Availability of Gas in the European Union in a Dynamic Geopolitical and Commercial Context

Alexandru MAXIM, PhD
CERNESIM Environmental Research Centre
Alexandru Ioan Cuza University of Iaşi

The presentation will address four issues

Contents

- Research context
- Evaluating natural gas vulnerability – Gas Vulnerability Indicator
- Proposal for the forecasting of gas availability

The context for gas supply to Europe is shifting

Gas demand and supply

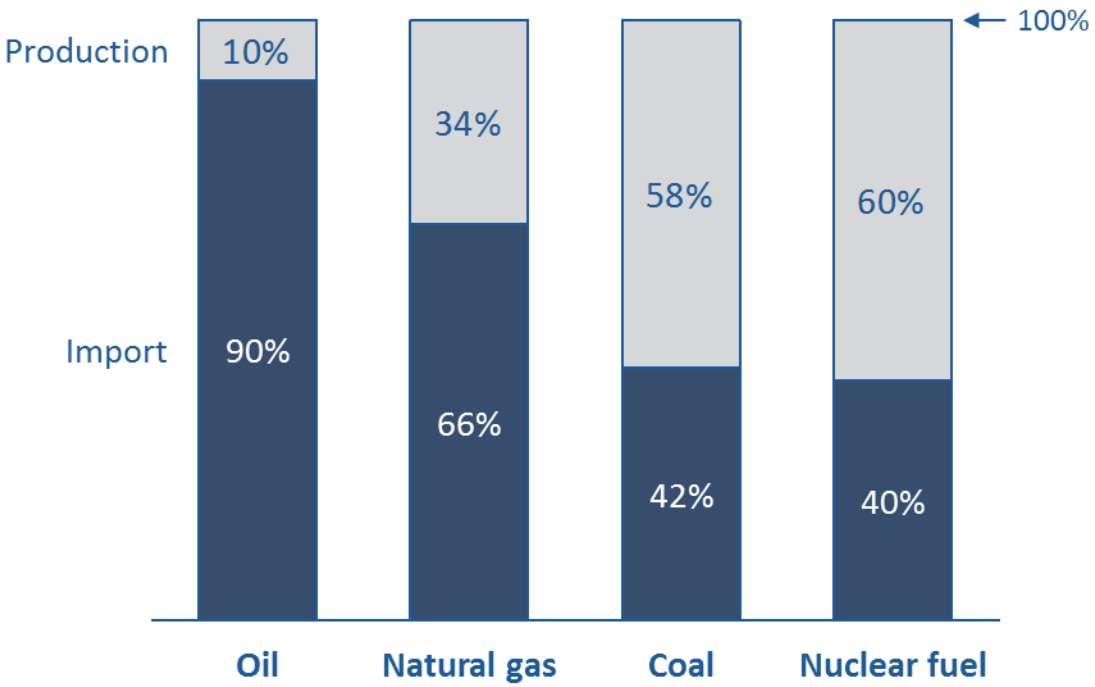
- European demand lower than initially expected – compared to 2011 (BP, 2016)
- Production and consumption surpassing forecasts in North America
- Shift in the status quo for Europe and the world (EIA, 2016 / BP, 2016):
  - Energy efficiency and carbon emissions targets
  - Post-Fukushima nuclear
  - Political instability in North Africa, Eastern Europe, Turkey and Caspian
  - Gas for commercial transportation (bus, large trucks, freight rail) … 3% to 11% in 2040
  - LNG trade increasing globally… +140% in 2040 vs. 2012, surpasses pipelines by 2035
  - Shale gas to reach ¼ of supply by 2035
  - New pipeline projects and LNG capacity around Europe

Gauge the vulnerability of the EU with regard to natural gas flows

Research context

Key facts about the EU energy market context

- The EU **imports 53% of the energy** it consumes



European Commission (2014)

Research context

Key facts about the EU energy market context

- Largest security of supply issue – strong dependence on a single external supplier
  - 6 EU states use Russian gas exclusively
  - 28% of EU gas consumption comes from Russia
  - gas imports: **39% Russia** (~75% in 1990), **33% Norway**, **22% Algeria & Libya**, 5% others
- EU external energy bill represents over **€1B / day** (€400B+ in 2013)
- Energy imports represent over 1/5 of EU imports
- Energy demand expected to increase by 27% globally by 2030

The EU-Russia interdependence focus on natural gas (NG)

Why interdependence?

