

**What will the nuclear industry say
when things go wrong ?**

S[☢]orry ?

Nuclear Liabilities: The uninsured risk

**Jan Vande Putte, Greenpeace Belgium
AEEC, November 23rd 2009**

Sorry

1. A Broad View:

- International Framework
- link with Stranded Benefits

A broad view: limited liability

“The limitation of the amount of his liability
Is clearly designed as an
Advantage for the operator,
In order not to discourage
Nuclear-related activities”

(IAEA, Explanatory text to the Vienna Convention)

A broad view: the promotion of nuclear power

- **Atoms for Peace** (Eisenhower 1955):
“encourage world-wide investigation into the most effective peacetime uses of fissionable material”
- **IAEA** (1957): Statute Art 2: *“The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world.”*
- **EURATOM** (1957): Treaty Art 1: *“...the speedy establishment and growth of nuclear industries”*
- **NPT** (1970): Treaty Art 4: *Parties to the Treaty ... shall co-operate in contributing ... to the further development of the applications of nuclear energy for peaceful purposes*

A broad view: impact of liberalisation

Pre-liberalisation (regulated market):

COST+ (regulated tariffs)

A contract: Conventions since 1955 (Belgium): “in the general interest”

A DEAL (although unfair):

- **COSTS:** Capital, O&M, Fuel + **liability** + waste + radiation dose
- **BENEFITS:** split between the utility and the society (consumers)

Liberalised market:

Competition, no direct link between costs and tariffs

A broken contract (Convention of 1955)

NO DEAL:

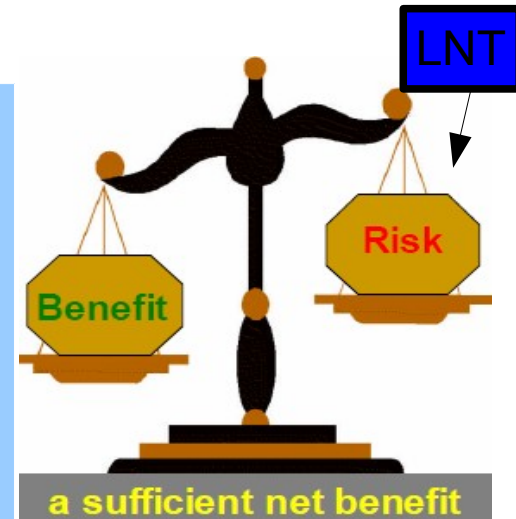
- **COSTS:** to the society (**liability**, waste, radiation dose)
to the utility (Capital, O&M, Fuel + **limited liability** & waste)
- **BENEFITS:** to the utility

The Three Pillars of Rad.Protection: (ICRP-60, EURATOM 96/29 “basic safety standards”)

JUSTIFICATION:

Net benefit to the society

ICRP 60: “no practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individual or to society to offset the detriment it causes”



OPTIMISATION:

ALARA : as low as reasonable achievable
'precautionary principle'

Limit or avoid if possible (even if very low)

LIMITATION: DOSE LIMITS:

(& Dose constraints)

Never exceed

A broad view: Summary:

4 types of 'Stranded Benefits':

- Capital Investment (accelerated depreciation)
- Limited liability
- Radiation dose
- Nuclear waste (delayed dose)

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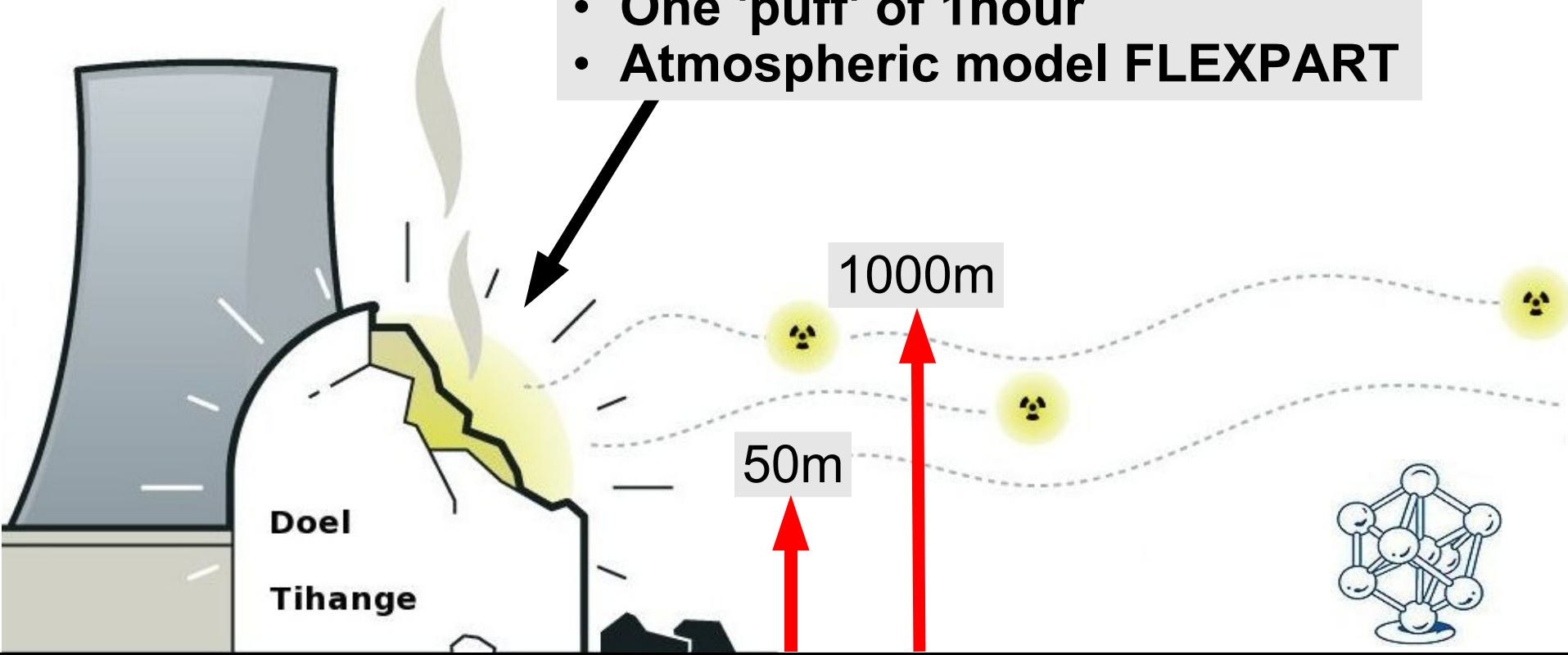
**2. Study:
Cs-137 contamination major
nuclear accident**

Study: dispersion of Cs-137 from a major nuclear accident

- **University of Vienna, BOKU**
- **Case studies: Doel 1, Doel 4 and Tihange 1**
- **Based on real meteorological data of 1995, representative for average wind conditions**
- **270 contamination maps (every 4days)**

Accident and release of radioactivity



- Core meltdown
- Open containment
- 50% of cesium released
- One 'puff' of 1 hour
- Atmospheric model FLEXPART

