botswana – Drought:

National government programmes to re-create employment options after drought;

capacity building of local authorities;

assistance to small subsistence farmers to increase crop production

## 2. Summary: CC – VIA

- *Adaptation* to weather/climate: human history
  - Anthropogenic CC: useable old knowledge but also new challenges: magnitudes, rates
  - *Options*: many known but room for innovation (technology, institutions, social organization)
  - *Private* adaptation: market sectors, own interest, profit max, private CBA - but public policies affect e.g. Agriculture: national; EU CAP'13); Trade (Doha)
  - *Public* adaptation: public/club goods; social CBA, Cost-effectiveness (standards, targets)
- Planning A*: consider previous policies/evolving trends

## 3. CC - Weather Extremes - Energy Systems

### Vulnerability of Energy Systems to Climate Change and Extreme Events

#### Motivations

- CC → possible increases in frequency and intensity of extreme weather events
- Energy systems: vulnerable under current climate regime and weather patterns; effort to reduce vulnerability
- IEA: USD 26 trillion investments to provide demand; 10.5 trillion extra to reduce GHG emissions
- IAEA: account for WEs in energy planning



# 3. CC - Weather Extremes - Energy Systems

Phenomenon <sup>a</sup> and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend <sup>b</sup>	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	<i>Very likely<sup>c</sup></i>	<i>Likely<sup>d</sup></i>	<i>Virtually certain<sup>d</sup></i>
Warmer and more frequent hot days and nights over most land areas	<i>Very likely<sup>e</sup></i>	<i>Likely (nights)<sup>d</sup></i>	<i>Virtually certain<sup>d</sup></i>
Warm spells/heat waves. Frequency increases over most land areas	<i>Likely</i>	<i>More likely than not<sup>f</sup></i>	<i>Very likely</i>
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	<i>Likely</i>	<i>More likely than not<sup>f</sup></i>	<i>Very likely</i>
Area affected by droughts increases	<i>Likely in many regions since 1970s</i>	<i>More likely than not</i>	<i>Likely</i>
Intense tropical cyclone activity increases	<i>Likely in some regions since 1970</i>	<i>More likely than not<sup>f</sup></i>	<i>Likely</i>
Increased incidence of extreme high sea level (excludes tsunamis) <sup>g</sup>	<i>Likely</i>	<i>More likely than not<sup>f,h</sup></i>	<i>Likely<sup>i</sup></i>

# 3. CC - Weather Extremes - Energy Systems

Sector/ Extreme	Tempera- -ture	Precipit- -ation	Wind	Tropical cyclones	Floods	Droughts	Coastal storms	Forest + wild fire	Landslides
coal fuel cycle									
oil and gas									
thermal power plants									
hydropower									
nuclear power									
solar energy									
wind power									
electric grid									

# 3. CC - Weather Extremes - Energy Systems

Workshop - commissioned keynotes:

Climate science: CC change → extreme events:  
columns

Energy systems: from coal to grid:

one per row → relevant cells: possible impacts;  
options to adapt / reduce vulnerability

Assessment and integration:

risk assessment tools  
energy planning tools

# 3. CC - Weather Extremes - Energy Systems

Workshop – volunteered contributions:

Specific energy technologies:  
in general or in a region/country

National/regional case studies:  
vulnerability of the energy system: present and future

# 3. CC - Weather Extremes - Energy Systems

Workshop – other presentations:

ICTP overview

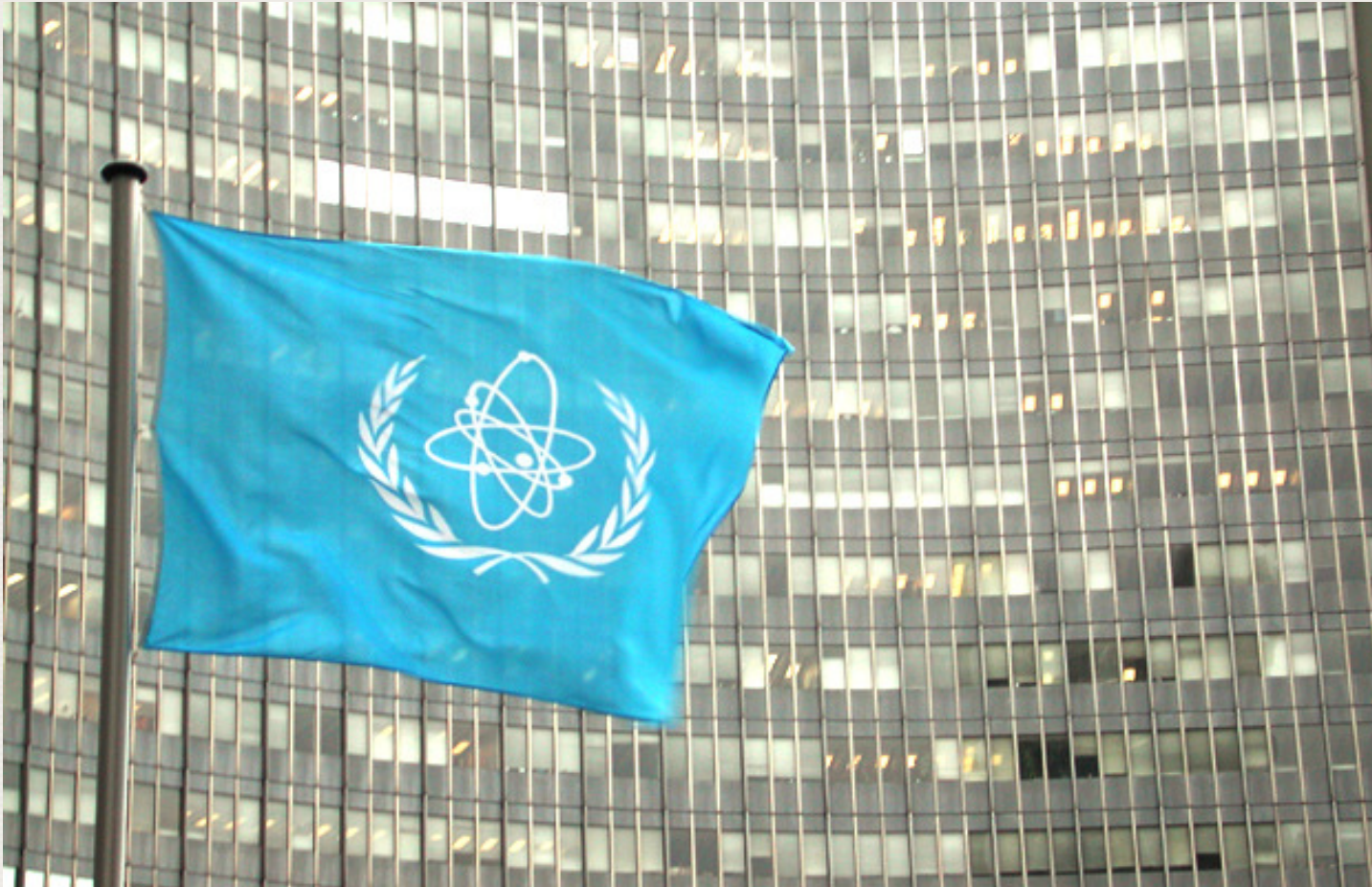
ICTP keynote: Prof Marsili

## 3. CC - Weather Extremes - Energy Systems

Post-workshop activities:

- Select papers for inclusion in publication
- Revise selected papers for peer-review
- Post-review revisions
- Editing, copy-editing
- Submission to publisher

# IAEA



*...atoms for peace.*