Energy efficiency trends in EU industrial sectors

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Summary

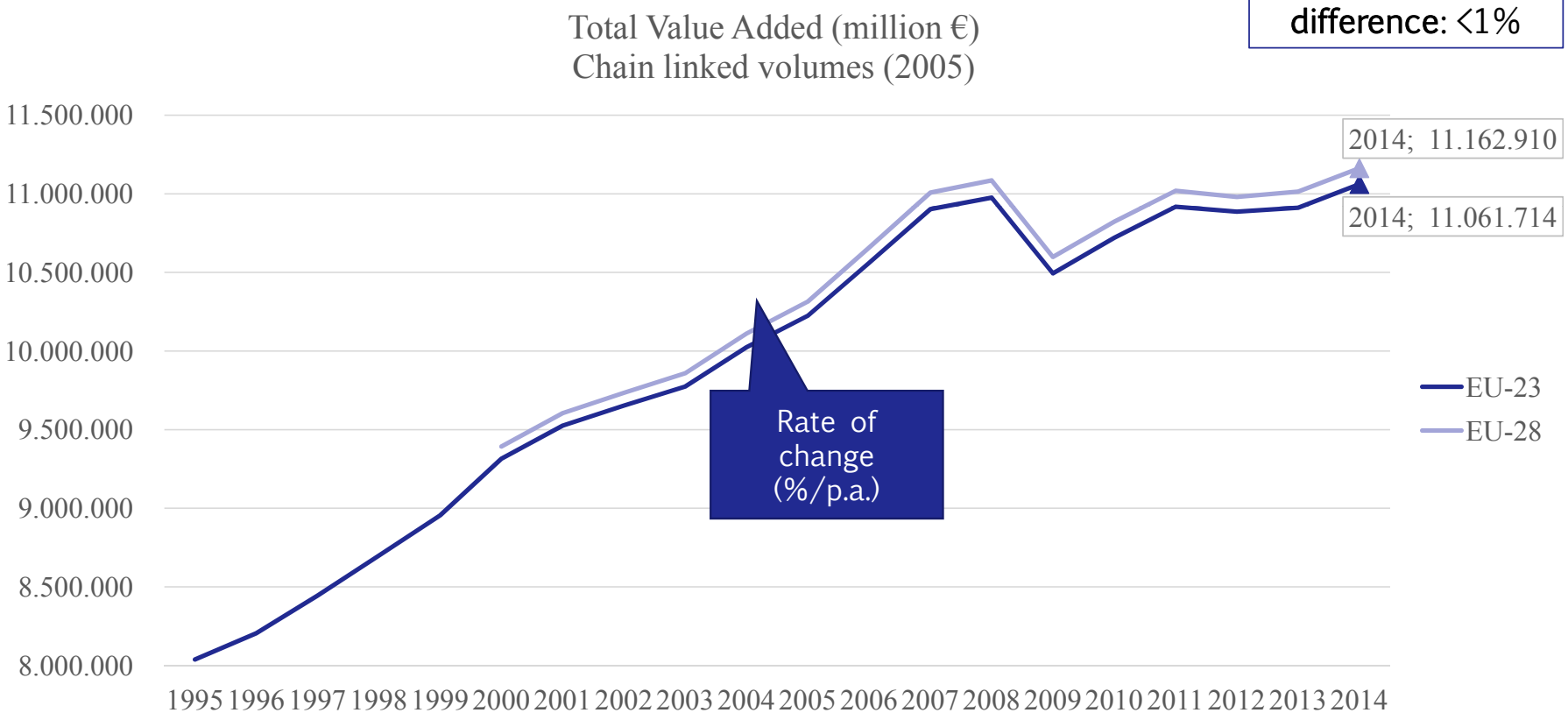
1. Introduction to energy intensity in the EU
2. Tools and methodology:
    1. Index Decomposition Analysis (IDA)
    2. Convergence analysis
    3. Convergence decomposition
    4. Factors of convergence
3. Results
4. Conclusions
5. References

1. Introduction to energy intensity in the EU

A1

ECONOMY IN THE EU

EU-23 vs. EU-28 difference: <1%



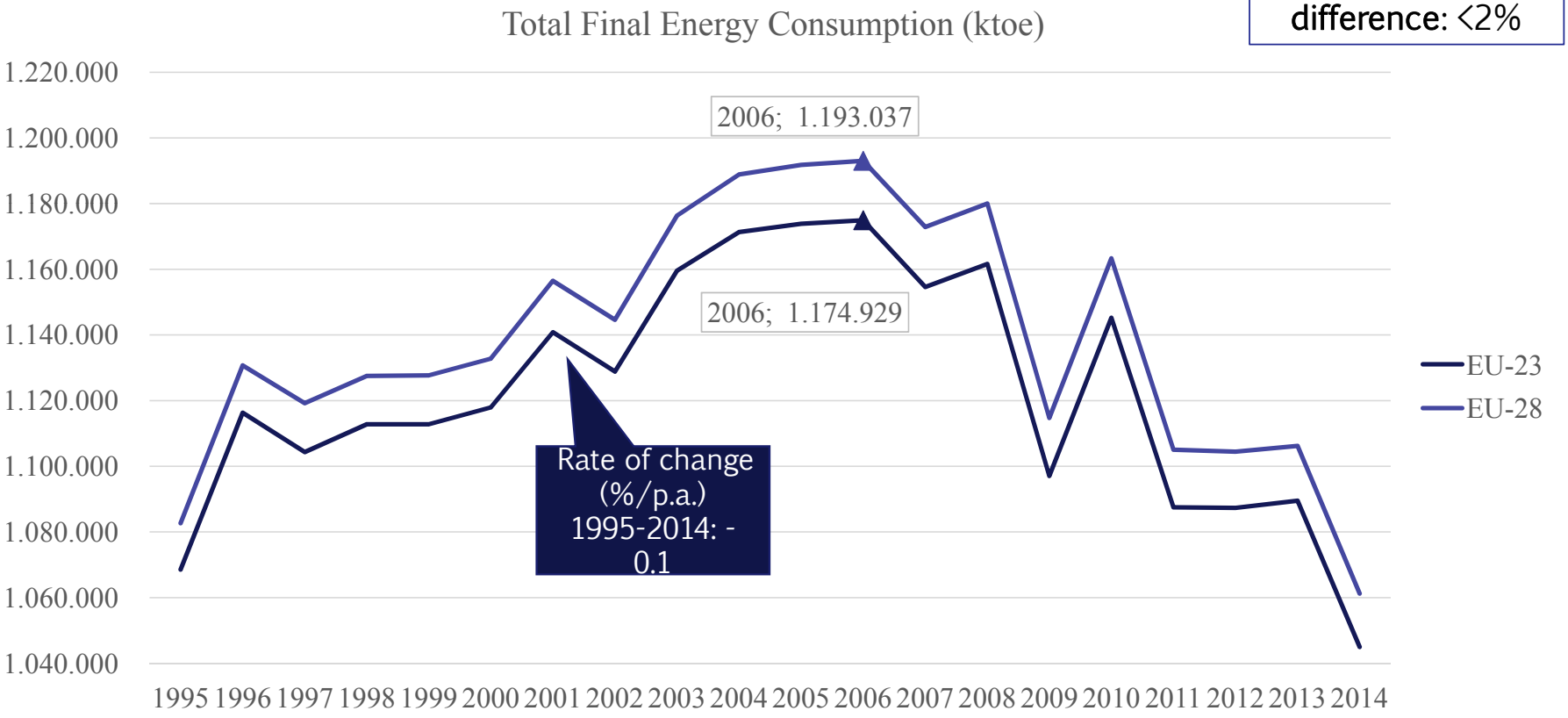
EU-23: EU-28 Member States except Croatia, Cyprus, Latvia, Luxembourg and Malta
Source: EUROSTAT (ESA10), missing data imputations for Bulgaria, Poland, Portugal, Slovakia, United Kingdom