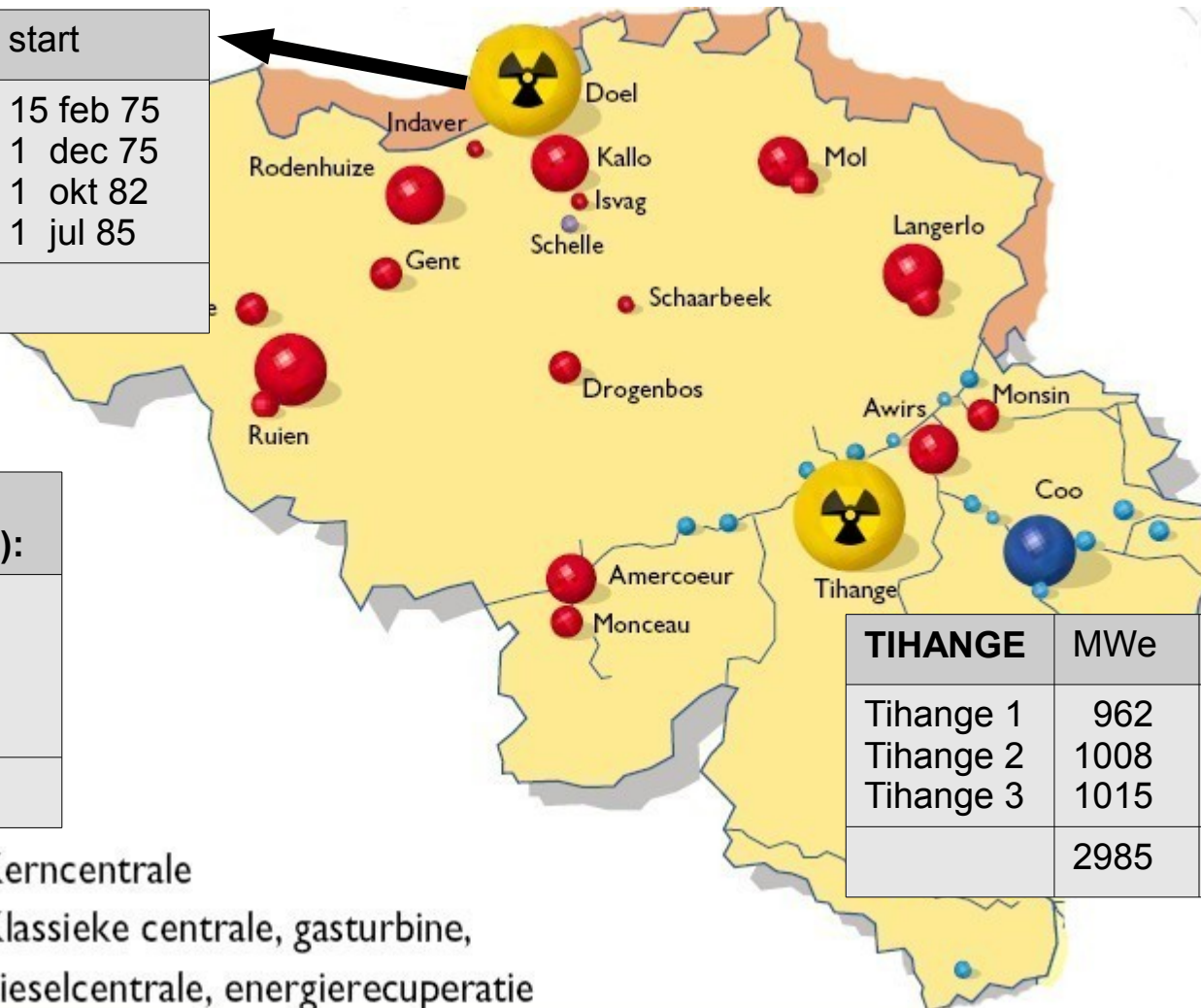


Electricity Plants in Belgium

DOEL	MWe	start
Doel 1	392	15 feb 75
Doel 2	433	1 dec 75
Doel 3	1006	1 okt 82
Doel 4	1008	1 jul 85
	2839	

Timing nuclear phaseout (law 2003):	
2015	1787
2022	1006
2023	1008
2025	2023
	5824

-  Kerncentrale
-  Klassieke centrale, gasturbine, dieselcentrale, energierecuperatie



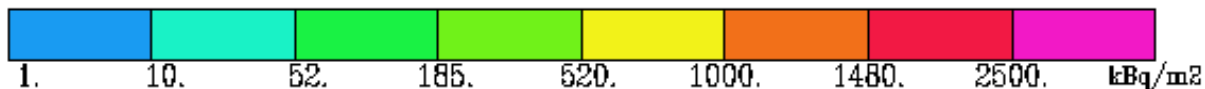
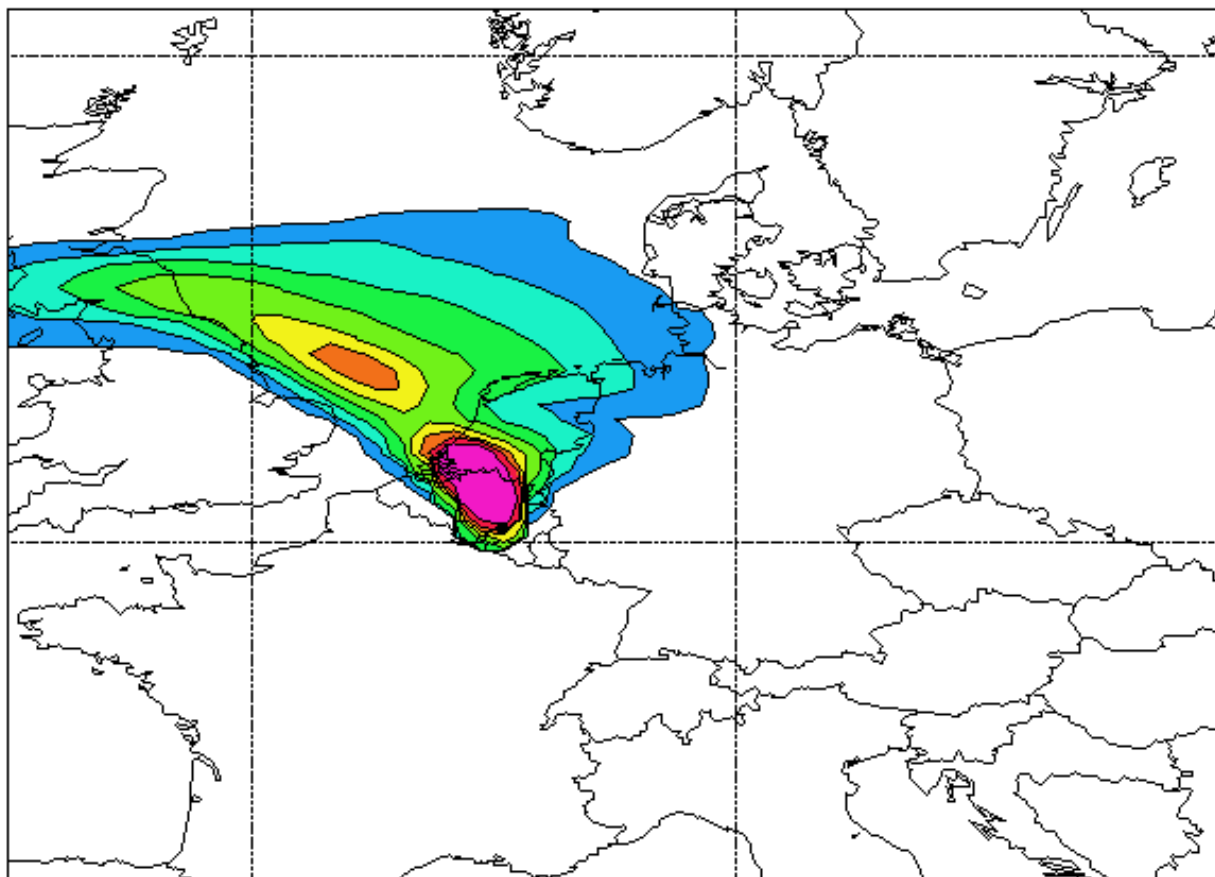
TIHANGE	MWe	start
Tihange 1	962	1 okt 75
Tihange 2	1008	1 feb 83
Tihange 3	1015	1 sep 85
	2985	

[source: Electrabel, IAEA, wet uitstap kernenergie]

