Business from technology

Case study – Using the CES risk assessment framework in the biomass and wind power sectors

Conference on Future Climate and Renewable Energy: Impacts, Risks and Adaptation

31 May – 2 June 2010
Oslo, Norway

Jaana Keränen
VTT Technical Research Centre of Finland

Outline

- Background information
- Risk Assessment Framework (RAF)
- Case-studies: biomass & wind power sectors
- Conclusions

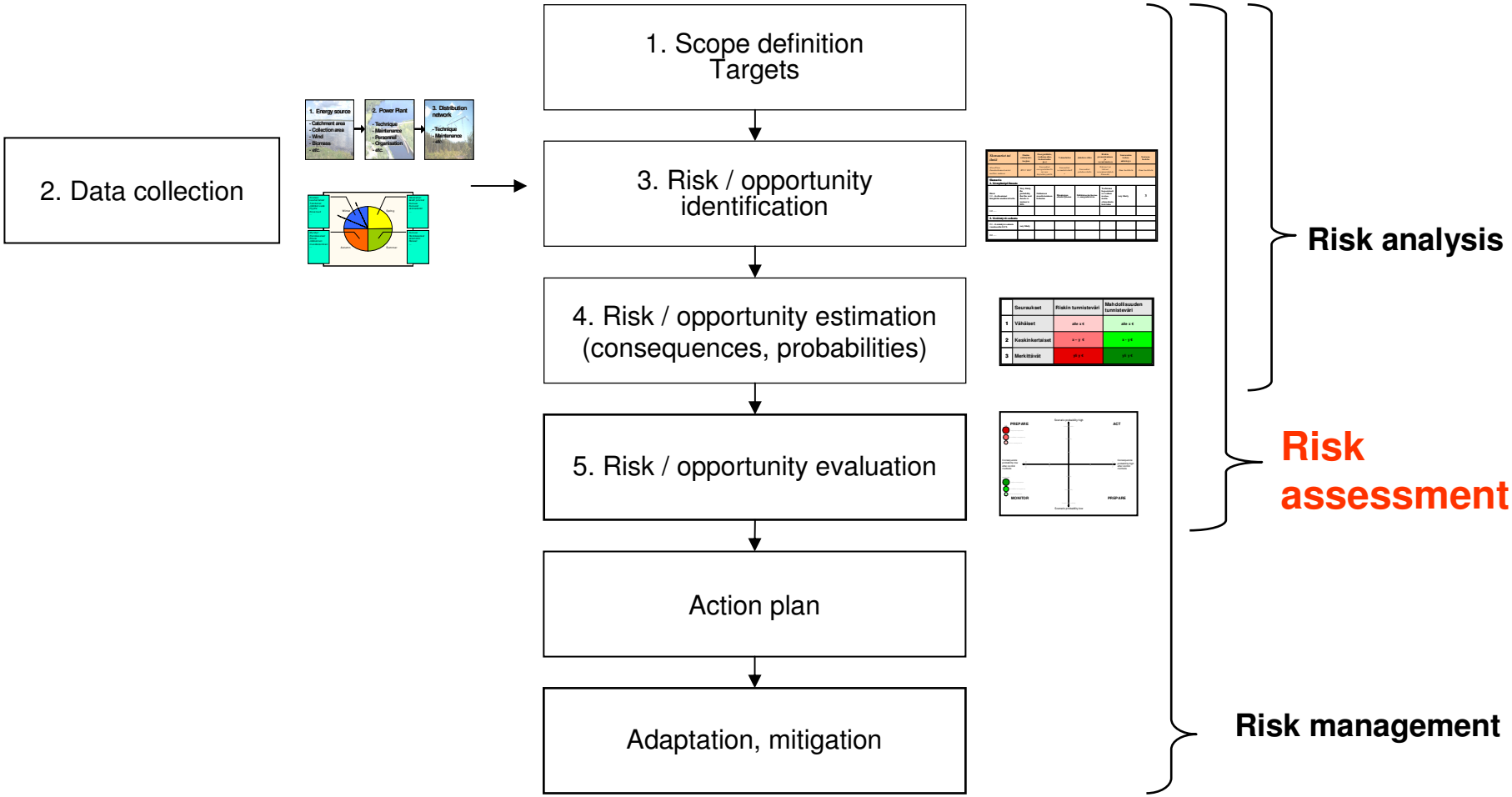
Background

- Part of the Climate and Energy Systems (CES) project
- Develop a practical method for climate change risk assessment for power plants
- Integration of climate scenarios with technical risk assessment traditions (IEC 60300-3-9 2000 Risk analysis of technological systems)
- The risk assessment framework is designed to assist power plants plan their future by identifying and prioritising the risks and possible opportunities associated with climate change
- The suggested risk/opportunity analysis could thus result in concrete proposals for the improvement of the technical or operational performance of power plants

Risk definition

- **Risk definition:** risk is a possible future event, which if it occurs might impact on the ability of an organization to achieve its objectives (Hillson, 2007)
- Risk can also be seen as an opportunity that might be lost if the essential information is not available
