



# From risk to resilience

## JRC insights on energy security

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# Joint Research Centre (JRC)

**Joint Research Centre is a DG of the European Commission**

**Does** research based policy support

**Independent** of private, commercial or national interests

Works for more than **40 European Commission policy departments**  
providing **science based policy support**



# JRC sites

Headquarters in **Brussels**  
and research facilities located  
in **5 Member States**:

Belgium (Geel)

Germany (Karlsruhe)

Italy (Ispra)

The Netherlands (Petten)

Spain (Seville)



# Directorate C: Energy, Mobility and Climate

## Unit C3: Energy Security, Distribution and Markets

Created in 2010, after RU-UA gas crisis of 2009

Located in Petten, Seville and Ispra JRC sites

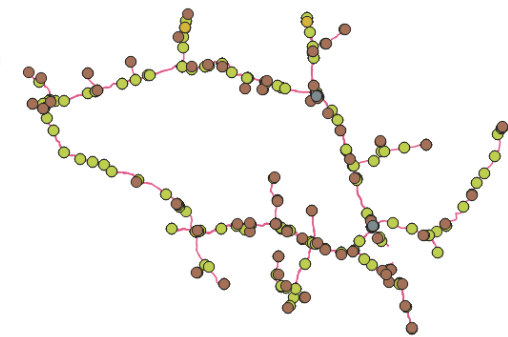
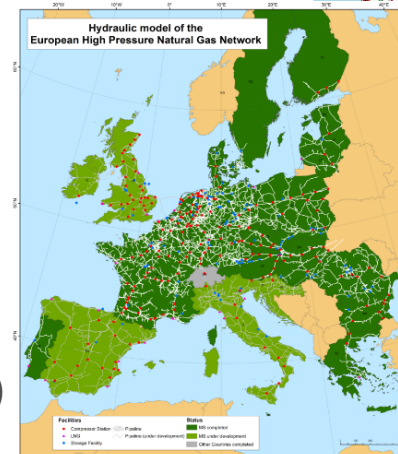
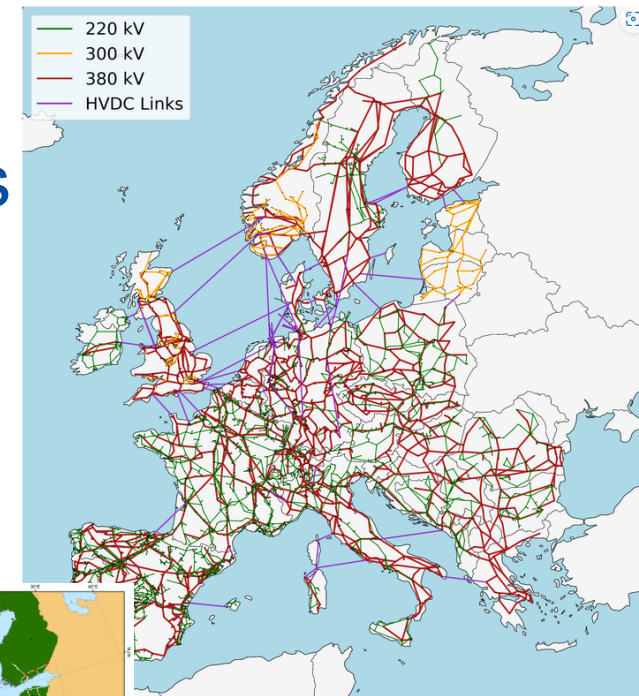
Works on critical energy infrastructure (natural gas and electricity supply)

- security of supply, protection, resilience,
- gas transmission network modelling  
(Synergi Gas, ProGasNet, GEMFLOW, SAInt),
- power system modelling  
(Plexos, PyPSA, DIgSILENT-PowerFactory)

In close cooperation with DG ENER (primary customer in policy)

- support to risk preparedness regulation in electricity sector
- support to gas security of supply regulation

Runs Smart grid and interoperability lab (Ispra and Petten)



# JRC.C3 Unit work in the Baltics

## Baltic synchronisation study, 2016

JRC study identified synchronisation route via Poland as most cost effective route

## Baltic gas supply risk assessment study, 2018

## A project in 2017-2019 under EPCIP/DG HOME:

Risk assessments of gas and power transmission networks and their interactions in the Baltics

## SecureGas project under Horizon 2020 programme, 2019-2021

Partners: Amber Grid (LT), Riga TU (LV), Guardtime (EE)

## Three Coherent Resilience Tabletop exercises in the Baltics

CORE2019/ CORE21-B/ CORE23-B in cooperation with NATO ENSECCOE



JRC SCIENCE FOR POLICY REPORT

Integration of the Baltic States into  
the EU electricity system:  
A technical and economic analysis

*Final report*

Arturs Purvins<sup>1</sup>, Tao Huang<sup>2</sup>, Shaghayegh Zalzar<sup>2</sup>,  
Ren Jian Pi<sup>2</sup>, Gianluca Flego<sup>2</sup>, Marcelo Masera<sup>2</sup>,  
Gianluca Fulli<sup>2</sup>, Ettore F. Bompard<sup>2</sup>, Angelo L'Abbate<sup>3</sup>

<sup>1</sup>JRC – Directorate C Energy, Transport and Climate

<sup>2</sup>Politecnico di Torino

<sup>3</sup>RSE (Ricerca sul Sistema Energetico)

Limited distribution  
2016

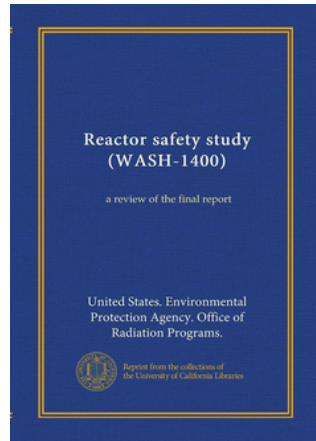


# Risk Science – historical perspective

- The first risk study is considered to be WASH-1400 by Rasmussen  
The Reactor Safety study, 1975
- The first quantitative definition of risk (Kaplan & Garrick, 1981):

Triplet of likelihood (P, probability), consequence (C, damage), scenario (S, scope)

- Nuclear industry developed risk assessment methods, techniques and stipulated applications
- We face history of over 50 years of risk science



# From research to regulatory requirements

- Nuclear industry is specifically regulated by risk based approach since late 90s, most NPPs have performed probabilistic safety (risk) assessments
- Seveso accident in a chemical plant in Italy in 1976 led to Seveso Directive to be adopted in 1982 and introduction of risk management requirements in chemical industry, revised in 1996 and 2012
- European Critical Infrastructure Directive 2008/114 introduced risk measures for many sectors in 2008, replaced by Resilience of Critical Entities (CER) Directive in 2023
- Cybersecurity risks are managed by the Directive on security of network and information systems (NIS Directive) since 2016. Replaced by NIS2 Directive in 2022



# From research to regulatory requirements

## Energy Sector

- Natural gas supply disruptions enabled Gas security of supply regulation 994/2010 in 2010, revised in 2017. It requires risk assessment to be performed by each MS.
- Electricity sector is regulated by risk preparedness regulation 2019/941 since 2019
- Both regulations currently are in the process of revision
- JRC is working on implementation of these Regulations, evaluation of their effectiveness and proposals of new legislation





# Emerging hazards and threats



- The world is changing fast
  - Emerging hazards (climate change)
  - New threats (hybrid attacks, cybersecurity threats)
- Regulations are adapting through new revisions or radical changes
- Recent shift from risk to resilience is most notable (ECI to CER Directive)



# Resilience of energy (power) systems



JRC TECHNICAL REPORT

Development of indicator framework for  
resilience of critical energy infrastructure

Project CEI-Resilience  
Deliverable 2020

Vamanu, B.  
Mortăscu, L.  
Kopustinskias, V.  
Mazars, M.  
Krausmann, E.  
Kopustinskias, V.

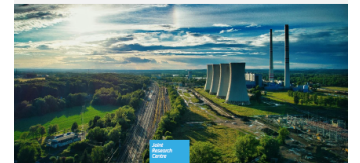


Resilience assessment: Methodological  
challenges and applications to critical  
infrastructures

Proceedings of the 63rd ESReDA Seminar  
Joint Research Centre, Ispra, Italy  
25-26 October 2023

Kopustinskias, V., Fortin, H., Alessio Bernini, L.

2024



JRC TECHNICAL REPORT

Tabletop exercise: Coherent Resilience 2019 (CORE 19)

Final report

Kopustinskias, V., Fortin, H., Alessio Bernini, L.,  
Mortăscu, L., Kopustinskias, V.

2020

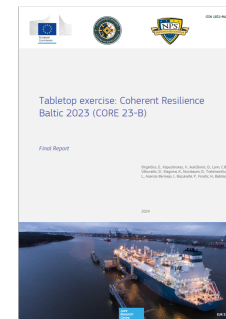
JRC TECHNICAL REPORT

Tabletop Exercise: Coherent Resilience  
Baltic 2021 (CORE 21-B)

Final Report

Kopustinskias, V., Fortin, H., Alessio Bernini, L.,  
Mortăscu, L., Kopustinskias, V.,  
Krausmann, E., Kopustinskias, V.

2022



Tabletop exercise: Coherent Resilience  
Baltic 2023 (CORE 23-B)

Final Report

Kopustinskias, V., Fortin, H., Alessio Bernini, L.,  
Mortăscu, L., Kopustinskias, V.,  
Krausmann, E., Kopustinskias, V.

2024

# Risk preparedness in electricity sector

- Support to DG ENER in implementation of 2019/941 Regulation:
  - Development of methodology
  - Assessing of risk scenarios
  - Support by modelling of electricity disruptions
  - Evaluation of risk preparedness plans of the MSs
  - Evaluation of the public consultation, impact assessment and proposals for new revision



# Concluding remarks

- Regulations are lagging behind the fast changing risk and security landscape
- JRC works in all the fields presented providing scientific support to policy DGs

## Recent shift in paradigm

From minimizing and managing risks through quantitative assessments

Towards

Resilience by adapting, withstanding and recovery

# Thank you



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