Diapositiva 4

A1 Autore; 19/02/2016

ENERGY IN THE EU

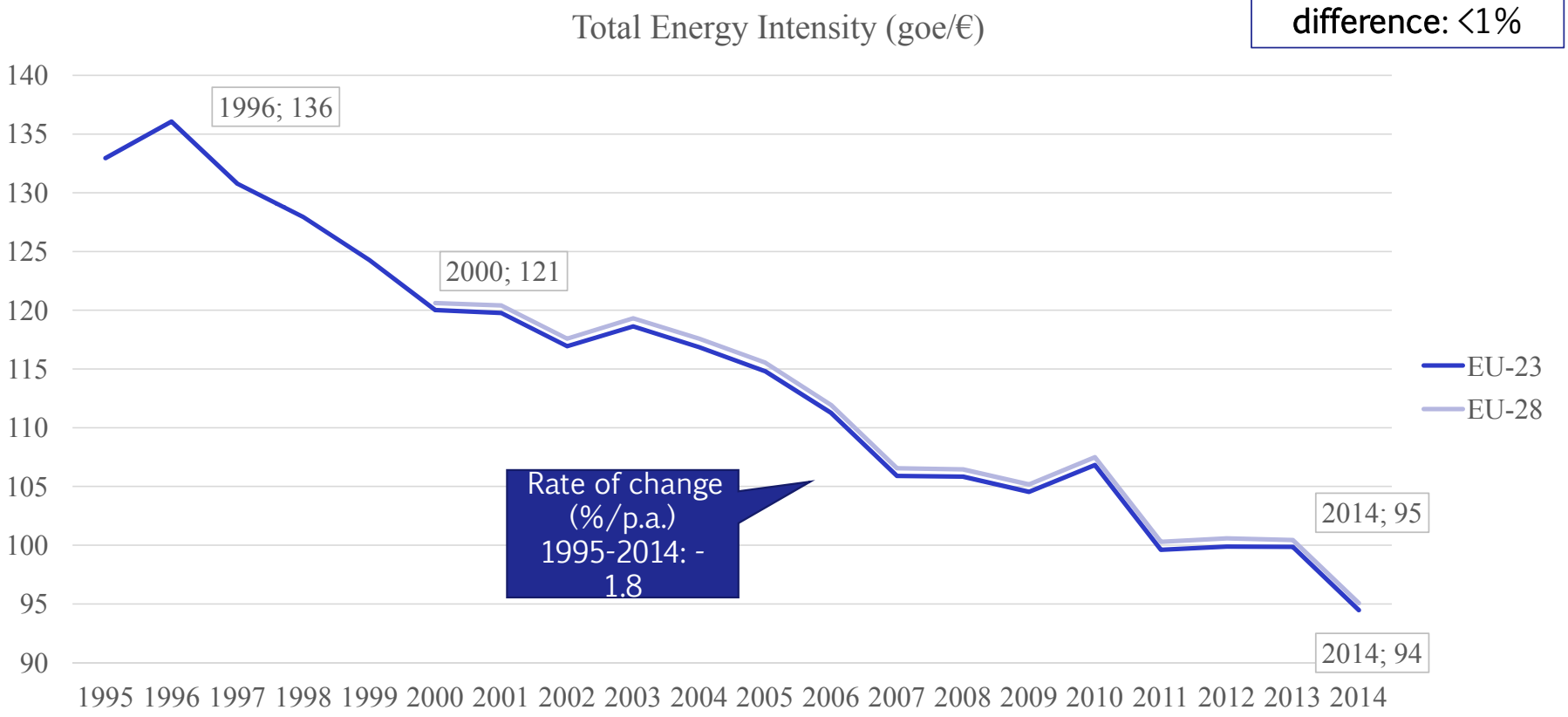
EU-23 vs. EU-28 difference: <2%



EU-23: EU-28 Member States except Croatia, Cyprus, Latvia, Luxembourg and Malta
Source: EUROSTAT

ENERGY INTENSITY IN THE EU

EU-23 vs. EU-28 difference: <1%



EU-23: EU-28 Member States except Croatia, Cyprus, Latvia, Luxembourg and Malta
Source: elaborations on EUROSTAT data

RESEARCH QUESTIONS

- Why is energy consumption declining in the EU?
  - FACTORS
- Do EU countries behave in the same way?
  - CONVERGENCE
- Which are the policy implications?
  - FACTORS OF CONVERGENCE

2. TOOLS AND METHODOLOGY

TOOL 1. DECOMPOSITION ANALYSIS

Index Decomposition Analysis (IDA)

- VARIABLES:
  - energy consumption
  - energy intensity

- OBJECTIVE:
  - To identify the role played by several factors:
    - economic activity (*IDA on energy consumption only*)
    - economic structure
    - technological development
    - fuel mix

LITERATURE

- Studies with IDA of energy consumption
  - Ang (2005)
- Studies with IDA of energy intensity
  - Choi and Ang (2012), Voigt et al. (2014)
- Studies with IDA of energy consumption for EU
  - ENEA (2014)
- Studies with IDA of energy intensity for EU
  - Fernández González et al. (2013), Löschel et al. (2015)