- Thus risk can be either negative or positive

Risk assessment framework



Adopted from: IEC 60300-3-9 2000 Risk analysis of technological systems

Principles of the risk assessment work

- In order to help create a common understanding of the possible future developments, the risk assessment framework is best carried out in brainstorming-based sessions

- risks/ opportunities are examined mainly from two perspectives:
  - how risks/ opportunities are connected to the power plants' functions
  - how they occur seasonally

Tools for data collection – Seasonal plan

- An example of the risk/ opportunities seasonal examination in biomass energy case-study

Humidity, mild winter, freezing rain, strong wind, ground frost

•Lack of ground frost or wet soil will hamper wood/reed/canary grass harvesting
•Increased snow-induced forest damage
•Changes in transportation and storage circumstances (humidity, microbes, biomass heat value, etc.)

Storms, heavy rains, ground frost

•Increased biomass moisture will change the transportation and storage conditions
•Increased wind damage

Earlier spring, drought

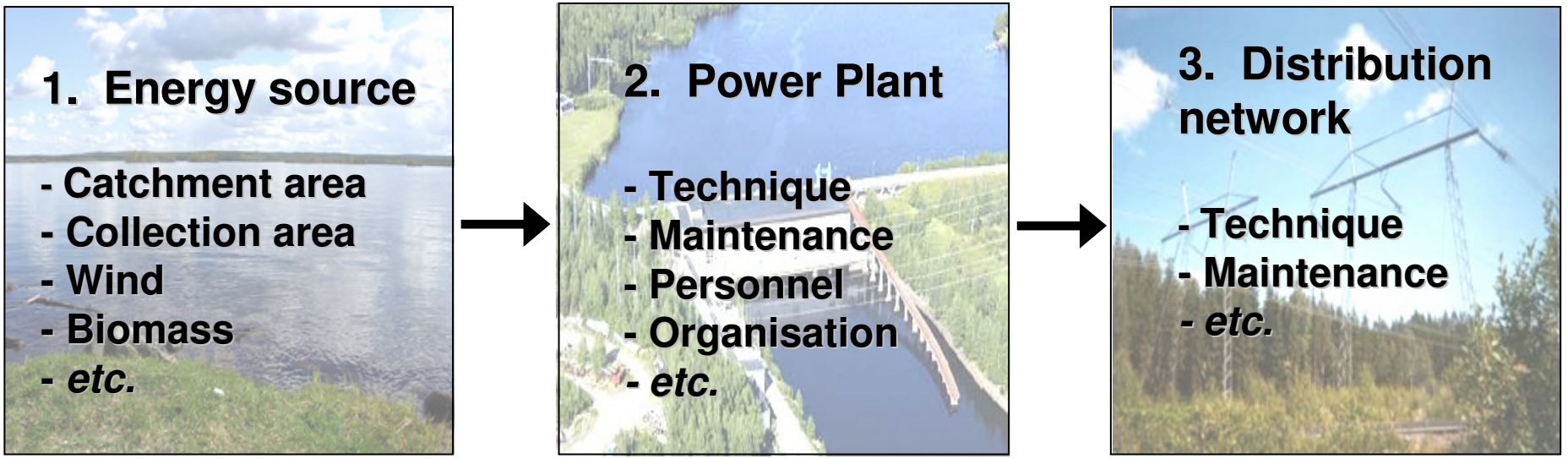
•Biomass growing season lengthens and growth accelerates
•Biomass growth weakness due to drought
•Increased risk of biomass fire