Cs-137 deposition maps

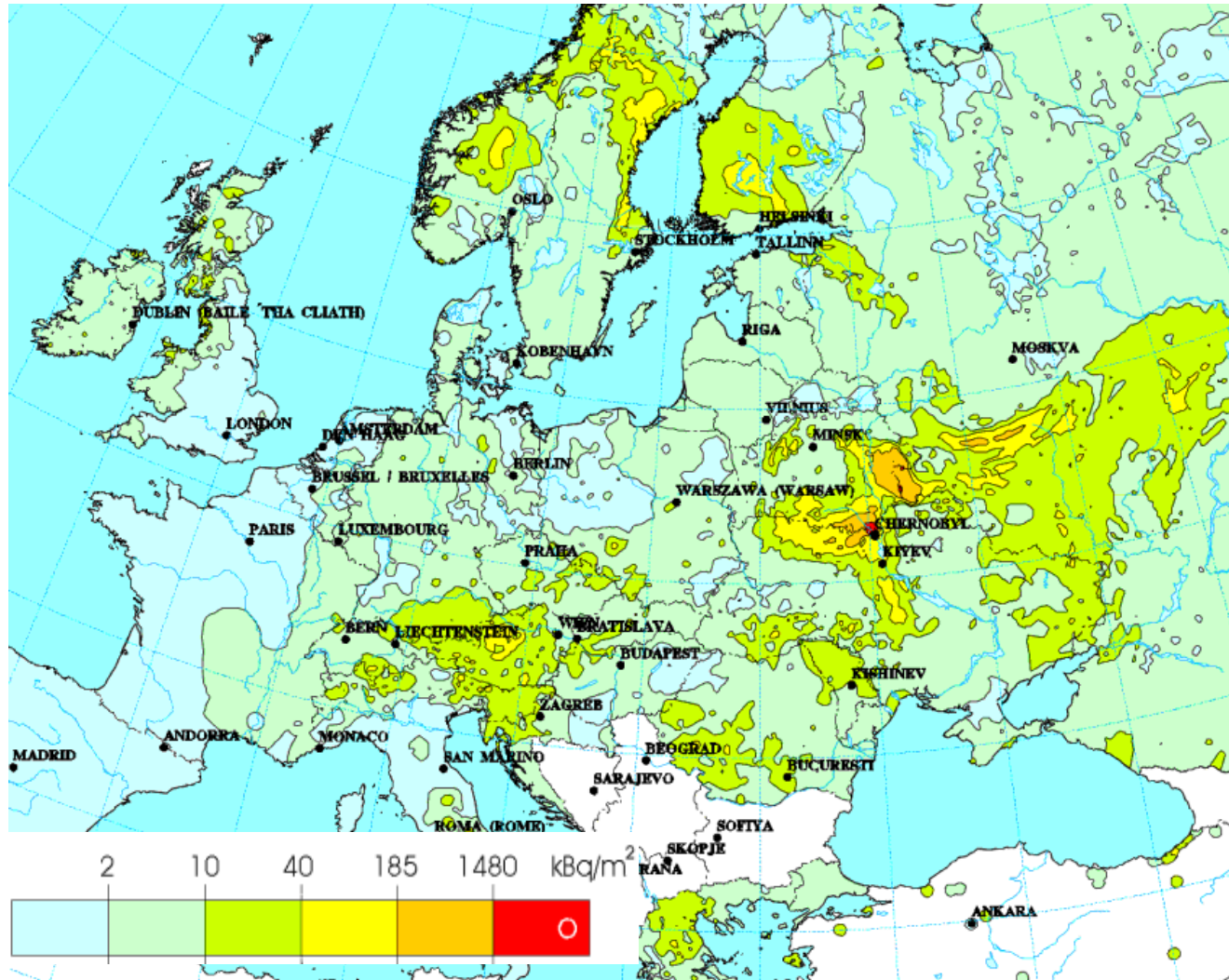
Tihange 1

tih 19951221 102353 Max= 12162

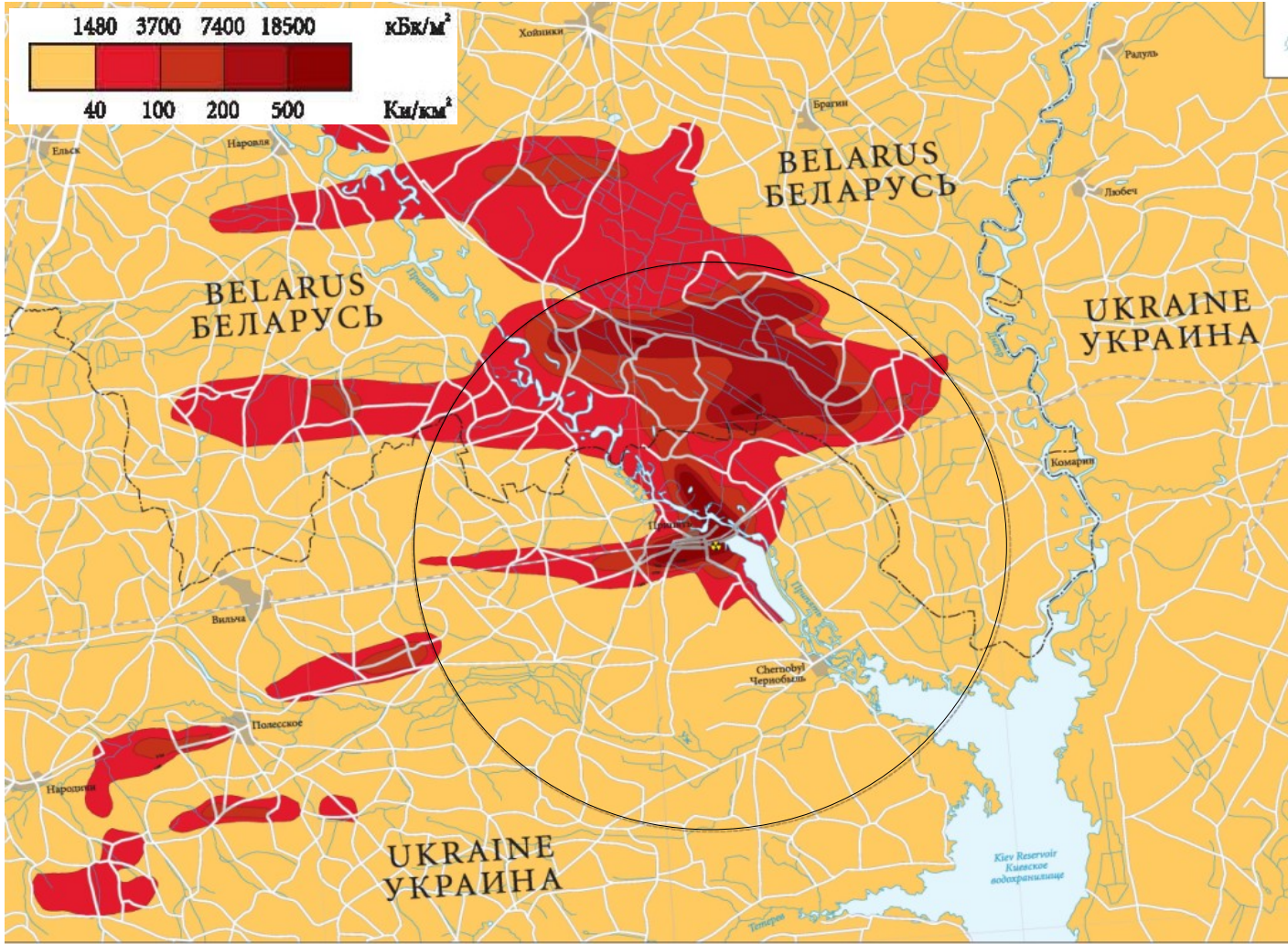


Cs-137 deposition maps





Chernobyl accident



Cs-137 deposition maps Chernobyl zone



Contamination zones:

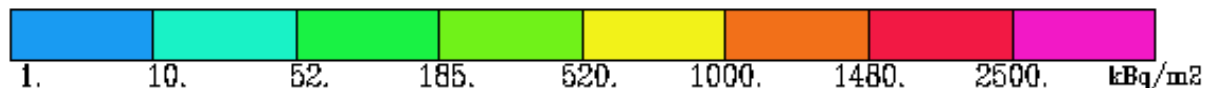
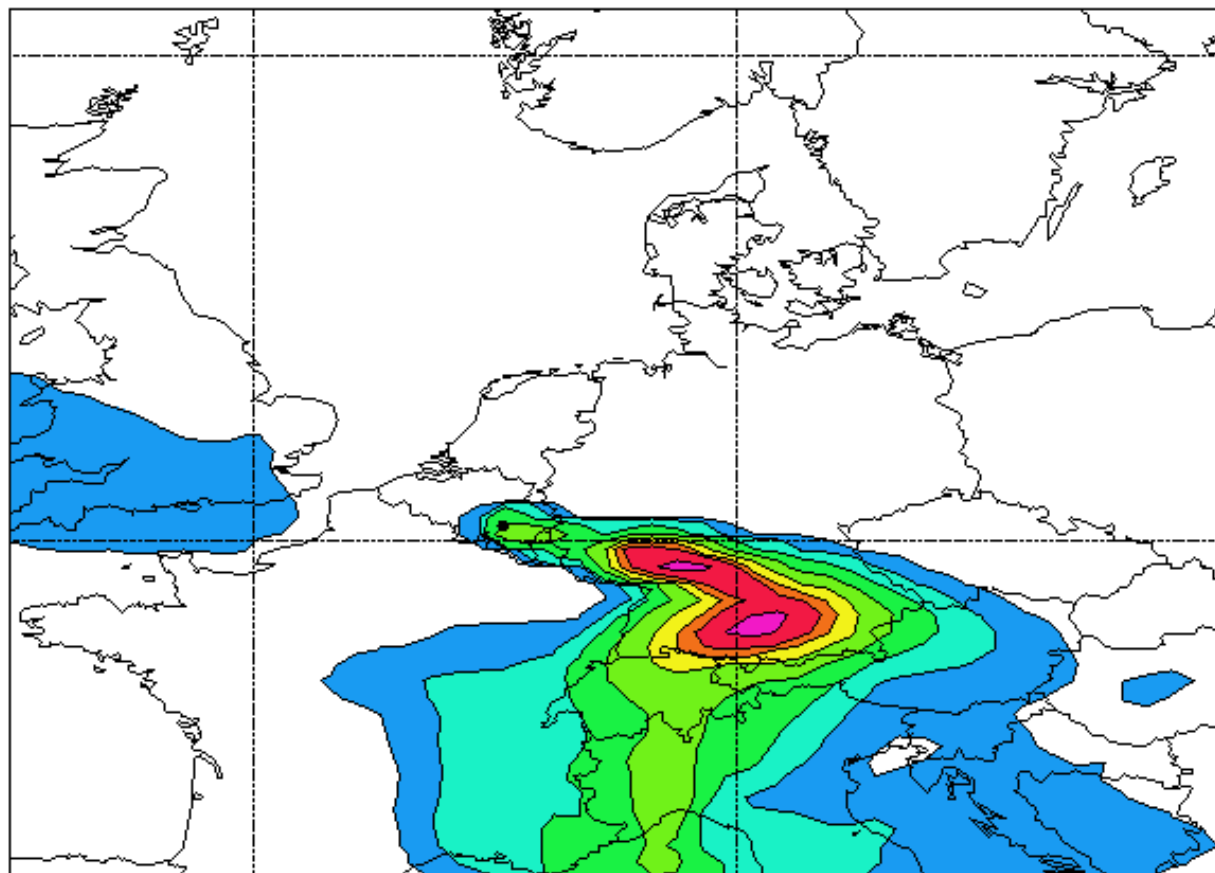
Summary of measures in Belarus, Ukraine, Russia [UNDP, 2002]	
Contamination density by ^{137}Cs (kBq/m ²)	designation of zones
37-185 	Zone of enhanced radiological control
185-555 	Right to resettle (if dose > 1 mSv/year)
555-1480 	Zone of secondary resettlement mandatory if dose > 5 mSv/year
>1480 	Zone of priority resettlement mandatory if dose > 5 mSv/year