TOOL 2. CONVERGENCE ANALYSIS

› PANEL DATA ECONOMETRICS

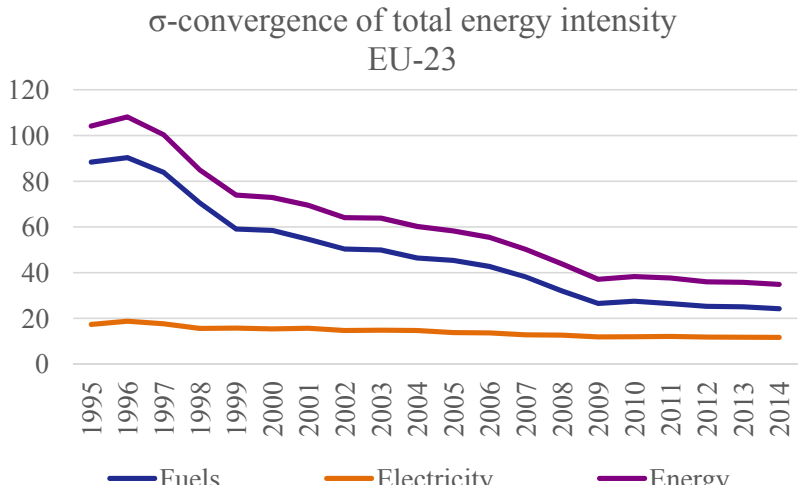
- › CROSS-SECTIONAL: max 23 individuals
- › TIME SERIES: 17 years and 13 years
  - – Periodization to reduce influence of business-cycle and serial correlation on residuals:
    - › 1995-2011 → 4 periods of 4 years intervals
    - › 1999-2011 → 3 periods of 4 years intervals
- › Observations: max 23x4=92

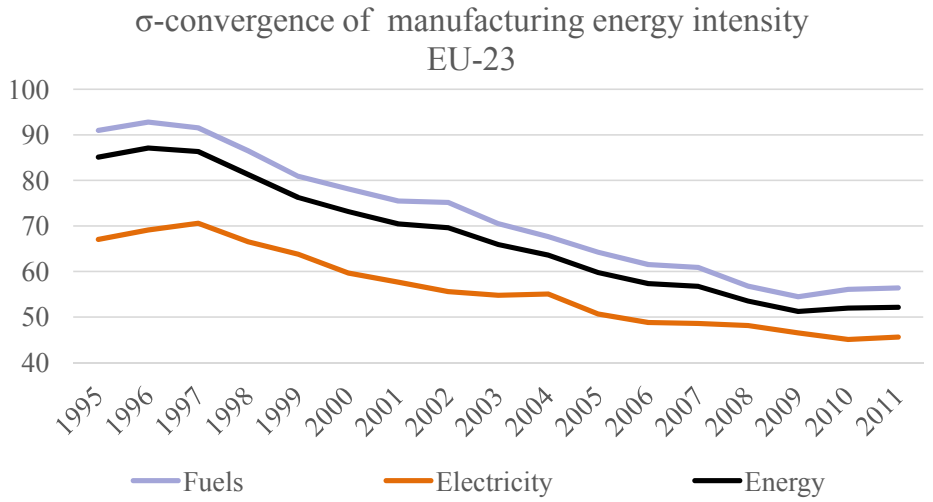
TOOL 2.1. σ-CONVERGENCE ANALYSIS

σ-convergence

- Cross-country dispersion in levels
  - Dispersion measured as standard deviation of energy intensity

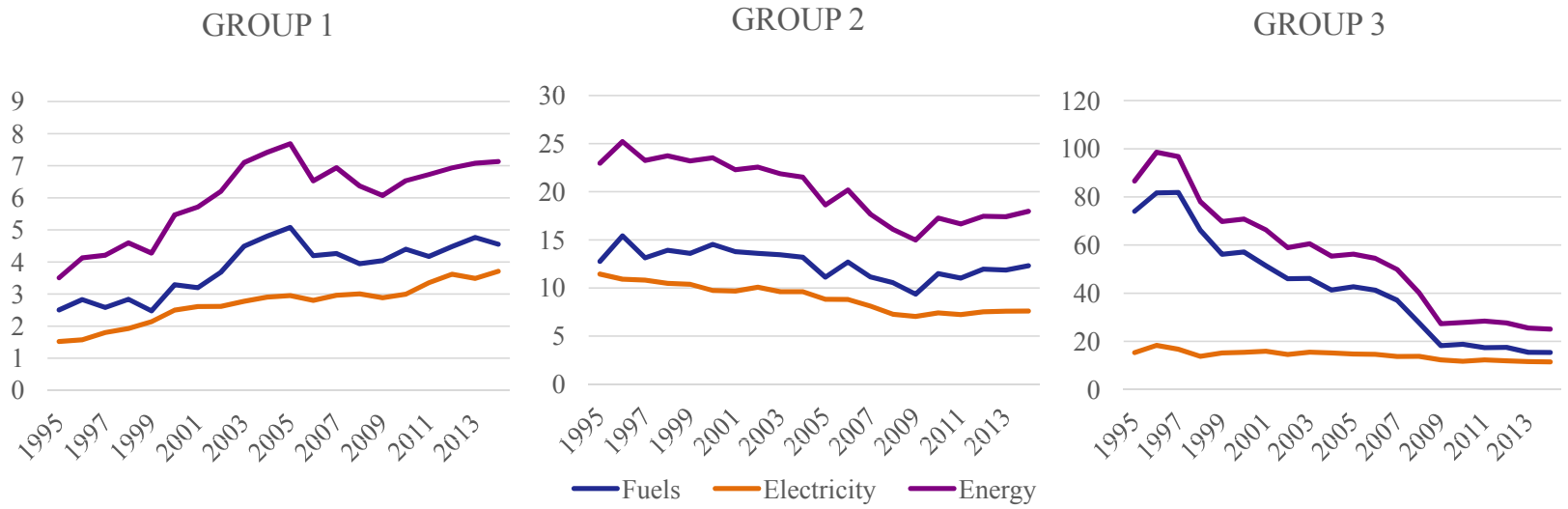
DECREASING TREND AS PROOF OF CONVERGENCE





TOOL 2.1. σ-CONVERGENCE ANALYSIS

Regional analysis – Total energy intensity



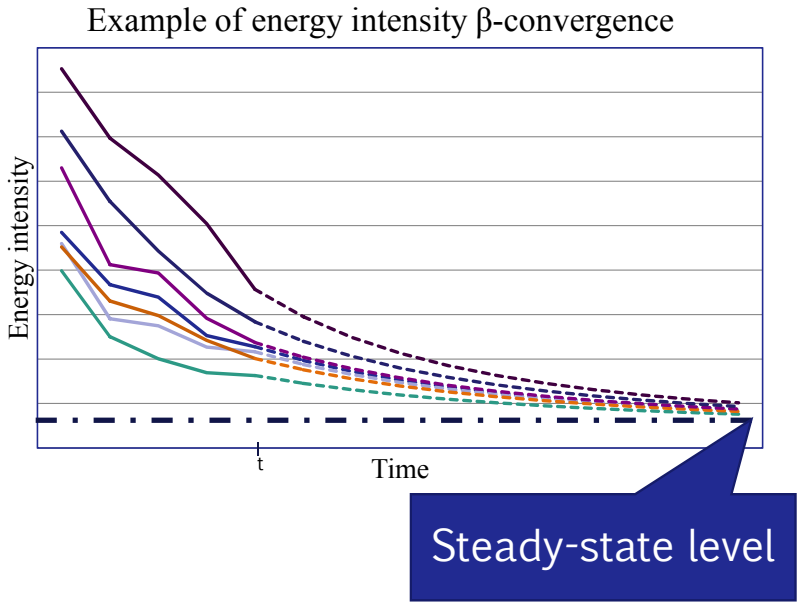
GROUP 1: High efficiency Western Europe (8 countries)
GROUP 2: Low efficiency Western Europe (7 countries)
GROUP 3: Eastern Europe (8 countries)