Drought, heavy rain, lightning strikes, hail

•Increased risk of biomass fire
•Peat harvesting will become easier on rainless summer
•Increased wind damage
•Higher temperatures will generally increase biomass growth

Tools for data collection – Functional model

- An overview to those functional parts of the power plant which are to be taken into account in the risk analysis process



Tools for risk/opportunity identification

Scenarios and Phenomena	Likelihood of the phenomena	Energy source, (e.g. catchment area, peat or biomass production area)	Power plant	Distribution network	Risk reduction / control / potential	Likelihood of the consequences to the energy production	Consequence category
Phenomena according to regional scenario of future climate, hydrological model or wind model.	*Probability according to IPCC 2007*	*The consequences of the phenomena to energy source and its usability*	*The consequences of the phenomena to the power plant*	*The consequences of the phenomena to the distribution network*	*The operations which will be done to protect against the phenomena and its consequences*	*Likelihood according to own ranking*	*Consequence category according to own ranking*
Scenario 1. warmer climate							
Phenomena 1.1 - higher temperatures, especially during winter	Very likely, the probability that the next decade is warmer is 90%.	increasing water capacity	hot weather decreases the lifetime of transformers	increased electrical resistance ◊ energy losses	increase turbine capacity	very likely	
1.2 - …							
Scenario 2. increased precipitation							
2.1 - More rainfall: annual runoff will increase 0-8 %	very likely						

Risk estimation – Likelihood of phenomena and risks

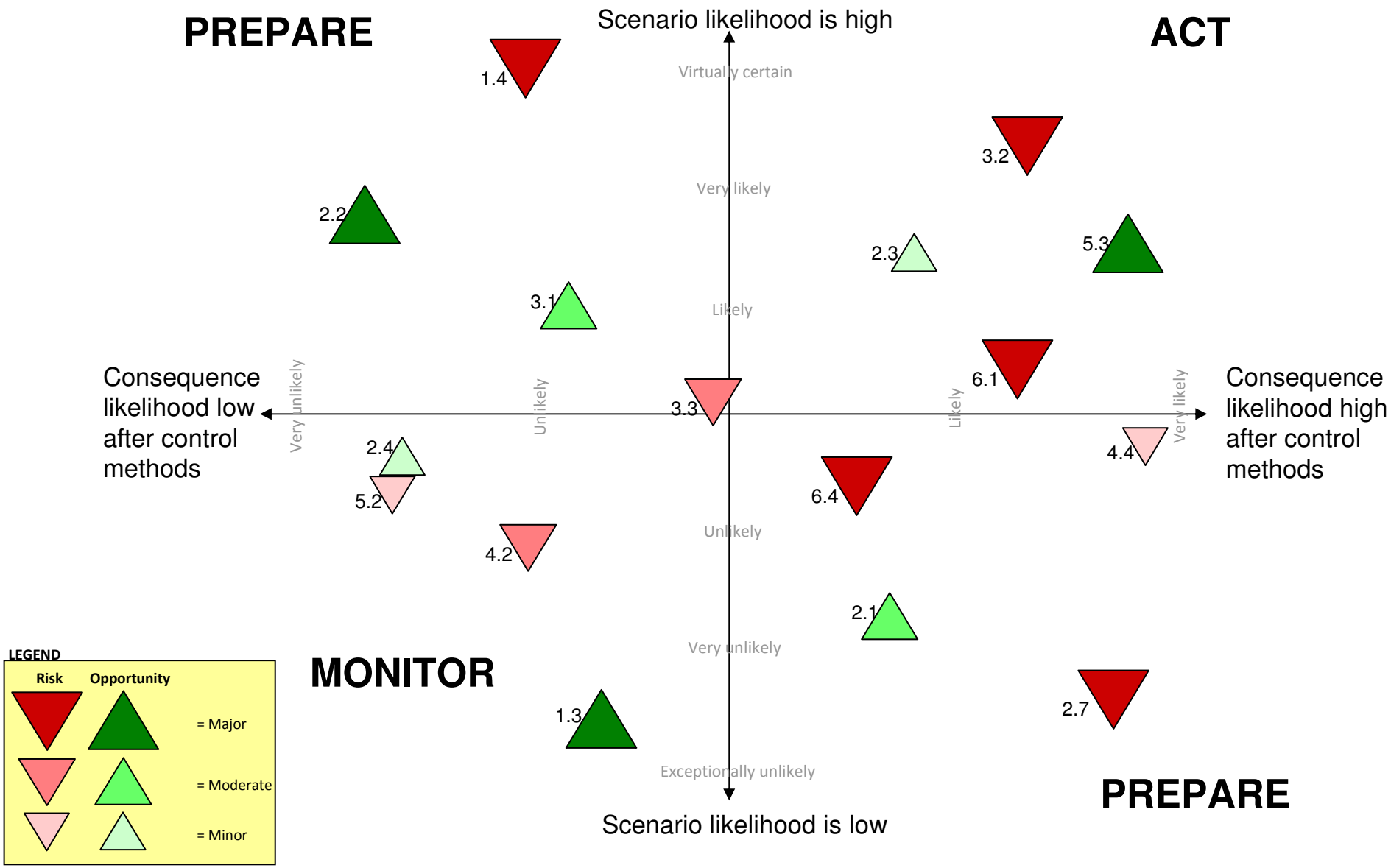
Terminology	Explanation of the term If the phenomena happens:
Very likely	There is only a one in a million chance to prevent the risk
	The opportunity's occurrence is almost certain
Likely	There are some possibilities to prevent the risk
	Some factors may reduce the opportunity's occurrence
Unlikely	There are a lot of possibilities to prevent the risk
	A lot of factors may reduce the opportunity's occurrence
Very unlikely	There are no difficulties in preventing the consequences
	The opportunity's occurrence is completely precluded

