



*Small Developing Island Renewable Energy
Knowledge and Technology Transfer Network*



Dealing with the Uncertain

- Information & Complexity in Climate Change -

Prof Thomas Thiel-Clemen

Hamburg University of Applied Sciences, Germany

Faculty of Engineering & Computer Science

Climate Change Awareness Week, Univ. of Mauritius, July, 13th-15th, 2011



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University of Mauritius



USP
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ACP S&T PROGRAMME



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Some personal Remarks



- **Travelling** (together with my wife)
- **Birdwatching** (ditto)
- **Nature Photography** (ditto)

Research topics:

- (Multi-Agent) Simulation for:
 - Disaster Management & Civil Protection
 - Ecology & Climate Change
- Interactive, simulation-based Learning



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Mauritius is doing fine

- Millennium Development Goals (MDGs): very good!
- Gross Domestic Product (GDP): **+4.5 %** (2011, expected)
- Environmental Performance Index (EPI):
Rank 6 in 2010 (Rank 58 in 2008)



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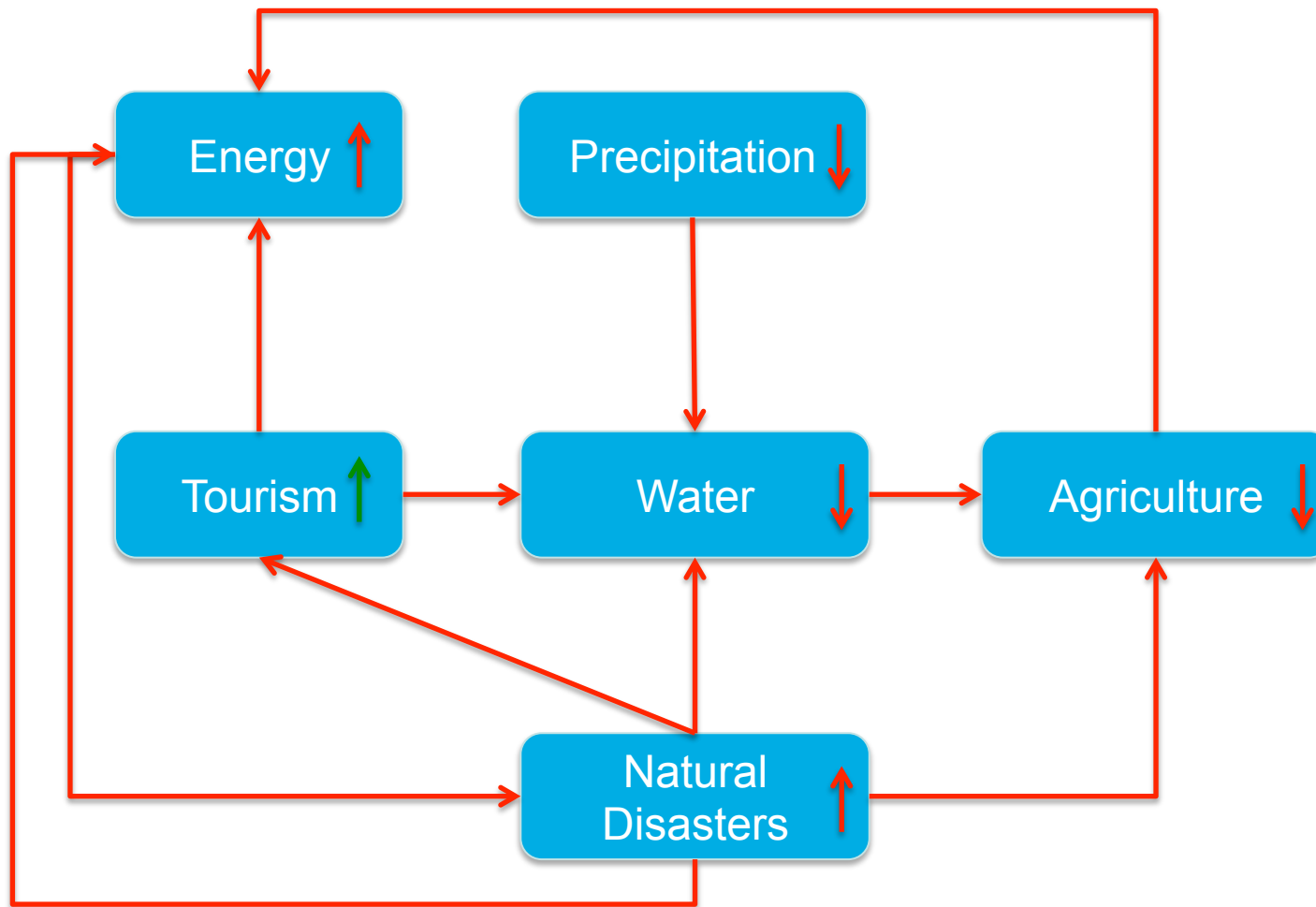
But: Mauritius is also changing

(2010 vs. 2009)

- Primary energy requirement: +5.8%
- Electricity: +4.3%
- Tourists: +4%
- Mean amount of rainfall: -24.7%
- Land-use by built-up areas: +27.7% (2005 vs. 1995)
- Vehicles: +4.8% (Road accidents: + 8.8%, fatal: +18.6%)