Bron: UNDP, 2002

Cs-137 deposition maps

Tihange 1

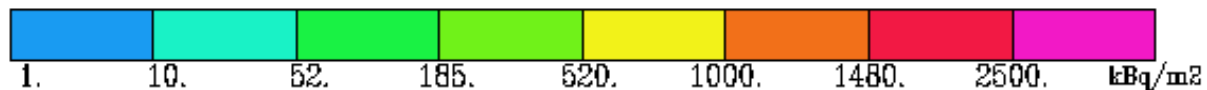
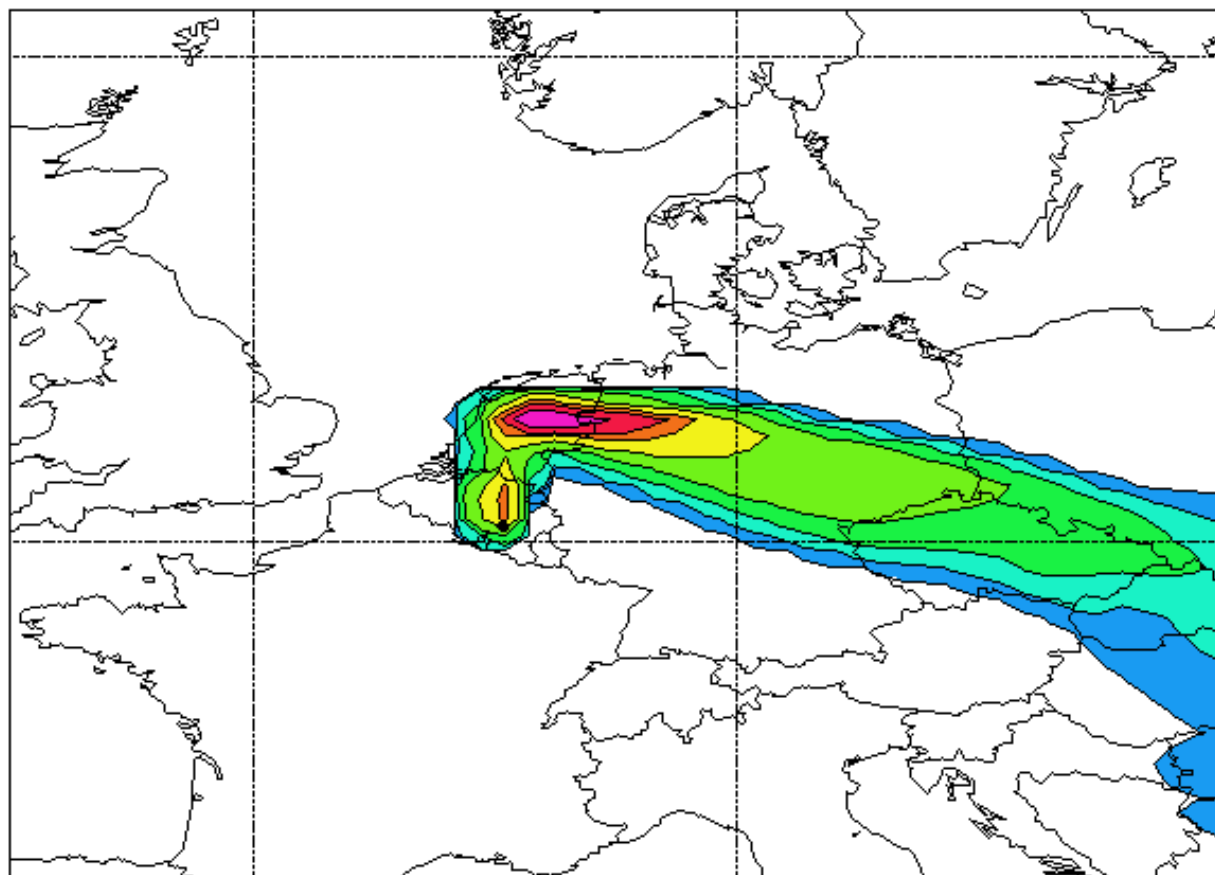
tih 19951225 115555 Max= 3052



Cs-137 deposition maps

Tihange 1

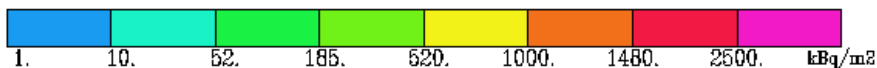
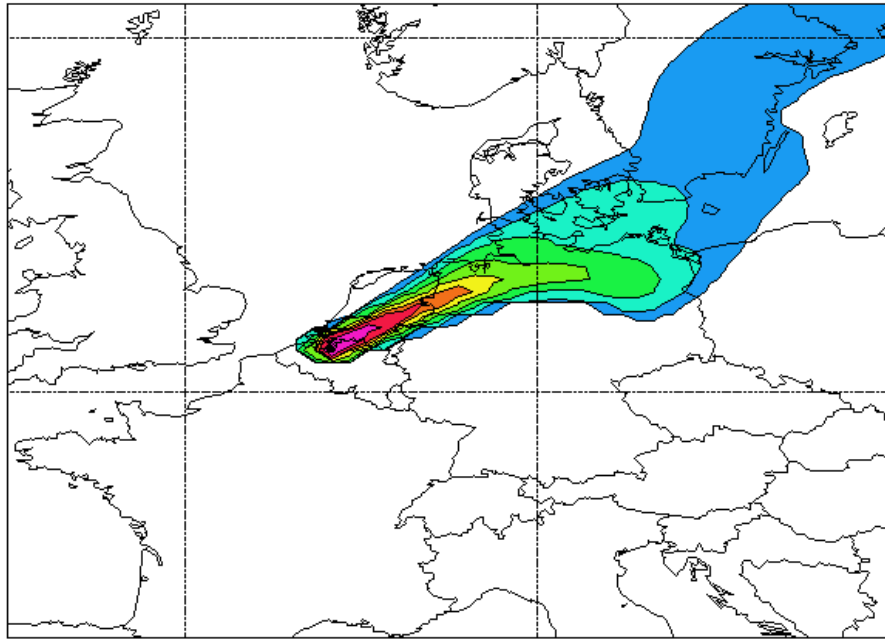
tih 19951217 085155 Max= 4122



