

# Risk-based Distribution System Asset Management

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# Outline

- SINTEF – the short story
- Motivation: Why "risk-based"?
- Presentation of the Risk-DSAM project
  - Scope
  - Results
  - Plans ahead



Technology for a better society





# Our research areas

Approx. 2000 employees per January 1<sup>st</sup> 2007

SINTEF Petroleum Research

SINTEF Energy Research

SINTEF Fisheries and Aquaculture

MARINTEK

SINTEF ICT

SINTEF Materials and Chemistry

SINTEF Health Research

SINTEF Technology and Society

SINTEF Holding





# Our partners

- **The Norwegian University of Science and Technology, NTNU**  
NTNU is a centre for technological education and research in Norway, with a solid foundation in the natural sciences.
- **The University of Oslo, UiO**  
The University of Oslo is Norway's largest and oldest institution of higher education.

## NTNU and the SINTEF Group Collaboration in R & D



# SINTEF in the World



International contracts were responsible for 15% of our turnover in 2005

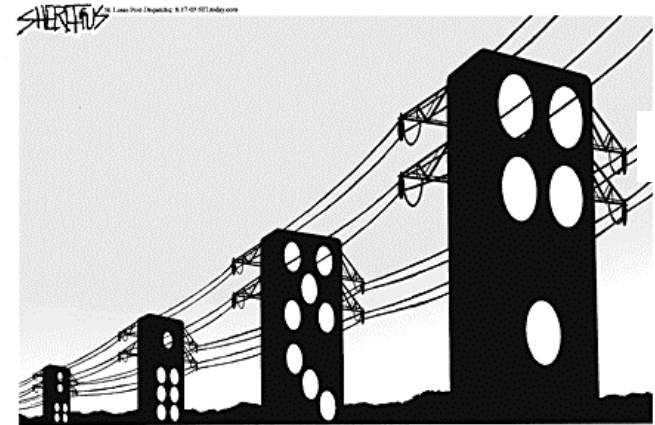
# Distribution System Asset Management

## ■ Characteristics

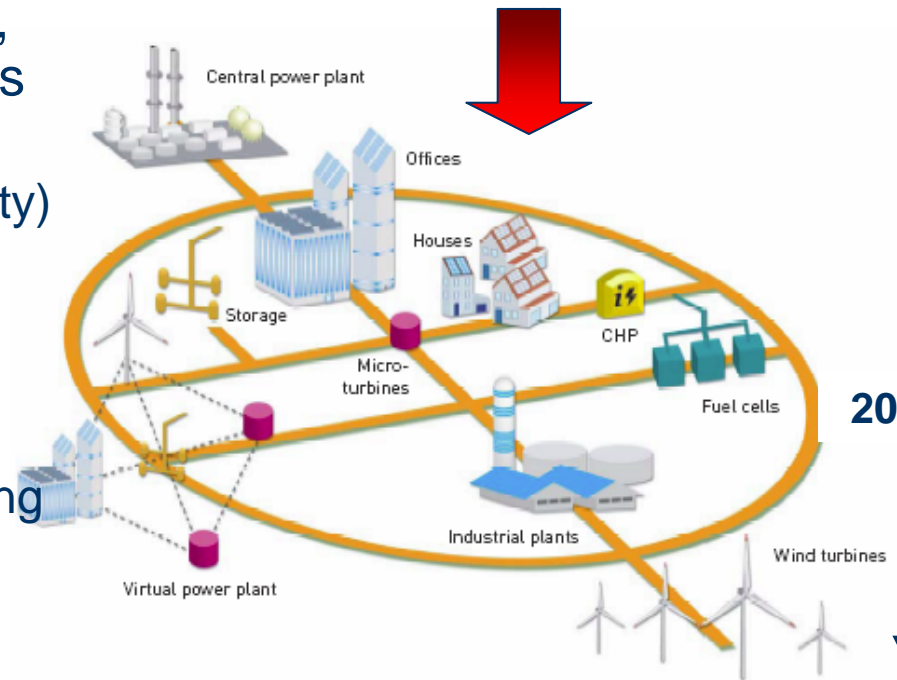
- Critical infrastructure
- Ageing (both grid and employees)
- An industry undergoing transformation

## ■ Task: Managing ageing networks, while meeting conflicting demands from:

- Customers (price, quality, flexibility)
- Governments and the society (efficiency, environment, vulnerability)
- Owners (return)
- And contribute to a well-functioning free market



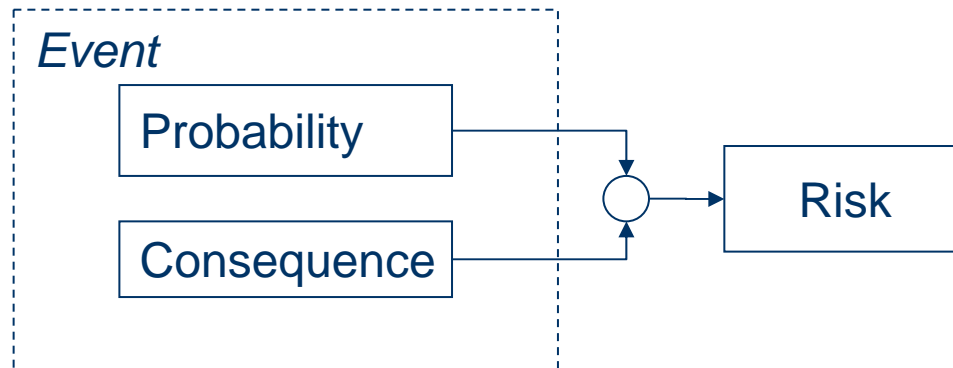
2006



2030?