- Importers dependent on constant supply of energy
- Exporters are highly dependent on income from energy exports
- **oil**, **coal** – traded and shipped globally; **gas** – shipped by pipeline (except LNG)
- *"political effects can occur without threats or breaks in economic relations … economic vulnerability is a powerful influence on the minds of decision makers" (Armstrong, 1981)*

- **Russia** – pipelines already in place, capacity to supply in the foreseeable future
- **EU** – large market, already connected, able to pay a good price

The EU-Russia interdependence focus on natural gas (NG)

The relationship between natural gas consumption and economic growth

- Pearson correlation, for the period **2005-2014**, between

  GDP growth (2005 constant) ←→ **NG consumption**

  for **each of the 28 EU states** and **EU-28** weighted average

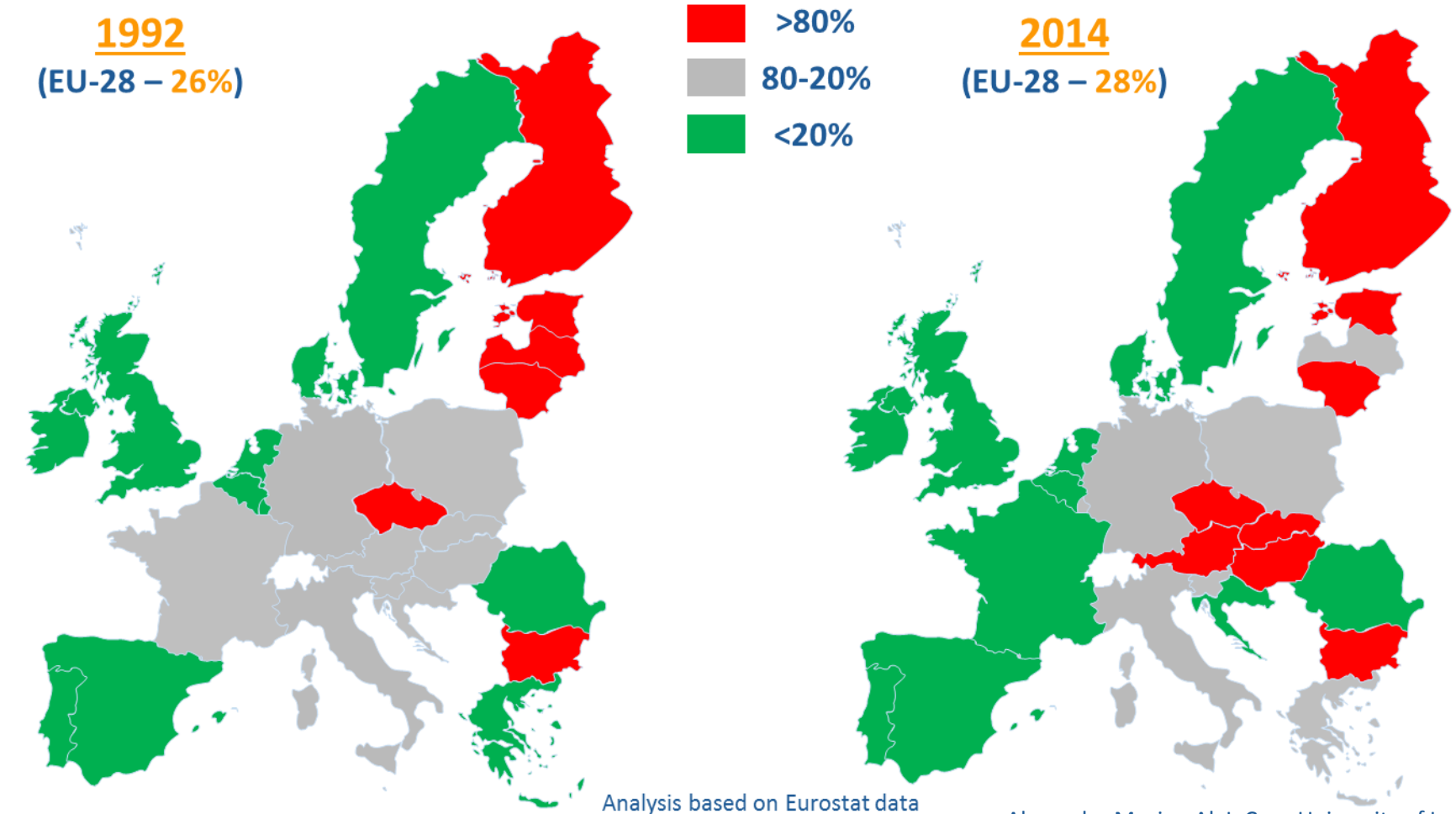
- **No significant correlation** exists between GDP growth and NG consumption (exception – Bulgaria)

- A direct connection exists between GDP growth and electricity demand

- This suggests that EU states can adapt to NG market fluctuations without affecting economic growth

EU dependence on Russian gas has decreased for some states, but remains relatively high

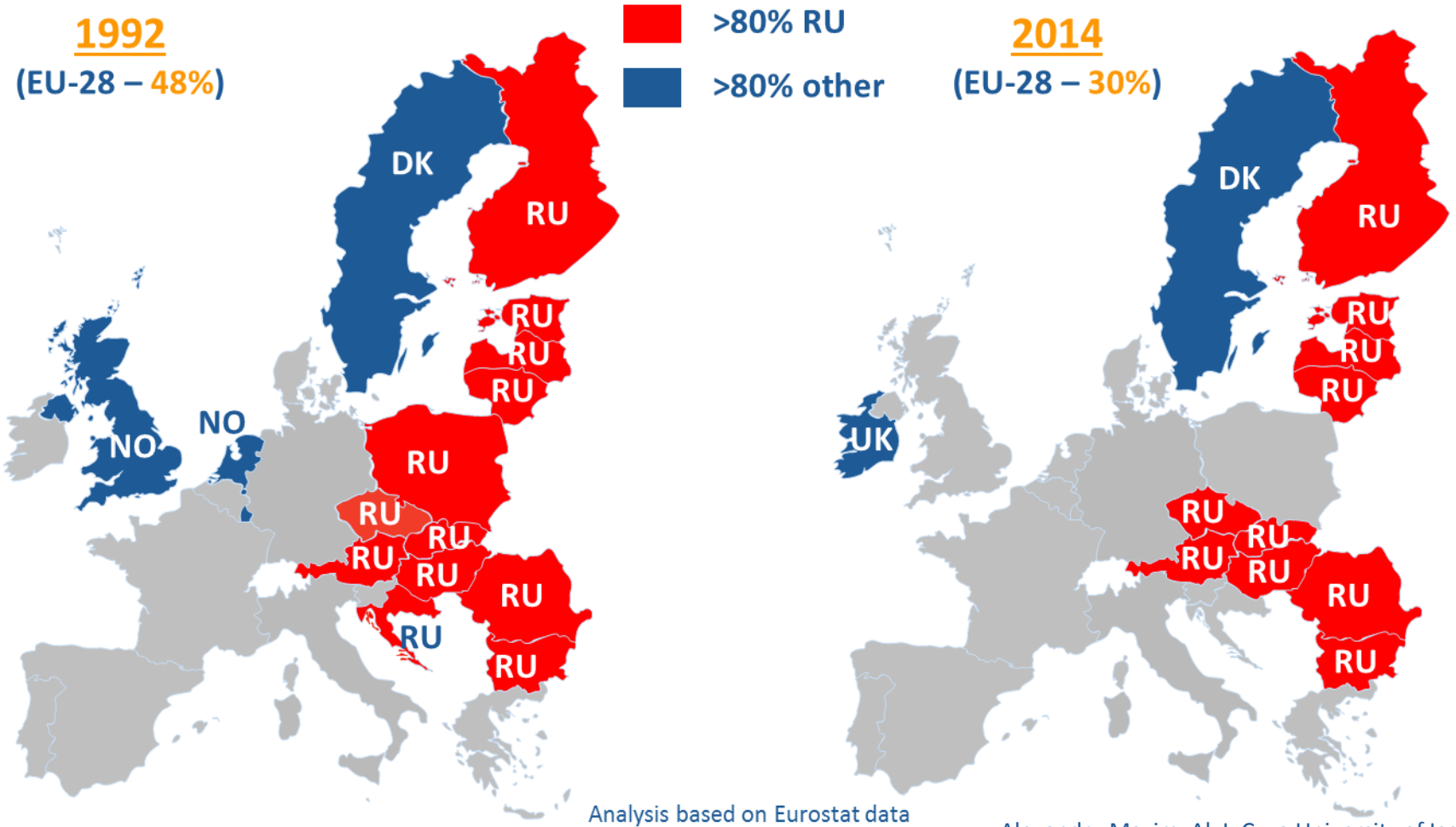
EU states dependence on Russian gas (% of total gas consumption)



Analysis based on Eurostat data

Diversification of suppliers has seen limited improvement, especially in Eastern Europe

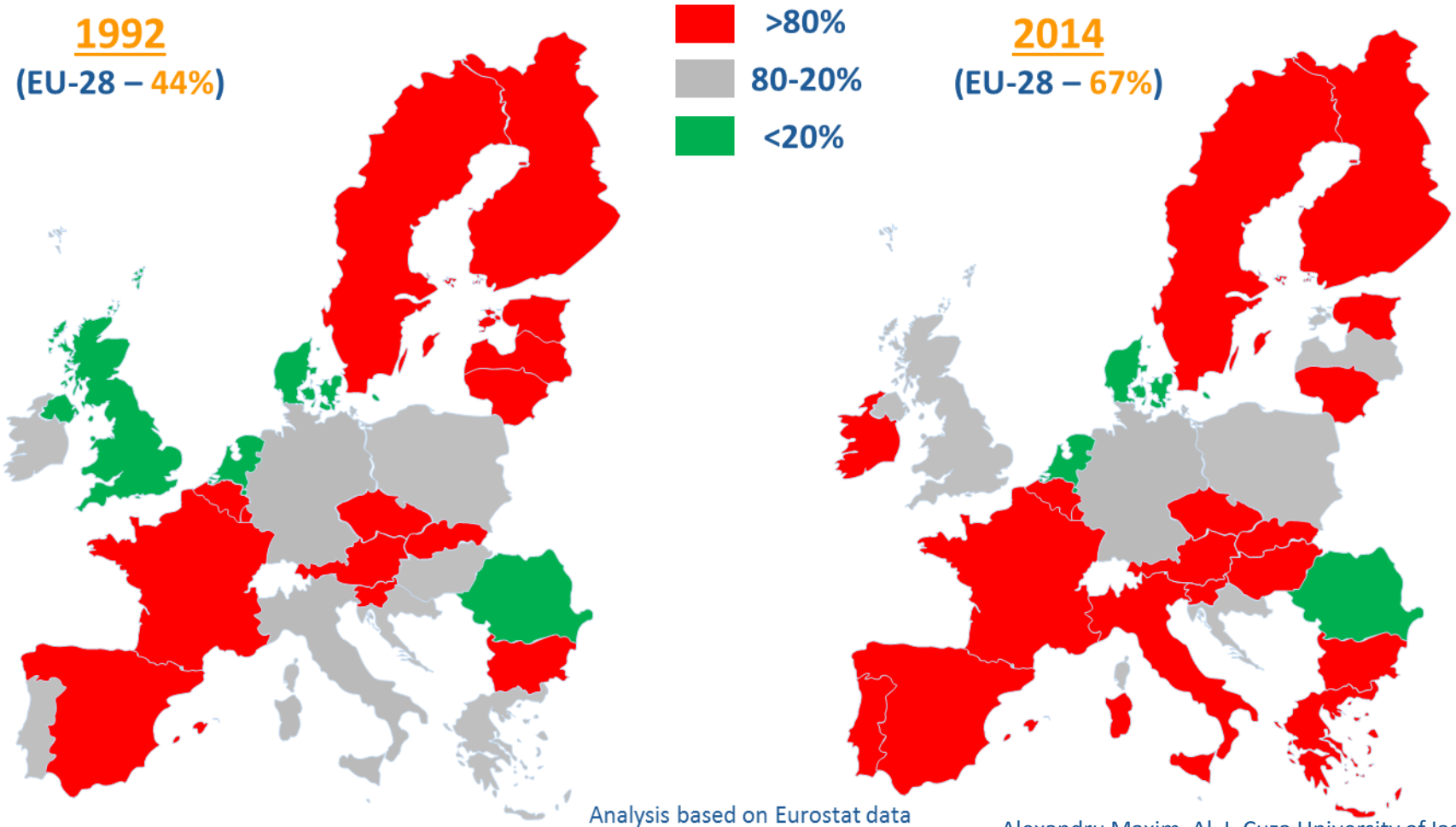
Share of the top natural gas supplier (% of total gas imports)



Analysis based on Eurostat data

Net import dependence has intensified across the European Union over the last decades

Net import dependence = (Imports - Exports)/ Consumption



Analysis based on Eurostat data

There is a need to evaluate natural gas vulnerability by looking at several aspects

Factors included in the analysis of natural gas vulnerability

- **Gas Vulnerability Indicator (GVI)** based on:
  - Net import dependence (%)
  - Natural gas consumption per capita (TJ/inhabitant)
  - Share of top supplier in imports (%)
  - Herfindahl–Hirschman Index (HHI) for concentration of suppliers (0-10 000)
  - Share of natural gas in overall energy consumption (%)
  - … indicator of the quality of relationship with the top supplier ?
- For purposes of methodological consistency, only Eurostat data was used

The indicator values are normalized and calculated using a weighted sum

Formulas used in the calculation of the GVI

- **Normalization of values** (0-1 interval)

$$y(x_k) = \frac{x_k - x_{min}}{x_{max} - x_{min}}$$

$y(x_k)$ – contribution of indicator *x*

x_k – indicator value for country *k*

x_{min} – minimum value of indicator *x*

x_{max} – maximum value of indicator *x*

- **Weighted sum**

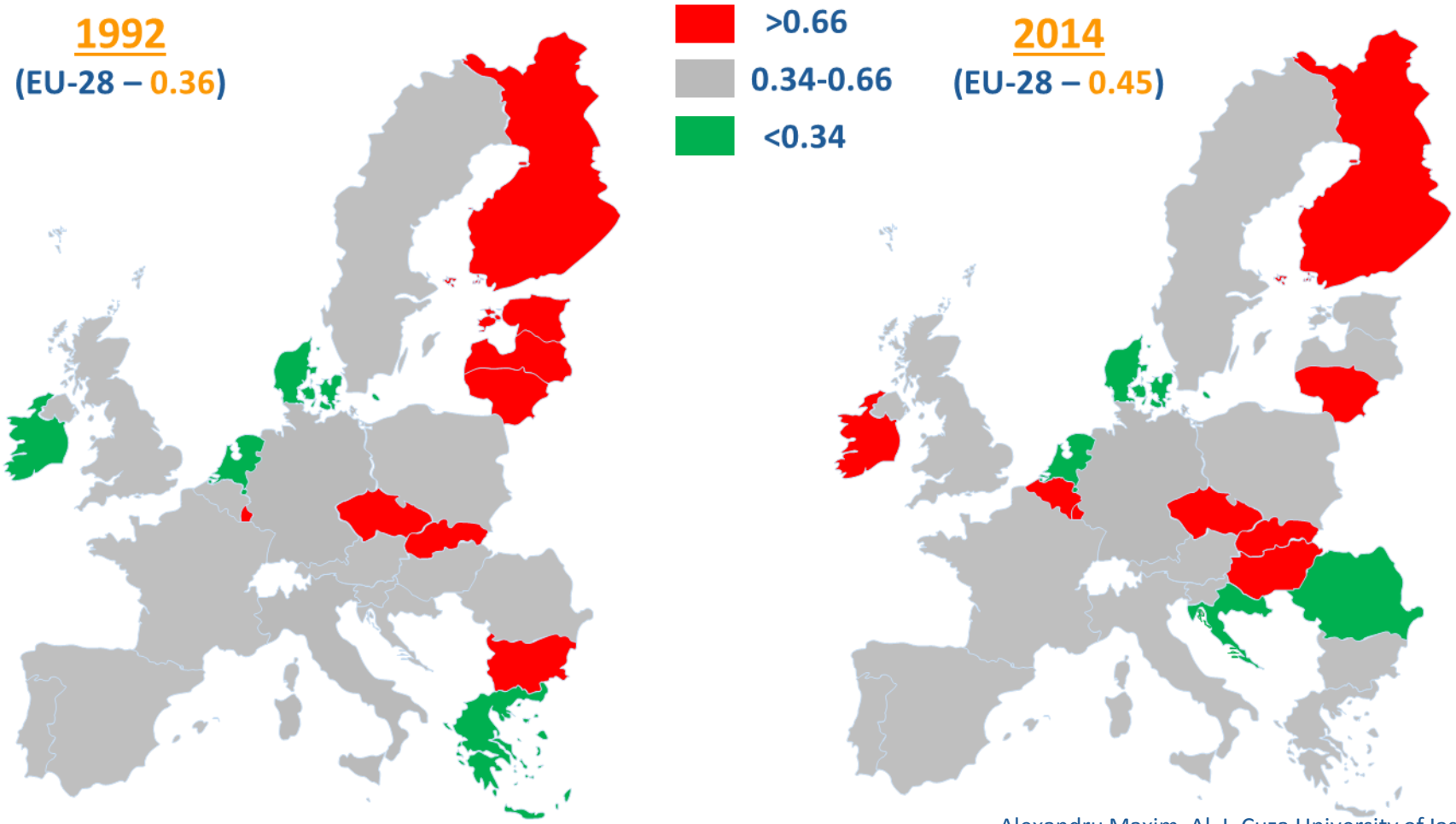
0.4 for net import dependence

0.3 for natural gas consumption per capita

0.1 for HHI, share of top supplier, share of natural gas in overall energy consumption

Overall gas vulnerability has increased and remains relatively high in Eastern countries

Evolution of GVI values from 1992 - 2014



The Gas Vulnerability Indicator (GVI)

Country	GVI '92	GVI '02	GVI '14
EU-28	0.36	0.38	0.45
BE	0.62	0.66	0.69
BG	0.68	0.64	0.63
CZ	0.67	0.64	0.67
DK	-0.19	-0.14	0.04
DE	0.50	0.52	0.58
EE	0.67	0.65	0.65
IE	0.09	0.66	0.75
EL	0.00	0.54	0.53
ES	0.49	0.56	0.59
FR	0.51	0.52	0.56
HR	0.40	0.38	0.30
IT	0.48	0.56	0.60
CY	0.00	0.00	0.00
LV	0.72	0.65	0.60

Country	GVI '92	GVI '02	GVI '14
LT	0.73	0.69	0.73
LU	0.67	0.83	0.80
HU	0.54	0.66	0.72
MT	0.00	0.00	0.00
NL	0.20	0.19	0.14
AT	0.62	0.55	0.63
PL	0.51	0.46	0.49
PT	0.00	0.59	0.56
RO	0.44	0.40	0.29
SI	0.58	0.56	0.56
SK	0.74	0.76	0.74
FI	0.67	0.69	0.68
SE	0.61	0.60	0.60
UK	0.38	0.30	0.47

xx - overall increase since 1992

Overall vulnerability has increased due to higher imports, but diversification is improving

Gas vulnerability at the overall EU level

		’92	’02	‘14
• **Share of top supplier :**	↘	48%	37%	30%
• **HHI:**	↘	3125	2260	1850
• **Consumption per capita:**	↗	0.28	0.32	0.36
• **Net import dependence:**	↗	44%	51%	67%
• **Natural gas in overall energy:**	↗	18%	23%	21%

Availability of gas can be forecasted by country and user type using dynamic energy balances

Proposal for the forecasting of gas availability

- **Energy balance**
  - **Production**
  - **Consumption (by main user categories)**
  - **Imports (by country of origin)**
  - **Exports**
  - **Residuals (stock changes, distribution losses, statistical differences etc.)**

- **Scenario forecasts** of availability at the country level, starting from a ‘base case’

- **Base case** constructed using the estimations of the EIA International Energy Outlook (2016 edition)

Availability of gas can be forecasted by country and user type using dynamic energy balances

Proposal for the forecasting of gas availability

- **Scenarios** to be considered:
  - **increased energy efficiency** of industry and households in Western and Eastern Europe
  - increase in gas trade between EU and **Caspian, North America, North Africa**
  - development of non-conventional gas production in Europe (**shale and offshore**)
  - increased demand for gas in the **transportation sector**
  - commissioning of **new pipelines** connecting Europe and Russia

Data sources:

BP; EIA; IEA; Gazprom Export; Eurostat; other industry/company reports and forecasts

Thank you for your attention!
I welcome your input and suggestions!

Alexandru MAXIM, PhD
CERNESIM Environmental Research Centre
Alexandru Ioan Cuza University of Iaşi

alexandrumaxim@outlook.com