Wir schaffen Wissen – heute für morgen

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Vergleichende Risikobewertung von Technologien zur Stromerzeugung

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1. Overall Framework for Energy Systems Analysis
2. Risk-relevant Criteria and Indicators
3. Severe Accidents in the Energy Sector
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5. Comparative Assessment of Severe Accidents
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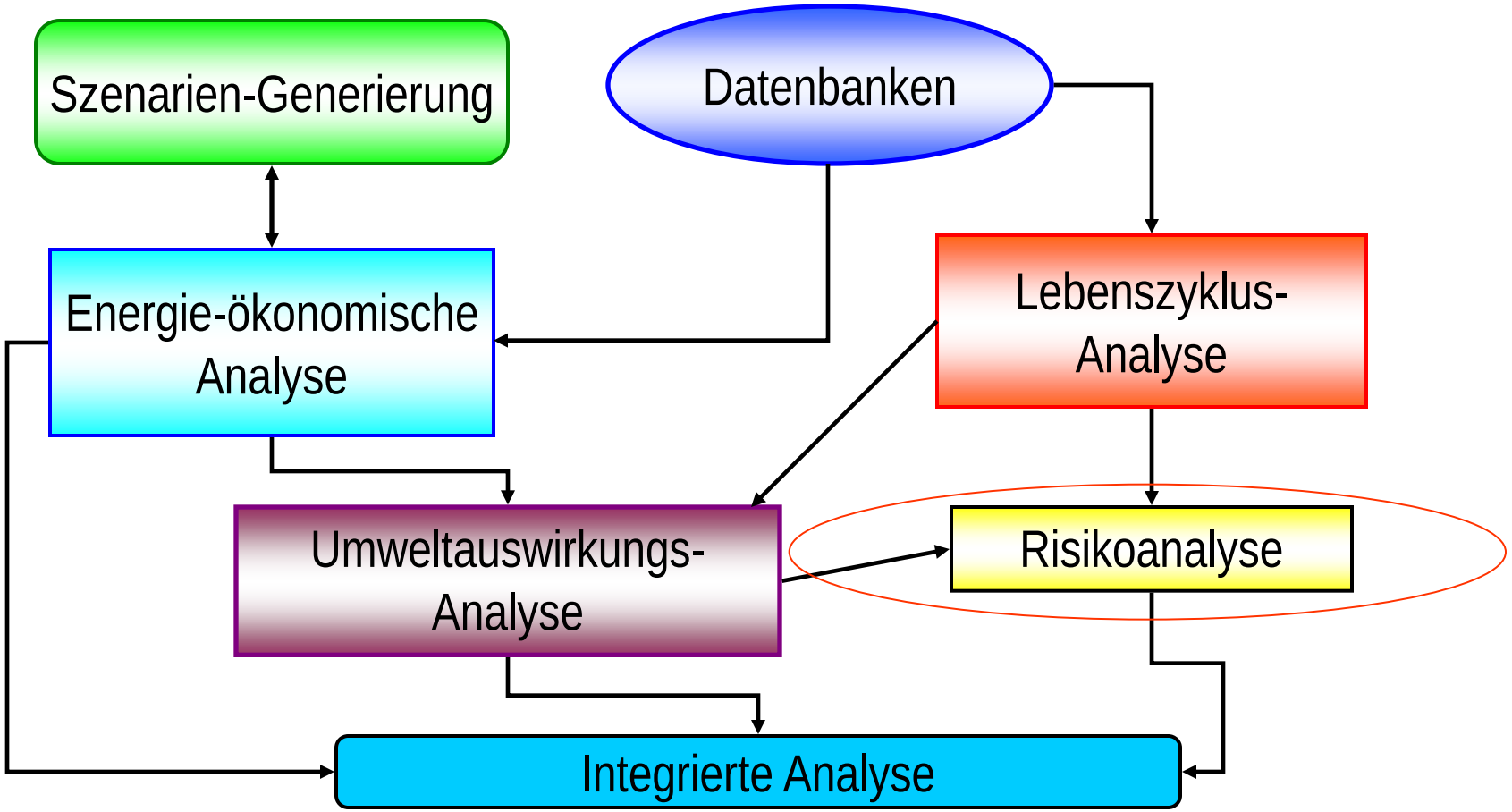
Integrierte Energiesystem-Analysen am PSI



Various Types of Risks in the Energy Sector

Import dependency
→ no/little diversity, transit countries

Availability risks
→ geopolitical, short- and/or long-term limitations

Uncertainty over liberalization
→ slow down of investments

Rising and volatile prices
→ domestic social/political issues

Regulatory risks
→ flawed regulations

Overall stability and reliability of the supply system → resilience

Climate change risks
→ environmental and health risks

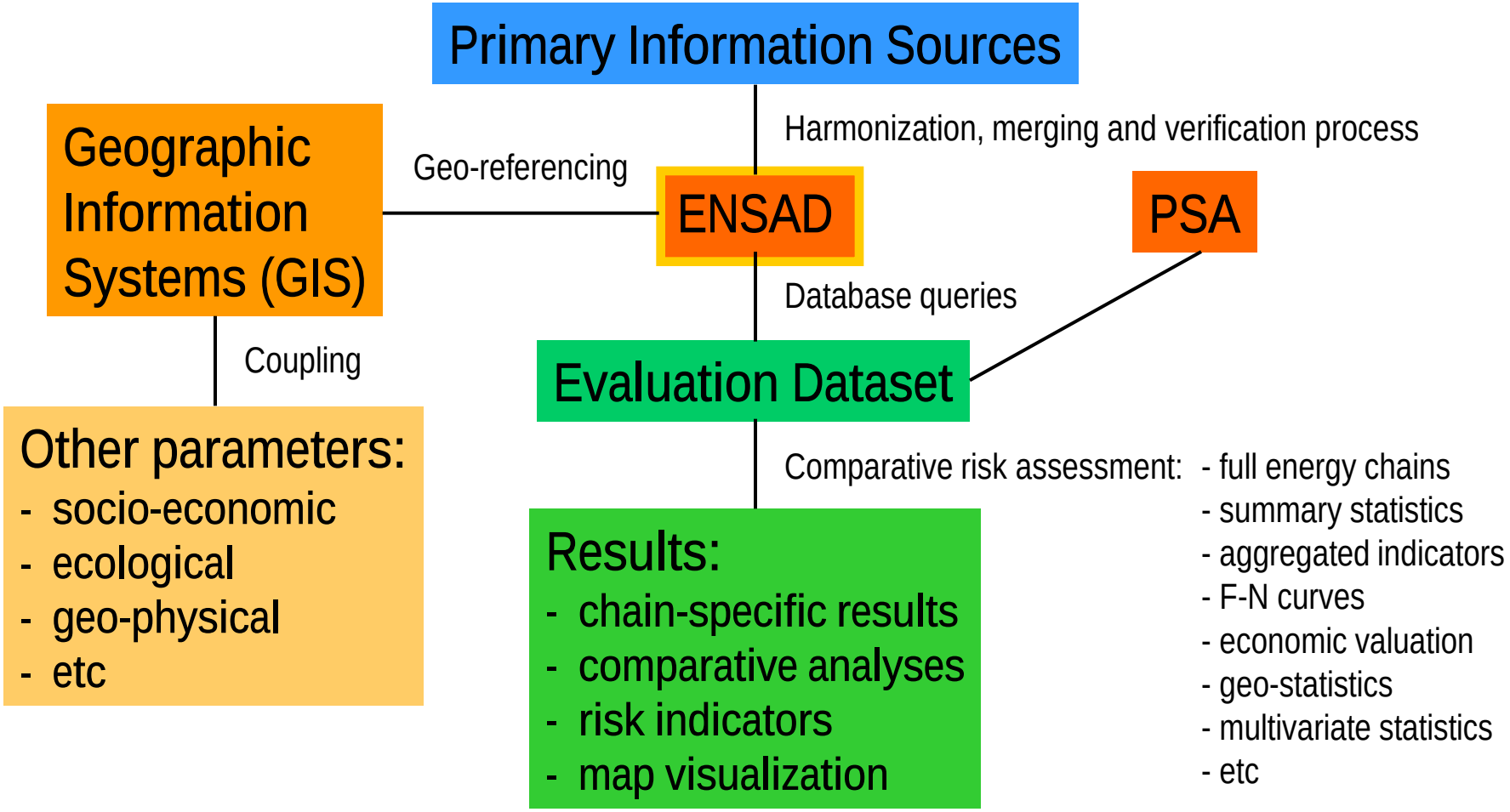
Severe accidents

Vandalism, sabotage and terrorist threat

} Comparative Risk Assessment
→Accident Database ENSAD
→PSA

Energy Infrastructure Accidents - Technological

Methodological Framework



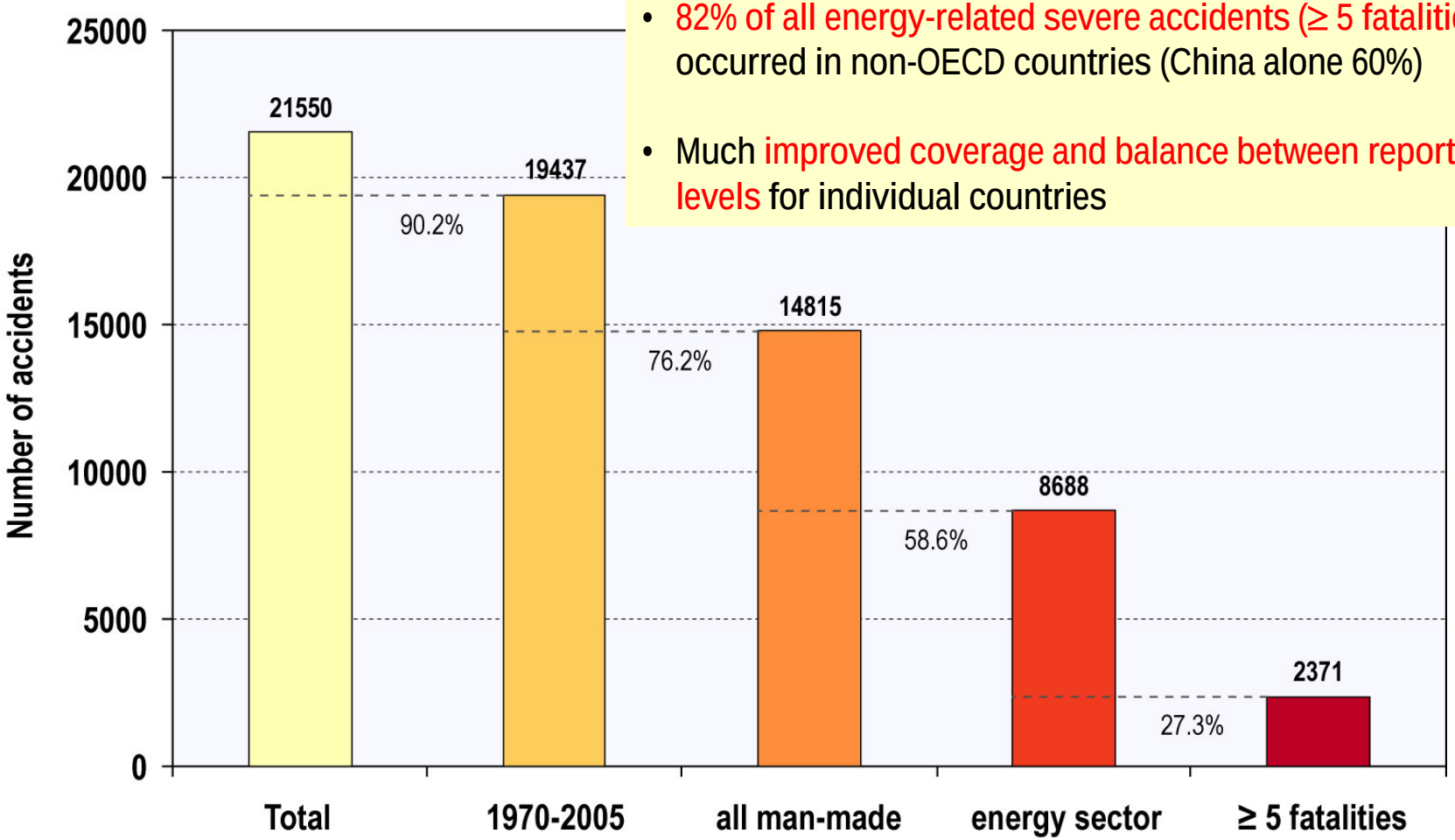
Severe Accident Definitions

Consequence indicator	ENSAD	Sigma	EM-DAT	NatCat	WOAD
Fatalities	≥ 5	≥ 20 (dead or missing)	≥ 10	> 20	≥ 1
Injured persons	≥ 10	≥ 50	aff.	-	-
Evacuees	≥ 200	≥ 2000 (homeless)	aff.	-	-
Extensive ban on consumption of food	yes	-	-	-	-
Release of hydrocarbons	≥ 10000 t	-	-	-	≥ 1000 t
Enforced clean up of land and water area	≥ 25 km^2	-	-	-	-
Economic loss	≥ 5 million USD(2000)	≥ 82.2 million USD(2007)	-	> 50 million USD (2007)	-

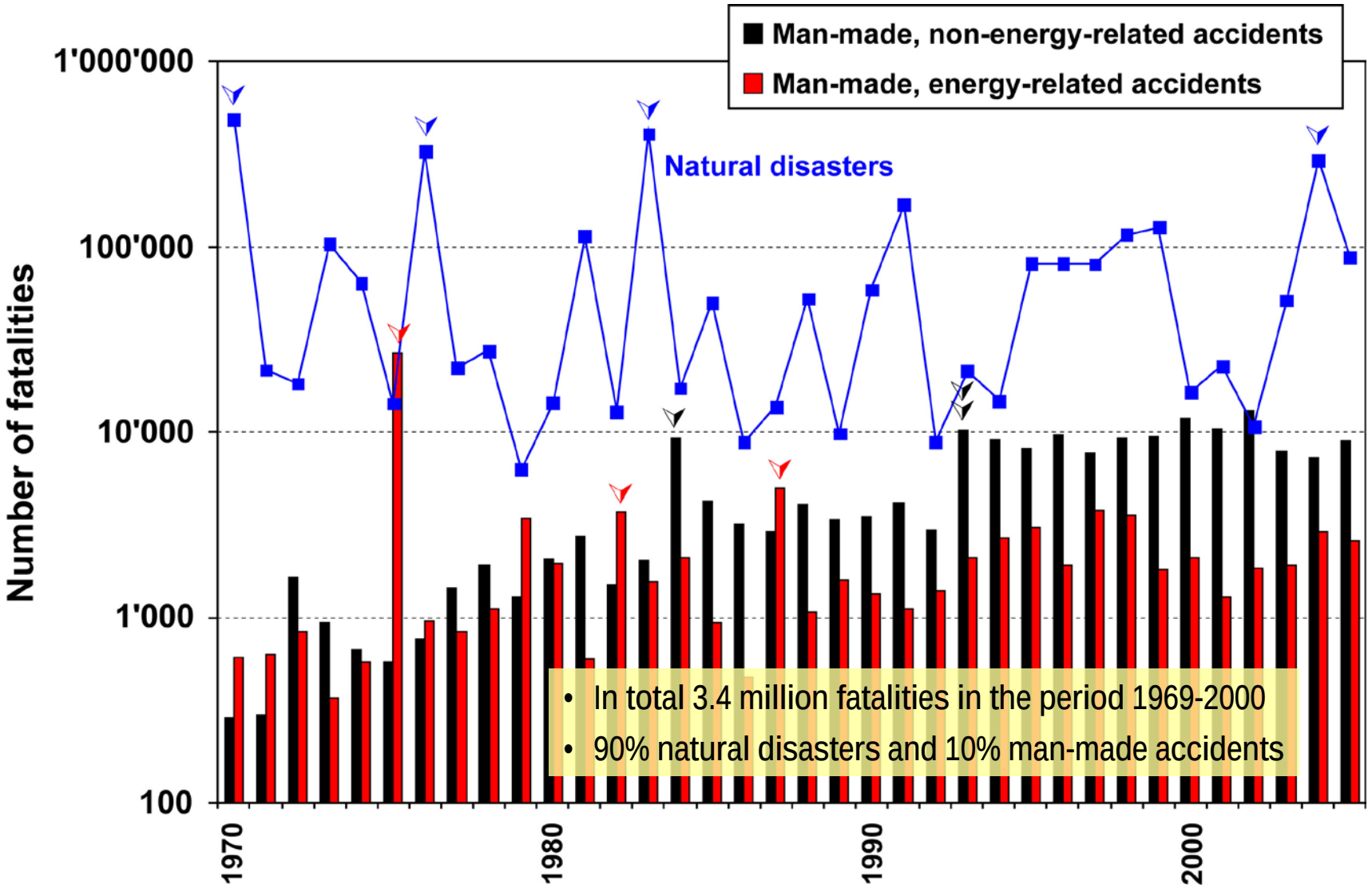
Sigma: sigma insurance research (Swiss Re)
EM-DAT: The International Emergency Disasters Database (Centre for Research on the Epidemiology of Disasters, CRED)
NatCat: Natural Catastrophes Service (Munich Re)
WOAD: Worldwide Offshore Accident Databank (Det Norske Veritas, DNV)

ENSAD and its Merits

- 82% of all energy-related severe accidents (≥ 5 fatalities) occurred in non-OECD countries (China alone 60%)
- Much improved coverage and balance between reporting levels for individual countries



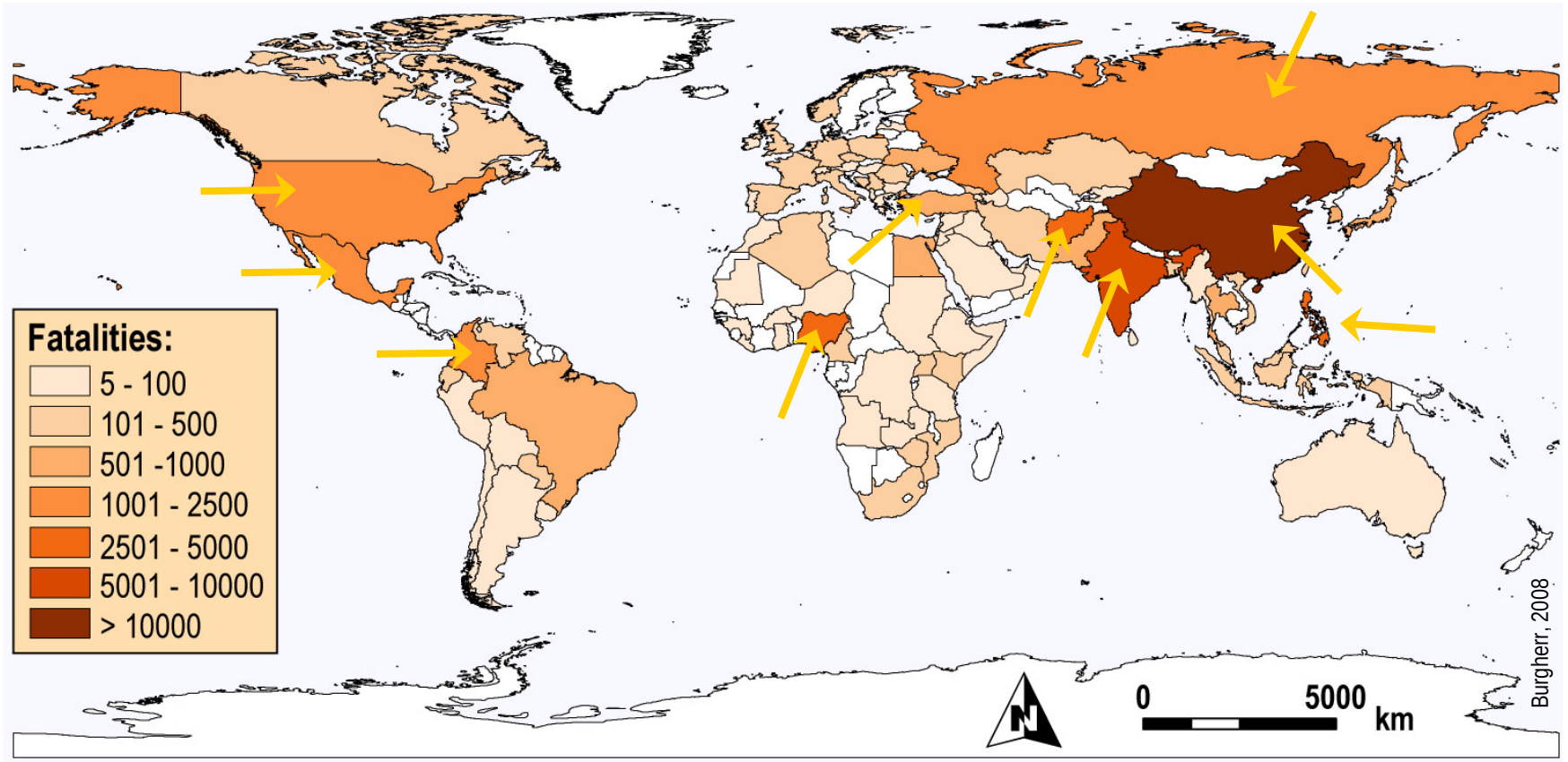
Severe Accidents and Natural Disasters



Relative share of accidental fatalities in the stages of various energy chains

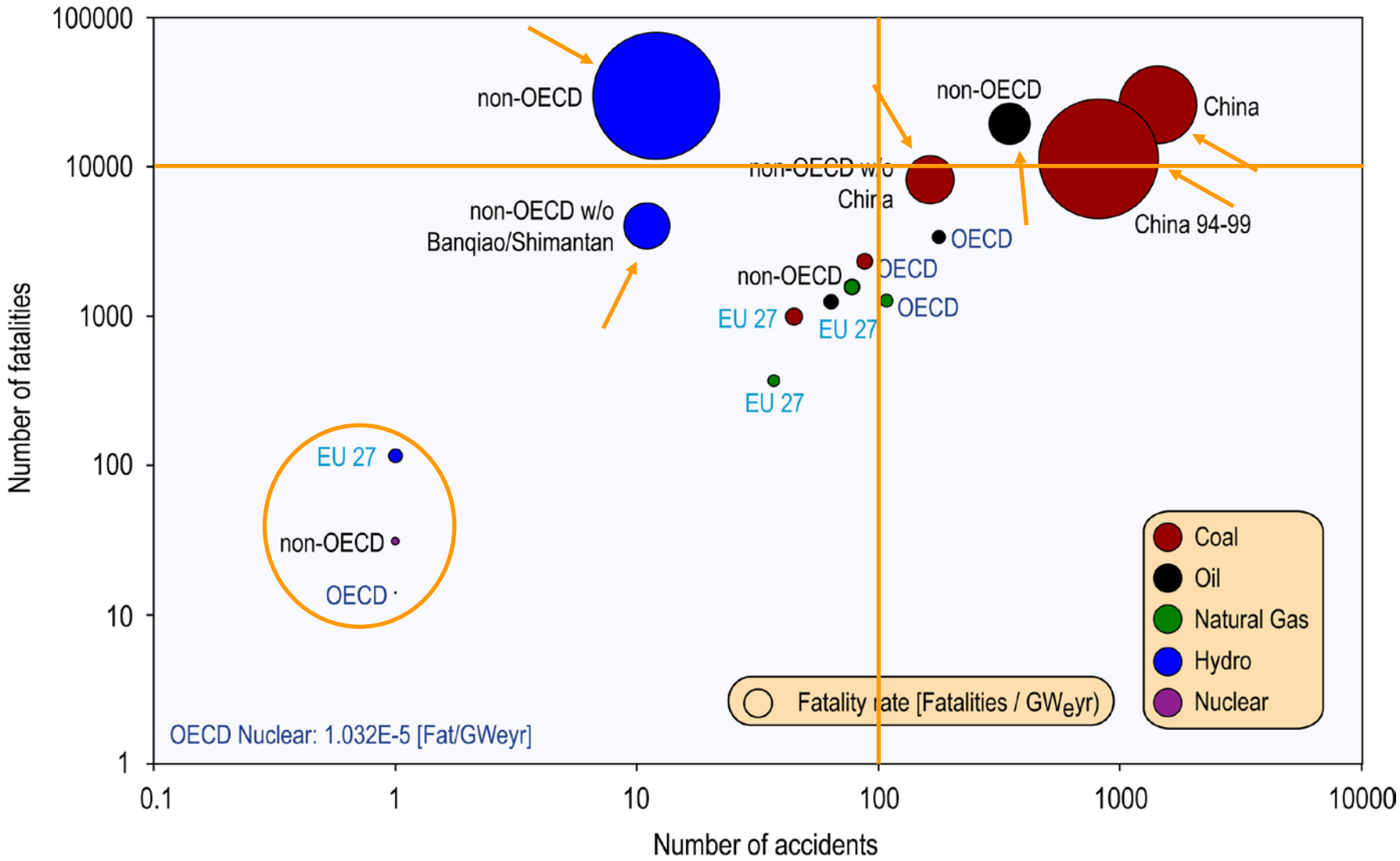
	Coal	Oil	Natural Gas	Hydropower	Nuclear
Exploration and production/ processing	Explosions and fires in coal mines	Well blowouts, accidents on drilling platforms at sea.	Well blowouts, accidents on drilling plat-forms at sea.		
Transportation		Tanker accidents at sea	Pipeline accidents		
Processing/ storage		Process acci-dents in refineries and tank farms			
Regional/ local division		Overturning and collisions of tank trucks	Pipeline accidents		
Powerplant or heat production			Process accidents	Overflow or failure of storage dams	Core meltdown with large release of radio-activity
Waste treat-ment/disposal					
	0 – 5 %	5 – 15 %	15 – 30 %	30 – 60 %	60 – 100 %

Worldwide Distribution of Severe Accidents



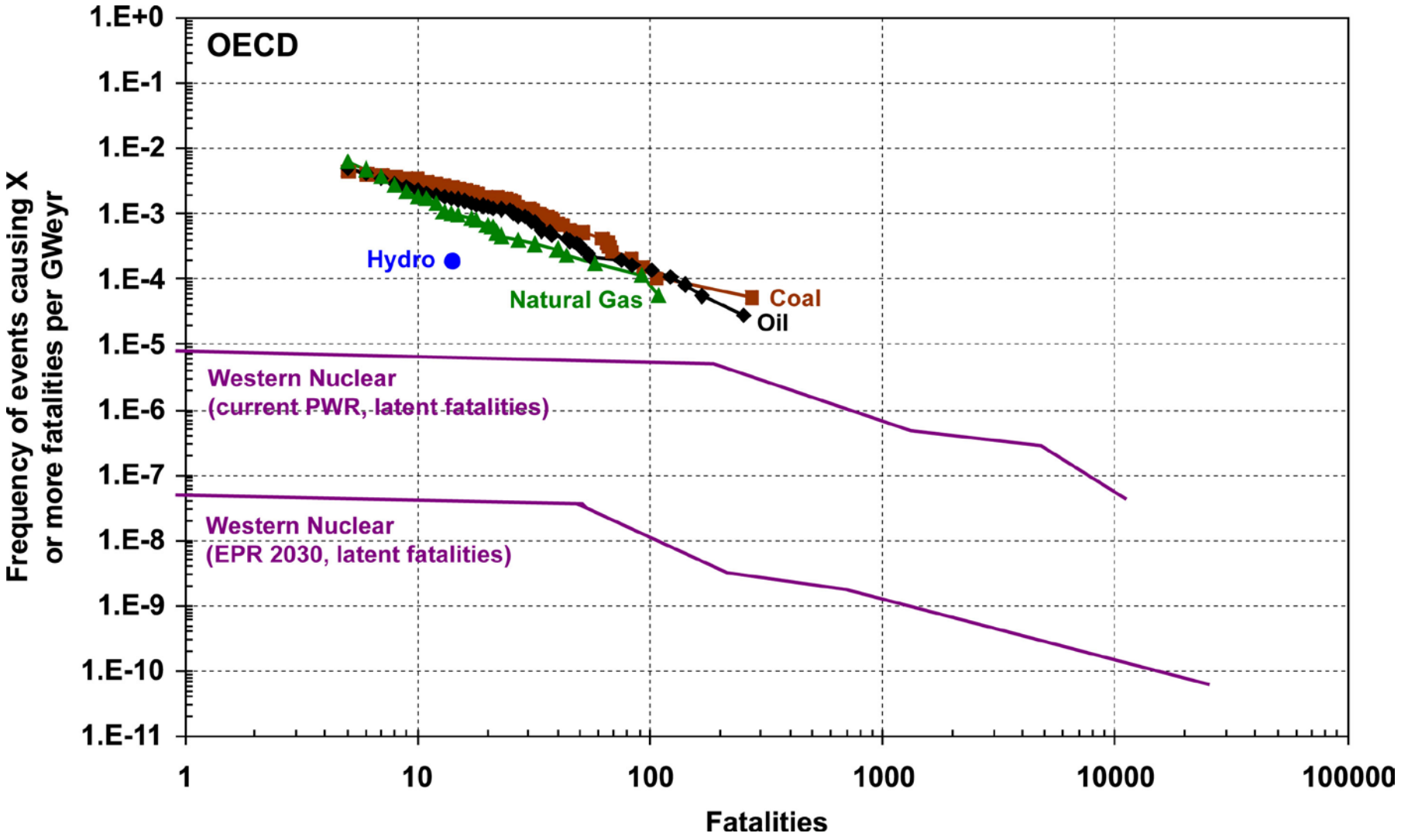
- China: almost 52000 fatalities; about 24450 in coal mine accidents; 26000 in Banqiao/Shimantan dam failure
- Philippines, Afghanistan, Nigeria, India, Mexico, Russia, Turkey and Colombia: single very deadly accidents
- USA: only few accidents with more than 50 fatalities

Aggregated Indicators (1970-2008)

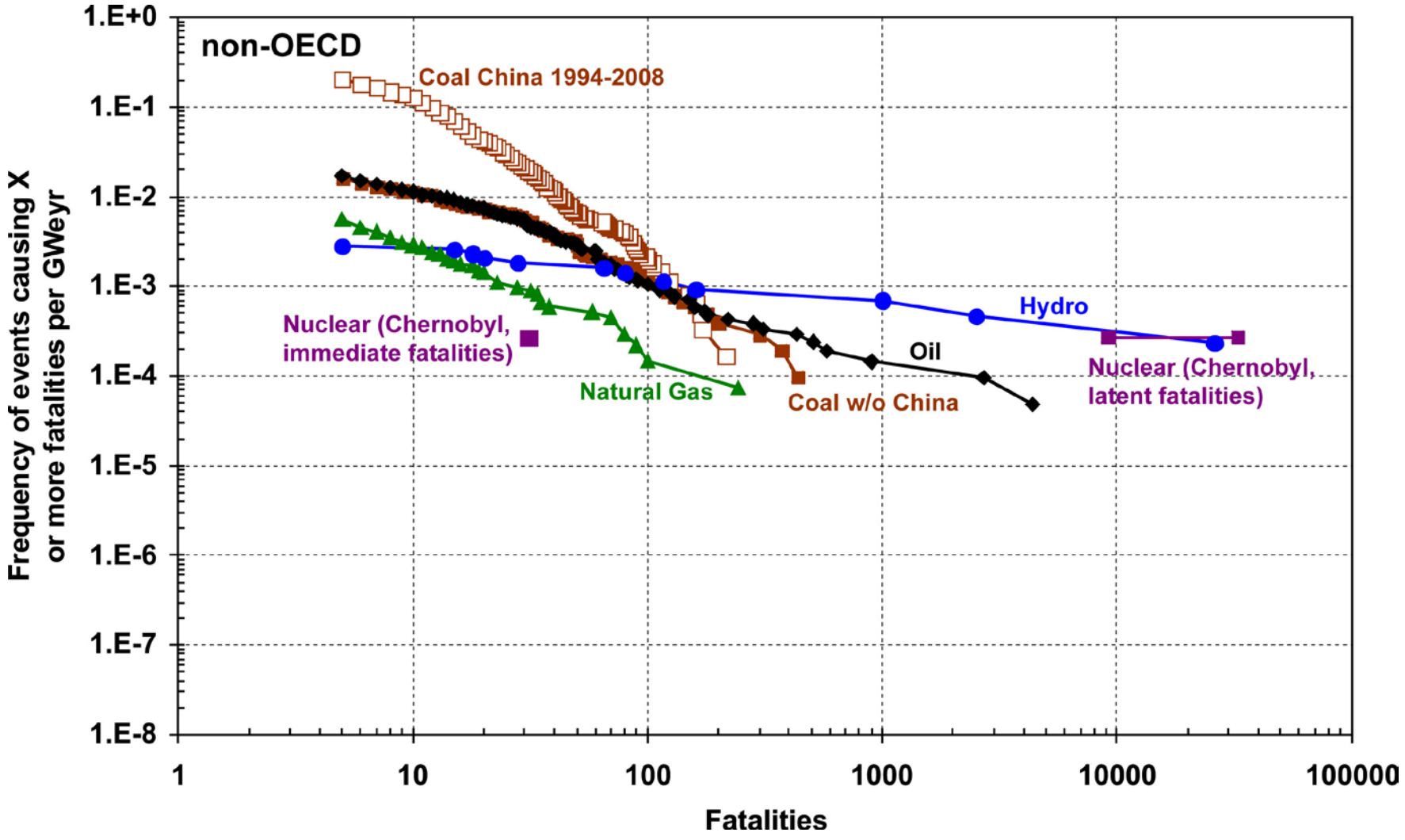


Burgherr et al., 2010

Frequency-Consequence Curves: OECD (1970-2008)



Frequency-Consequence Curves: non-OECD (1970-2008)

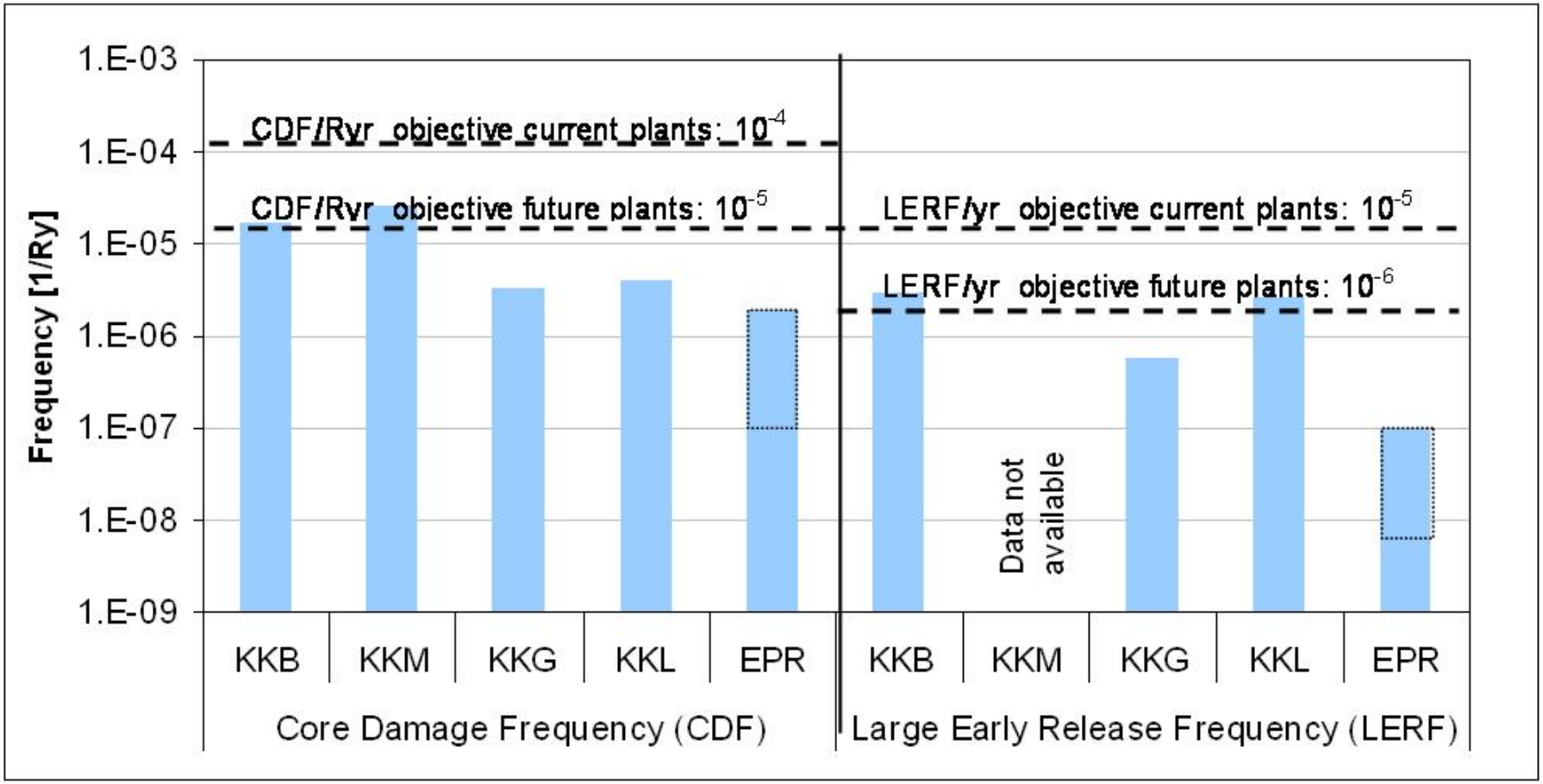


Contribution to SFOE Energy Perspectives 2050

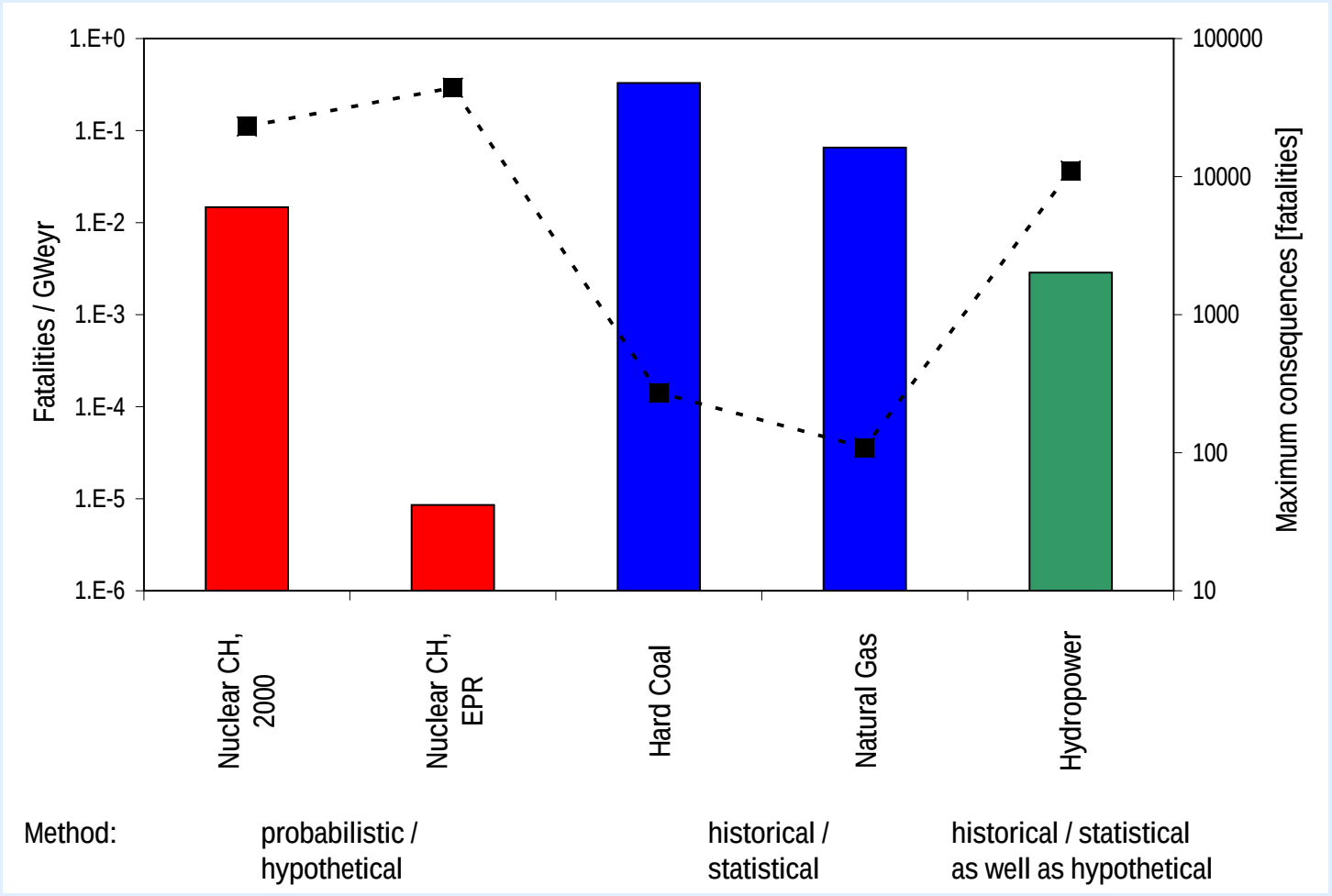
Bewertung aktueller und zukünftiger Kernenergietechnologien
Erweiterte Zusammenfassung des Berichts „Current and Future Nuclear Technologies“

Stefan Hirschberg[1], Petrissa Eckle[1], Christian Bauer[1], Warren Schenler[1], Andrew Simons[1]
Oliver Köberl[2], Jörg Dreier[3],Horst-Michael Prasser[4] und Martin Zimmermann[2]

Risks indicators for current Swiss NPPs and EPR



Severe Accident Risks (≥5 fatalities)



Conclusions: Severe Accidents

- The ENSAD database and PSA provide the quantitative basis for comparative risk assessment of severe accidents in the energy sector.
- Damages due to severe accidents in the energy sector are relatively small in comparison with natural catastrophes.
- Energy-related accident risks in OECD and EU 27 countries are substantially smaller than in non-OECD countries.
- Most accident-prone are fuel extraction, refining and transportation in fossil chains, and hydropower in the less developed (non-OECD) countries.
- Expected fatality rates are low for western hydropower and nuclear power plants with high safety standards. However, the maximum consequences can be very large. The associated risk valuation is subject to stakeholder value judgments and can be pursued in multi-criteria decision analysis.
- External costs associated with severe accidents are generally much smaller than monetized damages caused by air pollution.

„Accidents happen. In fact, accidents are what life is about.“

Tom Peters – „The Pursuit of Wow“

- Annual fatalities due to shark attacks world-wide: 10
- Annual fatalities due to falling coconuts world-wide: 150

"The nature doesn‘t know catastrophes, only men know catastrophes, as far as having survived them.“
(Max Frisch, writer and philosopher)

Thank you for your attention!

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