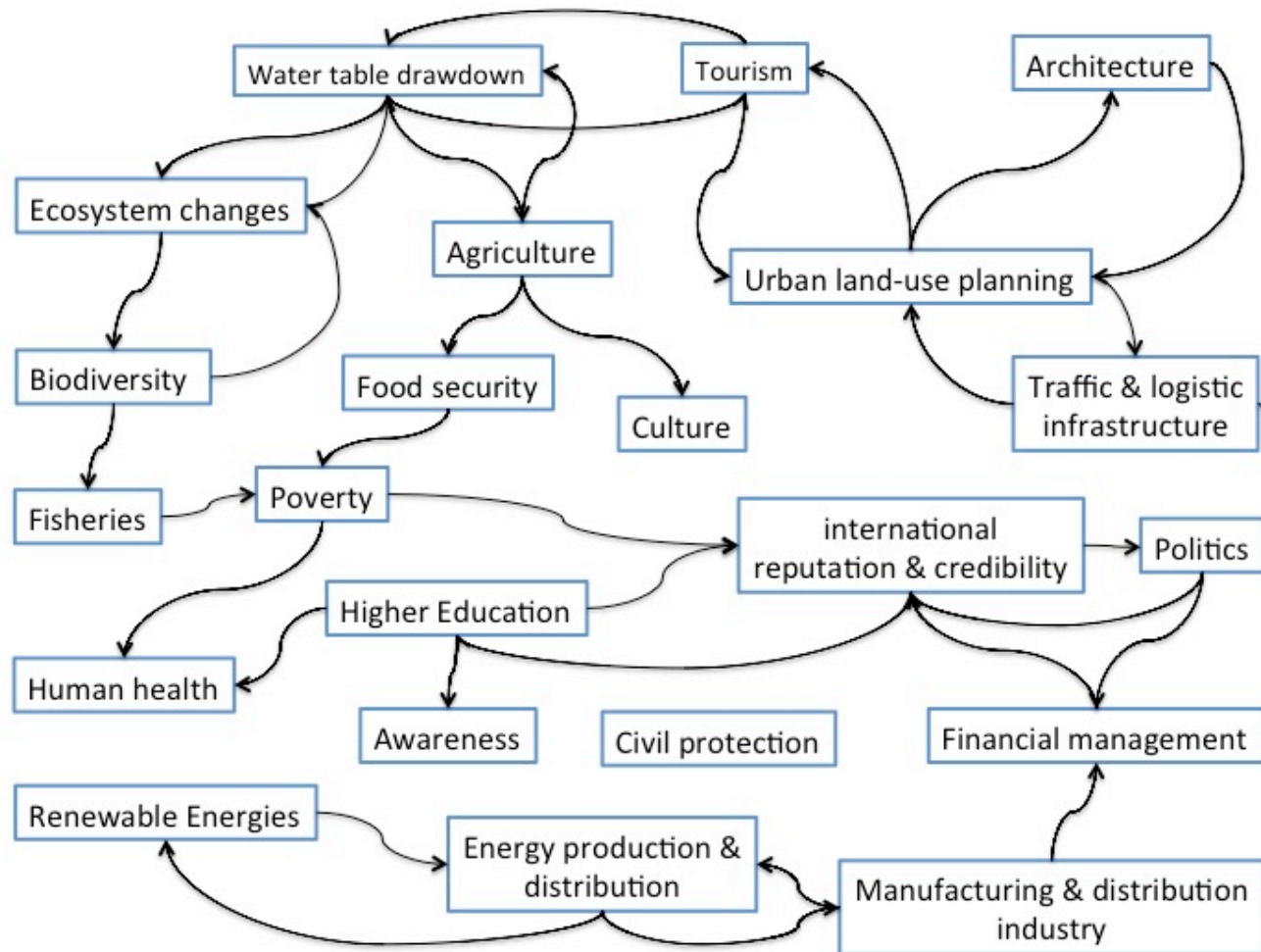


Is this complex?