Unit of measure: 1000 * st.dev. of energy intensity measured in mgep/€

TOOL 2.2. β-CONVERGENCE ANALYSIS

β-convergence

- growth behaviour in relation to proximity to the *steady-state* level
  - backward countries grow at faster rates



STEADY-STATE

Situation in which the various quantities grow at constant rates

- Rates depend on assumptions and growth model accepted
  - With diminishing returns to inputs, the *long-run* growth rate of factor productivity is 0

CONDITIONAL CONVERGENCE

- Steady-state levels may depend on characteristics that vary across economies
  - In this case productivity converges to multiple steady-states

TOOL 2.2. β-CONVERGENCE MODELS

› Alternative models for sectoral energy productivity β-convergence

Pooled OLS – Unconditional convergence

$$\Delta \ln P_{j,t} = \alpha + \beta \ln P_{j,t-1} + \epsilon_{j,t}$$

LSDV one way – Convergence conditional to country-specific fixed effects

$$\Delta \ln P_{j,t} = \beta \ln(P_{j,t-1}) + \mu_j + \epsilon_{j,t}$$

LSDV two ways – Convergence conditional to country and time fixed effects

$$\Delta \ln P_{j,t} = \beta \ln(P_{j,t-1}) + \mu_{j,t} + \epsilon_{j,t}$$

P=Energy source productivity; μ=dummy variable; ε=residual;
Country: j=1,…,23; Time t=1,…,4

TOOL 3. CONVERGENCE DECOMPOSITION

› β-convergence decomposition of energy intensity

$$\beta = \sum_{i,m} \beta_{tec} + \sum_{i,m} \beta_{str} + \sum_{i,m} \beta_{mix}$$

– 3 equations, one for each factor:
  › Dependent variables:
    1. Growth rate of sectoral energy source intensity
    2. Growth rate of sectoral value added share
    3. Growth rate of sectoral energy source share
  › Independent variables
    1. Initial levels of aggregate energy intensity (Pooled OLS)
    2. Individual dummies (LSDV one way)
    3. Individual and time dummies (LSDV two ways)

Sector: i=1,…,14; Energy source m=1,…,3

TOOLS 4. CONVERGENCE FACTORS

Models for β-convergence with additional variables are used also to detect factors of cross-country inequalities

- ADDITIONAL VARIABLES TESTED:
  - RESEARCH&DEVELOPMENT
  - INVESTMENTS
  - FIRM SIZE
  - ENERGY PRICES

LITERATURE

› Studies on energy intensity convergence
  – Mulder (2015)

› Studies on energy intensity convergence factors
  – Miketa and Mulder (2005), Mulder and de Groot (2007), Wan et al. (2015)

NEW RESEARCH AREAS TOUCHED

IMPROVED TOOLS

› IDA with fuel mix factor for Europe

› β-convergence decomposition with fuel mix factor

› New variables tested as factors of convergence

ADDITIONAL DATA COVERED

› Time series 1995-2011 + EU-23 sample + 14 sectors

› Energy source dimension

- Fuels, Electricity → 1995-2011
- Non renewable fuels, Renewable fuels, Electricity → 1999-2011

3. RESULTS

IDA: main findings

- Energy sources consumption in economic sectors
  - COUNTRY ANALYSIS
    - Consumption remained stable or had a little increase in Western Europe, while it lost ground in Eastern countries
    - Technology effect had a negative impact on consumption as well as structure effect
    - In Western Europe the two effects are nearly equivalent, in Eastern countries technology effect is superior
    - Increasing role of electricity and huge growth of renewable fuels
    - Fuel mix had a very low impact

- Energy sources intensity in economic sectors
  - SECTORAL ANALYSIS
    - Energy intensity increased in 4 sectors
    - Supremacy of technological change as the main factor of economy-wide efficiency
    - Structural changes remained in the background, with the same sign (tertiarization and energy intesive sectors value added share loss)
    - Energy mix has an almost imperceptible impact

σ-CONVERGENCE: main findings

EU-23 σ-convergence of energy sources intensity (number of sectors)							
	1995-2011			1999-2011			
	FUE	ELE	TOT	NON-REN	REN	ELE	TOT
CONVERGENCE	12	12	12	11	9	10	8
NOT CONCLUSIVE	-	-	1	-	2	1	1
DIVERGENCE	2	2	1	3	3	3	5
Total n. of sectors	*14*	*14*	*14*	*14*	*14*	*14*	*14*

- Convergence in almost all sectors and all energy sources
- Convergence process concentrated in the '90s and stopped after the recent economic crisis
- Fuels intensity main cause of dispersion
- Thermal renewables intensity converging

β-CONVERGENCE: main findings

EU-23 β-convergence of energy sources intensity (number of sectors)							
	1995-2011			1999-2011			
	FUE	ELE	TOT	NON-REN	REN	ELE	TOT
Unconditional CONVERGENCE	3	2	1	5	-	1	2
Conditional one way CONVERGENCE	3	6	4	4	11	10	9
Conditional two ways CONVERGENCE	8	6	9	5	3	3	3
NOT CONCLUSIVE	-	-	-	-	-	-	-
DIVERGENCE	-	-	-	-	-	-	-
Total n. of sectors	14	14	14	14	14	14	14

- All sectors and energy sources convergent
- Presence of unspecified time variant effects intensities mainly in the longer time interval 1995-2011
- Traditional energy sources intensity greater propensity to approach a common steady-state level
- Renewables with high initial level of dispersion rapidly converging

β-CONVERGENCE DECOMPOSITION

- Technological progress and structural change of the economies both spurring total energy intensity convergence 1995-2011
  - Technology changes are by far the main source of convergence
  - Energy mix irrilevant
- Structural change had a negative impact on convergence 1999-2011
- Fuels confirmed to have a major role in driving convergence

FACTORS OF CONVERGENCE: Research&Development

- VARIABLES:
  - N. of researchers of the economy (human capital)
  - N. of researchers per employment (human capital)
- FINDINGS:
  - Impact on energy intensities is not homogenous
    - Some sectors benefit from country R&D resources availability
    - Cases of sectors taking advantage of country backwardness are also found
  - Same considerations are valid for technology leaders (EU-8)
  - At energy source level there are no huge differences
  - Renewables are found to expand faster in higher domestic R&D effort countries