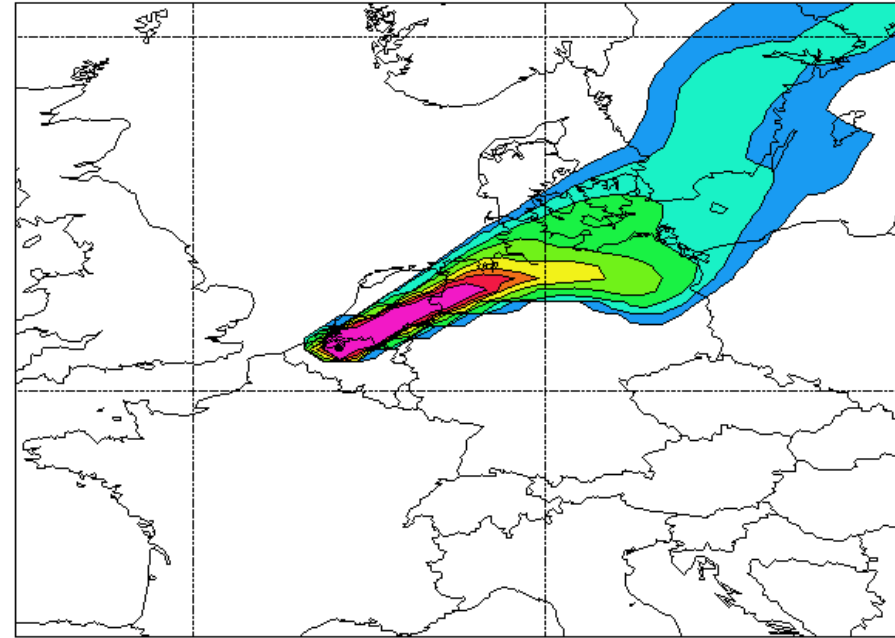
Cs-137 deposition maps

Doel 1 vs Doel 4

doel 19951005 051555 Max= 4653



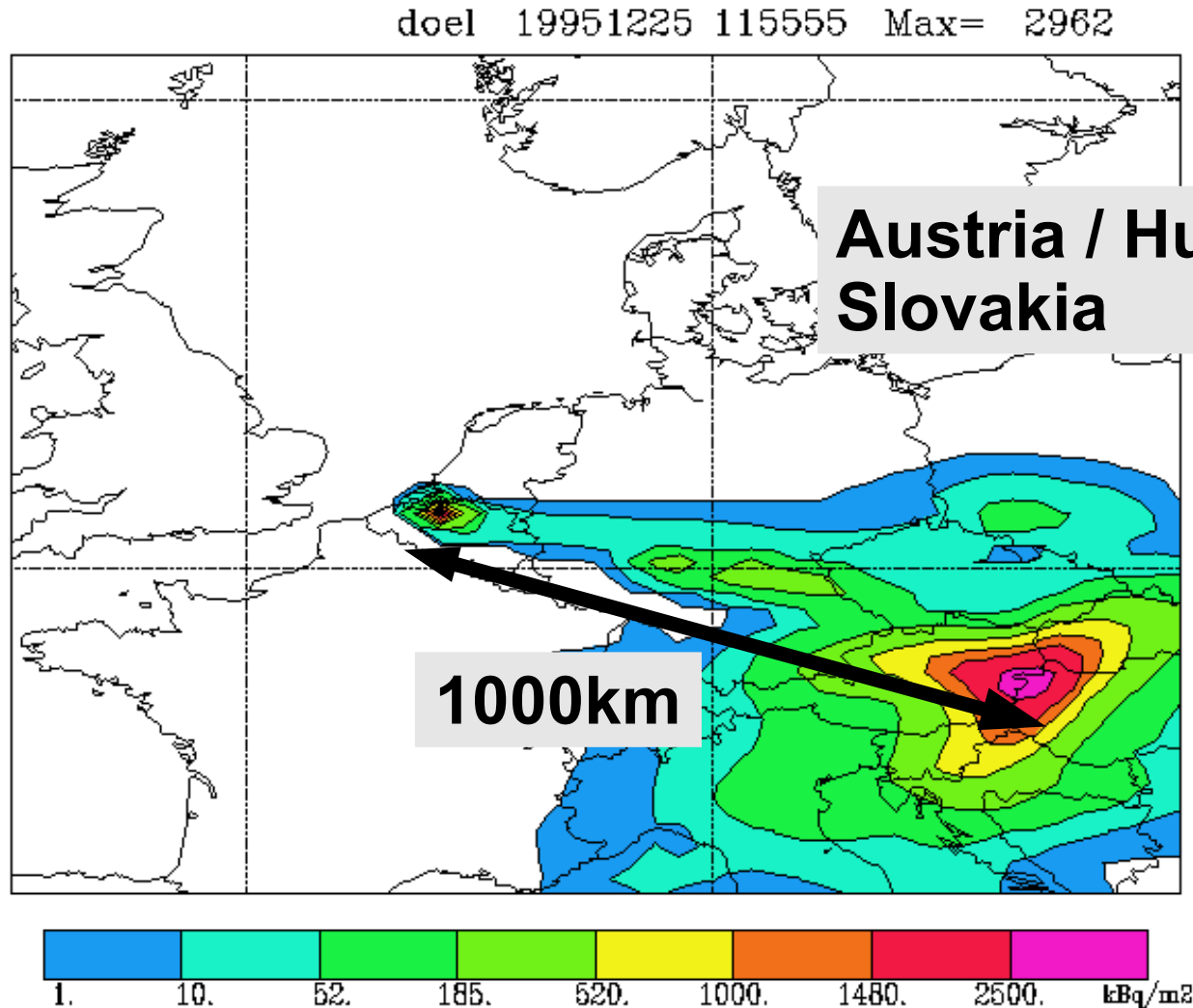
doel 19951005 051555 Max= 13880



**Source term of Doel 4 is 3x
higher than for Doel 1**

Cs-137 deposition maps

Doel 4



Main Conclusions

- An area as large as Belgium becomes inhabitable for decades
- Dominant West winds
- Tihange1: main risks for Liège, Namur, Brussels, Antwerp and Rotterdam
- Doel 1: main risks for Antwerp, but also for Brussels, Namur, Liège and Rotterdam
- A high risk for the Netherlands and Germany

Phase 1 of research project:

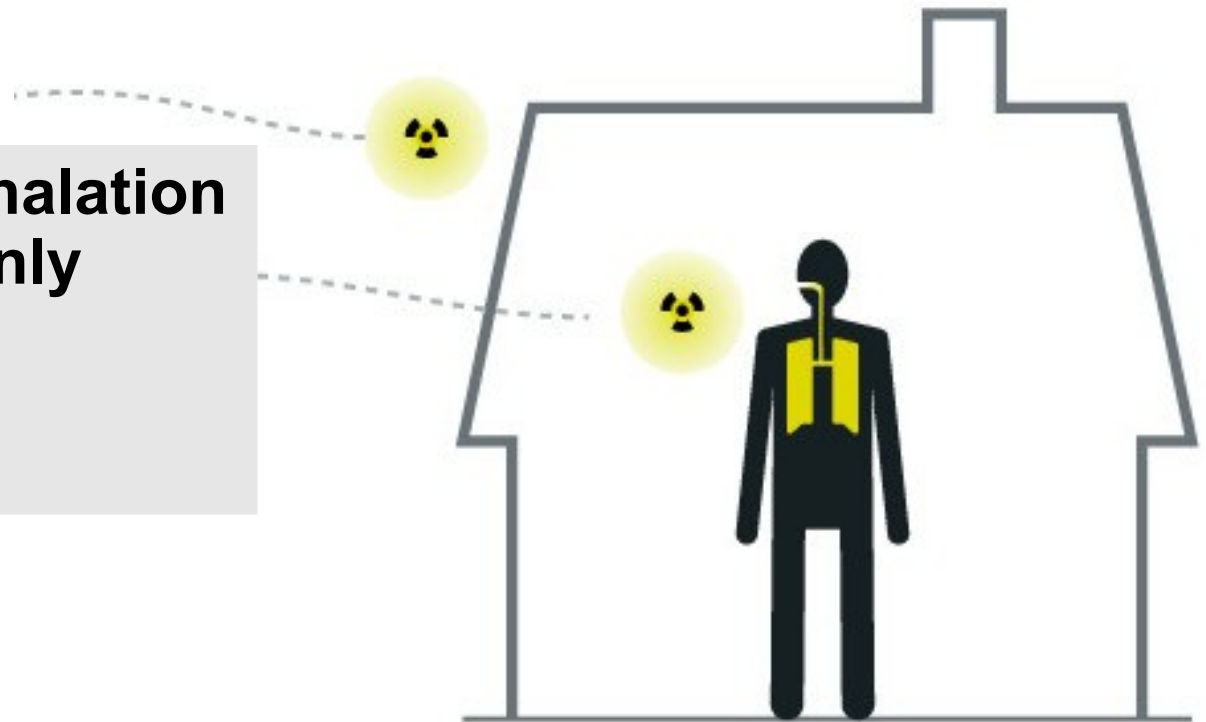
- **Calculation of the reactor inventory**
- **Calculation of the source term (release fraction)**
- **Atmospheric model FLEXPART (Europe)**
- **Deposition of cesium-137**

Phase 2 of research project:

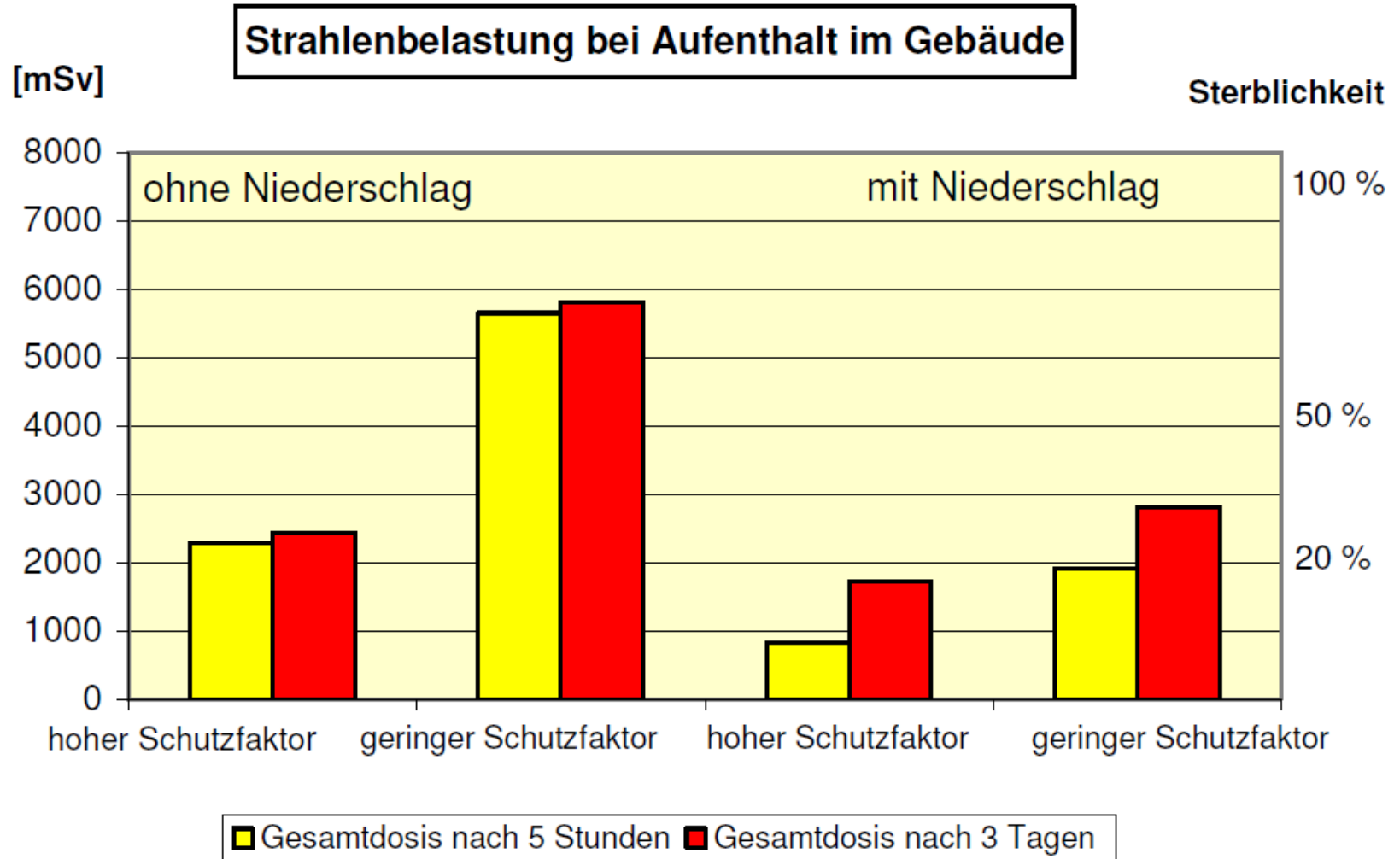
- Other isotopes (I-137, Sr-90,...)
 - Other atmospheric models (Hotspot, Cosyma) for shorter distances (10-100km)
 - Define emergency zones
 - Calculate effective dose to population
 - Health effects
 - Economic losses
- = Total cost**