# Why 'Risk based'?

- Stochastic impact / outcome of many different aspects in distribution systems
- Evaluating both the probability and consequence of an unwanted event





# Why 'Risk based'? II

- Putting company efforts where it is needed the most
- A dynamic approach providing differentiated solutions
- A measure for seeking cost-efficient risk reduction
  
- As an opposite to rule based decision making

# Background (i)

*"Everybody is talking about the weather, but no-one seems to do anything about it.."*

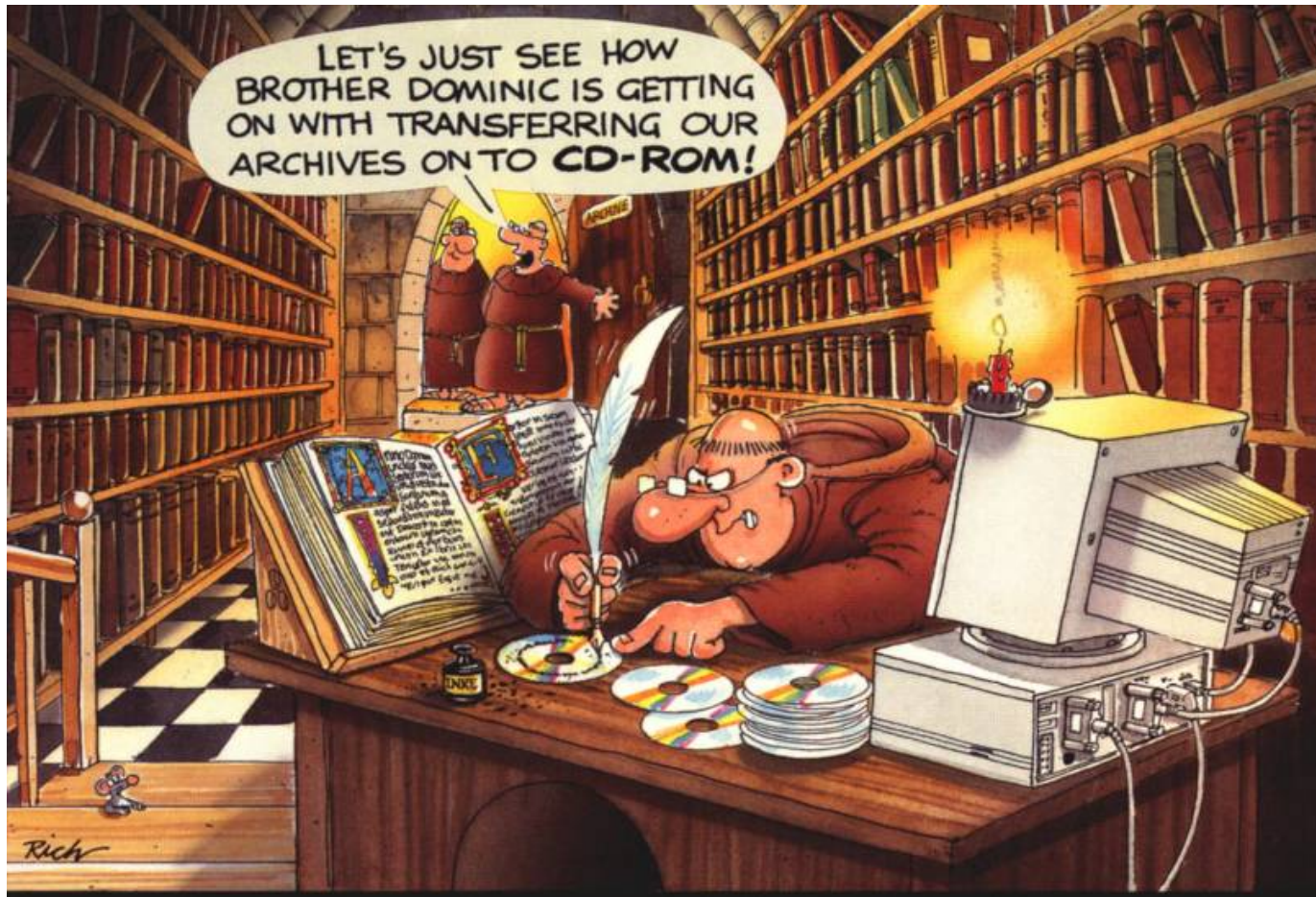
Origin unknown



The risk is  
out there...

# Background (ii)

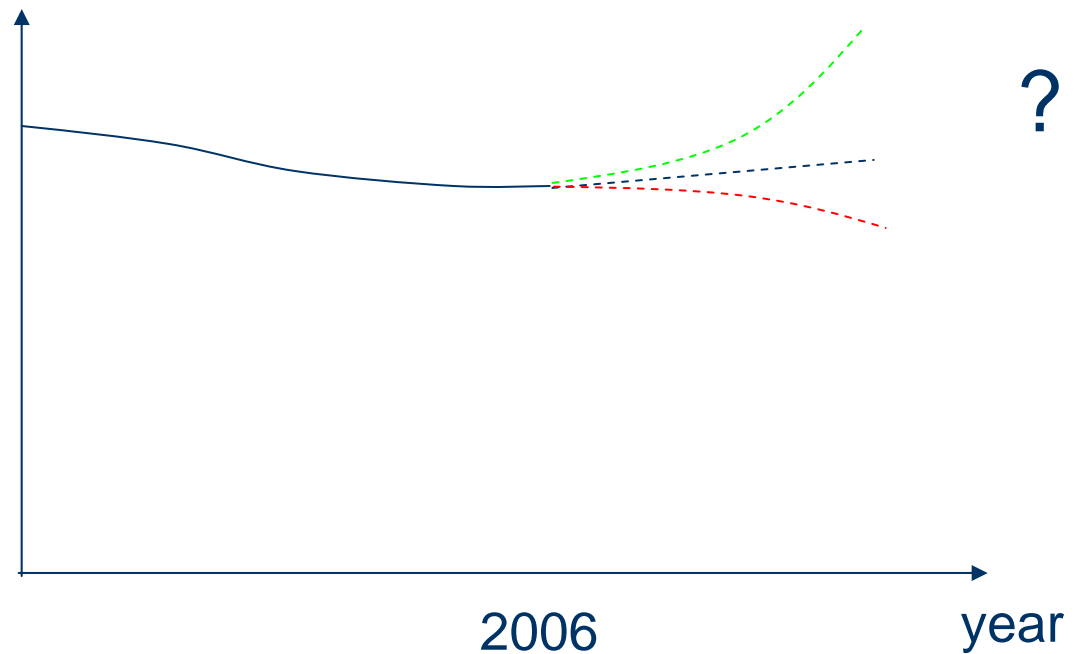
Existing methods and tools are not necessarily adequate in a rapidly changing and uncertain environment



# Background (iii)

- The uncertainties are higher than ever.

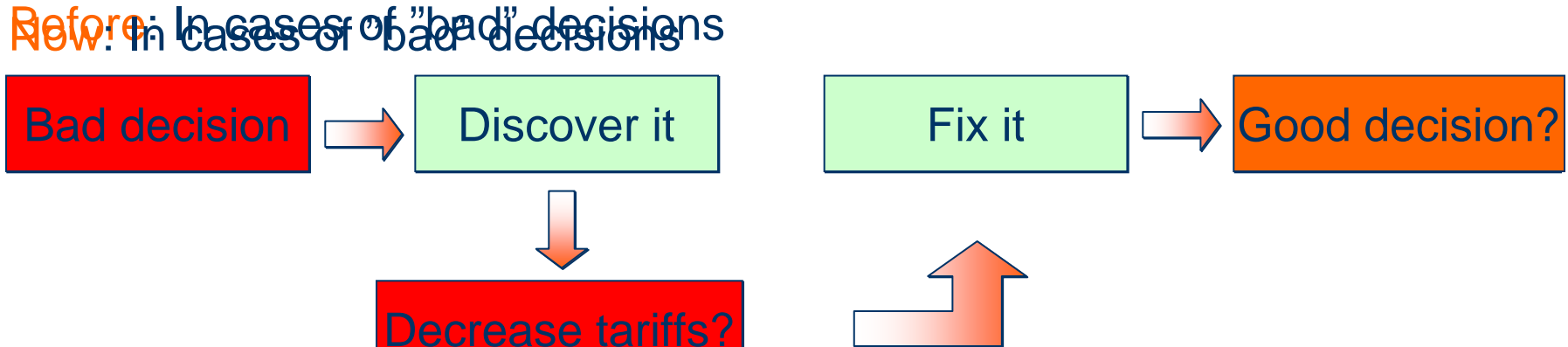
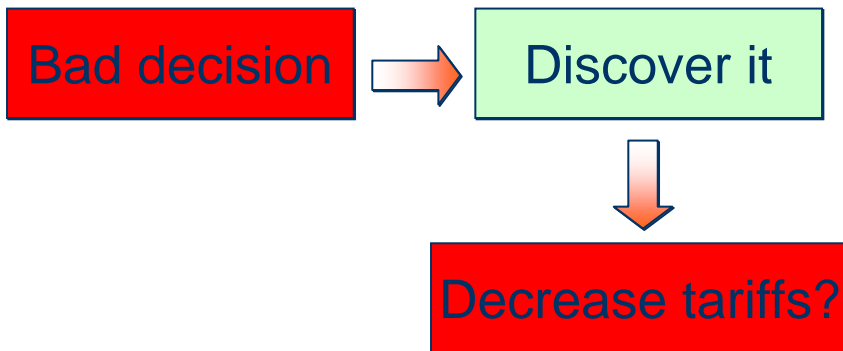
Y-axis alternatives:  
Income cap  
Safety level  
etc



# Uncertainty in regulatory framework: What has changed?

Regret is not an option. You have to do it right the first time.

Before: In cases of "bad" decisions



# Risk DSAM: Motivation

- To not take risk aspects into consideration is to take decisions wearing blindfolds.
- AND: Decisions are being made. Every day!



# The risk is out there...

- Risk is present whether we like it or not. We have to let it influence on the decisions we make.
- Not taking action is also a decision.  
Are we aware of the risk?
- Is the company operating within risk-margins we are comfortable with?
- The society is more dependent on stable electricity supply than ever before. Are we aware that we face the risk?

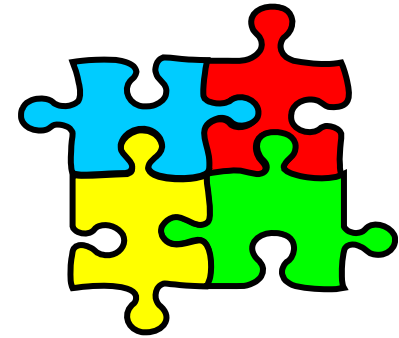
# Does existing methods and tools provide the solution?

- Existing methods and tools are not necessarily adequate for today's distribution company
- The RISK DSAM project has been launched to address this challenge

*Risk based Distribution System Asset Management*



# The Risk DSAM project

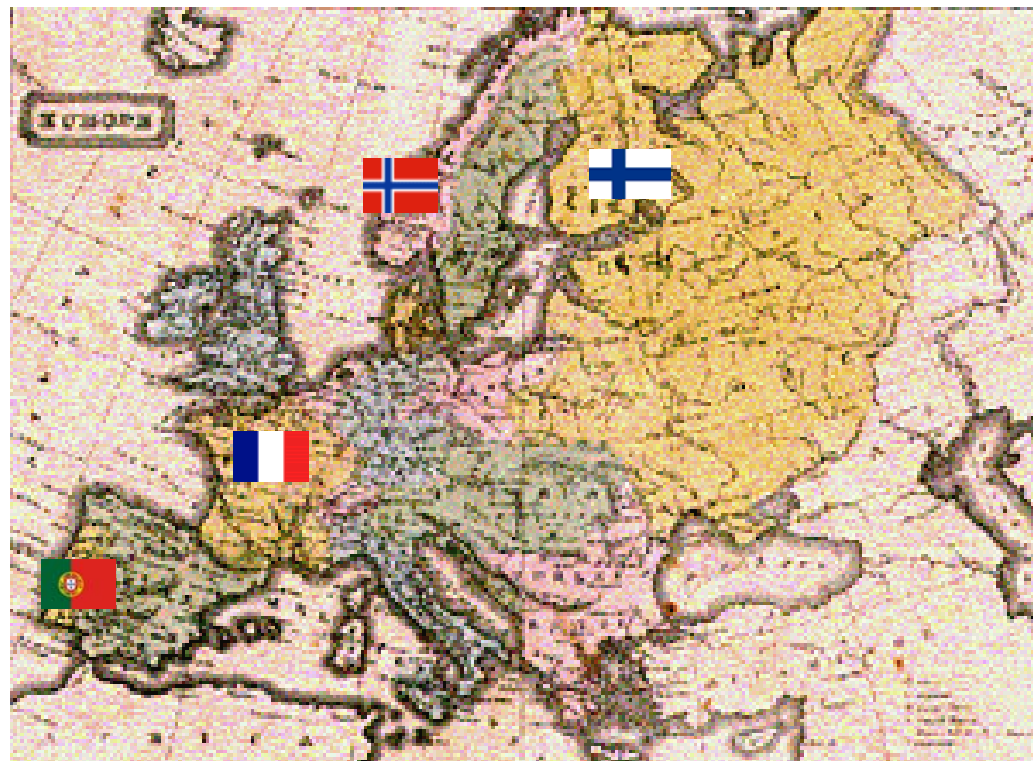


- Objective: To improve the knowledge of relevant methods and approaches for holistic risk management within distribution companies.
- The project will address several issues related to risk assessment in distribution system companies - including:
  - Measures of quantification of risk exposure on strategic level
  - Identifying maintenance and reinvestment strategies' impact on the risk exposure
  - Quantification of utility value both on project, and project portfolio level

# Project partners:

## ■ R&D partners:

- Research Council of Norway
- Électricité de France R&D
- The Norwegian University of Science and Technology
- SNF – Institute of Research in Economics and Administration (Norway)
- Lappeenranta University of Technology (Finland)
- University of Porto/INESC (Portugal)



## ■ Utility partners:



# Project activities 2006-2010

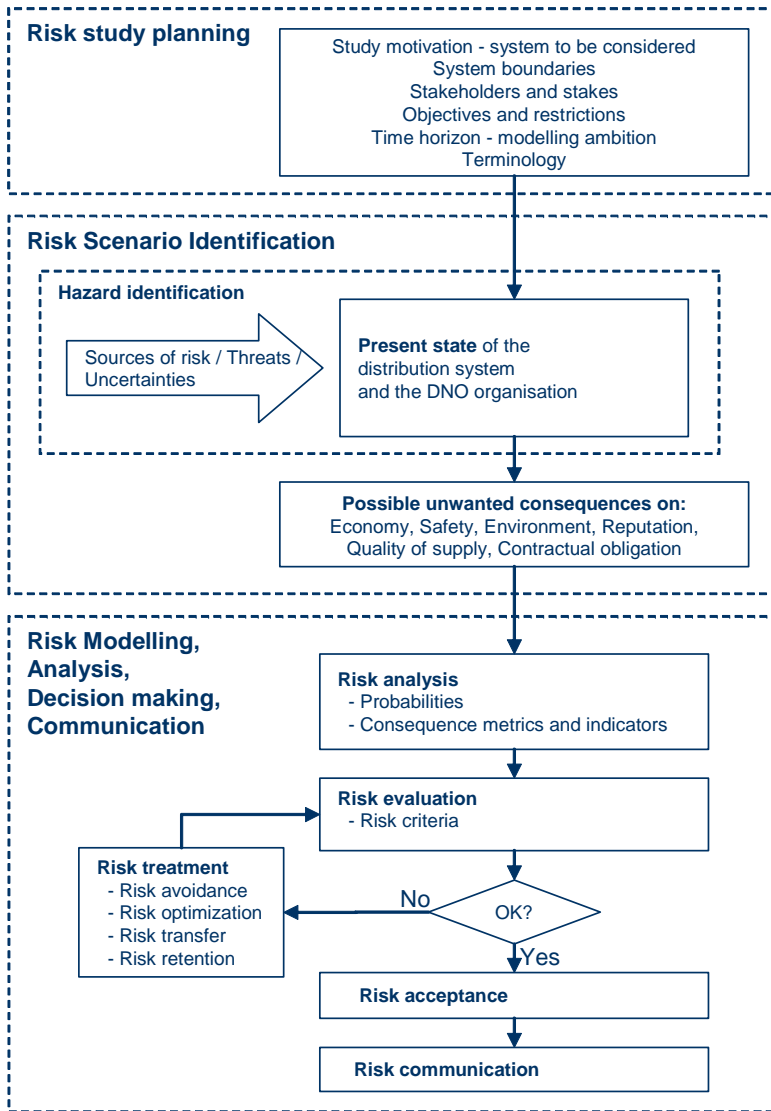
- PhD study
- Current risk exposure in the distribution sector
- Risk exposure on strategic level
- Utility value on project level
- Maintenance and reinvestments strategies impact on the risk exposure
- Decision support methods and processes

# Risk Management in general

ISO/IEC

Risk Management		
Risk Assessment	Risk Analysis	
		Risk Scenario Identification
		Risk Estimation
	Risk Evaluation	
	Risk Treatment	
		Risk Avoidance
		Risk Optimization
	Risk Transfer	
	Risk Retention	
Risk Acceptance		
Risk Communication		

# Applied to the Distribution system:



## ■ Top-Up or Bottom-Down?

### ■ Risk study planning

Problem formulation is a key success factor.

- Motivation for the study
- System boundaries
- Stakeholders
- Objectives and restrictions
- Time horizon

### ■ Risk scenario identification

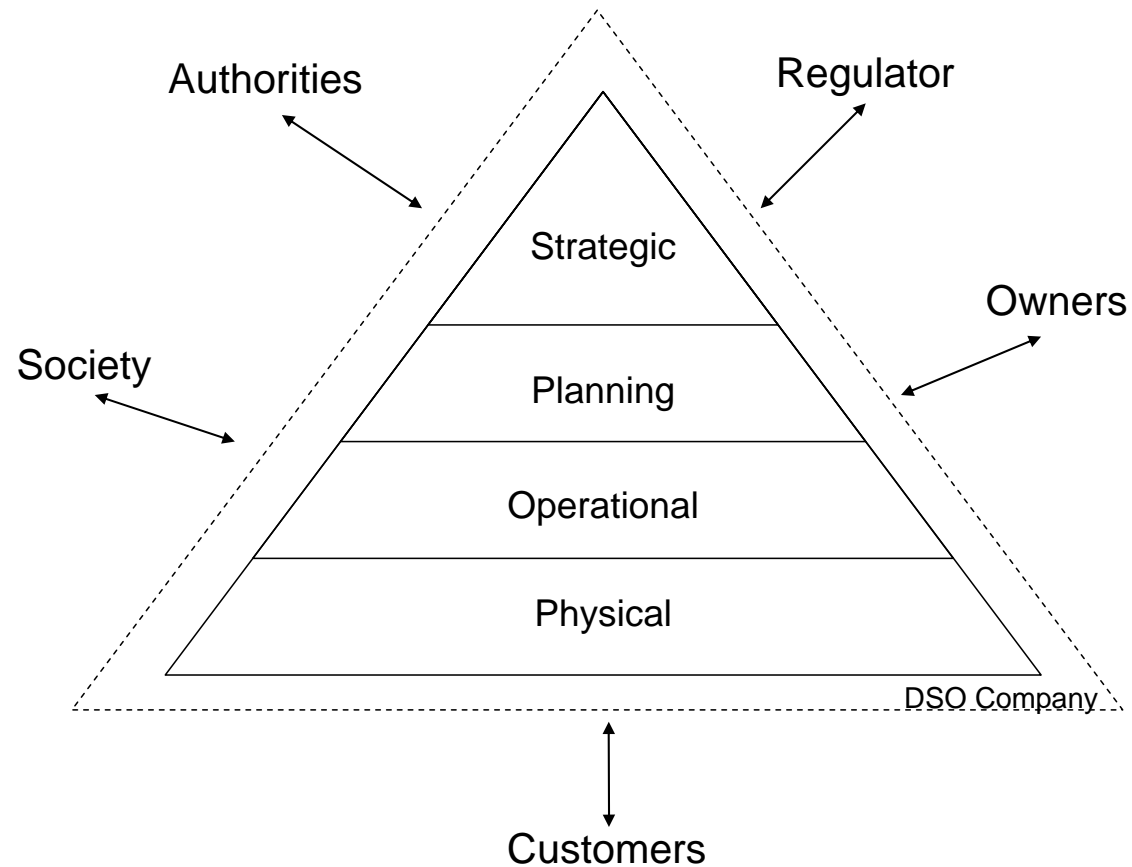
Threats and sources of risk which affect the system are elaborated. This includes items, events or activities having a potential for a harmful consequence.

### ■ Risk modeling – Analysis – Decision making – communication

- Risk assessment
- Risk treatment
- Risk acceptance
- Risk communication

# Current Risk Exposure

- Different decision levels and external stakeholders



# Current Risk Exposure II

- Some of the key questions being asked by distribution system asset managers are:
  - When is the right time to do the maintenance?
  - Should we reinvest instead of doing maintenance? Is extension of lifetime possible?
  - When is the right time to reinvest?
  - What are the economical and technical aspects?
  - Are the installations safe? How safe?
  - Is the company facing an acceptable risk concerning economic performance, safety and other risk criteria?
- The complex answers to these questions hold the essence of risk based distribution system asset management.

# Current Risk Exposure III

- *Risk exposure* is the aggregation of exposure to different *risk criteria*
- An initial survey among the participating companies in the project points out the following risk related challenges as being the most relevant:
  - Challenges regarding operational/legal framework
  - Organisational challenges
  - Technical challenges
  - Environmental challenges
  - Reputation challenges
  - Societal challenges
- The different risk criteria address different sides to the DSO's total risk exposure, and are by their nature somewhat different and may call for different methods for handling.



# Challenges regarding operational/legal framework

- Unpredictable regulatory framework – regulatory risk
- Contractual obligations towards local authorities / customers
- Changes in quality of supply regulation
- Changes in safety / environmental regulation
- Changes in owner demands with increasing profit expectations

# Organisational challenges

- Outsourcing of services: Having control and making sure that rules and regulations are complied with, and that safety is sufficiently handled
- Possible threats regarding an inactive service market
- Cases with in-house contractors: The interface between owner and contractor may become a challenge with regard to responsibilities during operation.
- Mergers of companies with diverging history and culture - taking care of risk handling in a transition period
- Degrading / vanishing competence and local knowledge due to reductions in working staff and retirements
- Lack of competence regarding the use of new methodology within several areas of asset management, such as risk assessment and condition monitoring of different components
- Cooperation with other infrastructure services e.g. in term of sharing infrastructure paths
- Possible threats regarding disappearance of manufacturers of the aged components (lack of spare parts)

# Technical challenges

- Generally ageing infrastructure which is getting nearer it's estimated useful lifetime
- Reinvestment decisions on whether to still maintaining existing components or the replace with new. A key issues here is end-of-life estimation
- Wrong handling of components
- Uncertainty in load development in the network
- Reduction in load in rural areas
- Introduction of distributed generation such as wind and small hydro power
- Introduction of new end-user technologies of questionable quality that gives power quality challenges

# Environmental challenges

- Land use problems
- Potential local pollution, e.g. oil spill from distribution transformers or other oil filled components, and possible run-off from imbued wooden poles
- Other types of pollution, e.g. SF6-gas leakages from switchgear

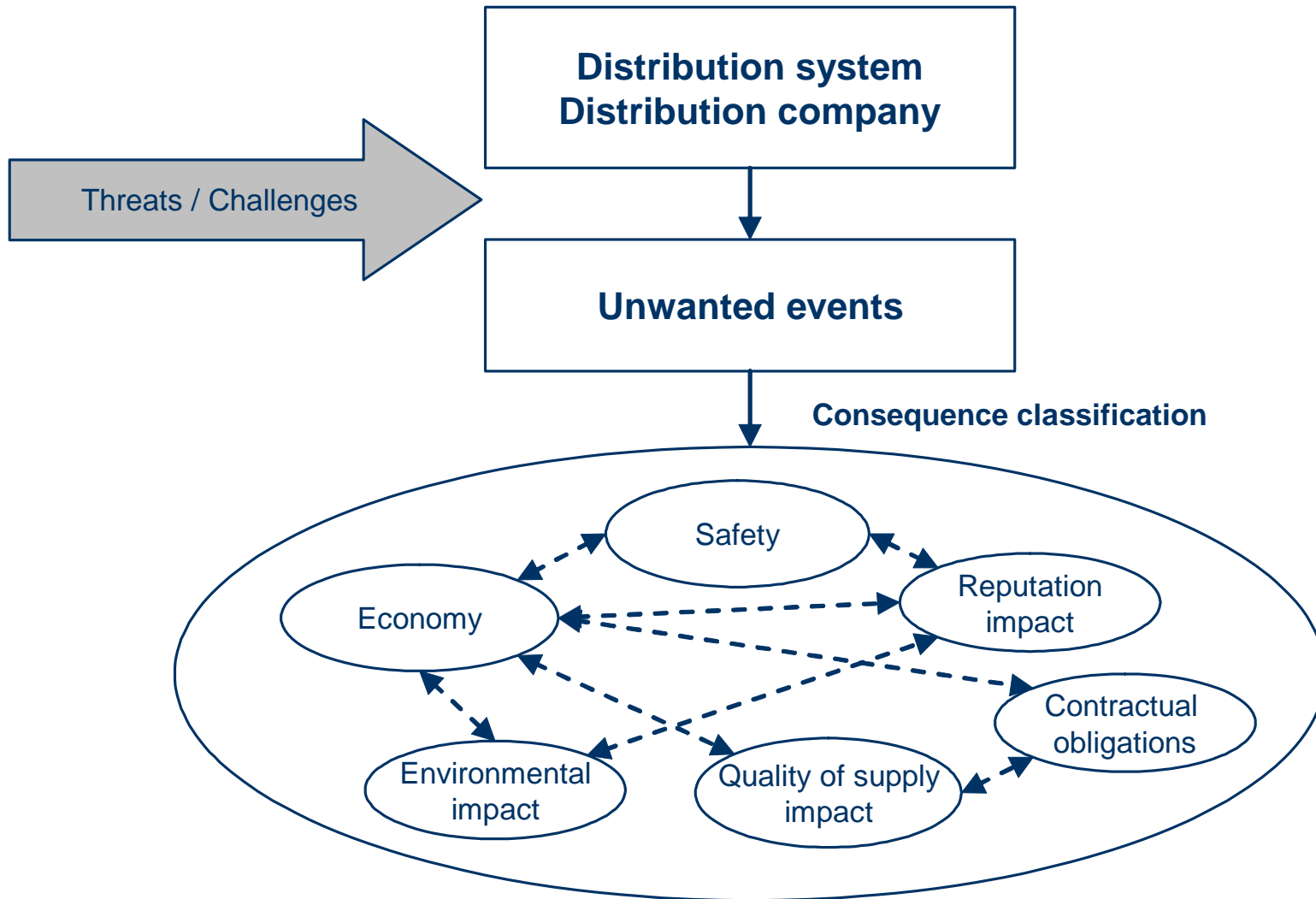
# Reputation challenges

- Disputes regarding land use
- The aesthetics of power grid components
- Decreasing reliability in parts of the grid
- Decreasing voltage quality in parts of the grid
- Safety of professionals and the general public
- Bad relationship with media

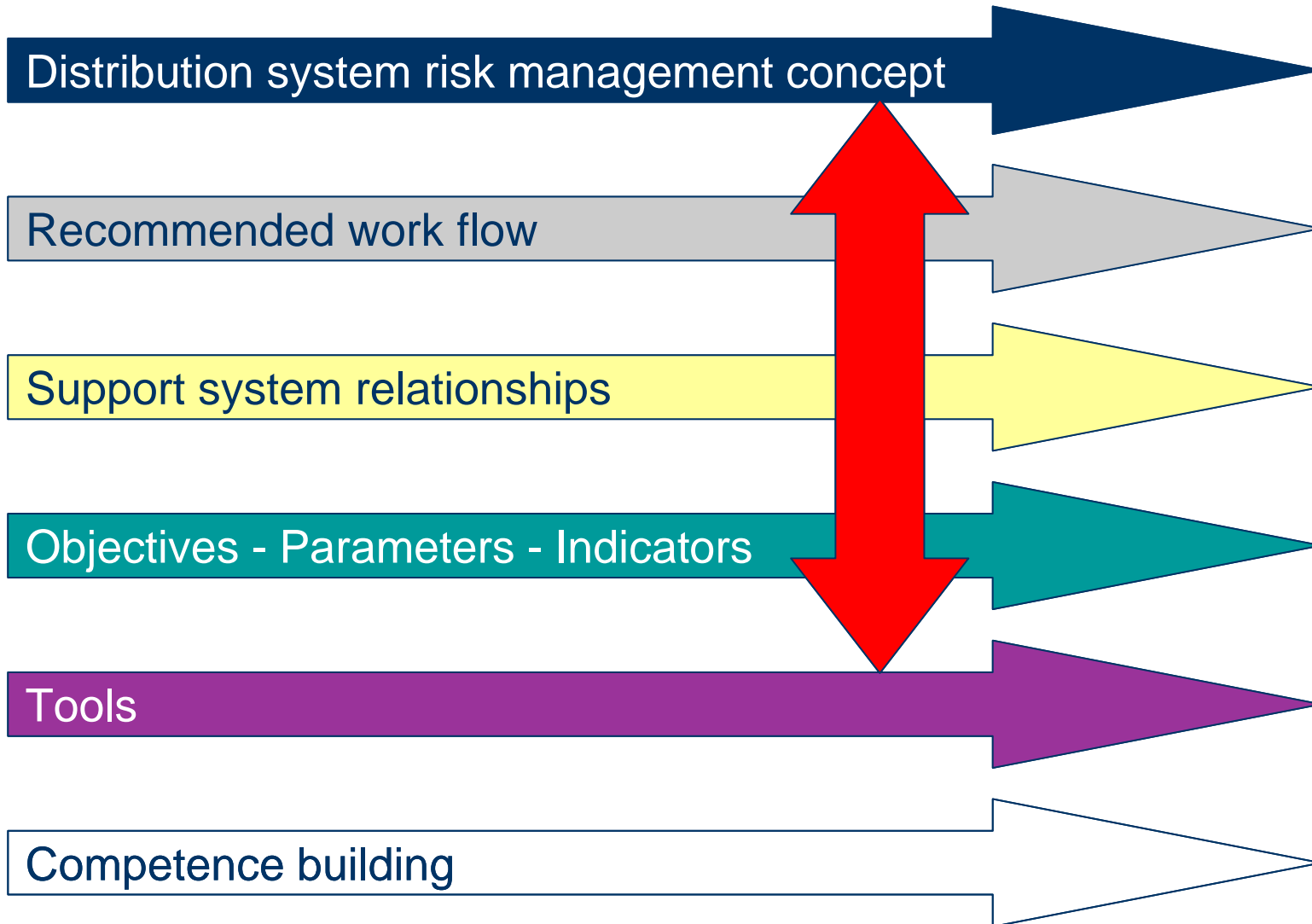
# Societal challenges

- Increasing vulnerability due to adverse weather, severe faults, increased utilisation of the network, etc.
- Increasing reliability and voltage quality demands

# Schematic risk picture for distribution companies



# Further work



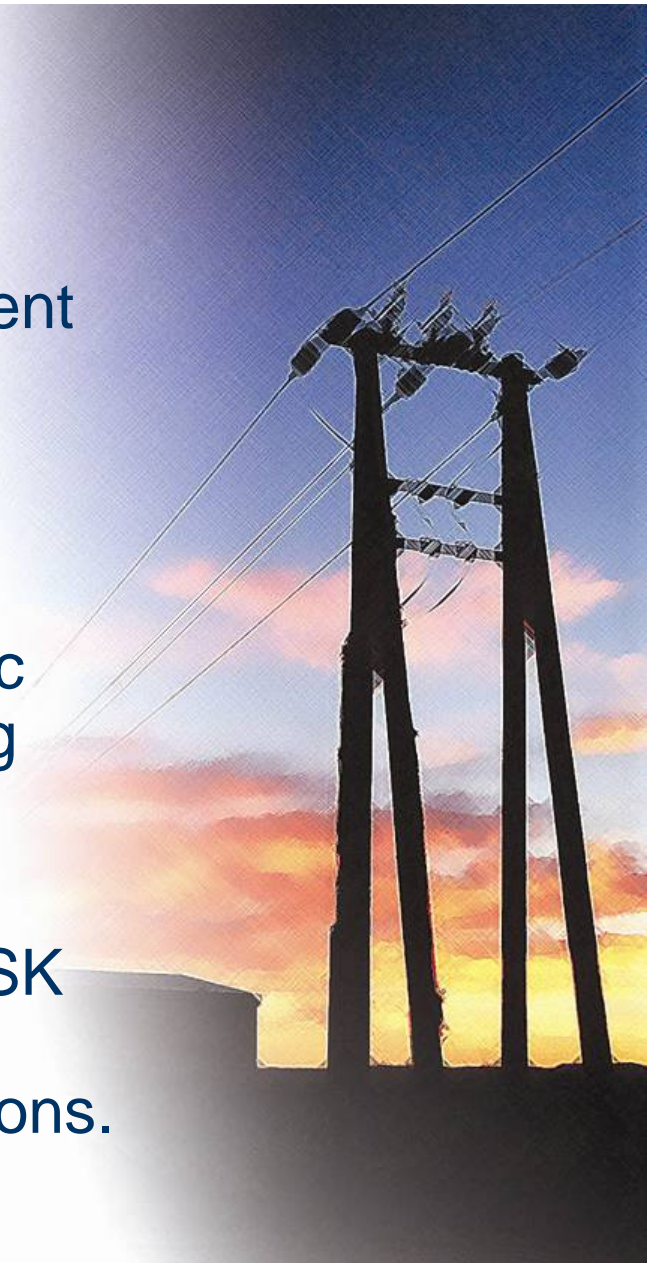


# Further work I

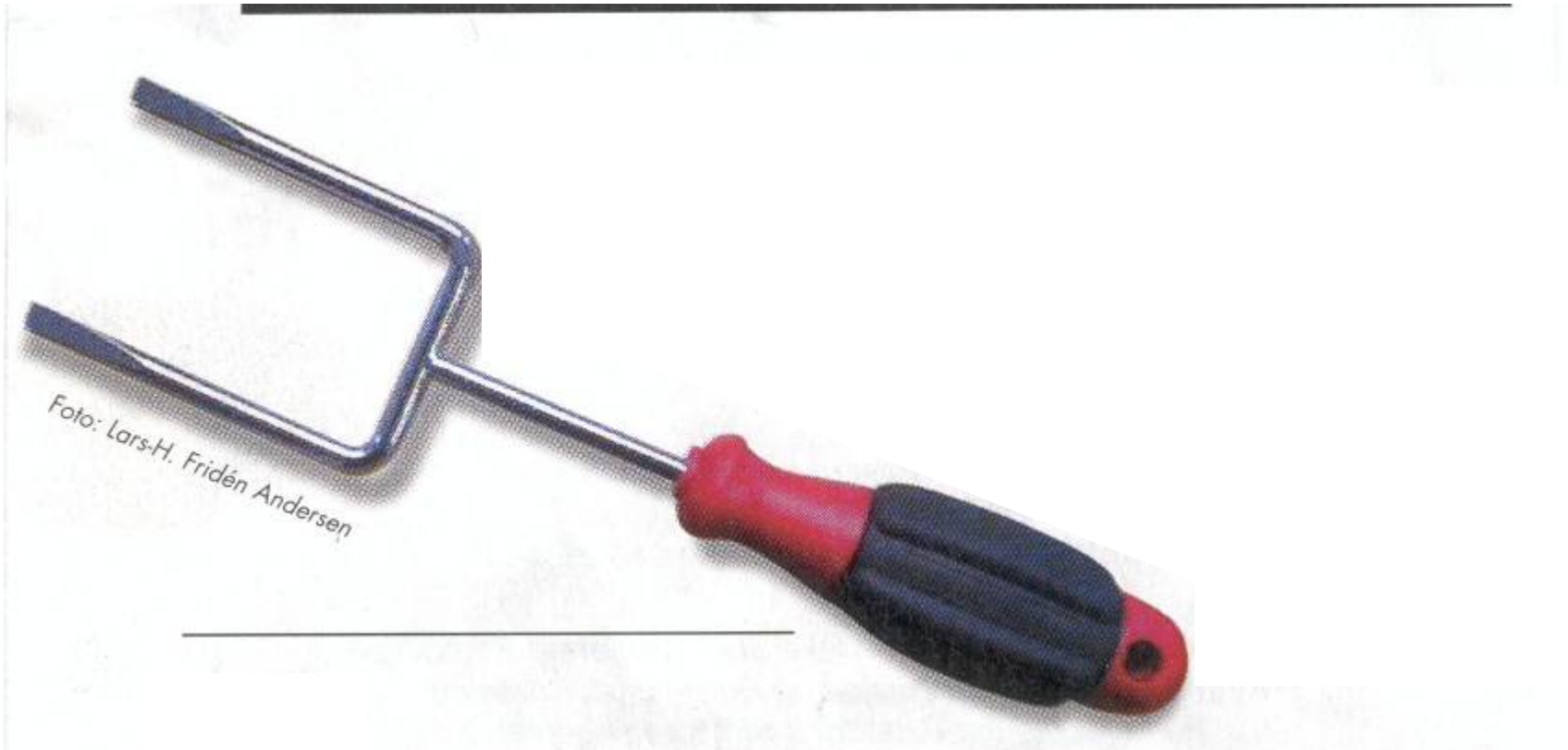
- Risk exposure on company/strategic level
  - Develop methods, which can be used to describe the risk exposure for a distribution company.
- Maintenance and reinvestment strategies' impact on the risk exposure
  - Develop methods, which can be used to describe how alternative maintenance and reinvestment strategies affect the technical condition of the network and then the related risk exposure on company level.
- Utility value on project level
  - Develop methods, which can be used to describe the utility value of maintenance and reinvestment projects.
- Decision support methods and processes
  - Investigate and describe how information about risk exposure on strategic level, planning, operative and physical level can improve the decision processes in a distribution company.

# Summarised

- Distribution system asset management cover many rather different issues – economic, technical and other more qualitative criteria such as safety of personnel.
- There is a need to establish a holistic asset management scheme covering these issues.
- To address these challenges the RISK DSAM project has been launched to build competence and provide solutions.



# New solutions? Hopefully better than this...



*"The picture shows a double screwdriver invented by senior economist M. Oney. The essence of the invention lies in the efficiency potential for tightening twice as many screws at the same time..."*

# Concluding remarks

- To not take risk aspects into consideration is to take decisions wearing blindfolds.
- Risk is present whether we like it or not. We have to let it influence on the decisions we make.
- Existing methods and tools are not necessarily adequate in a rapidly changing and uncertain environment
- Do you want to join us in our efforts? Visit our web site, and get in touch.

<http://www.energy.sintef.no/Prosjekt/RISKDSAM/>

# Look ahead!