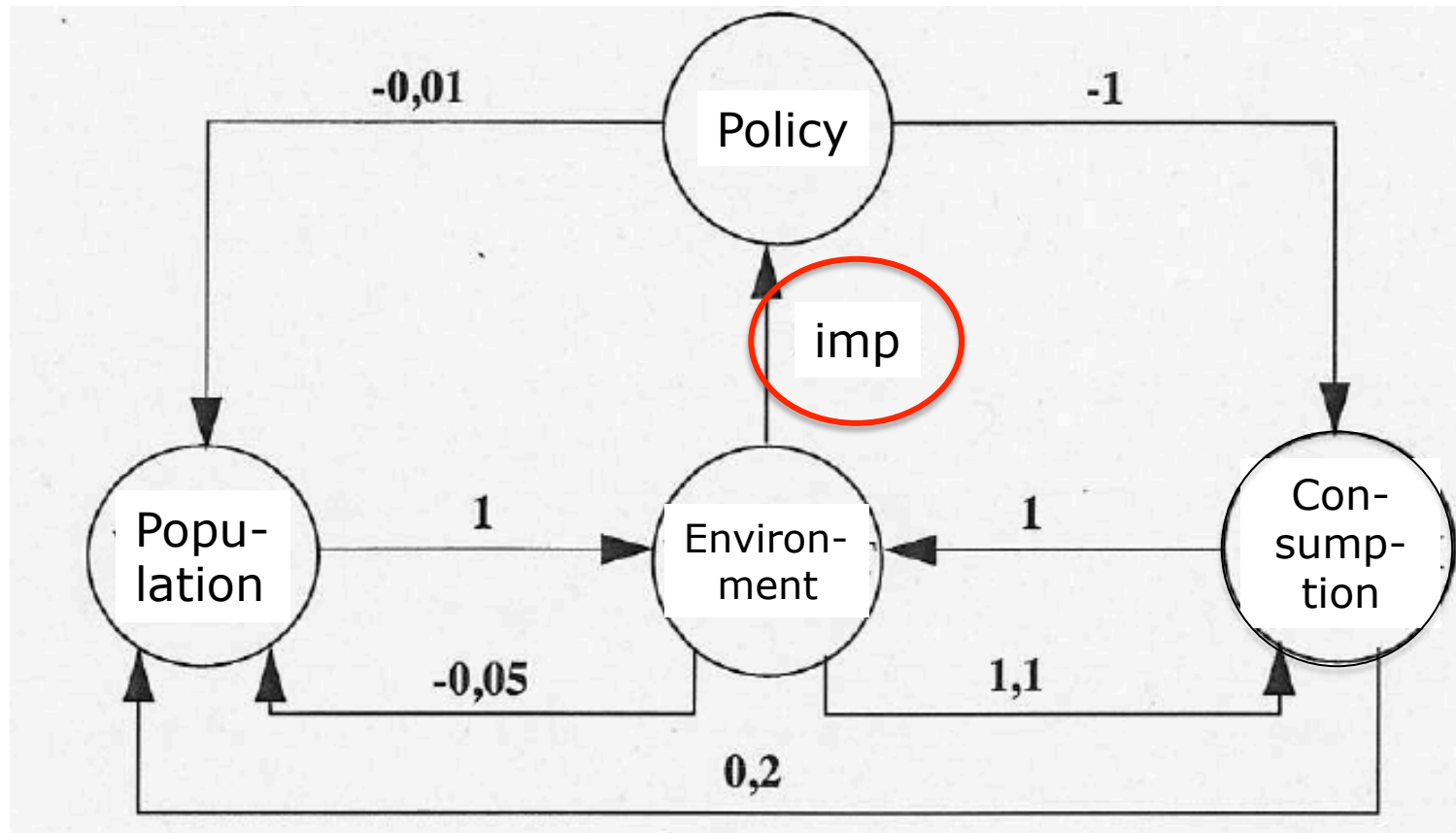


And that?





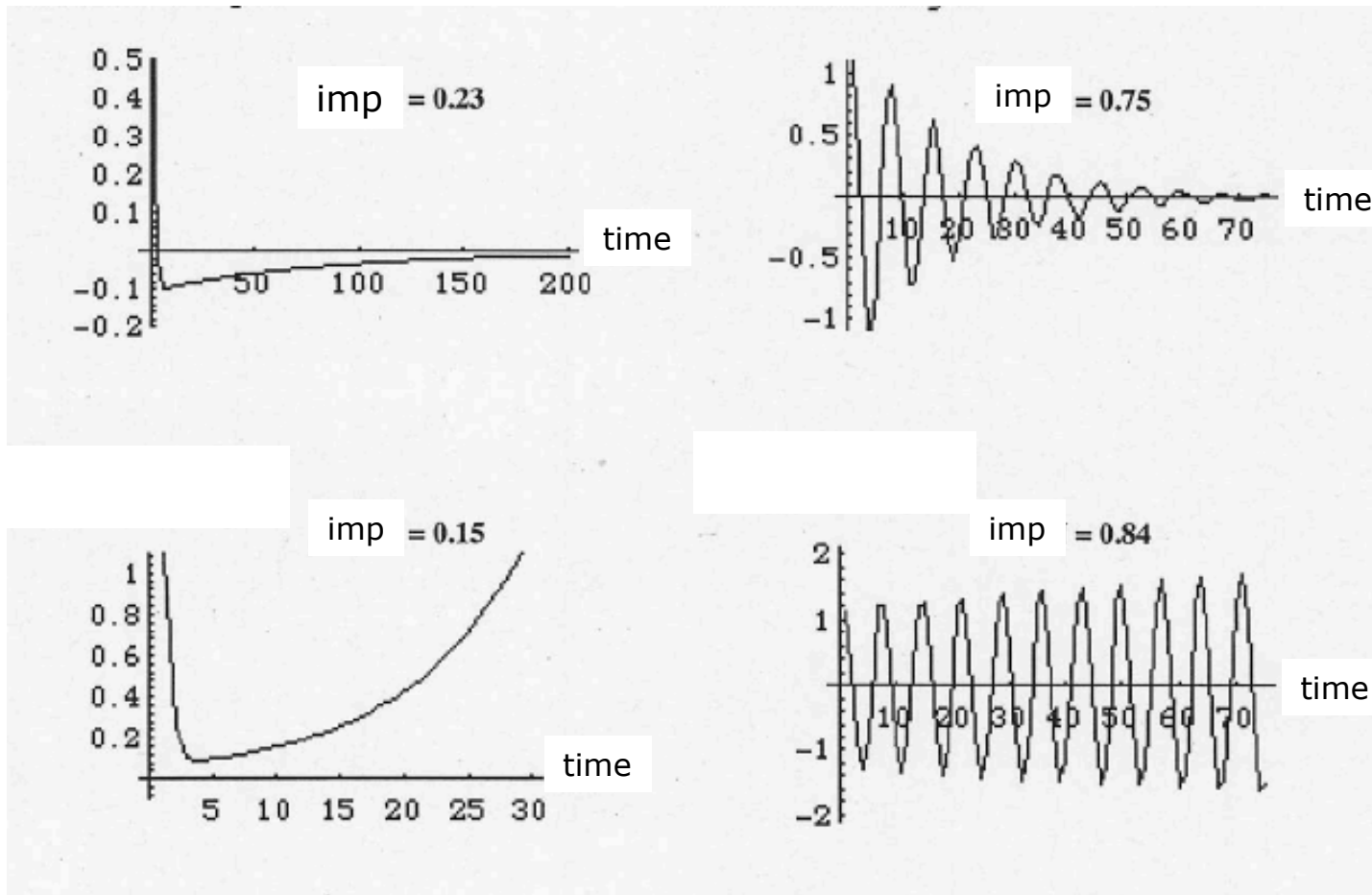
Impact of Feedback-Loops



(Club of Rome (1971))