Phase 2 preview: Radiation dose at 25km (Biblis)

- Effective dose inhalation
- All isotopes (mainly Cs-137 / I-131)
- Inside buildings
- Closed windows



Radiation dose at 25km (Biblis) inhalation in closed buildings



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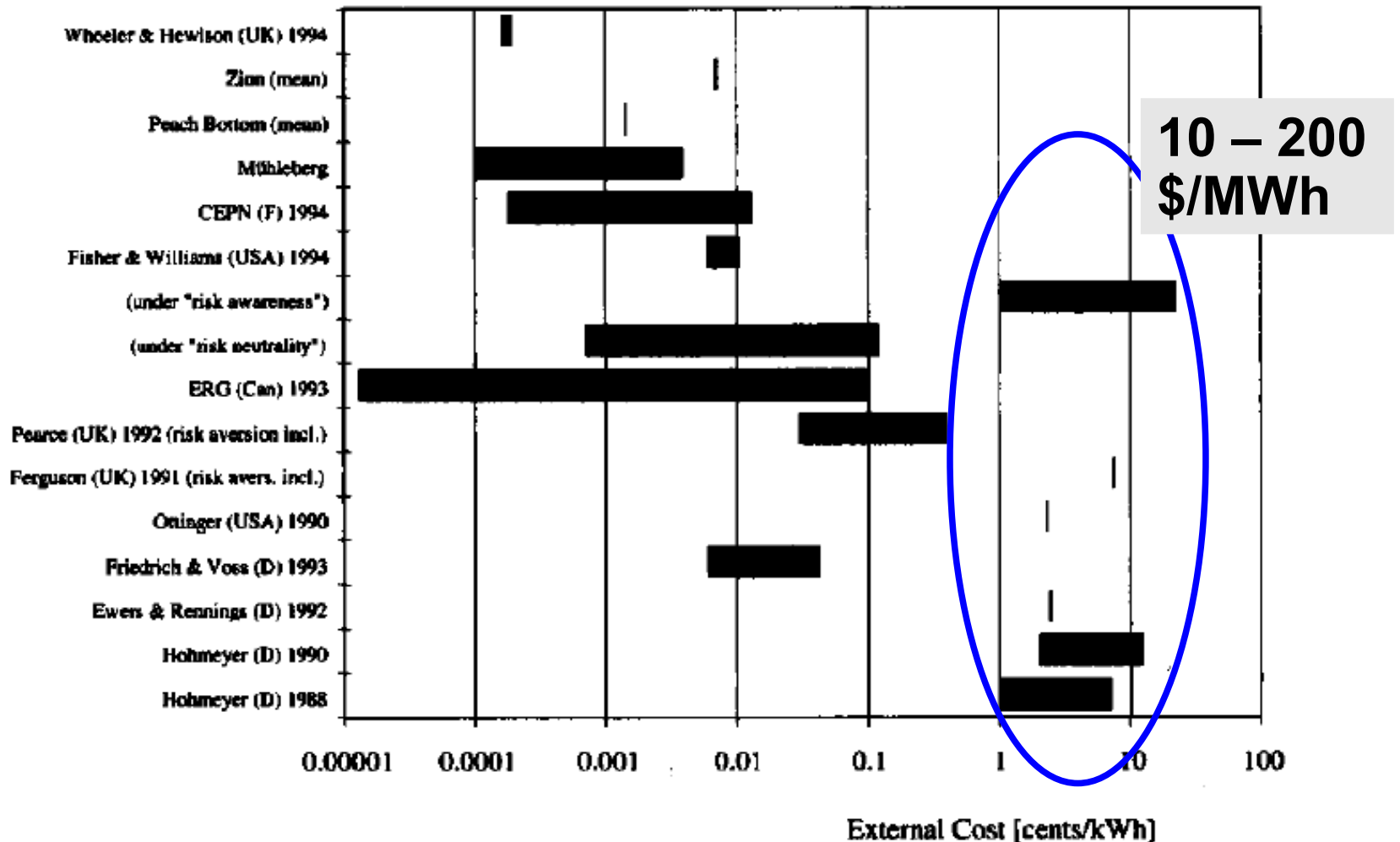
**2. Risk-tax:
compensation for the
uninsured nuclear risk**

Estimated cost of an open containment accident:

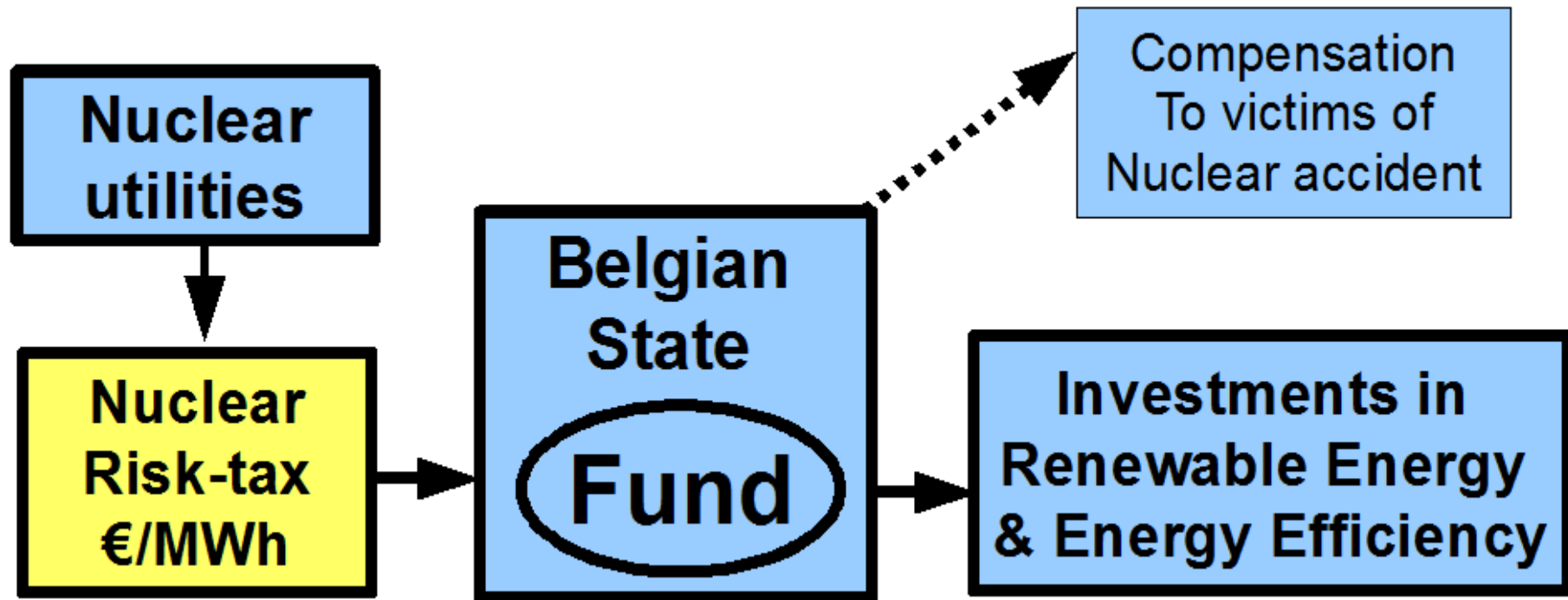
<i>cost nuclear accident</i>	<i>source</i>
US\$ 67 million to 15.5 billion	General Accounting Office (USA)
US\$ 21.3 to 695 billion	Sandia National Lab. (USA)
DM 4.5 - 83,250 billion	Fraunhofer Institut (Germany)
US\$ 6,800 billion (worst- case)	Prognos AG (Germany)
US\$ 613 - 652 billion	Pace University Centre
5,000 billion €	Ewers H.J. and Rennings K.