FACTORS OF CONVERGENCE: Investments

- VARIABLES:
  - Sectoral gross fixed capital
  - Sectoral gross fixed capital per unit of value added
- FINDINGS:
  - All energy sources intensities influenced by capital formation in more than one sector
    - Many cases with countries taking advantage of their sectoral investments effort
  - The 'advantages of backwardness' hypothesis prevails in technology advanced countries (EU-7) rather than in the wider sample (EU-17)
  - Electricity intensity is much more affected by investments than fuels, suggesting that capital goods embody electricity-based technologies

FACTORS OF CONVERGENCE: Firm size

- VARIABLES:
  - Sectoral value added per enterprise
  - Sectoral SMEs share on total number of enterprises
- FINDINGS:
  - Firm size cannot be considered, in general, as a factor for energy intensity
  - Smaller businness structured countries show the most important decline of energy intensity
    - For technology leaders (EU-9) the impact remains the same, but slightly weaker
    - Eastern countries which more rapidly abandoned the large scale dogma recorded major declines in intensity

FACTORS OF CONVERGENCE: Energy prices

- VARIABLES:
  - Real gross price of natural gas for high industrial consumers
  - Real gross price of electricity for high industrial consumers
  - Share of non recoverable taxes and levies on real gross price of natural gas
  - Share of non recoverable taxes and levies on real gross price of electricity
  - Electricity to gas gross and net real price ratio
- FINDINGS:
  - Energy prices relevant in many cases, but not with the same effect on productivity
  - Taxes, levies and general system charges have no clear impact
  - Interfuel substitution between fuels and electricity occurs beyond their relative competitivness

4. CONCLUSIONS

CONCLUSIONS

- Convergence in sectoral energy intensities, driven by technological change, is confirmed at EU level
- Fuels rather than electricity boosted the reduction of cross-country inequalities
- Convergence process stopped after the recent economic crisis
- Several factors have impact on energy intensity and further research is required to identify the origin of cross-country differences

POLICY IMPLICATIONS

- If governments intend to remove the barriers that hinder the achievement of the highest possible levels of sectoral efficiency, they have to promote capital formation, both in physical and human terms, rather than implement price based policies
- To reach higher renewable energy targets, it would be easier to spur electricity penetration in energy end uses. Also in this case, governments should use the instruments indicated above

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8. REFERENCES - IDA

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Regards

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APPENDIX

COUNTRY GROUPS

› GROUP 1
  – Western Europe countries
  – Total energy intensity below the EU-23 average (2011)

› GROUP 2
  – Western Europe countries
  – Total energy intensity above the EU-23 average (2011)

› GROUP 3
  – Eastern Europe countries

GROUP 1
Denmark
France
Germany
Greece
Ireland
Italy
Spain
United Kingdom

GROUP 2
Austria
Netherlands
Portugal
Sweden
Belgium
Slovenia
Finland

GROUP 3
Lithuania
Hungary
Poland
Estonia
Czech Republic
Romania
Slovakia
Bulgaria

COUNTRY GROUPING

- GROUP 1 (8): Denmark, France, Germany, Greece, Ireland, Italy, Spain, United Kingdom
- GROUP 2 (7): Austria, Belgium, Finland, Netherlands, Portugal, Slovenia, Sweden
- GROUP 3 (8): Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Poland, Romania, Slovakia

BAD NOTES

- 5 EU countries excluded
  - No reliable sectoral economic data
- Fisheries excluded
  - No reliable energy data
    - <0,1% of EU-28 total value added
- Intrasectoral changes in value added lead to sectoral intensity changes and cannot be distinguished from technological changes
  - No studies in this field have a richer sectoral detail for industry

ENERGY INTENSITY AND EFFICIENCY

- Concept of energy intensity measured as the ratio ENERGY (physical) / OUTPUT (value) can be criticised as a measure of energy efficiency
  - because
- Reduction of total energy intensity (increase in total energy productivity)
  - can be considered valuable if it derives from technological improvements
  - cannot be considered valuable if it derives from structural changes unless there exist a preference for energy extensive sectors
- Sectoral energy intensity factors
  - Innovation in productive process
  - Product innovation
  - Changes in the value of the finished product
  - Changes in the value of intermediate goods
  - Other external factors (climate, etc.)

LMDI-I vs. LMDI-II

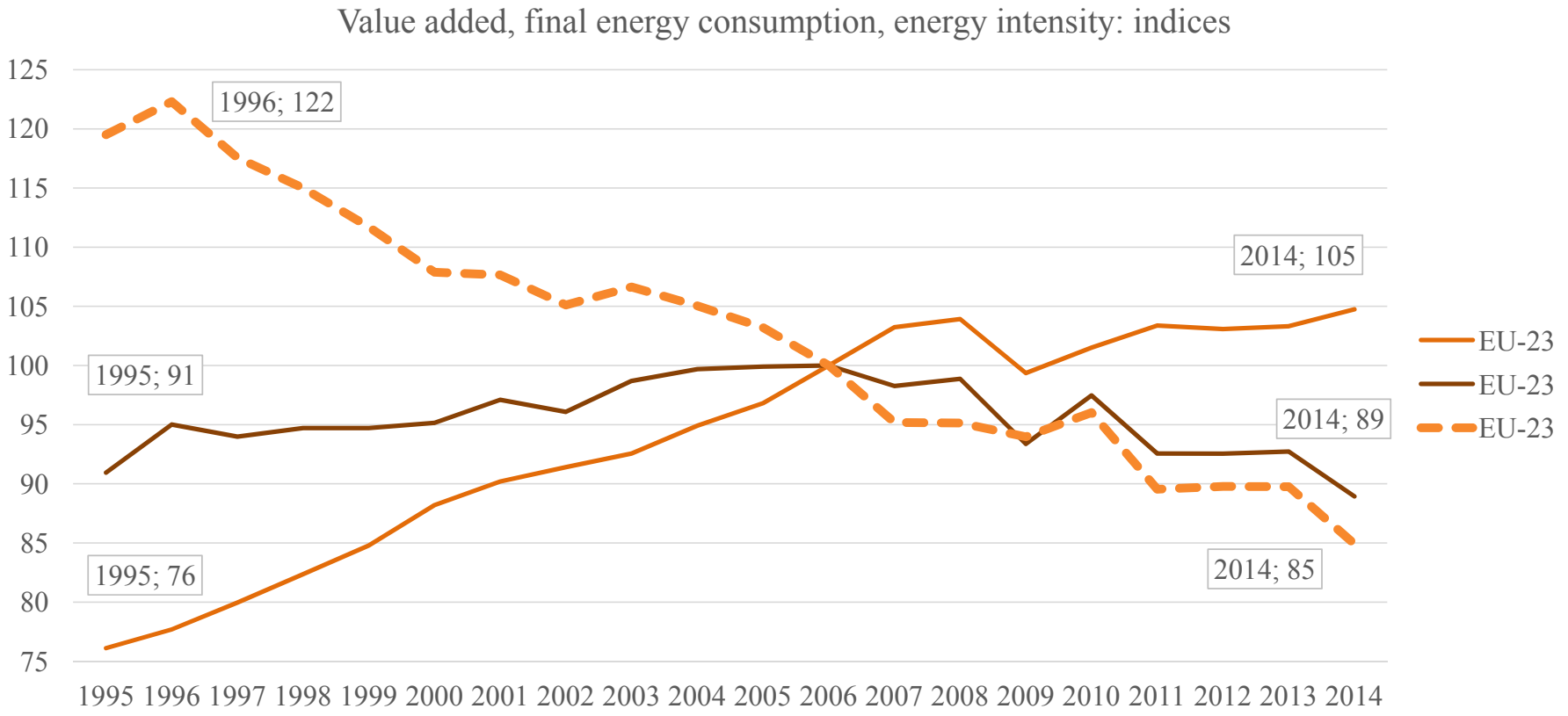
› Depending on how the Divisia index is approximated, the LMDI method has two versions: Montgomery-Vartia index (LMDI-I) e based on Montgomery [38] and Vartia [39,40] e and Sato-Vartia index (LMDI-II) which derives from Sato [41] and Vartia [40]. (Fernandez-Gonzales 2013)

ENERGY INTENSITY TRENDS 1960-1997

The rate of change in energy intensity (%/p.a.) for 15 EU countries						
	1960-70	1970-80	1980-90	1990-97		Trend 1960-97
Belgium	0.69	-1.82	-1.42	-0.84		-1.25
Denmark	3.78	-2.45	-2.73	-0.47		-1.64
Germany	3.29	-1.03	-2.25	-1.91		-2.01
Greece	4.39	2.21	1.71	0.42		1.03
Spain	1.51	2.36	0.18	0.63		0.52
France	0.74	-0.58	-0.39	-0.08		-0.49
Ireland	0.94	-1.57	-1.46	-4.29		-2.28
Italy	4.01	-1.23	-1.19	-0.19		-1.17
Luxembourg	-1.19	-3.77	-4.45	-5.45		-4.53
Netherlands	3.61	-0.11	-1.89	-0.76		-1.33
Austria	0.56	-1.10	-1.20	-0.85		-1.15
Portugal	0.73	0.78	1.81	0.92		1.66
Finland	1.45	-0.13	-1.72	1.06		-0.39
Sweden	1.62	-1.16	-0.46	0.41		-0.29
United Kingdom	-0.23	-2.23	-2.05	-0.75		-1.74
MEAN	*1.73*	*-0.79*	*-1.17*	*-0.81*		*-1.00*

Source: elaborations on Sun, 2001

1. ENERGY AND ECONOMY IN THE EU



EU-23: EU-28 Member States except Croatia, Cyprus, Latvia, Luxembourg and Malta
Source: elaborations on EUROSTAT data

TOOL 4. CONVERGENCE FACTORS

› Models for β-convergence with additional variables

– Pooled OLS

$$\Delta \ln P_{j,t} = \alpha + \beta \ln P_{j,t-1} + \gamma \ln VARIABLE_{j,t-1} + \epsilon_{j,t}$$

– LSDV one way

$$\Delta \ln P_{j,t} = \alpha + \beta \ln P_{j,t-1} + \gamma \ln VARIABLE_{j,t-1} + \mu_j + \epsilon_{j,t}$$

– LSDV two ways

$$\Delta \ln P_{j,t} = \alpha + \beta \ln P_{j,t-1} + \gamma \ln VARIABLE_{j,t-1} + \mu_{j,t} + \epsilon_{j,t}$$

METHODOLOGY

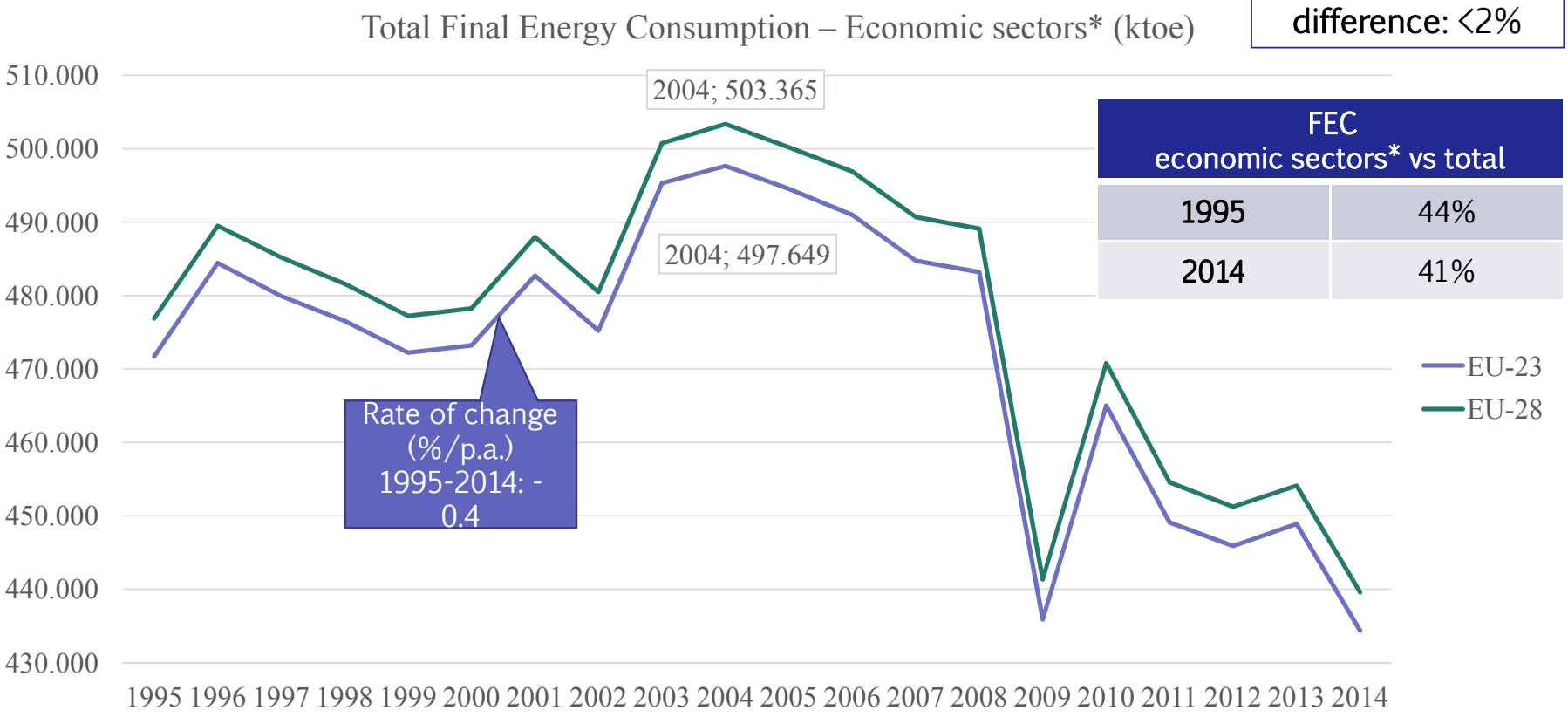
- TESTS FOR BEST FITTING MODEL
  - LSDV two ways vs LSDV one way
    - Wald test on time dummies non jointly significant
    - Null rejection → LSDV two ways
  - LSDV two ways vs Pooled OLS
    - F-test for common intercept (individual dummies are all equal)
    - Null rejection → LSDV two ways
    - F-test for common iLSDV one way vs Pooled OLS
    - ntercept (individual dummies are all equal)
    - Null rejection → LSDV one way
  - Pooled OLS vs GLS
    - Breusch-Pagan test on abscence of heteroskedasticity of the error term (OLS)
    - Null rejection → GLS
  - GLS vs LSDV
    - Hausman test on non correlation between random effects and regressors
    - Null rejection → LSDV

RESULTS: AN INTERPRETATION GUIDE

	UNKNOWN EFFECTS	$\beta<0$	$\beta=0$	$\beta>0$	Steady-state
POOLED OLS	No unexplained variability	Convergence	Inconclusive	Divergence	1
LSDV ONE WAY	Country fixed effects	Conditional convergence	Inconclusive	Divergence	Multiple
LSDV TWO WAYS	Country+time fixed effects	Conditional convergence	Inconclusive	Divergence	Multiple

ENERGY IN ECONOMIC SECTORS

EU-23 vs. EU-28 difference: <2%



FEC economic sectors* vs total	
1995	44%
2014	41%

* Excluding Fisheries - EU-23: EU-28 Member States except Croatia, Cyprus, Latvia, Luxembourg and Malta
Source: EUROSTAT

ENERGY CONSUMPTION IN ECONOMIC SECTORS PEAKS

Year of peak	Country
1995	Bulgaria, Czech Republic, Lithuania, Romania, Slovakia
1996	Denmark, Hungary, Poland, Sweden
1999	France, Slovenia
2001	United Kingdom
2002	Portugal
2004	EU-23
2005	Italy, Spain
2006	Finland, Ireland
2007	Greece
2008	Austria, Estonia, Netherlands
2010	Germany
2011	Belgium

Source: elaborations on EUROSTAT

COUNTRY GROUPS

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Slovenia
Finland

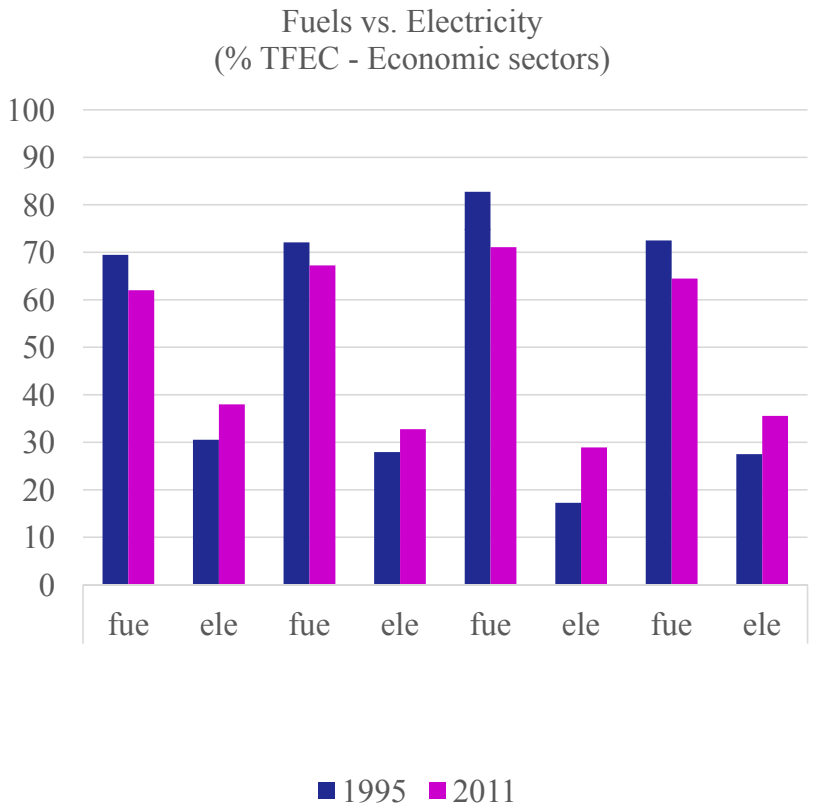
GROUP 3
Lithuania
Hungary
Poland
Estonia
Czech Republic
Romania
Slovakia
Bulgaria

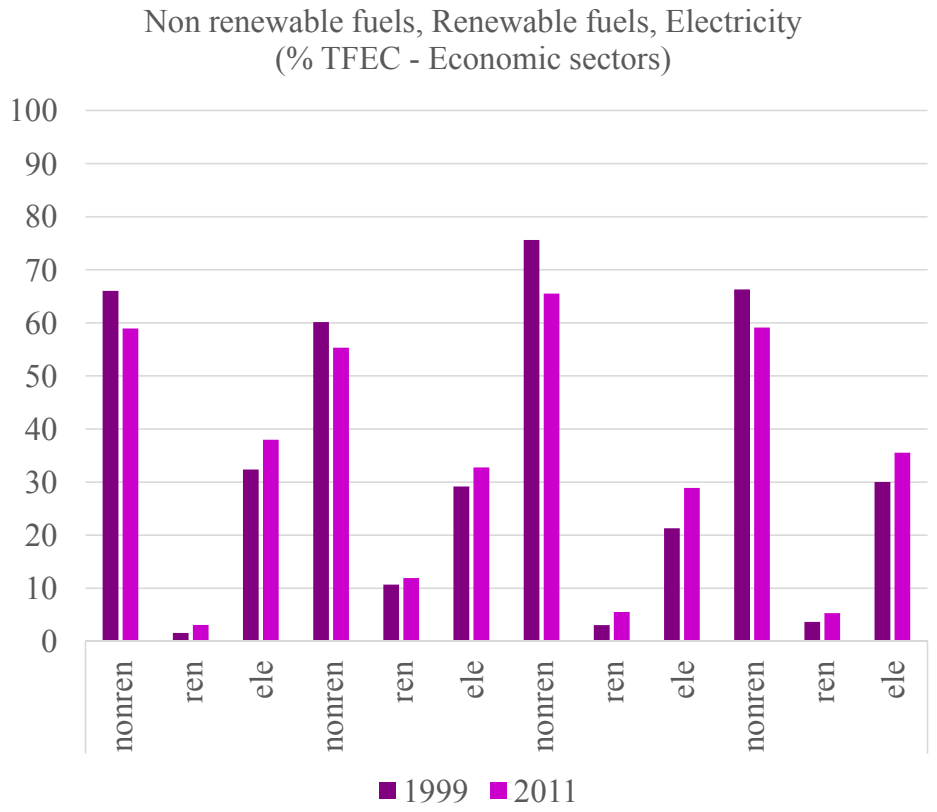
ENERGY CONSUMPTION DECOMPOSITION

GROUP 1	1995 SHARE E	62%	GROUP 2	1995 SHARE E	19%
	2011 SHARE E	64%		2011 SHARE E	21%
ΔE	334	0.1%	ΔE	7,212	2.5%
ΔE_{tec}	-41,390	-12399%	ΔE_{tec}	-14,145	-196%
ΔE_{str}	-40,022	-11989%	ΔE_{str}	-13,364	-185%
ΔE_{mix}	-282	-85%	ΔE_{mix}	-199	-3%
ΔE_{act}	82,028	24573%	ΔE_{act}	34,919	484%
GROUP 3	**1995 SHARE E**	19%	**EU-23**	**1995 SHARE E**	100%
	2011 SHARE E	15%		**2011 SHARE E**	100%
ΔE	-21,793	-7.5%	ΔE	-14,247	-4.9%
ΔE_{tec}	-55,733	256%	ΔE_{tec}	-111,267	781%
ΔE_{str}	-6,438	30%	ΔE_{str}	-59,824	420%
ΔE_{mix}	-64	0%	ΔE_{mix}	-545	4%
ΔE_{act}	40,442	-186%	ΔE_{act}	157,390	-1105%

Energy in ktoe

ENERGY SOURCES DETAIL





4. RESULTS

BY SECTOR

SECTOR GROUPS

› GROUP A
  – Energy intensive manufacturing sectors

› GROUP B
  – Energy extensive manufacturing sectors

› GROUP C
  – Non-manufacturing sectors

GROUP A
Basic metals
Non-metallic minerals
Paper, Pulp and Print
Chemical and Petrochemical

GROUP B
Wood and Wood products
Food and Tobacco
Other manufacturing
Textile and Leather
Transport equipment
Machinery and Fabricated metals

GROUP C
AGRICULTURE AND FORESTRY
Mining and Quarrying
SERVICES
Construction

SECTORAL ENERGY INTENSITY

EU-23 sectoral energy intensity decomposition by sector group

	VA share %		VA	EN	INT	ΔI_{tec}	ΔI_{str}	ΔI_{mix}
	1995	2011	%/p.a.	%/p.a.	%/p.a.	%	%	%
GROUP A	4,6	4,1	1,2	-0,8	-1,9			
Basic metals	0.9	0.6	-0.5	-1.7	-1.3			
Non-metallic minerals	0.9	0.7	0.4	-0.8	-1.2			
Paper, Pulp and Print	1.1	0.9	0.3	0.6	0.3			
Chemical and Petrochemical	1.7	1.9	2.6	-0.3	-2.8			
GROUP B	12.9	12.6	1.7	-1.0	-2.7			
Wood and Wood products	0.4	0.3	0.5	2.1	1.6			
Food and Tobacco	2.6	2.1	0.6	-0.5	-1.1			
Other manufacturing	2.2	2.2	1.9	-2.2	-4.0			
Textile and Leather	1.2	0.6	-2.0	-4.6	-2.6			
Transport equipment	1.8	1.9	2.4	-0.3	-2.7			
Machinery and Fabricated metals	4.7	5.4	2.7	-0.3	-2.9			
GROUP C	82.8	83.2	1.9	0.9	-1.0			
Agriculture and Forestry	2.0	1.7	0.7	-1.1	-1.8			
Mining and Quarrying	1.4	0.7	-2.9	-1.1	1.9			
Services	72.0	75.1	2.1	1.5	-0.6			
Construction	7.3	5.8	0.4	0.5	0.1			
TOTALS								
Manufacturing	17.4	16.7	1.6	-0.8	-2.4			
Non-manufacturing industry	8.7	6.4	0.0	-0.1	-0.1			
Total	100.0	100.0	1.9	-0.2	-2.0	82.0	17.7	0.3

σ-convergence main findings

Sectoral energy source intensity standard deviation 1995-2011	FUE	ELE	TOT
	%/p.a.	%/p.a.	%/p.a.
GROUP A			
Basic metals	-3.8	-3.0	-3.8
Non-metallic minerals	-9.3	-7.4	-9.2
Paper, Pulp and Print	0.2	-0.4	0.2
Chemical and Petrochemical	-6.3	-6.1	-6.3
GROUP B			
Wood and Wood products	-3.8	-1.6	-3.2
Food and Tobacco	-6.7	0.6	-4.8
Other manufacturing	-10.5	-4.9	-9.5
Textile and Leather	-10.5	-4.9	-9.5
Transport equipment	-14.5	-7.1	-12.4
Machinery and Fabricated metals	-14.1	-9.1	-12.0
GROUP C			
Agriculture and Forestry	-2.0	-2.0	-1.9
Mining and Quarrying	-0.3	0.1	-0.5
Services	-6.1	2.1	-3.9
Construction	-5.1	-4.3	-5.4
TOTALS			
Manufacturing	**-8.8**	**-5.5**	**-8.3**
Non-manufacturing industry	**-5.2**	**-2.0**	**-4.8**
Total	**-7.3**	**-2.5**	**-6.3**

Sectoral energy source intensity standard deviation 1999-2011	N-REN	REN	ELE	TOT
	%/p.a.	%/p.a.	%/p.a.	%/p.a.
GROUP A				
Basic metals	-3.4	4.4	-4.0	-3.8
Non-metallic minerals	-7.6	2.0	-6.7	-7.4
Paper, Pulp and Print	-9.9	3.4	-1.4	-0.7
Chemical and Petrochemical	-5.4	-15.7	-5.7	-5.4
GROUP B				
Wood and Wood products	-9.5	-4.1	-4.8	-6.4
Food and Tobacco	-5.8	1.4	-0.3	-4.1
Other manufacturing	-12.7	4.8	-9.4	-12.1
Textile and Leather	-12.7	4.8	-9.4	-12.1
Transport equipment	-10.9	-10.5	-9.4	-11.1
Machinery and Fabricated metals	-15.3	-13.7	-9.5	-12.9
GROUP C				
Agriculture and Forestry	-1.6	-1.8	0.3	-1.0
Mining and Quarrying	0.8	20.7	3.0	1.7
Services	-5.8	-1.9	2.9	-3.2
Construction	-3.4	0.4	-2.6	-3.9
TOTALS				
Manufacturing	**-11.5**	**-2.9**	**-7.4**	**-10.3**
Non-manufacturing industry	**-3.4**	**1.3**	**-0.9**	**-3.2**
Total	**-7.4**	**-2.2**	**-1.9**	**-5.8**