Impact of Feedback-Loops





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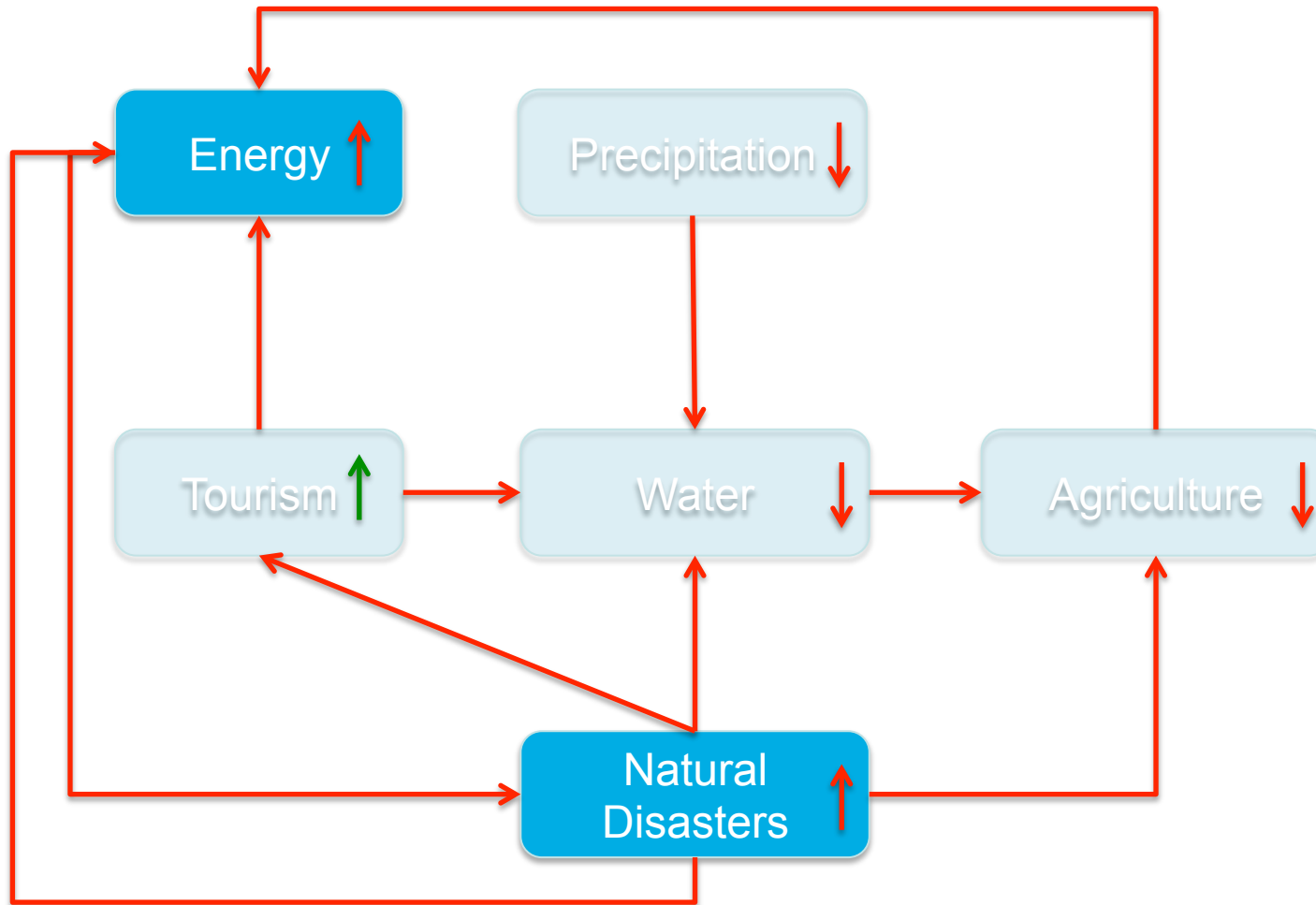
Assumptions by a Systems Theorist

- Real impact of CC not yet predictable
- Mauritius is highly vulnerable
- Effects will be non-linear (because of complexity)
- Incidents will cascade
- Time-frame is unclear

But: This is surely no reason to do nothing!



More Thoughtfulness about...





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German Renewable Energy Act (EEG / FIT)

- Implemented in 2000 to foster development of renewable energies due to cost reductions and improved efficiency from economies of scale over time
- **Central elements:**
 - Guaranteed grid access for RE installations, incl. grid expansion if necessary
 - Prioritized feed-in and distribution of electricity produced with RE
 - 20 years (fixed) rate contract for remuneration (**Feed-in tariffs, FiT**) to reward the produced kWh of electricity by RE



Development of Renewable Energy Technologies

Increase in share of RE in Germany:
electricity production:
3.1 % (1990) → 15.1% (2008)

gross electricity consumption:
6.4% (2000) → 16.8% (2010)

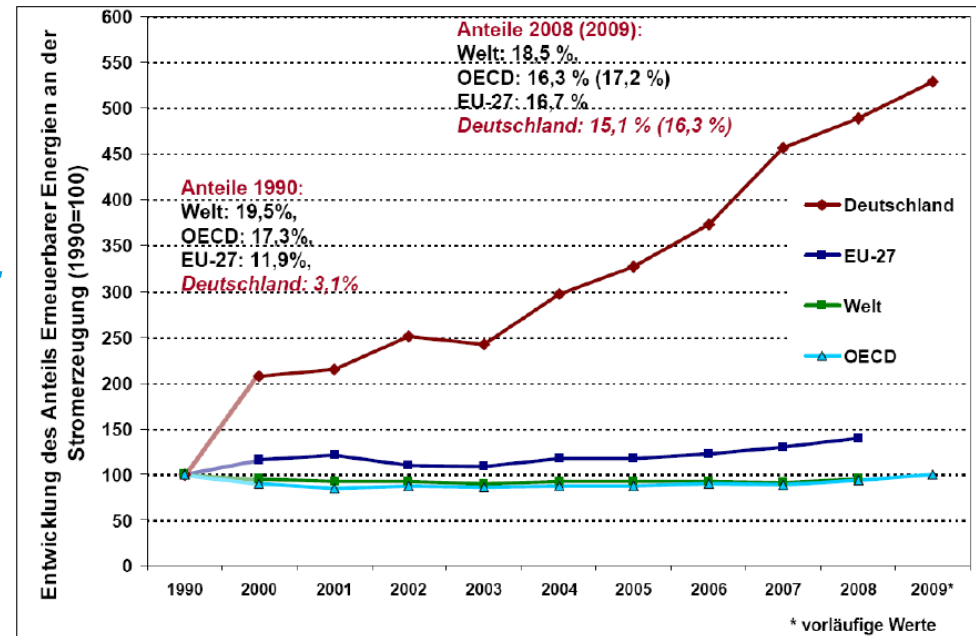
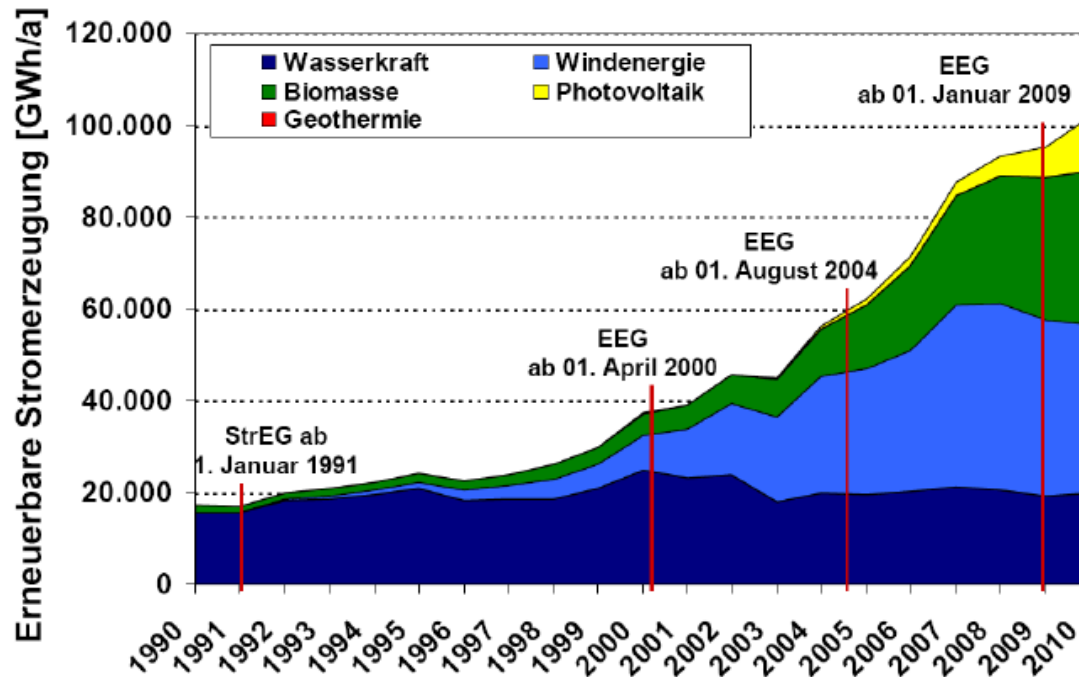


Figure: Share of RE at Electricity production (1990 = 100)



Development of Renewable Energy Technologies



Remarkable growth in new installations particularly in onshore wind, biomass and lately photovoltaic due to German Renewable Energy Act

Figure: Development of different RE at electricity production



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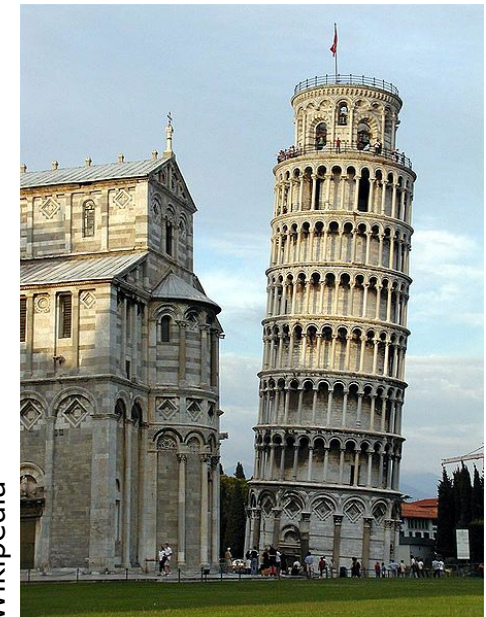


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Challenges or 'Nothing is Perfect'

- **Unbiased distribution :**
high: onshore wind farms, biomass burning (Bagasse in Mauritius?) and PV
low: offshore wind farms, geothermic
- **Long term reduction of investment risks** resulted especially in unpredictable growth particularly of PV installations in Germany
- Investments in electricity installations: 23.7 bn EUR
(19.5 bn EUR = 80% in PV)
- **Costs:** Remuneration / FiT in 2010: approx. 12 bn EUR
- **Whole system is still very inflexible**
(e.g. negative quotes at European Energy Exchange)



Wikipedia



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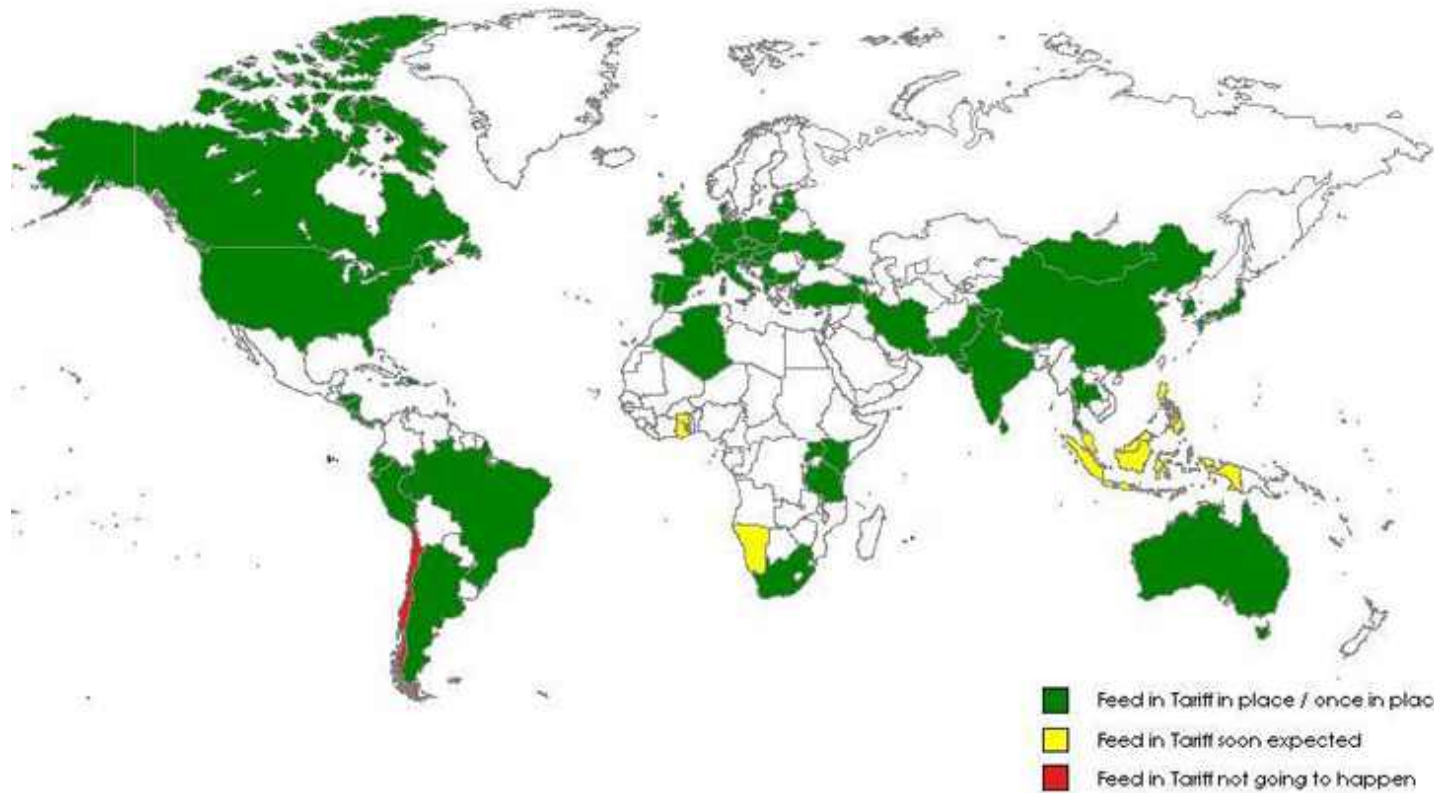
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Global Feed-in-tariffs





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Energy Concept of Germany

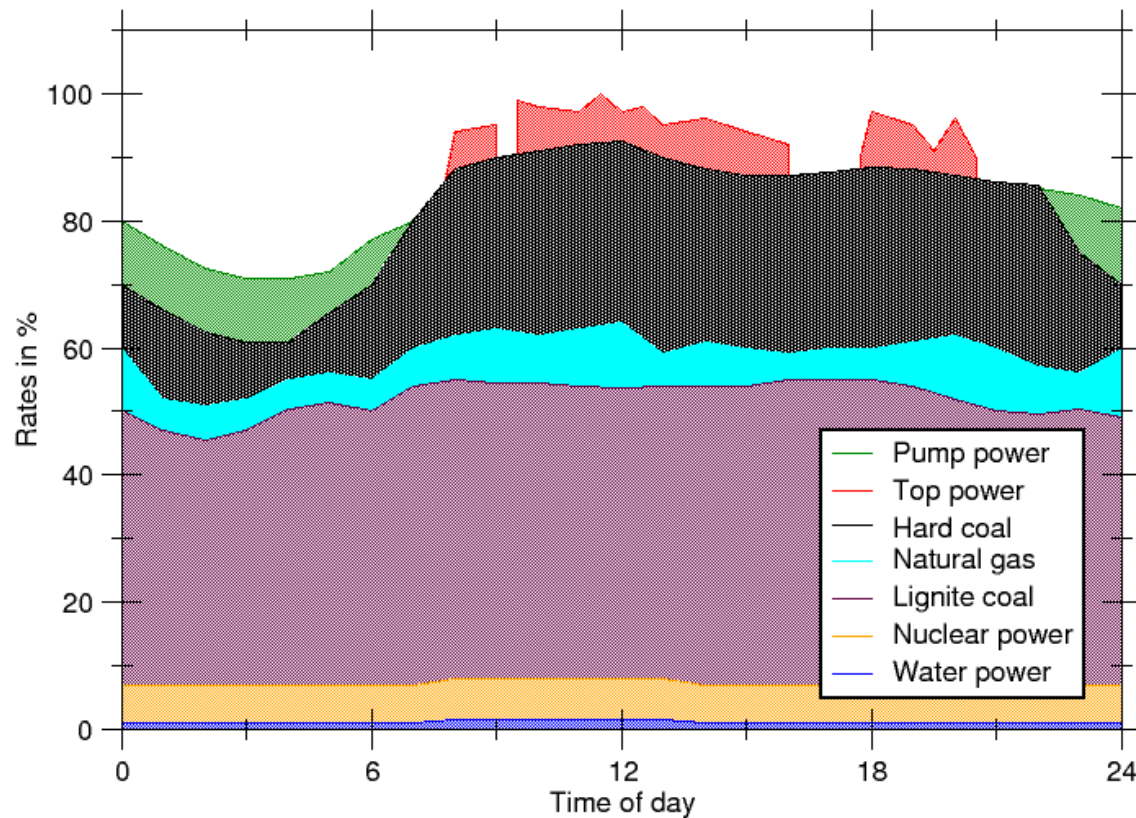
Year	CO ₂ Reduction (vs. 1990)	Percentage of RE
2020	-40 %	35%
2030		50%
2040		65%
2050	-80%	80%

Federal Government of Germany (2011)



Typical daily Consumption in Germany

Daily consumption of electrical power



(Wikipedia)



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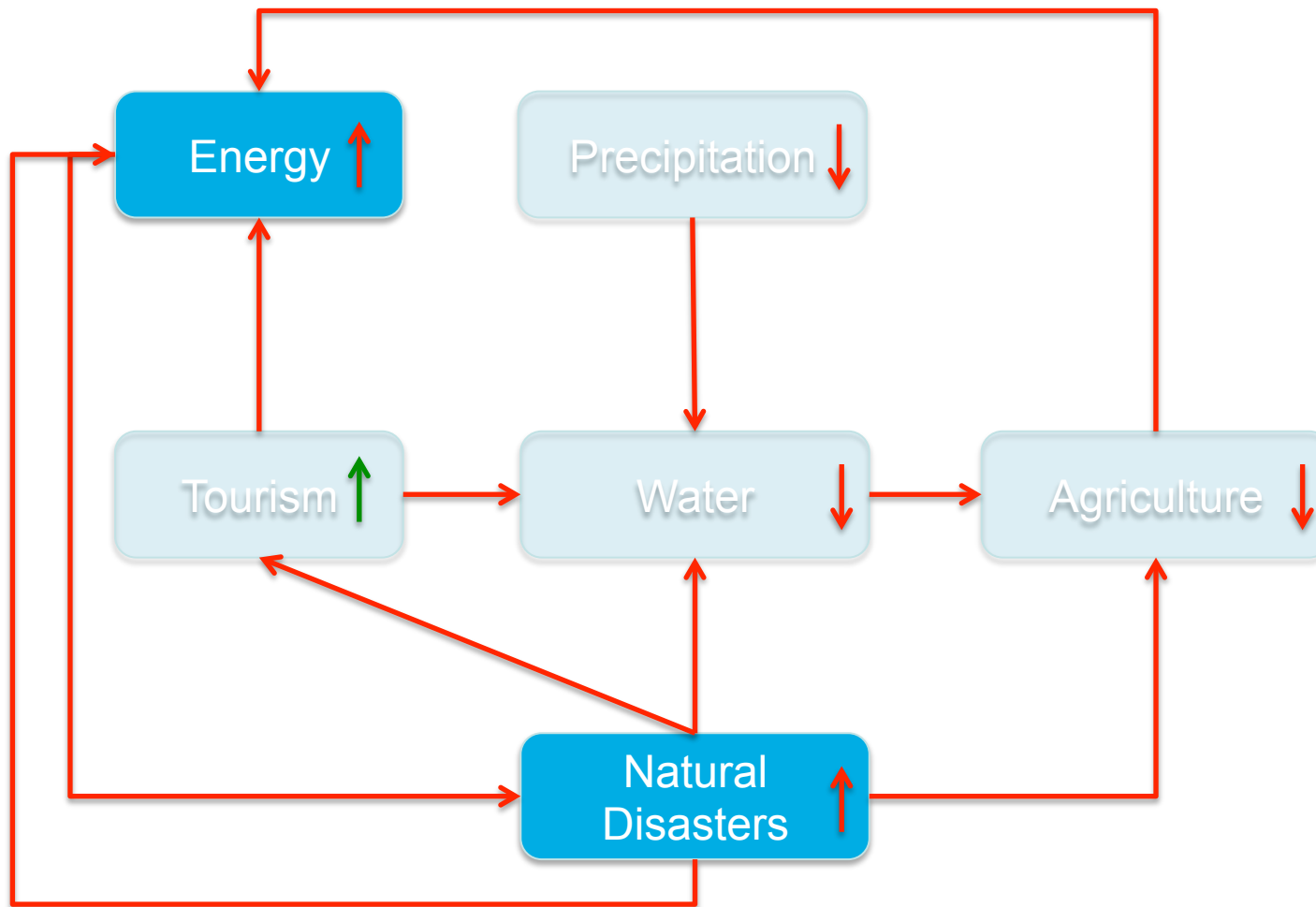


Learning from FiT (EEG)

- **Better control, more efficiency and higher innovation cycles of technology**
 - Germany: offshore wind power plants are a 'must!' (altitude of hubs > 100 meters)
 - Participation of adjustable renewable energy producers (biomass, Bagasse) to enhance system stability
 - Special research focus to energy storage facilities
 - Deeper level of system integration
- **Investment protection**
- **Increase cost efficiency**
- **Reduction of bureaucracy**
- **No PVs and wind farms in critical habitats** like nature reserves and national parks



Agenda - next Topic





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Commission on Civil Protection of the German Federal Government

- At the suggestion of the physicist Werner Heisenberg, the Protection Commission was founded in 1951
- Independent scientists should provide advice to the Federal Ministry of the Interior in all questions related to the defence against terror attacks, natural disasters, large-scale accidents and other geopolitical threads, which could occur to German citizen



Schutzkommission
beim Bundesministerium
des Innern



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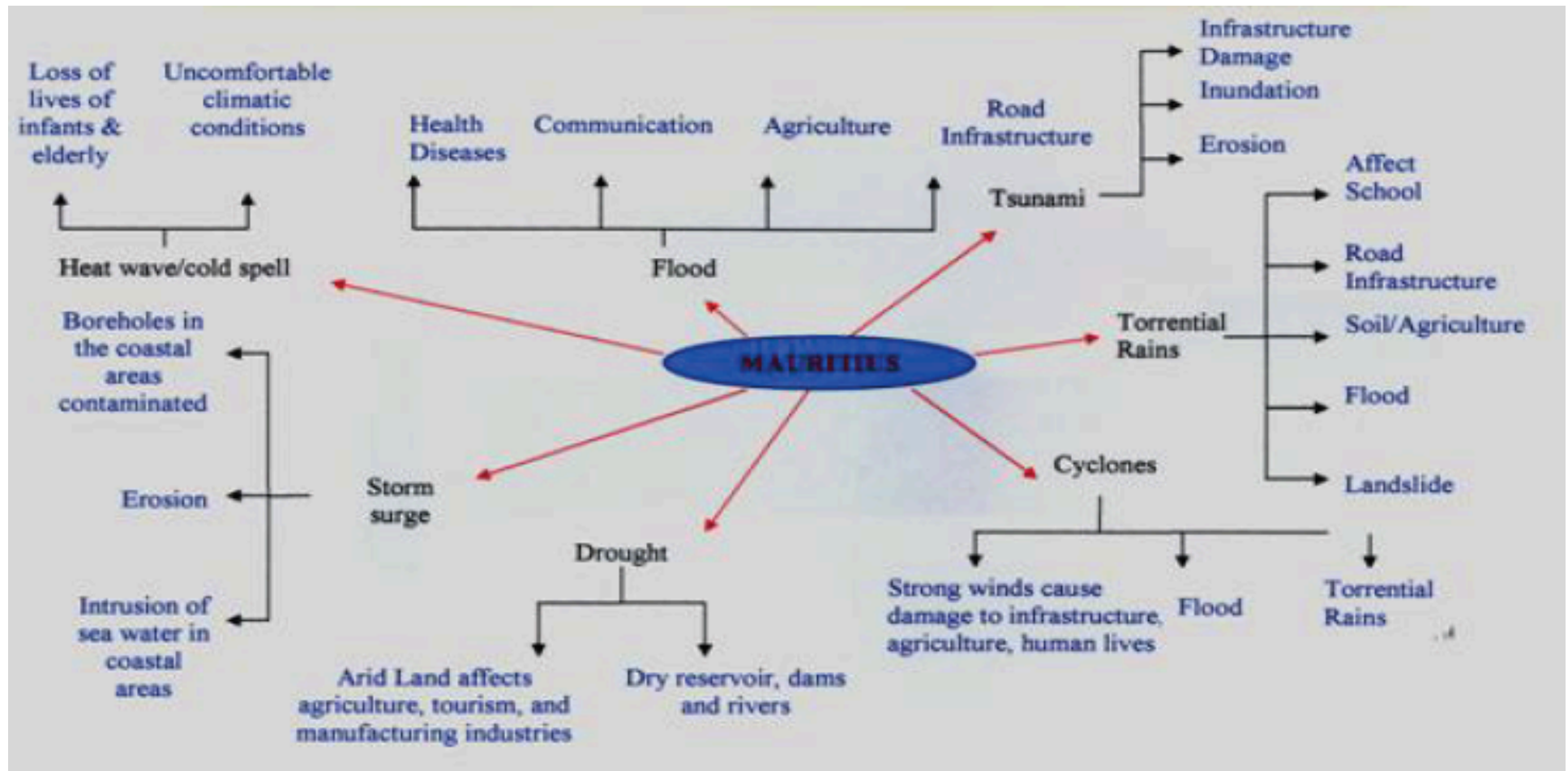


Main Research Topics related to CC

- Primary adverse health effects by heat waves, flash floods, drought, cyclones etc.
- 'New' infectious diseases (or faster distribution) by changing environments
- Droughts and crop shortfall destabilise social structures
- Mass migration of climate refugees



Natural Disasters affecting Mauritius





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Key Vulnerabilities due to CC

- Safety and Health of the people
- Water and food
- Supply of Energy



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German CC Adaption Strategy

- Key Objectives:
 - Identify groups of people, geographic regions and critical infrastructures that are most vulnerable to CC
 - Enhance environmental stability to absorb natural disasters
 - Inform the German people about potential risks and strength their resilience
- Next Steps:
 - Define specific action plan
 - Intensify interdisciplinary dialog and research
 - Monitor changes (water level, unusual diseases, frequencies of hazards etc.)
 - Use of innovative ICT to develop more sophisticated knowledge-based information and interactive eLearning systems (Serious Games)

Information and Communication is key!



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Conclusions



1. Compose an integrated, multi-scale, interdisciplinary **CC adaption policy for Mauritius** that provide clear guidelines for integration and implementation of strategies, programmes and activities
2. Does a '**Commission of Civil Protection of the Republic of Mauritius**' make sense?
3. Fight complexity (and feedback-loops) by extended use of **simulation models**
4. Take over **Leadership** (for other SIDS, for Africa)
5. **Win the people** (of Mauritius)
 - Higher education
 - Intensified use of ICT (social media, eLearning etc.)
 - Transfer experience (in and out) / effective communications



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Thank you for your attention!

Prof Thomas Thiel-Clemen
Hamburg University of Applied Sciences
thomas.thiel-clemen@haw-hamburg.de



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