NEA: overview external cost (\$c/kWh)

Figure 2.1 Span of estimated external costs of severe reactor accidents



Draft law nuclear liability: Risk-tax as compensation for uninsured risk



Thank you for your attention

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RISKMAP PROJECT:

Creation of a Map of the Nuclear Risk for Europe

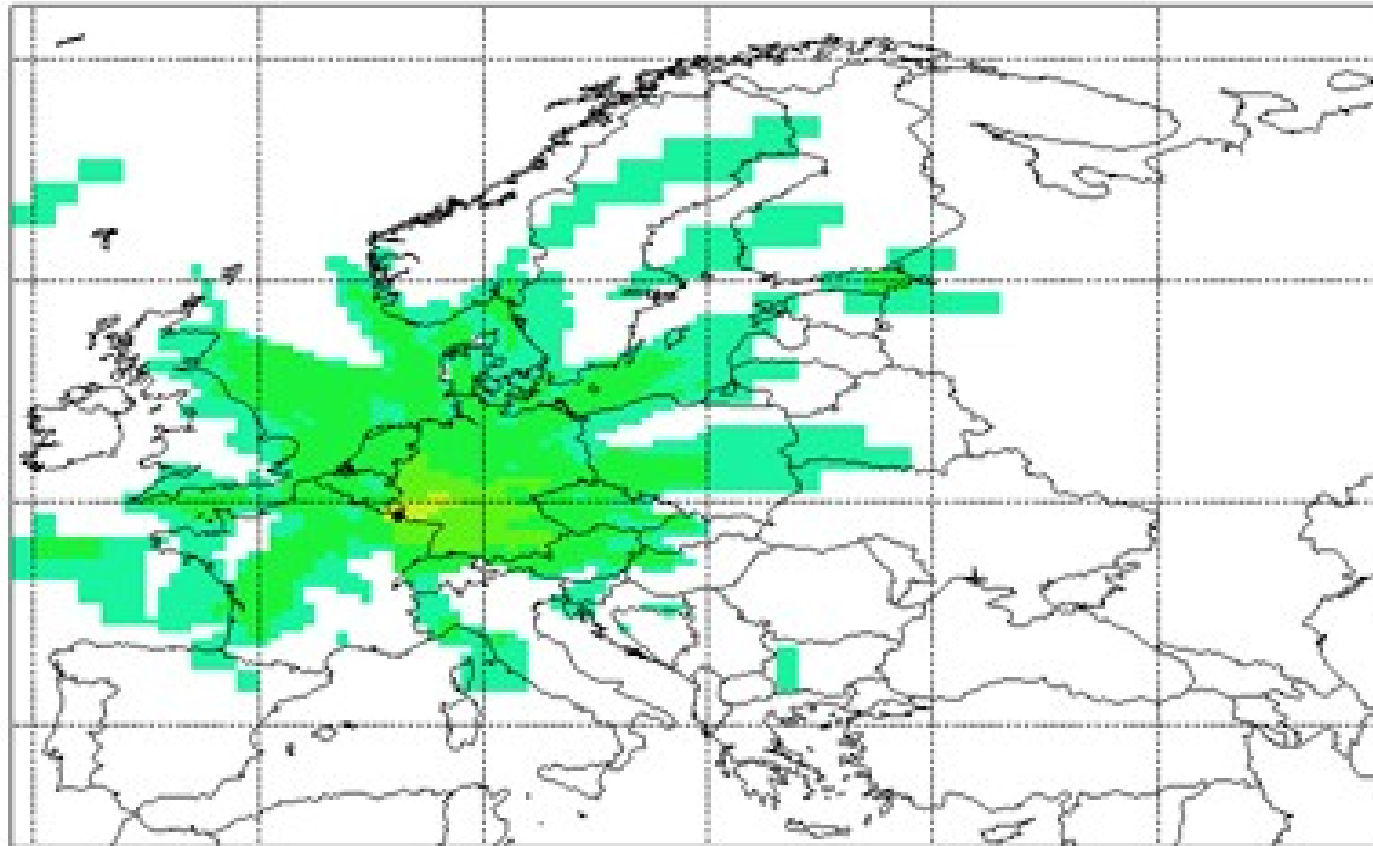
Institute of Risk Research,
University of Vienna, Austria
Institute of Meteorology and Physics,
BOKU University of Agricultural Sciences, Vienna, Austria

On behalf of the Federal Ministry for the Environment, Austria

<http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/kernenergie/Riskmap/English/Main.htm>

risk of a contamination with Cs-137 exceeding 185 kBqm-2 (Cattenom)