Risk estimation – Consequences of risks

- Classification of risks & opportunities could done in a variety of ways. For instance:
  - economic category
  - estimated effect on power production interruption

	Consequence	Risk colour	Opportunity colour
1	Minor	–	+
2	Moderate	––	++
3	Major	–––	+++

Risk evaluation



Biomass study results 1/2

- Some future challenges for biomass-based power production are related to the expected increase in precipitation
- For instance, a shorter period of ground frost might hamper biomass (wood and reed canary grass) harvesting and transportation, which may also pose a risk to a power plant's fuel supply
- Also, the power plant's combustion process efficiency is rather dependent on the moisture of fuel components, so the storage aspect might focus on the avoidance of harmful moisture-based contamination

Biomass study results 2/2

- Because the biomass-based fuel components supply reliability and storage capacity were seen as being more vulnerable in the future, better preparation is needed for:
  - the biomass storage capacity
  - locations could be defined partially based on the climate change information and identified risks
- Extreme weather events make it more difficult to forecast the energy needs (district heat) in the municipality ➔ making it more difficult to control the power plants heat production

Wind power study results

- Investors are interested on extreme wind speed value forecasts for the next 2 to 3 decades (repayment period)
- Frozen power plant structures could result in a significant decline in power production. Increased weather extremes can result in significant ice formation & more serious freezing damage to the power plants' infrastructure
- At the same time, higher wintertime temperatures and a shorter ice season would probably reduce wintertime power interruptions and increase power production
- Pack-ice could cause problems for wind turbines located on sea areas

Conclusions

- The risk assessment framework was seen to generate the best feedback when used in conjunction with local environmental knowledge (e.g. powerplant's operating personnel)
- Climate scenarios provide the basic structure for an examination, but there is a need for the “translation” of the knowledge & modelling results in practice (link between climate scenario, etc. information and the stakeholders)
- The necessary climate scenarios, etc. information needs to be available stakeholders (for example, “Climate services”)
- Stakeholders might not even know what kind of information could be produced

Thank you!

VTT creates business from technology