CATTENOM

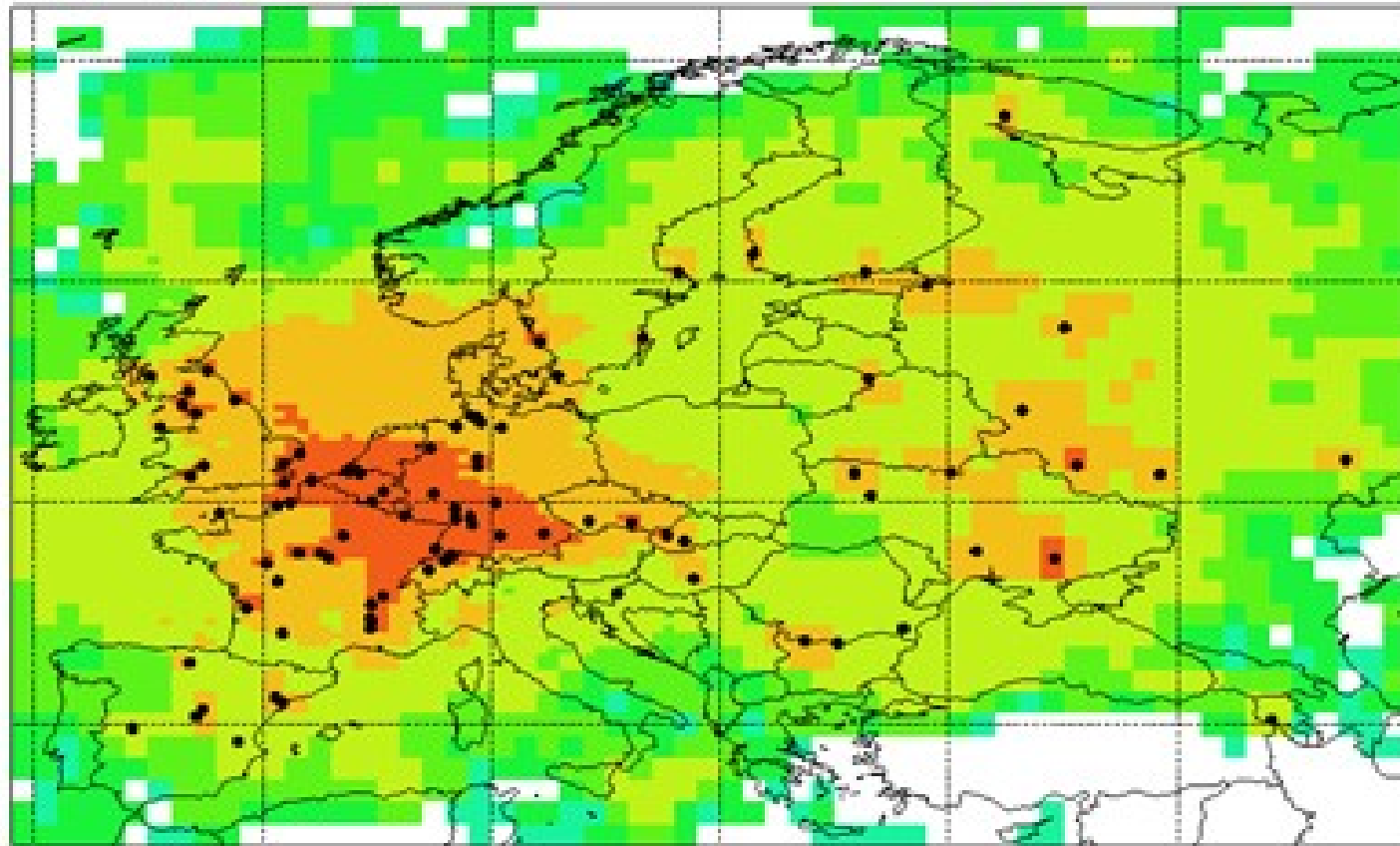


Max=0.88E-05



risk of contamination with Cs-137 exceeding 185 kBqm-2 : all reactors

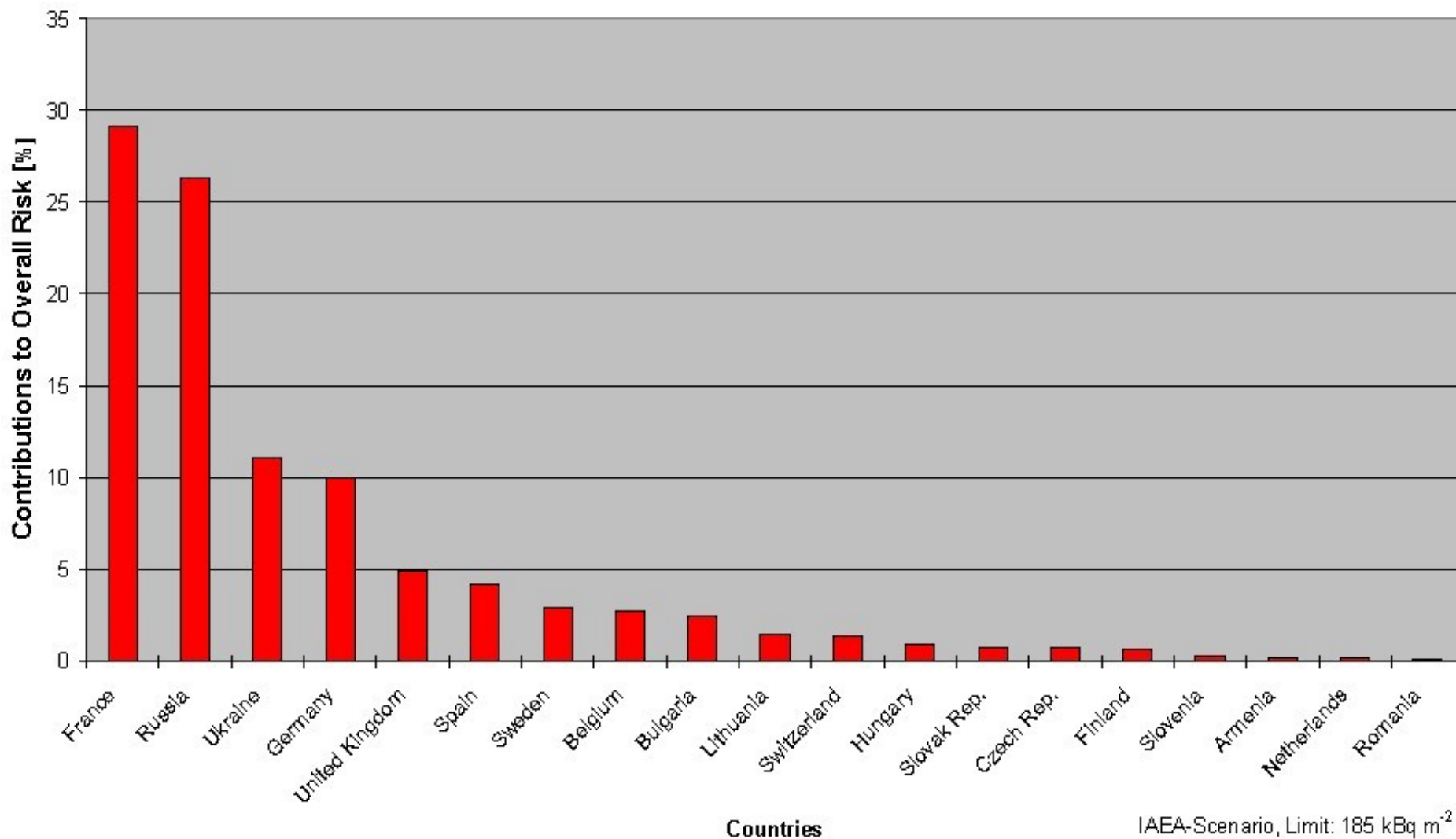
ALL COUNTRIES



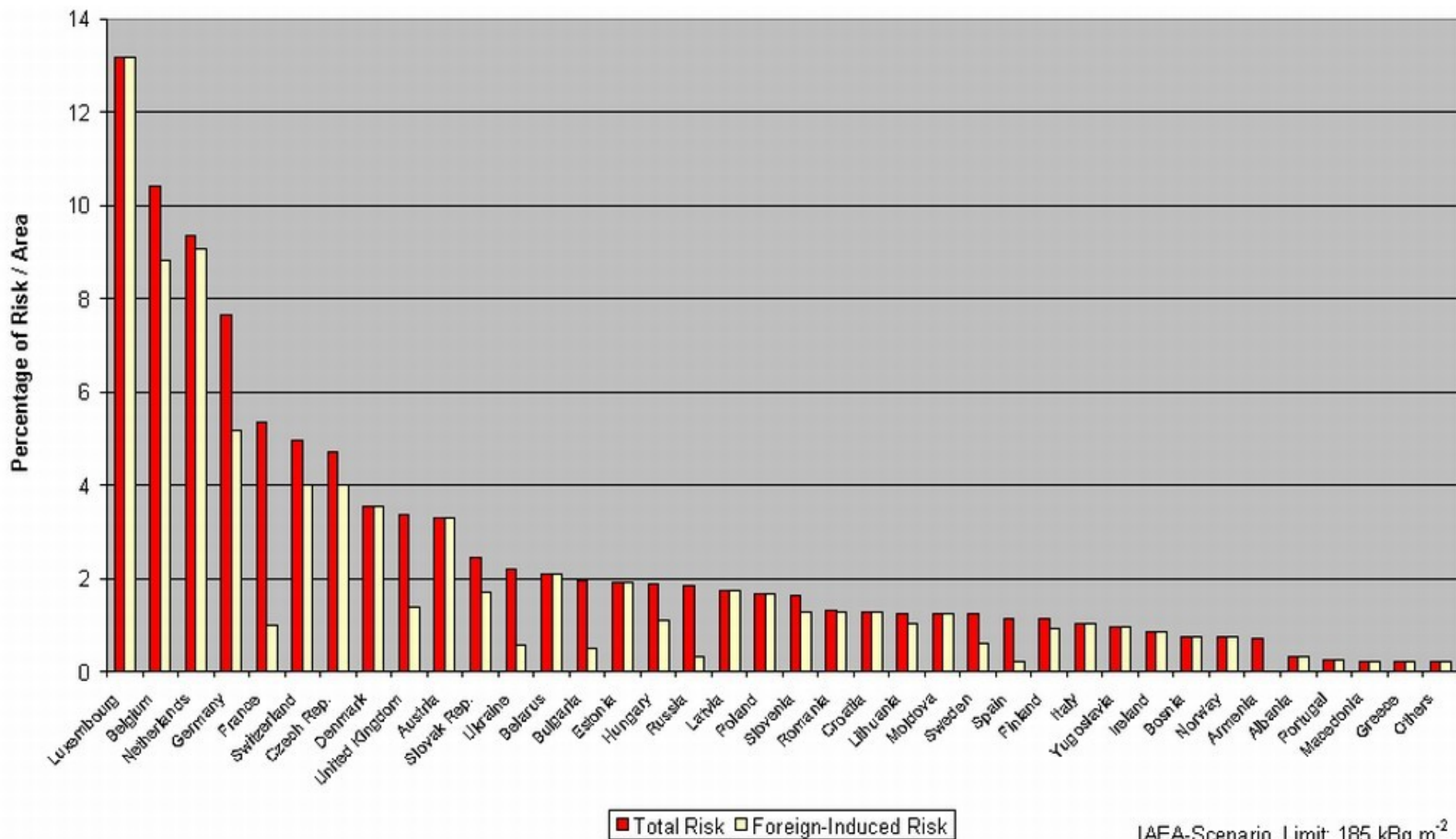
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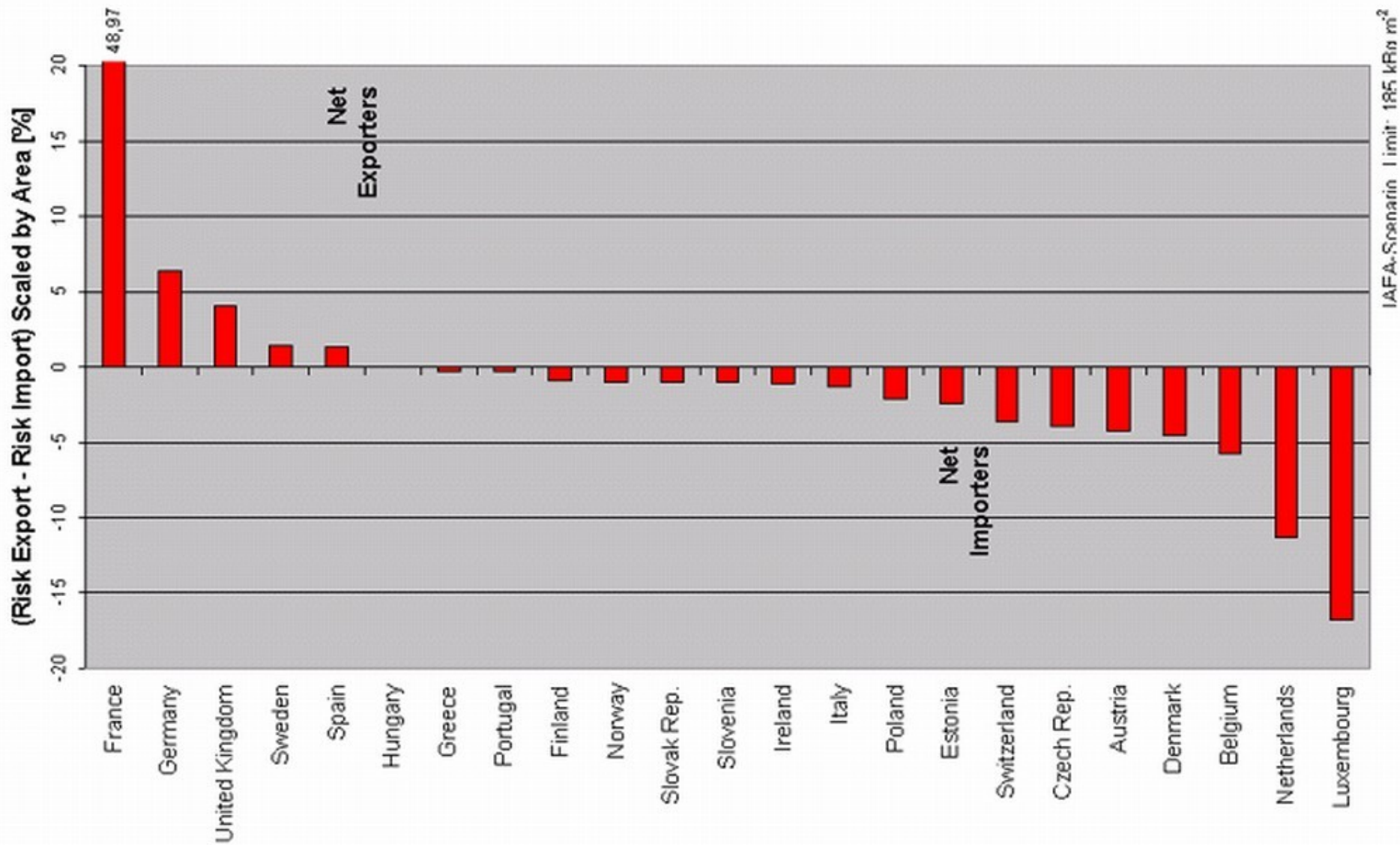
Initiators of nuclear risk in Europe



Nuclear Risk scaled by surface



Risk import – export



Risk initiators for Belgium:

