Final report

Study on energy prices and costs: evaluating impacts on households and industry - 2023 edition

Annexes

Written by Trinomics et al.
December 2022

PDF ISBN: 978-92-68-14285-1 doi: 10.2833/348118 ISSN: 2599-8803 MJ-AG-24-002-EN-N

Luxembourg: Publications Office of the European Union, 2024

EUROPEAN COMMISSION
Directorate-General for Energy
Directorate A — Energy policy: Strategy and Coordination
Unit A4 — Chief Economist
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European Commission
B-1049 Brussels

Study on energy prices and costs: evaluating impacts on households and industry – 2023 edition

Annex A: Country fact sheets

Annex B: Selected energy intensive industries

Contract details

European Commission, DG ENER

Specific contract: Study on energy prices and costs; evaluating impacts on households and industry's costs – 2022 edition - ENER/A4/2021-329

Under framework contract MOVE/ENER/SRD/2020/OP/0008 Lot-2: Socio-economic assistance in the field of energy

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Date

Rotterdam, 11 December 2022

Rotterdam, 11 December 2022

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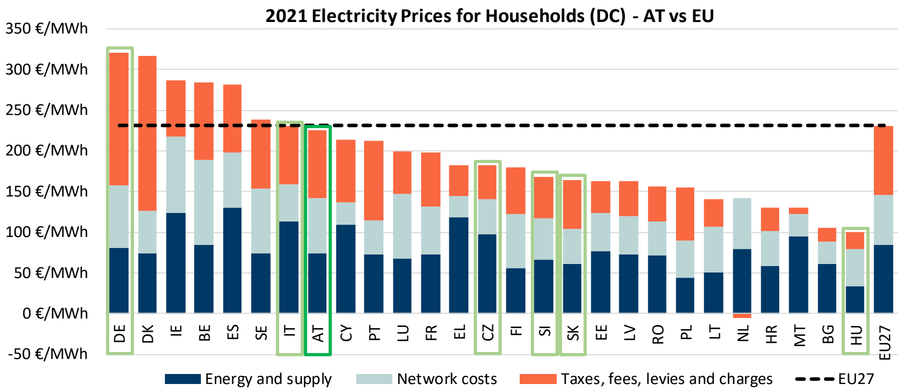
Katja Schumacher, Katja Hünecke, Viktoria Noka (Oeko)

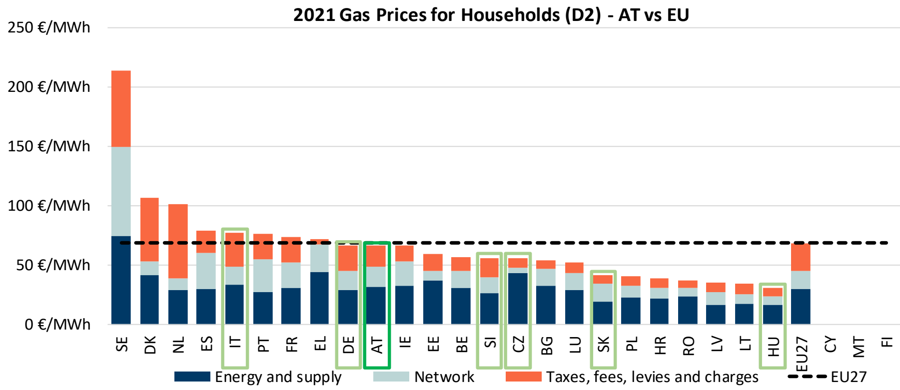
In association with:

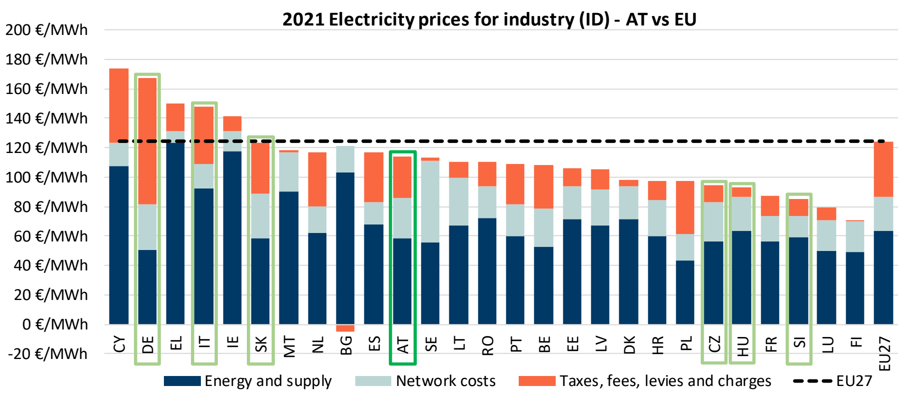
CONTENTS

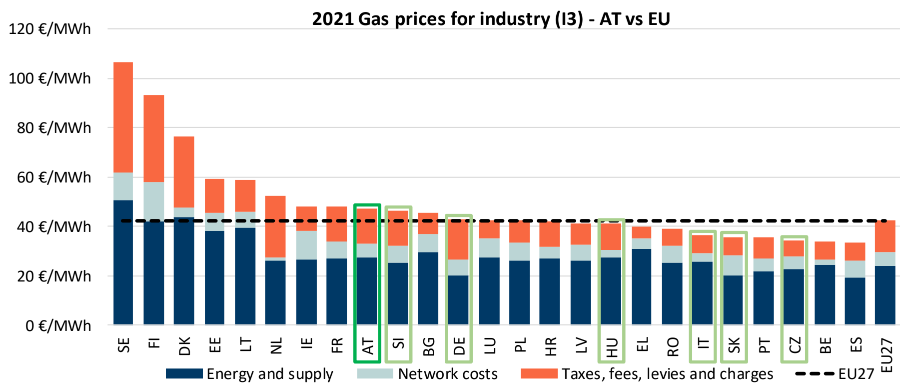
Annex A Country fact sheets

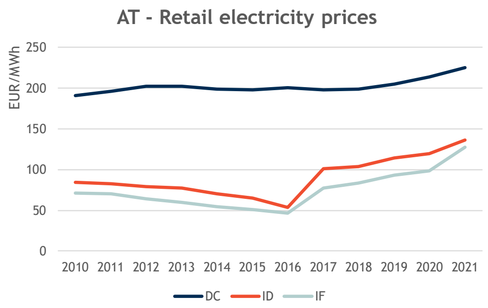
Austria

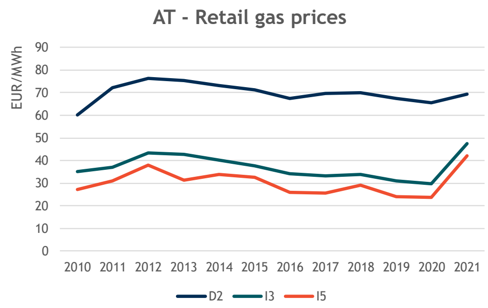


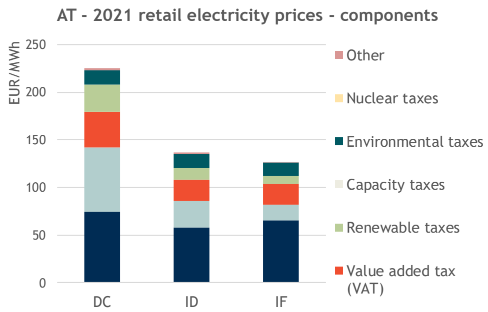


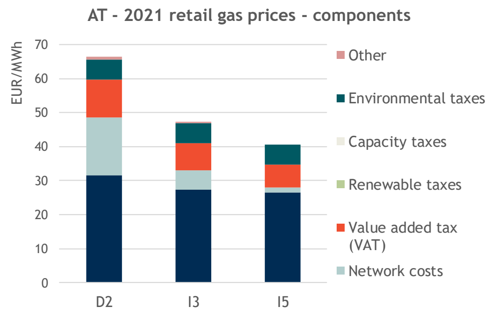


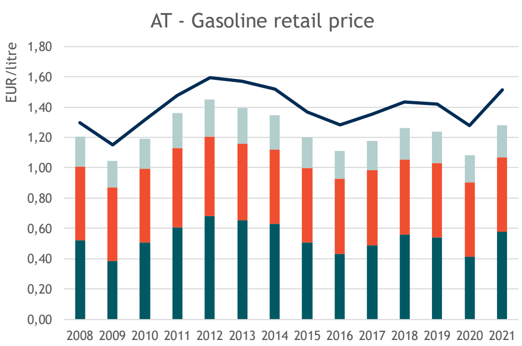


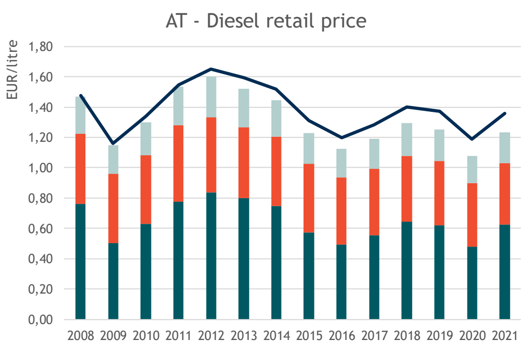

AT - Retail electricity prices
EUR/MWh
250
200
150
100
50
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

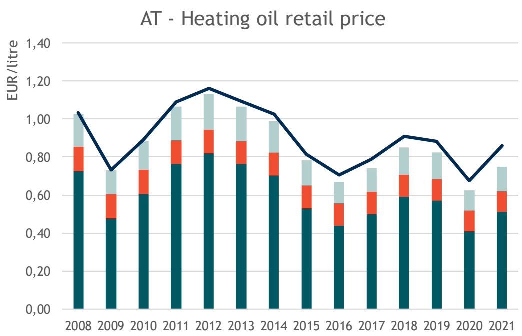

AT - Retail gas prices
EUR/MWh
90
80
70
60
50
40
30
20
10
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

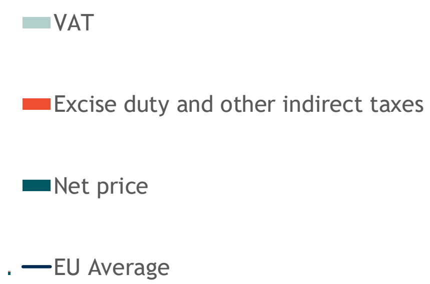

AT - 2021 retail electricity prices - components
EUR/MWh
250
200
150
100
50
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


AT - 2021 retail gas prices - components
EUR/MWh
70
60
50
40
30
20
10
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

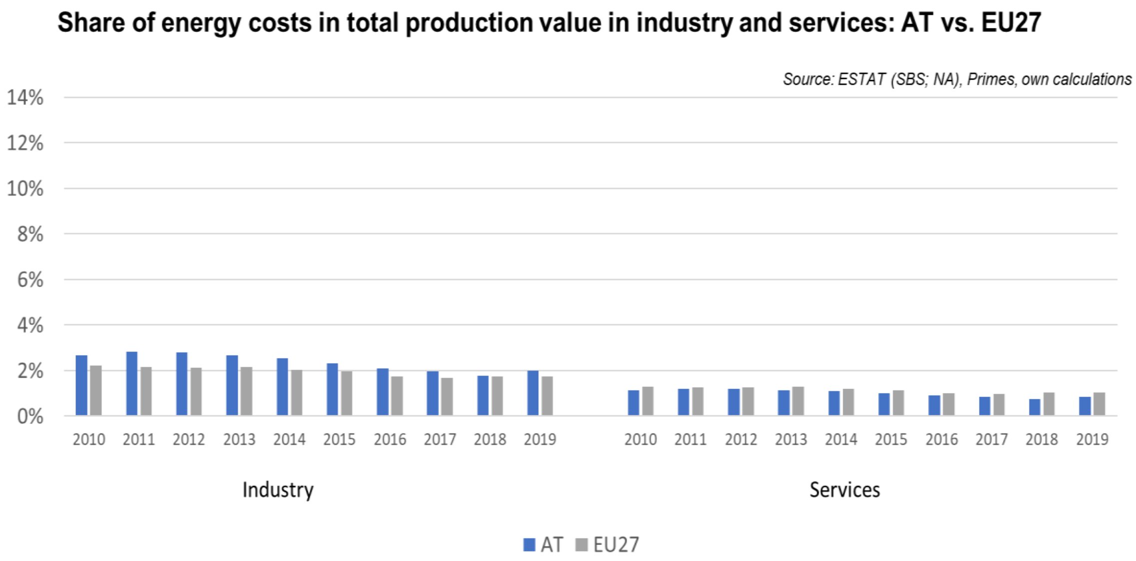

AT - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

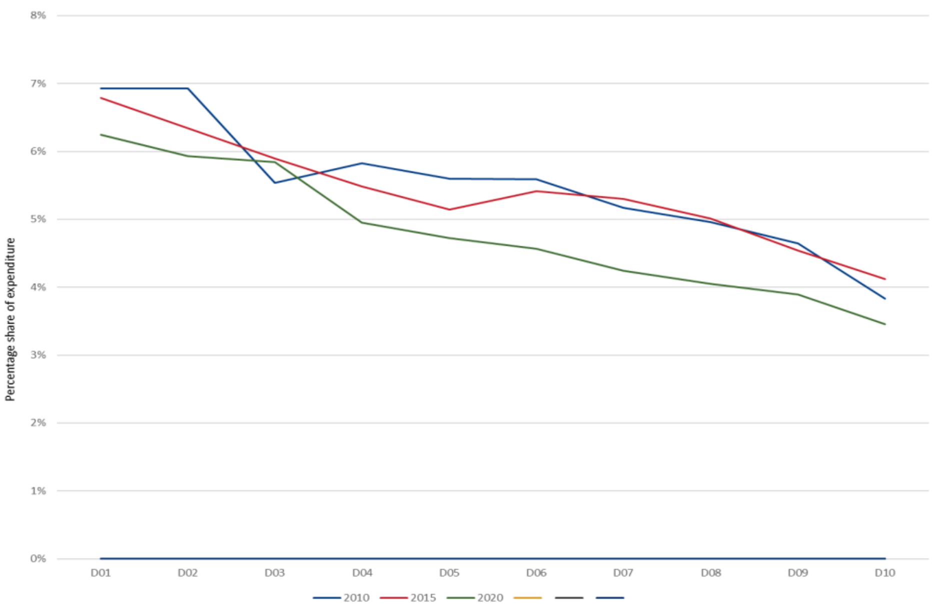

AT - Diesel retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


AT - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

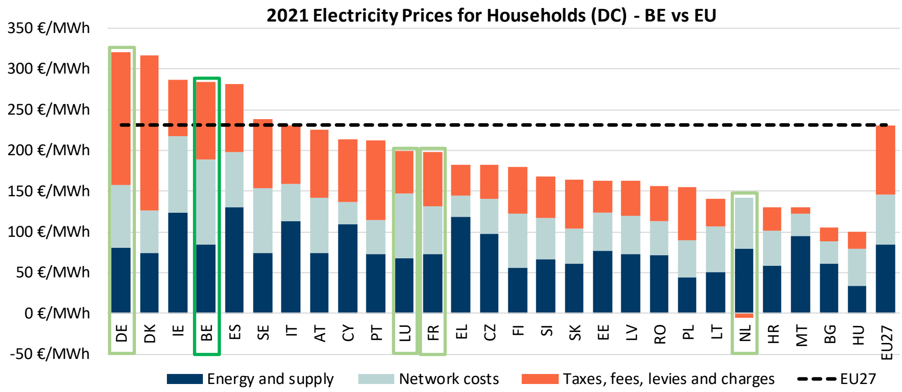

VAT
Excise duty and other indirect taxes
Net price
EU Average

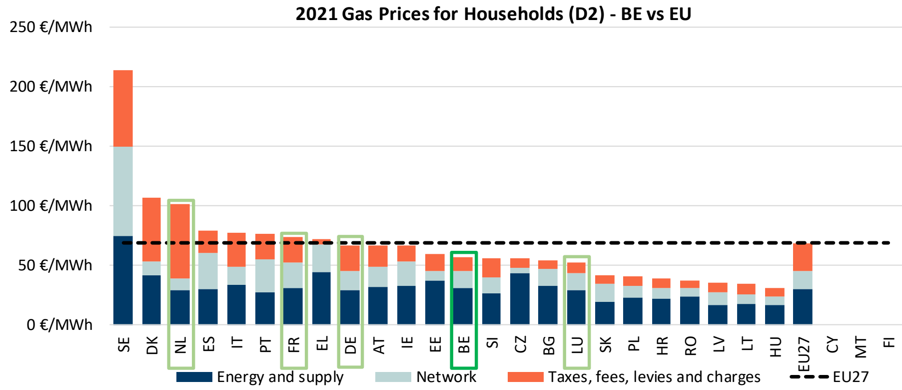
Energy costs for households, industry and services

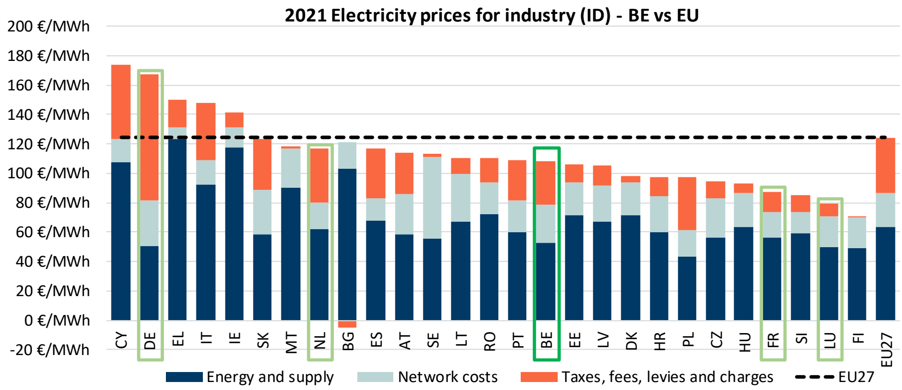


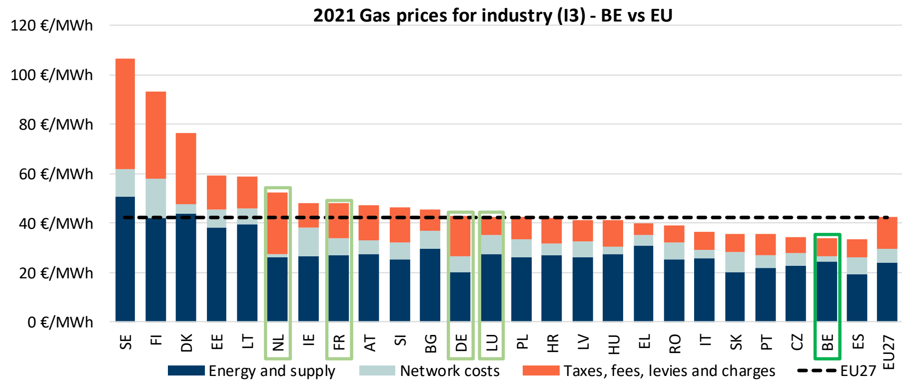


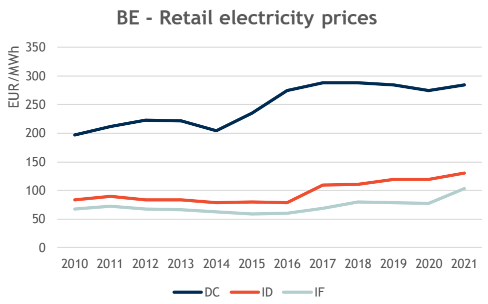
Belgium

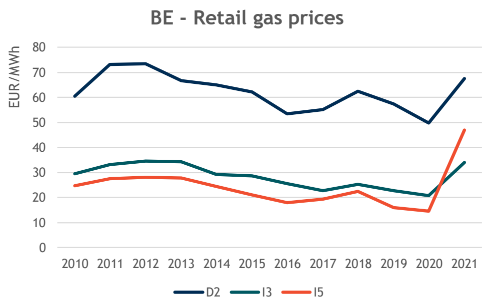

2021 Electricity Prices for Households (DC) - BE vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

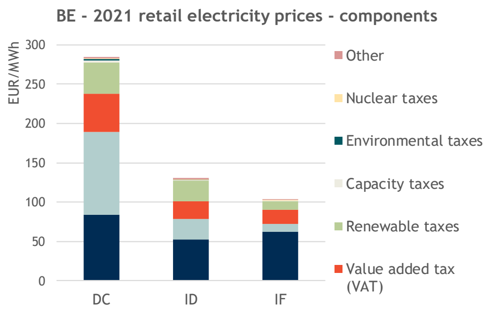

2021 Gas Prices for Households (D2) - BE vs EU
Energy and supply
Network
Taxes, fees, levies and charges
EU27

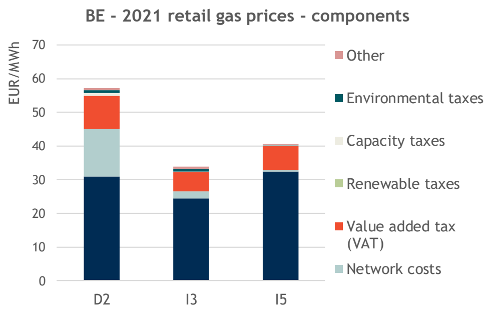

2021 Electricity prices for industry (ID) - BE vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

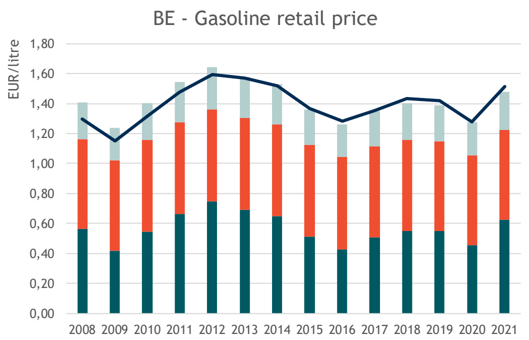

2021 Gas prices for industry (I3) - BE vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

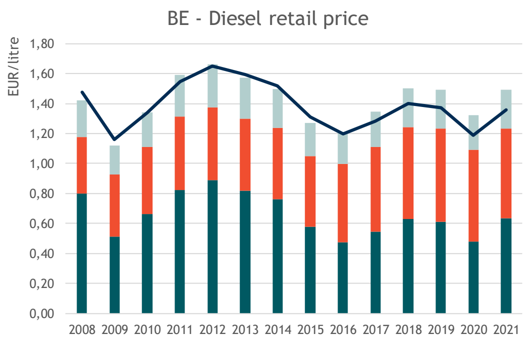

BE - Retail electricity prices
EUR/MWh
0
50
100
150
200
250
300
350
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

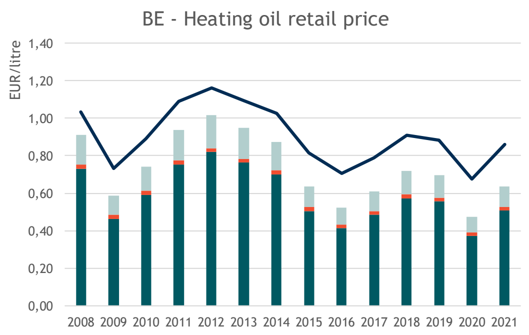

BE - Retail gas prices
EUR/MWh
0
10
20
30
40
50
60
70
80
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

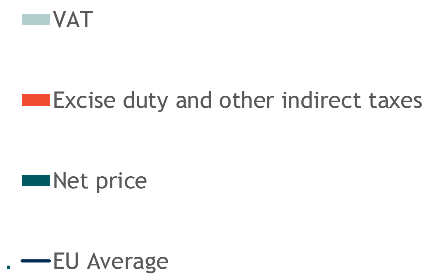

BE - 2021 retail electricity prices - components
EUR/MWh
0
50
100
150
200
250
300
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


BE - 2021 retail gas prices - components
EUR/MWh
0
10
20
30
40
50
60
70
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

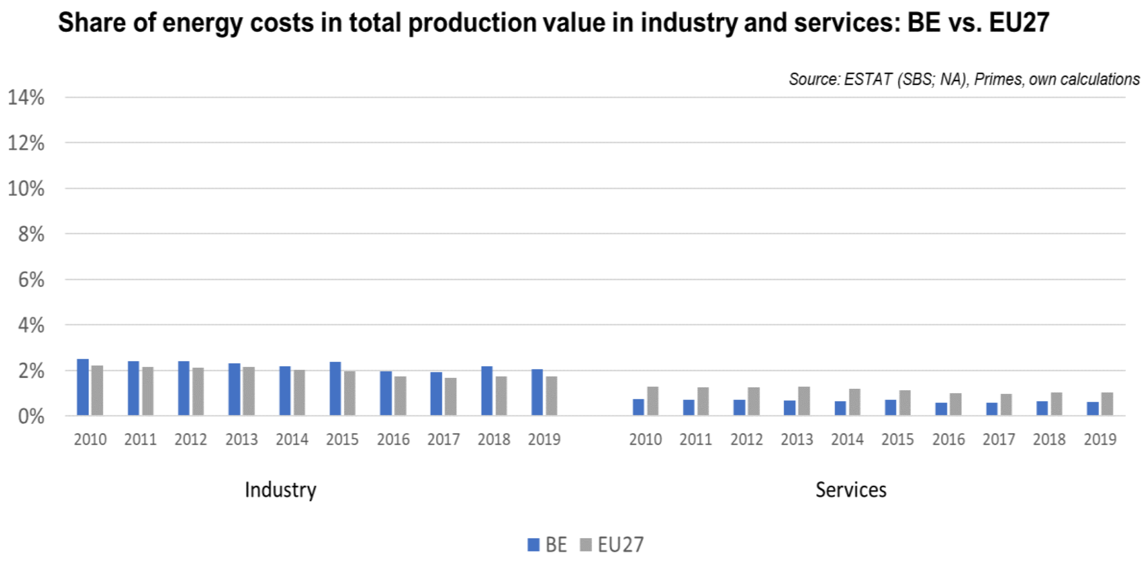

BE - Gasoline retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


BE - Diesel retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

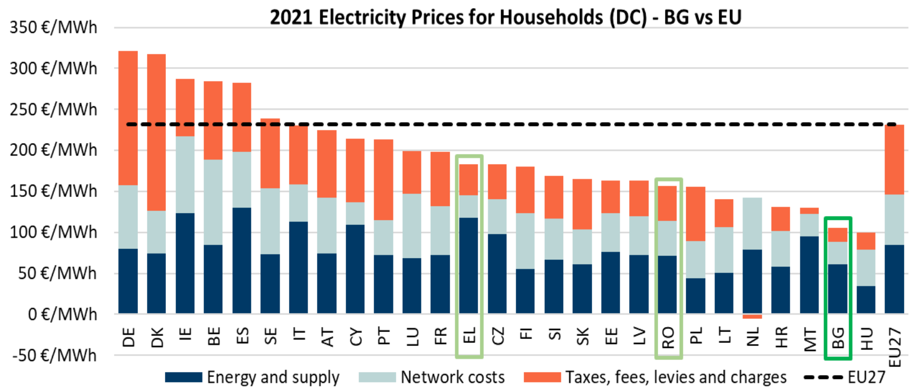

BE - Heating oil retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

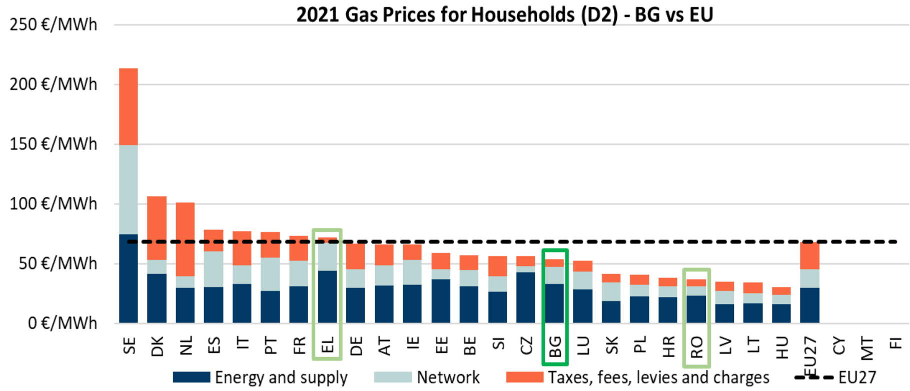

VAT
Excise duty and other indirect taxes
Net price
EU Average

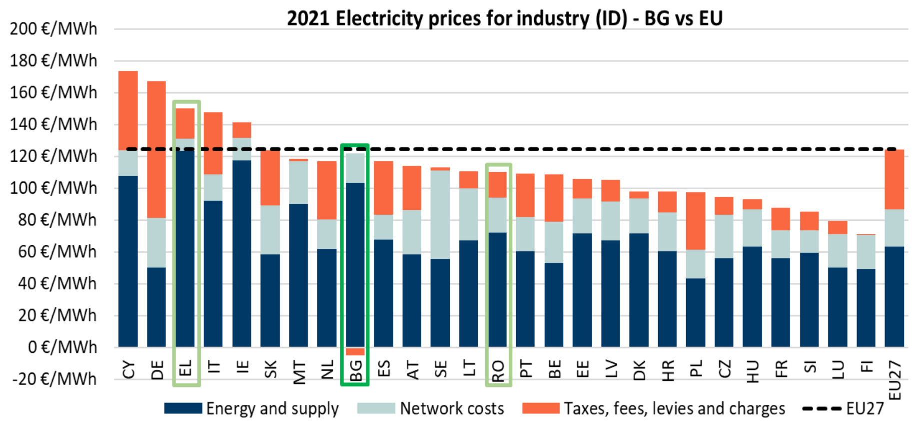
Energy costs for households, industry and services



Bulgaria


2021 Electricity Prices for Households (DC) - BG vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - BG vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - BG vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
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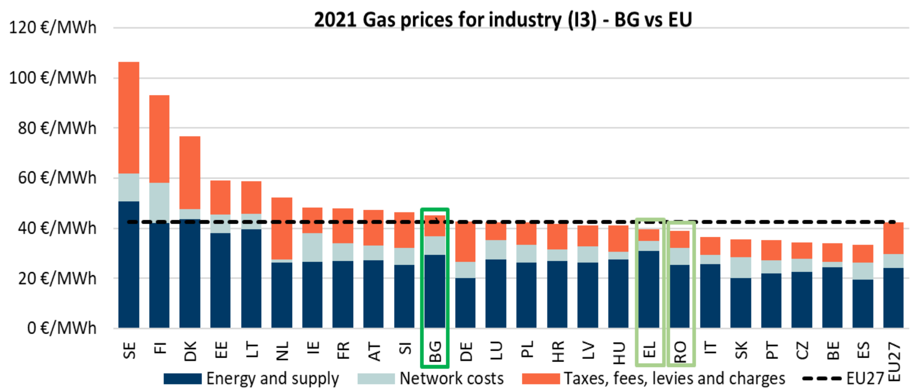
2021 Gas prices for industry (I3) - BG vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
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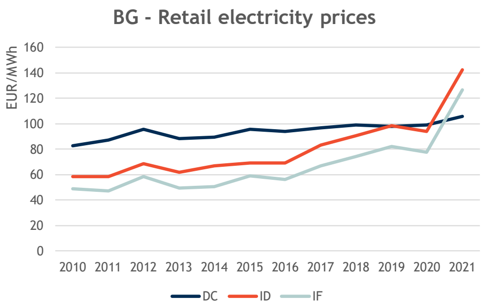
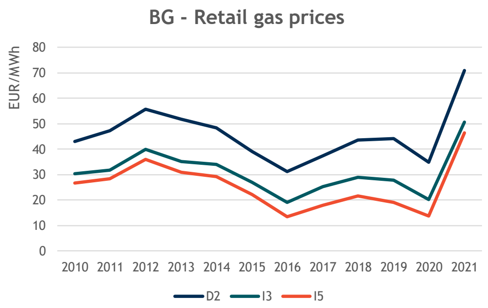
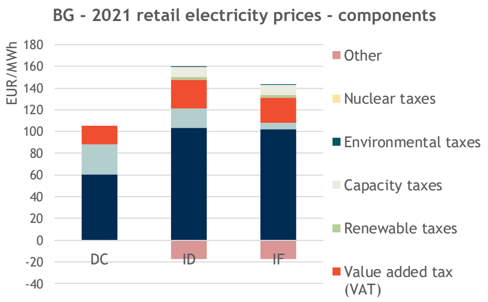
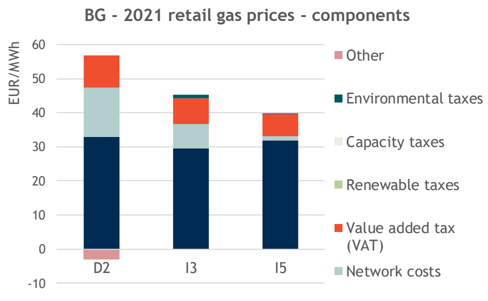
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


BG - Retail electricity prices
EUR/MWh
DC
ID
IF


BG - Retail gas prices
EUR/MWh
D2
I3
I5


BG - 2021 retail electricity prices - components
EUR/MWh
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)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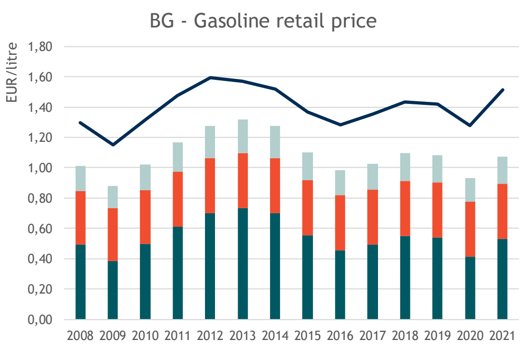
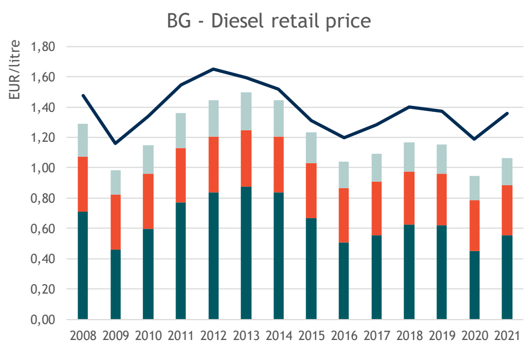
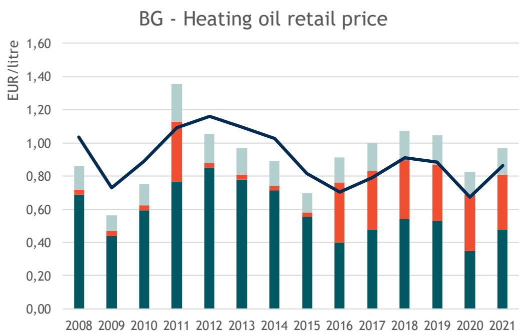
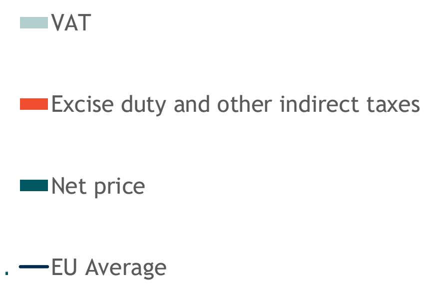
Network costs

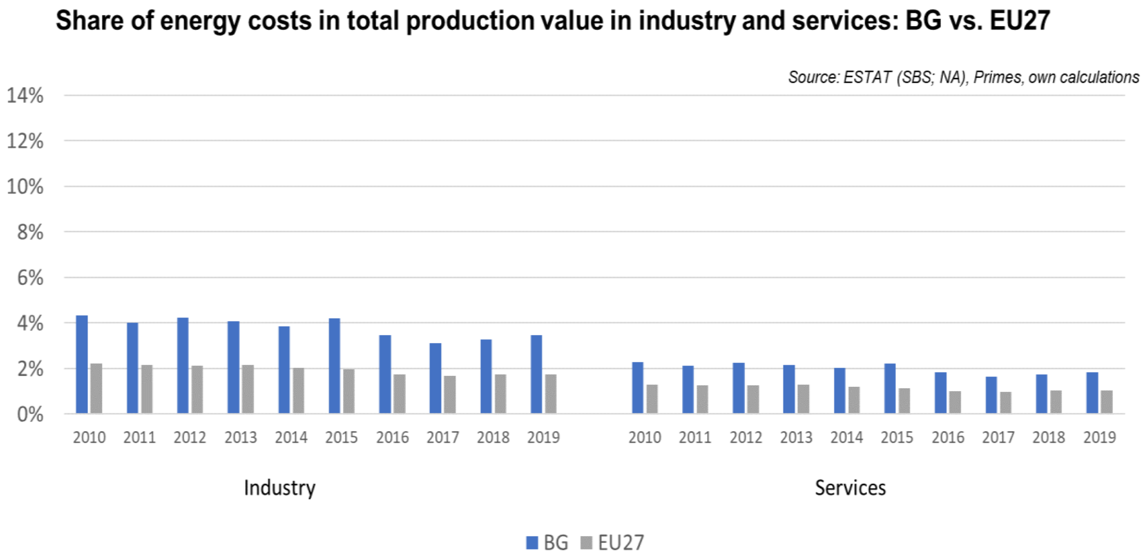

BG - Gasoline retail price
EUR/litre

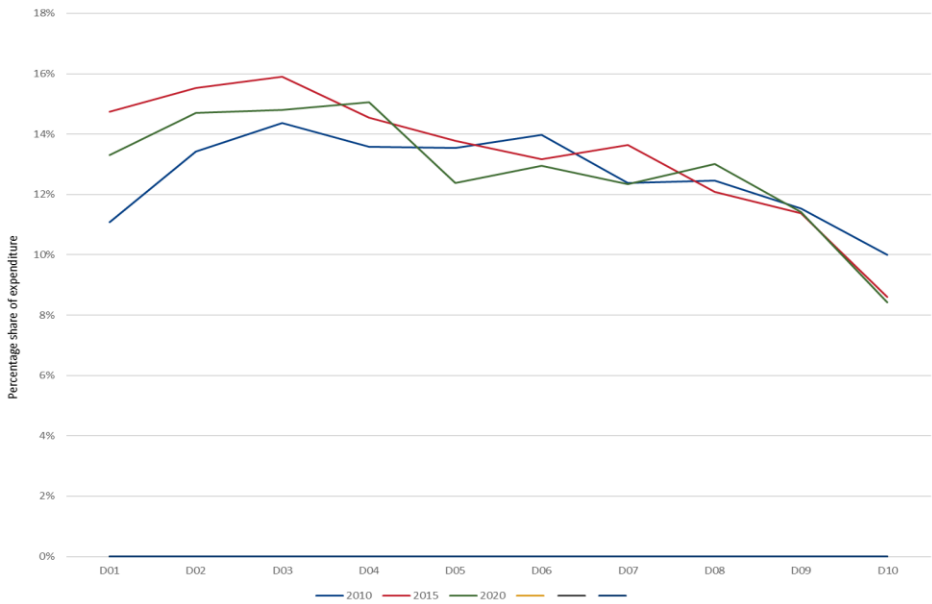

BG - Diesel retail price
EUR/litre


BG - Heating oil retail price
EUR/litre

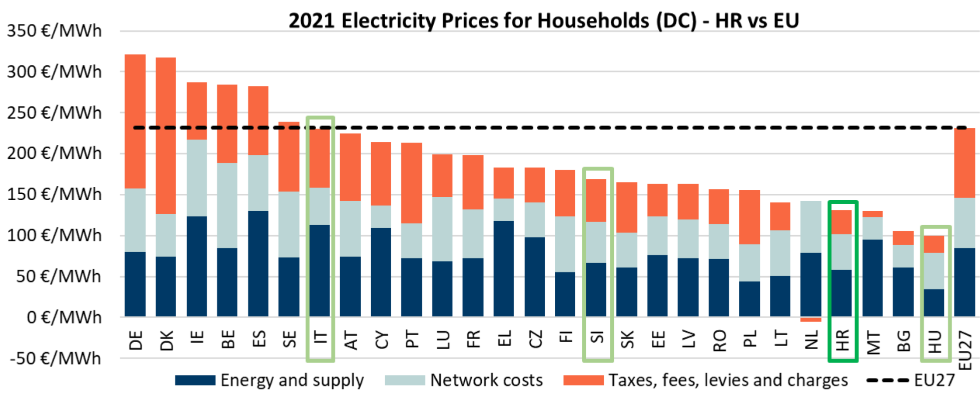

VAT
Excise duty and other indirect taxes
Net price
EU Average

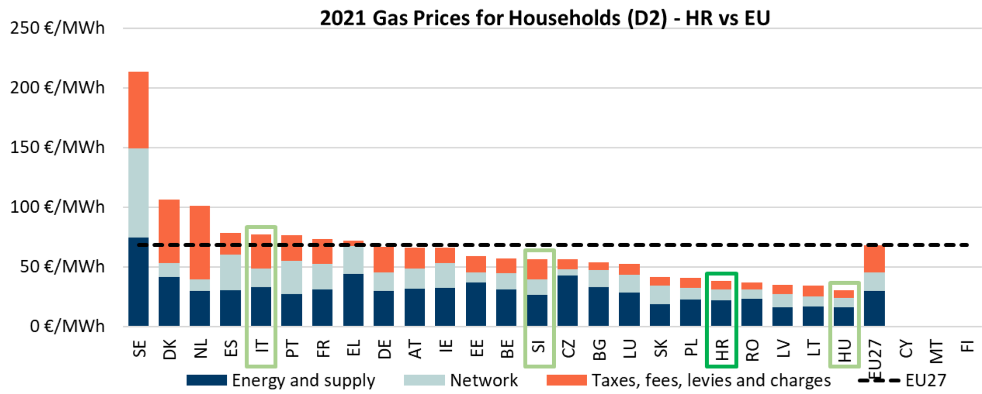
Energy costs for households, industry and services

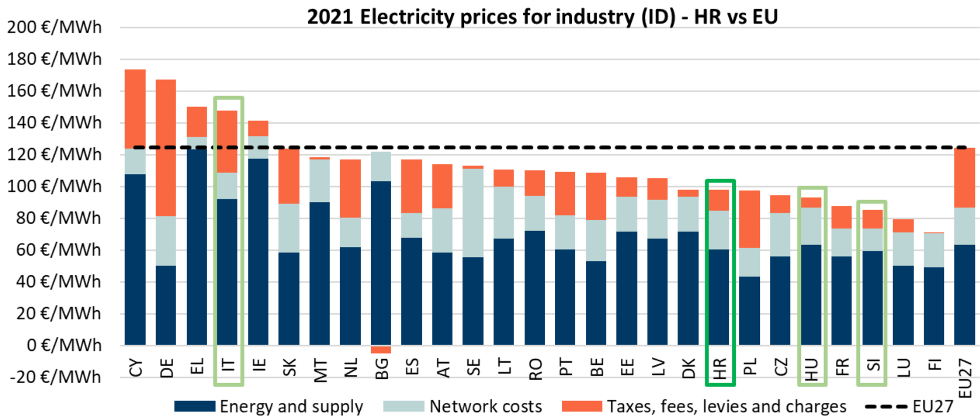


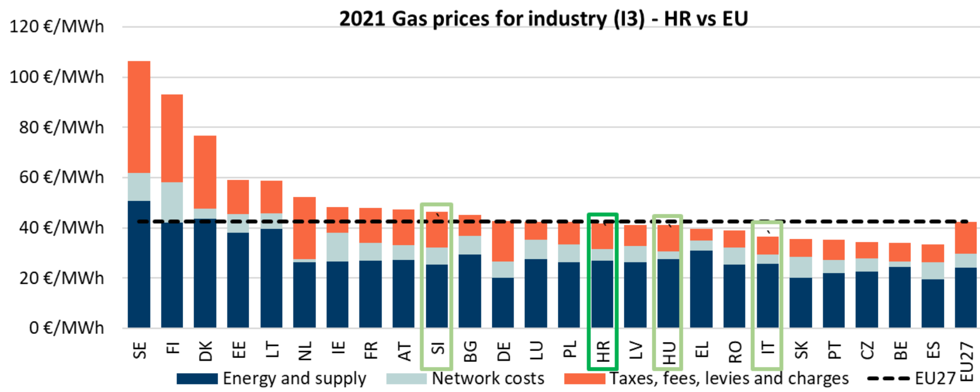


Croatia


2021 Electricity Prices for Households (DC) - HR vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - HR vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - HR vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas prices for industry (I3) - HR vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
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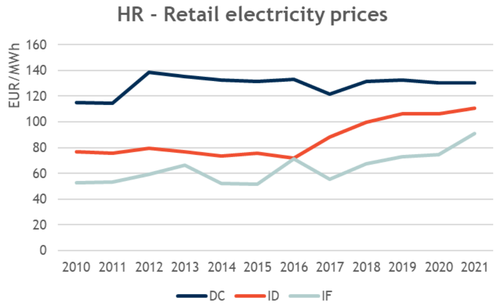
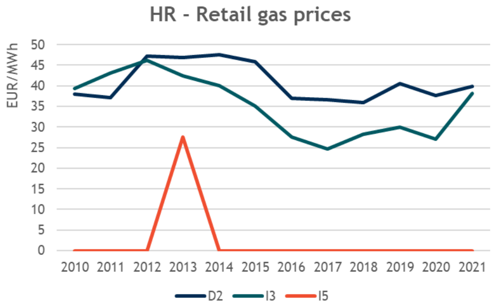
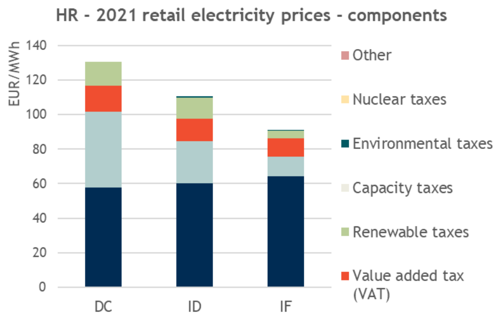
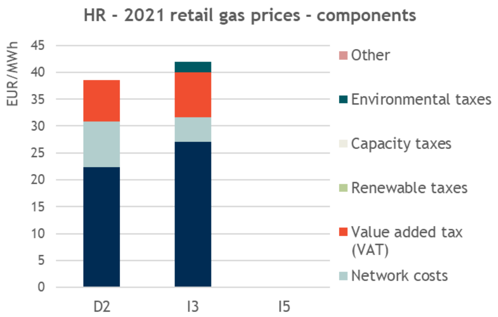
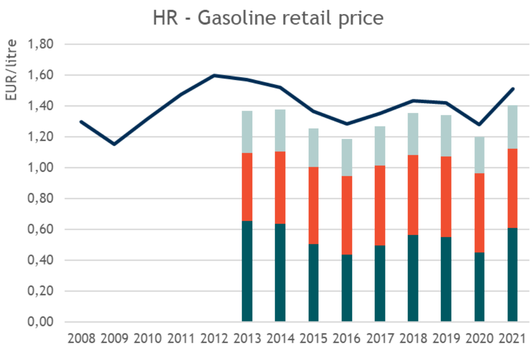
EU27

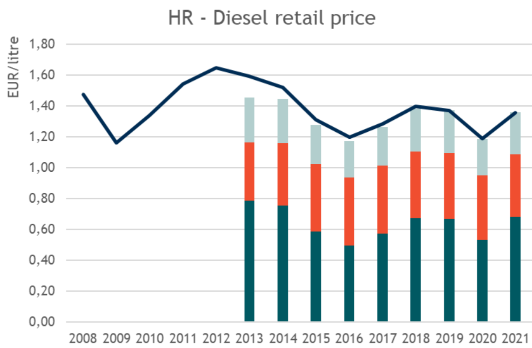

HR - Retail electricity prices
EUR/MWh
160
140
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

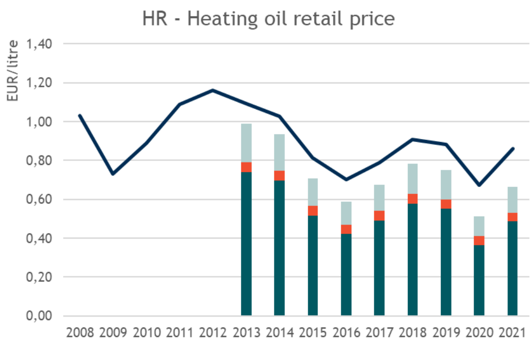

HR - Retail gas prices
EUR/MWh
50
45
40
35
30
25
20
15
10
5
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

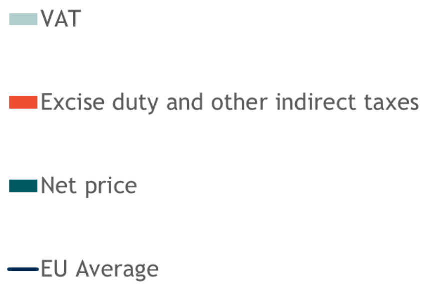

HR - 2021 retail electricity prices - components
EUR/MWh
140
120
100
80
60
40
20
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


HR - 2021 retail gas prices - components
EUR/MWh
45
40
35
30
25
20
15
10
5
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

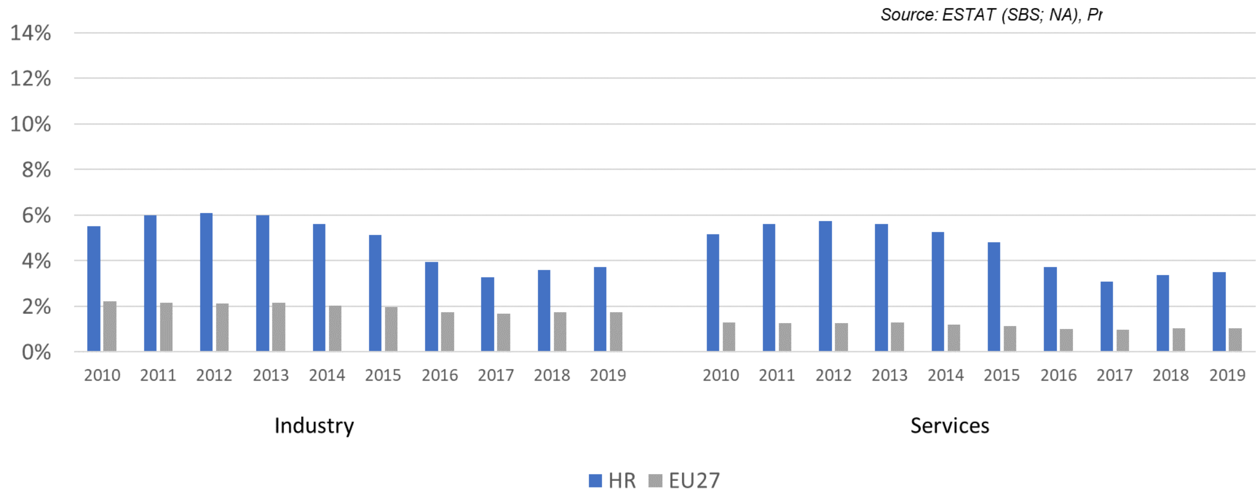

HR - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

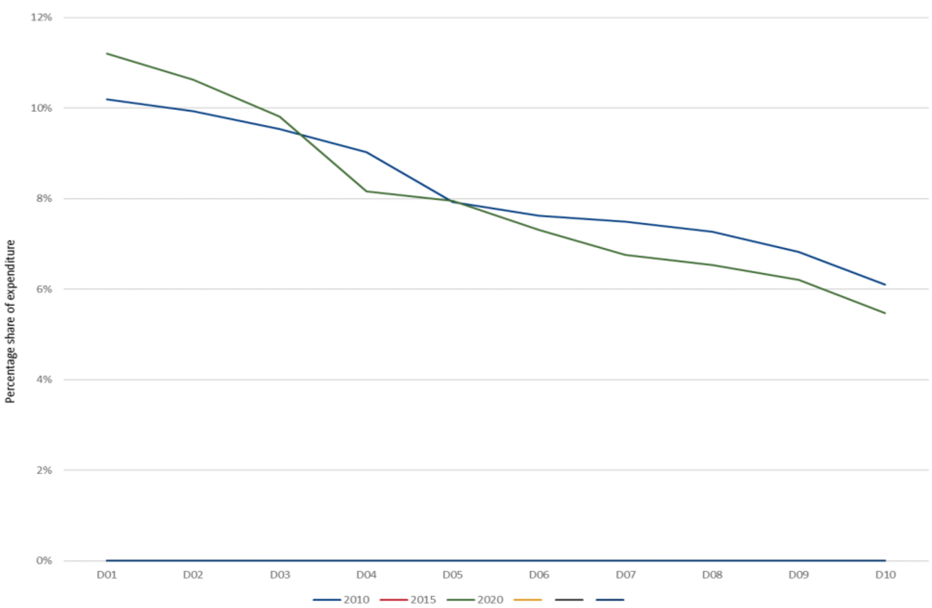

HR - Diesel retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


HR - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

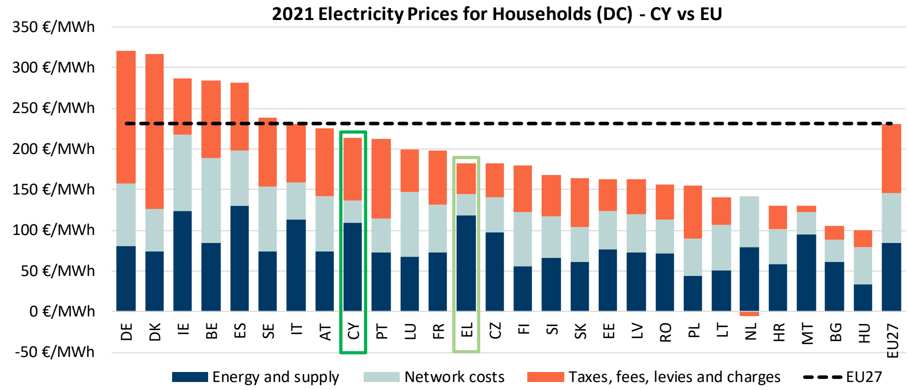

VAT
Excise duty and other indirect taxes
Net price
EU Average

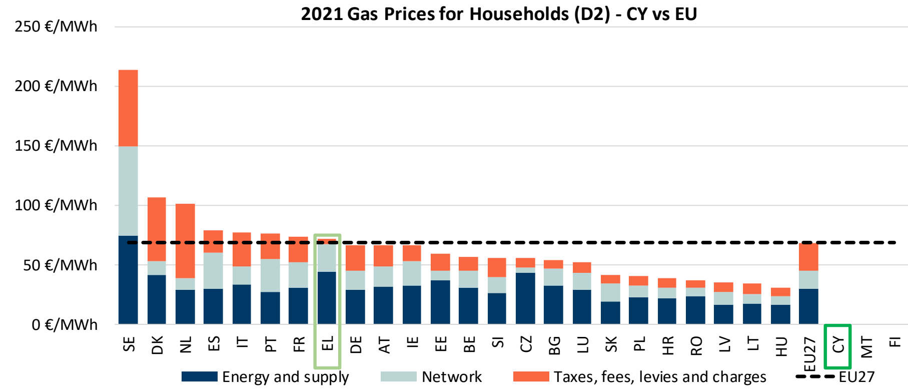
Share of energy costs in total production value in industry and services: HR vs. EU27

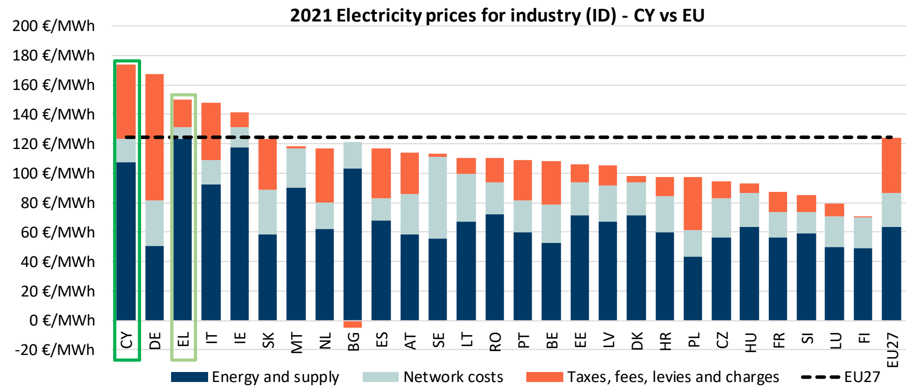


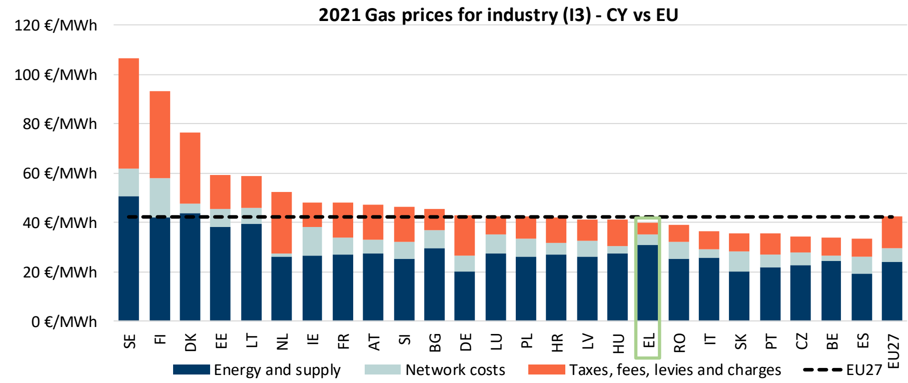


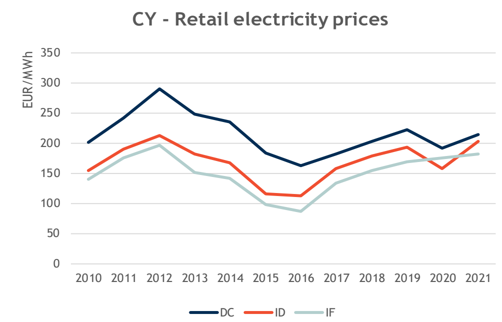
Cyprus

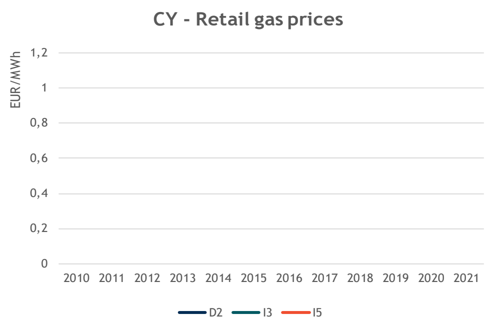

2021 Electricity Prices for Households (DC) - CY vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

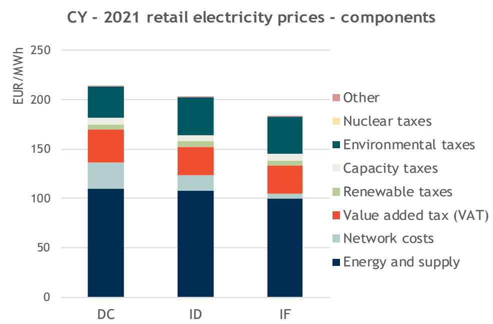

2021 Gas Prices for Households (D2) - CY vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

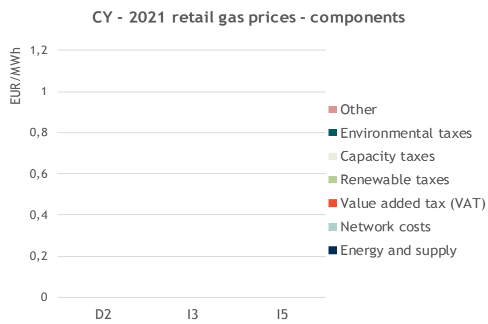

2021 Electricity prices for industry (ID) - CY vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

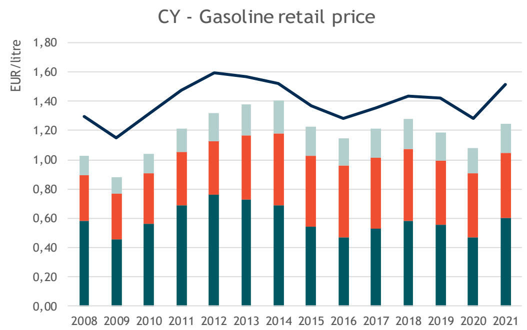

2021 Gas prices for industry (I3) - CY vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

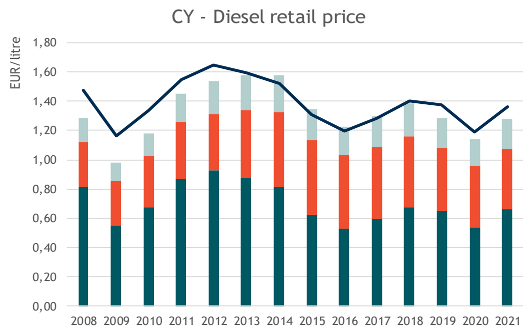

CY - Retail electricity prices
EUR/MWh
350
300
250
200
150
100
50
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

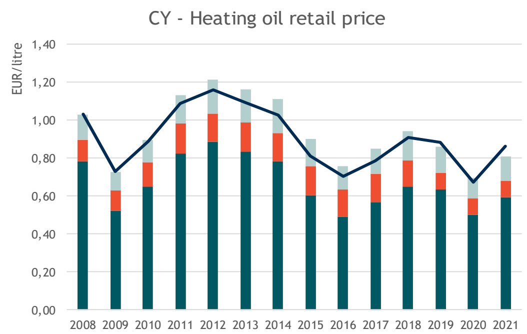

CY - Retail gas prices
EUR/MWh
1,2
1
0,8
0,6
0,4
0,2
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

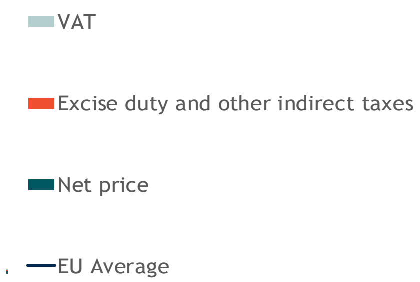

CY - 2021 retail electricity prices - components
EUR/MWh
250
200
150
100
50
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply


CY - 2021 retail gas prices - components
EUR/MWh
1,2
1
0,8
0,6
0,4
0,2
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply


CY - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

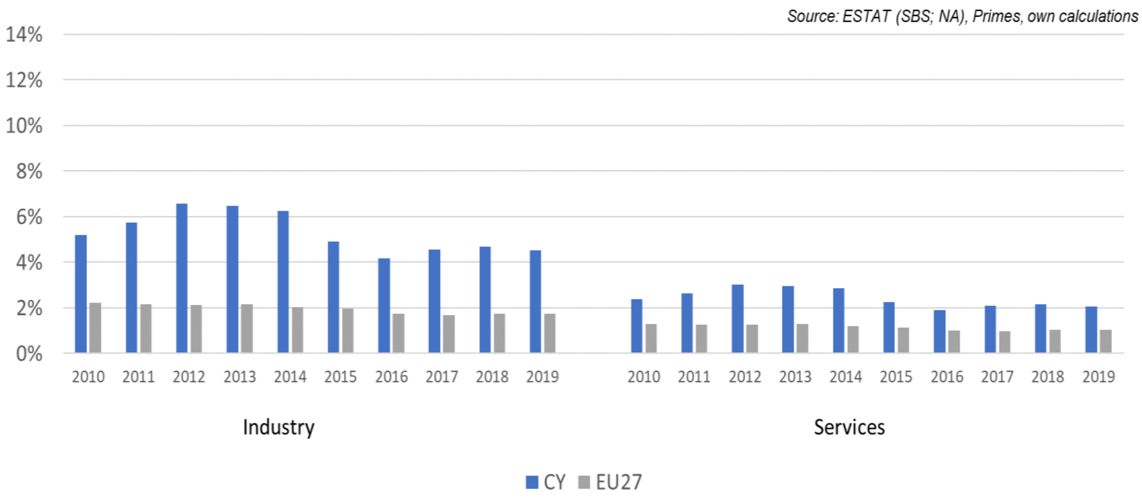

CY - Diesel retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

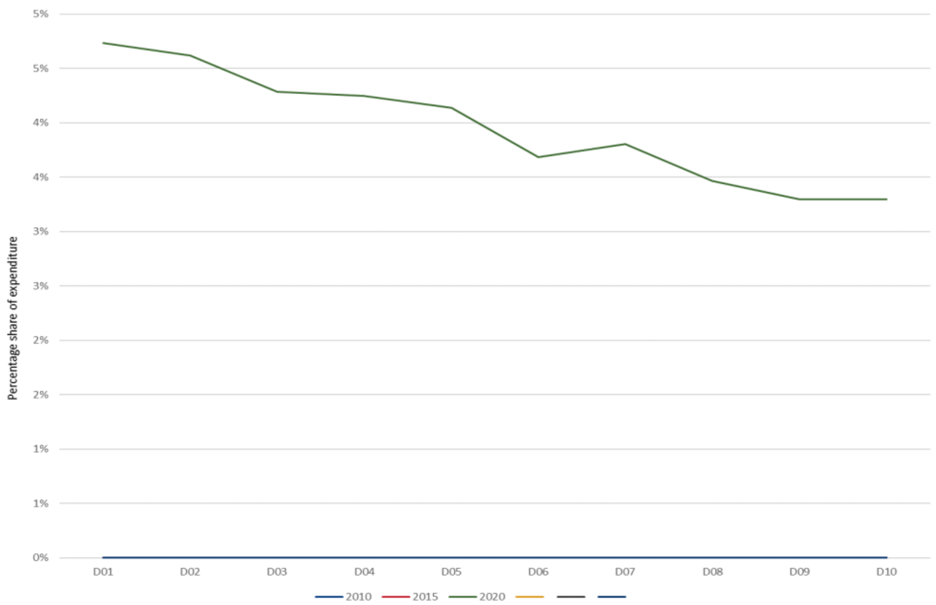

CY - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


VAT
Excise duty and other indirect taxes
Net price
EU Average

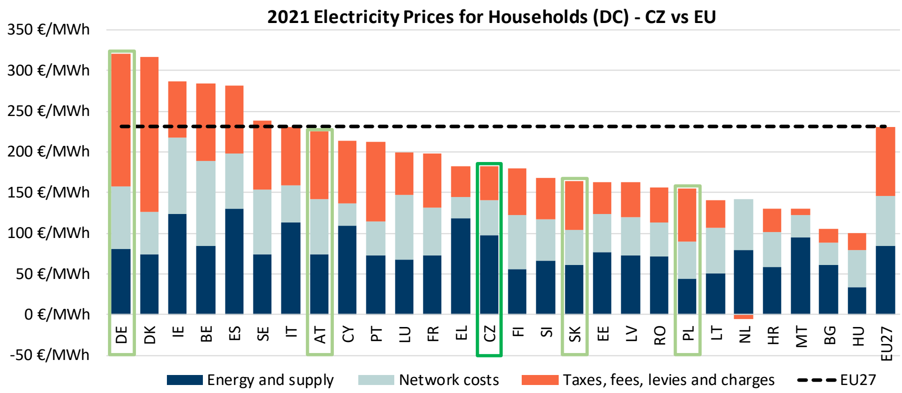
Energy costs for households, industry and services

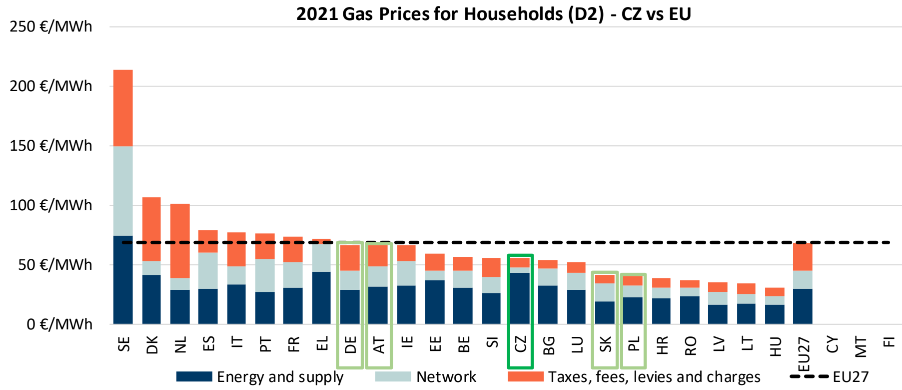
Share of energy costs in total production value in industry and services: CY vs. EU27

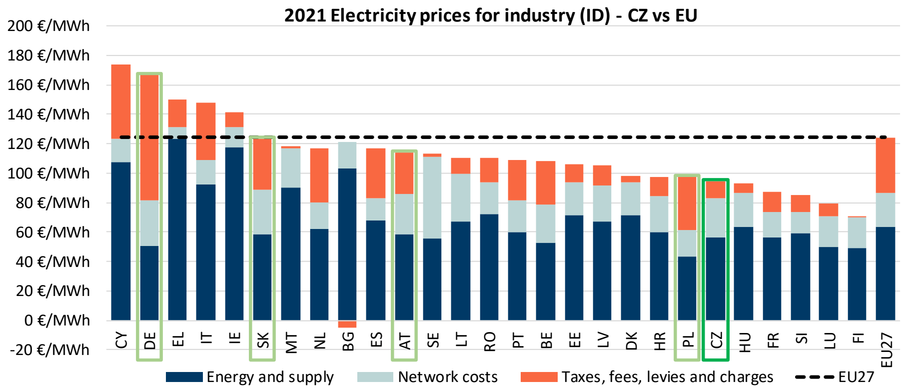


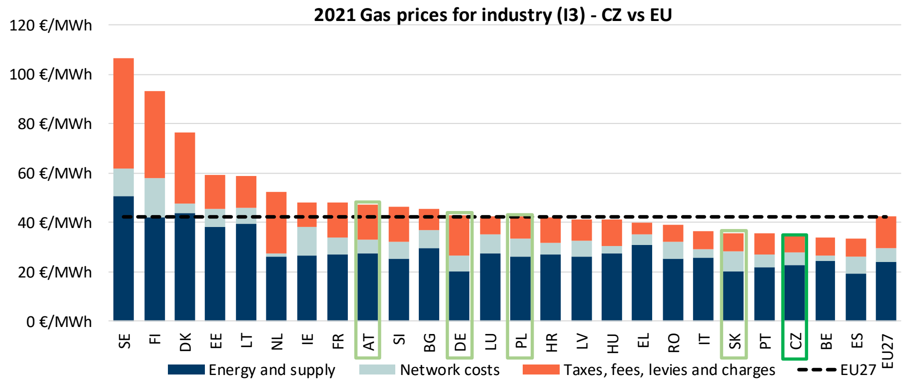


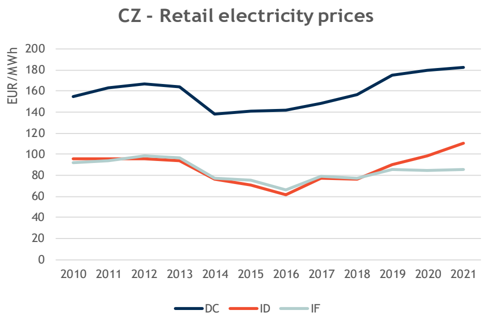
Czech Republic

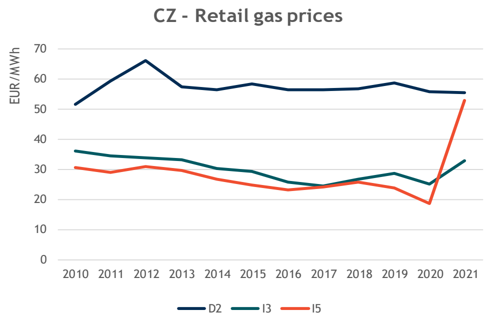


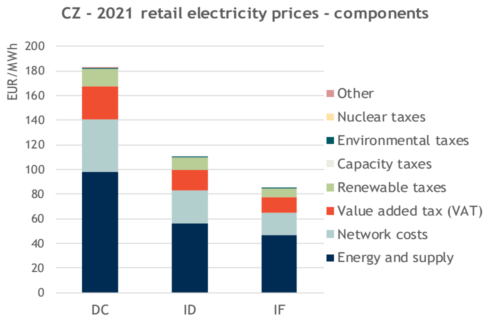


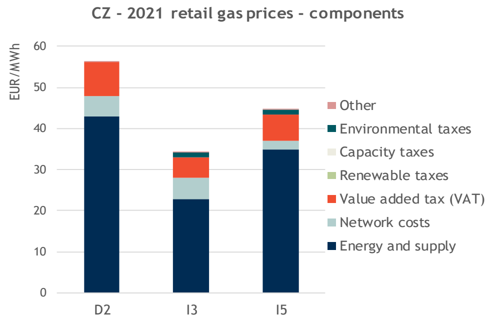


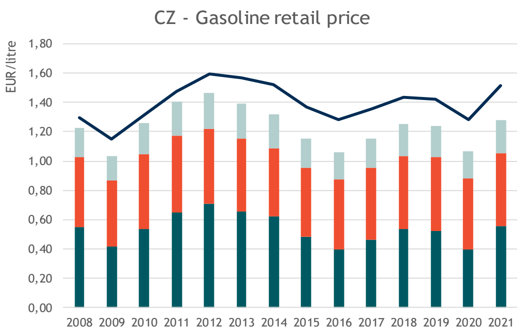


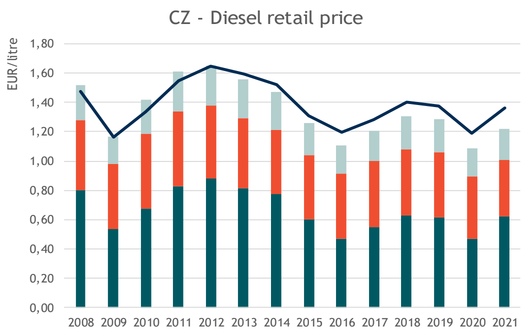


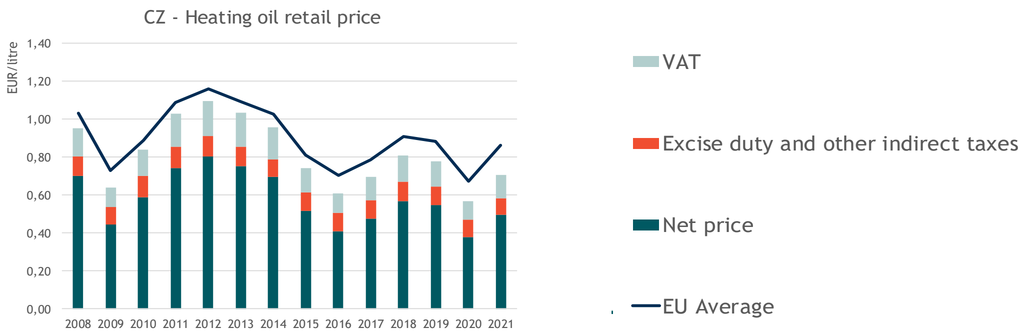






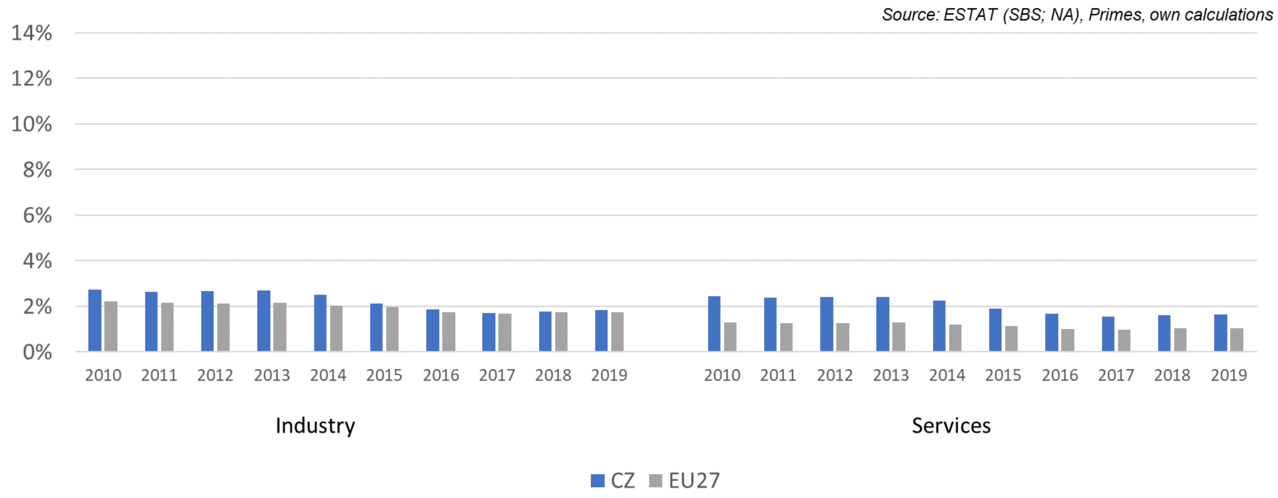


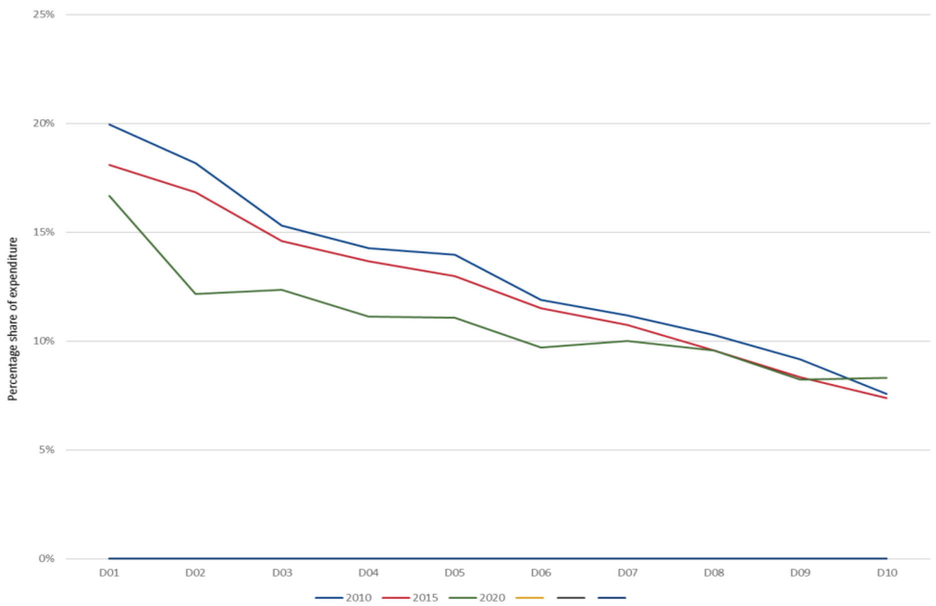




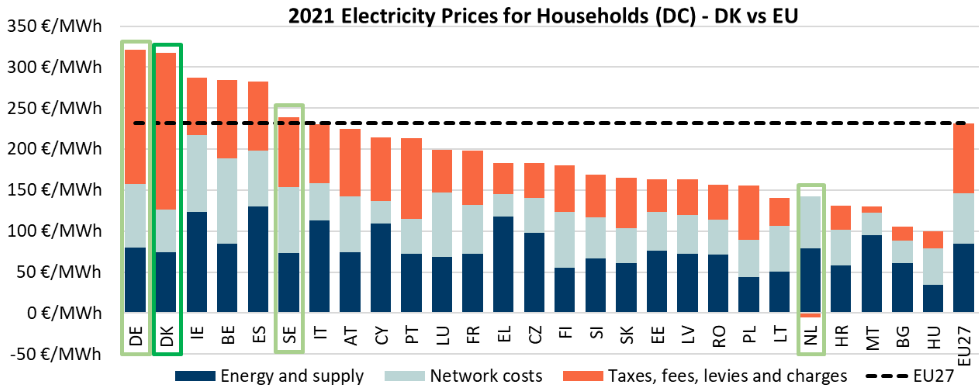
Energy costs for households, industry and services

Share of energy costs in total production value in industry and services: CZ vs. EU27

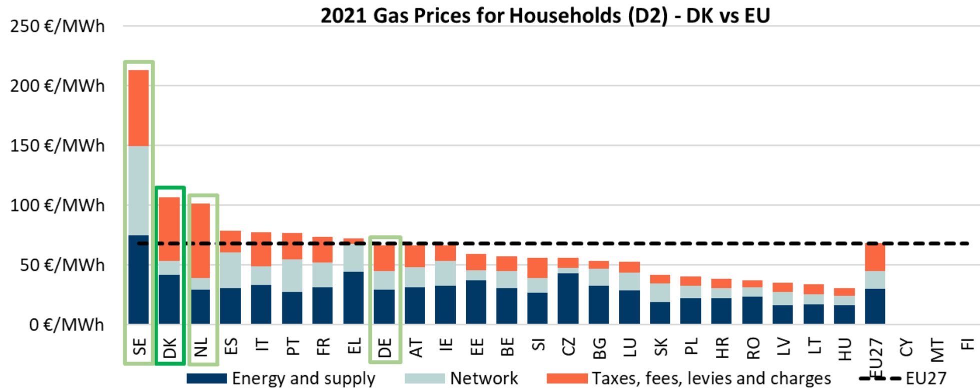




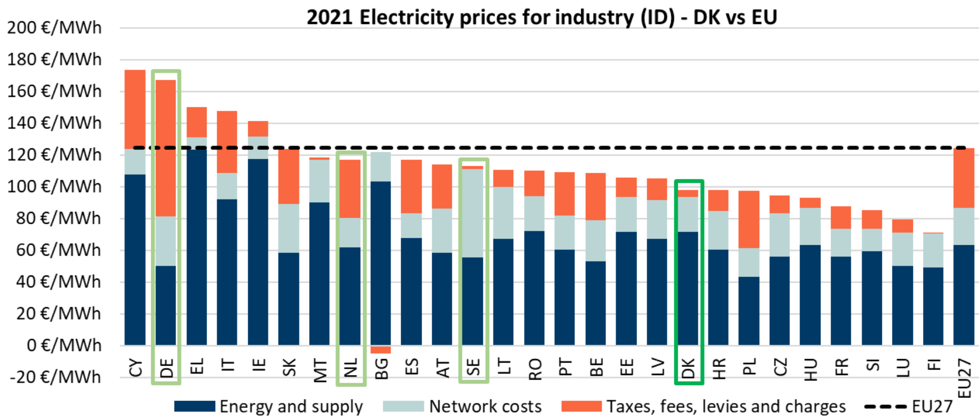
Denmark



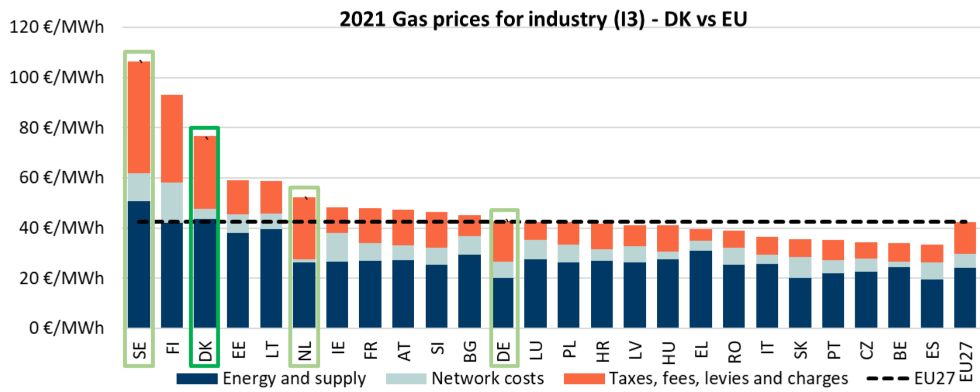
2021 Electricity Prices for Households (DC) - DK vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



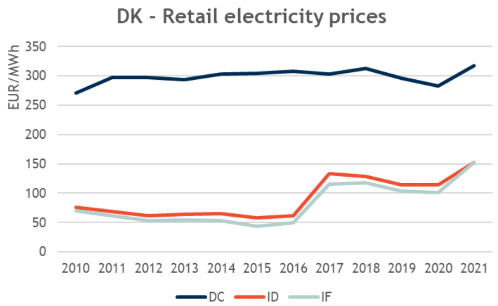
2021 Gas Prices for Households (D2) - DK vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

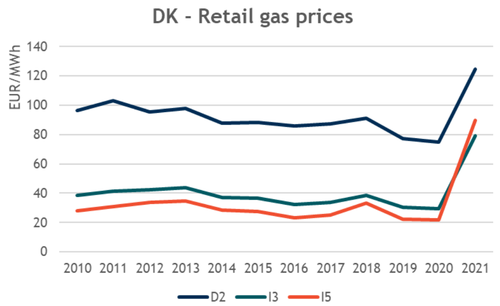


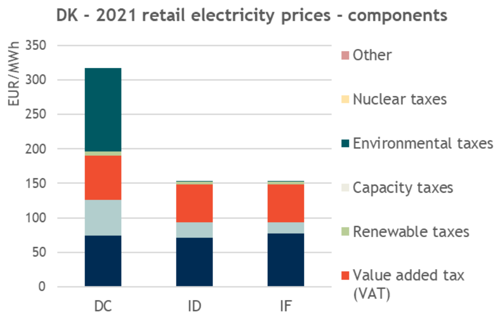
2021 Electricity prices for industry (ID) - DK vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

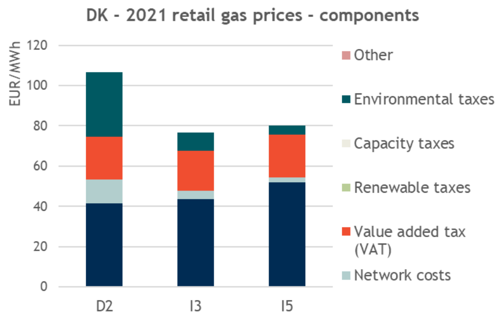


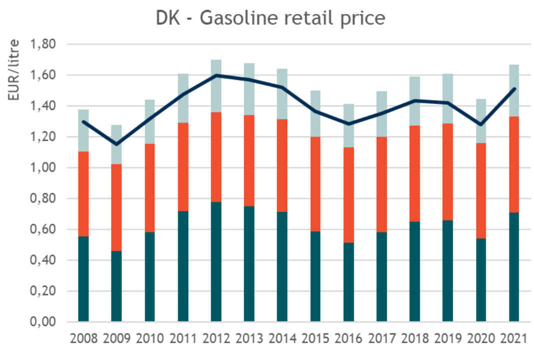
2021 Gas prices for industry (I3) - DK vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

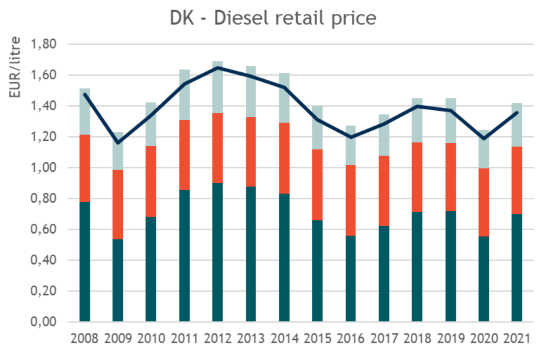

DK - Retail electricity prices
EUR/MWh
DC
ID
IF

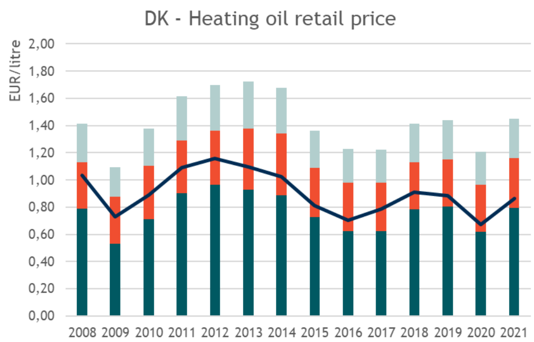

DK - Retail gas prices
EUR/MWh
D2
I3
I5

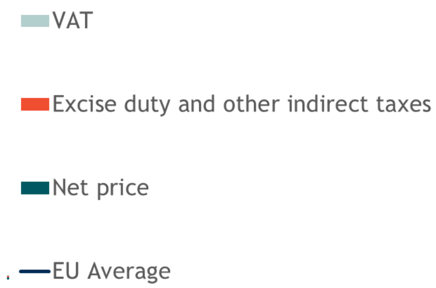

DK - 2021 retail electricity prices - components
EUR/MWh
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


DK - 2021 retail gas prices - components
EUR/MWh
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs


DK - Gasoline retail price
EUR/litre

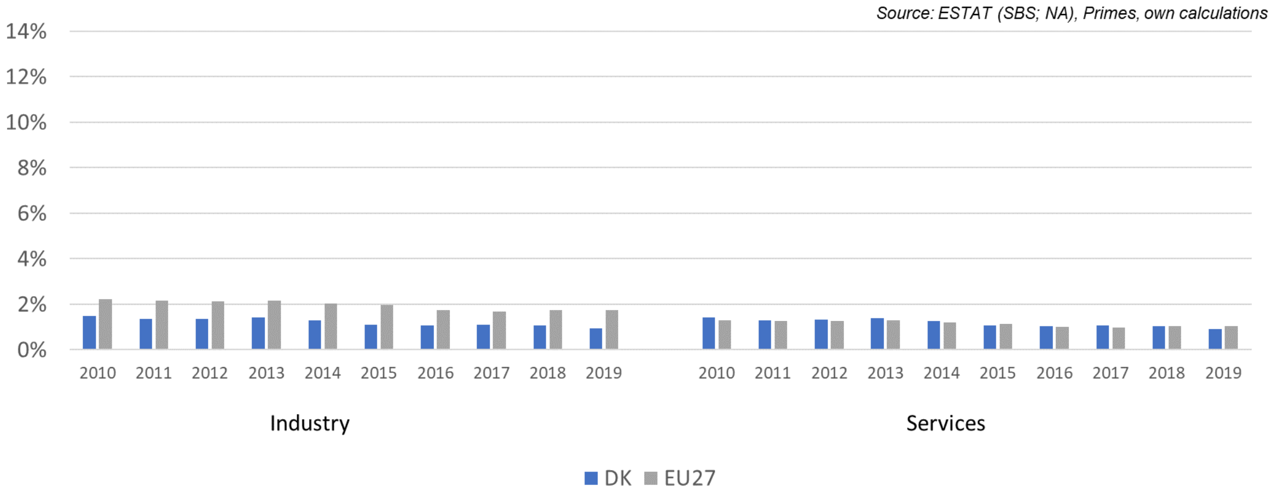

DK - Diesel retail price
EUR/litre

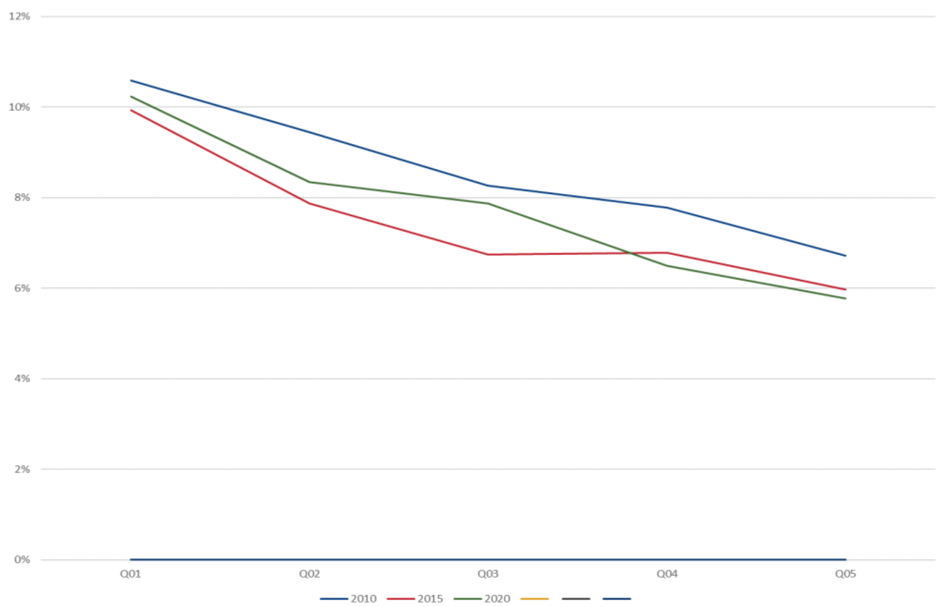

DK - Heating oil retail price
EUR/litre


VAT
Excise duty and other indirect taxes
Net price
EU Average

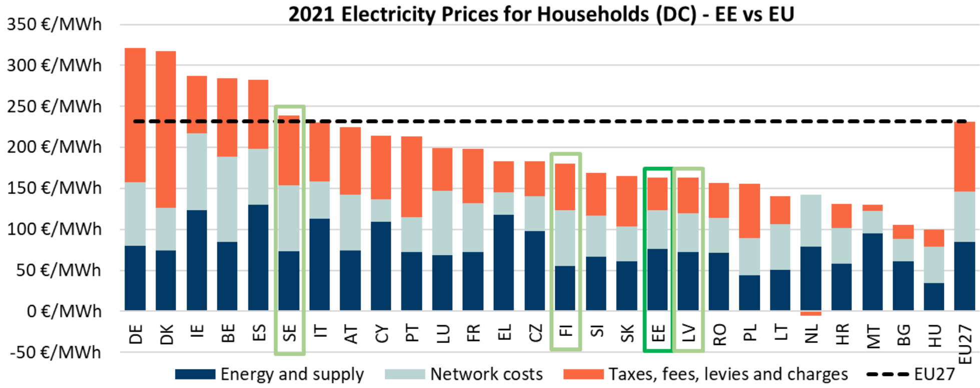
Energy costs for households, industry and services

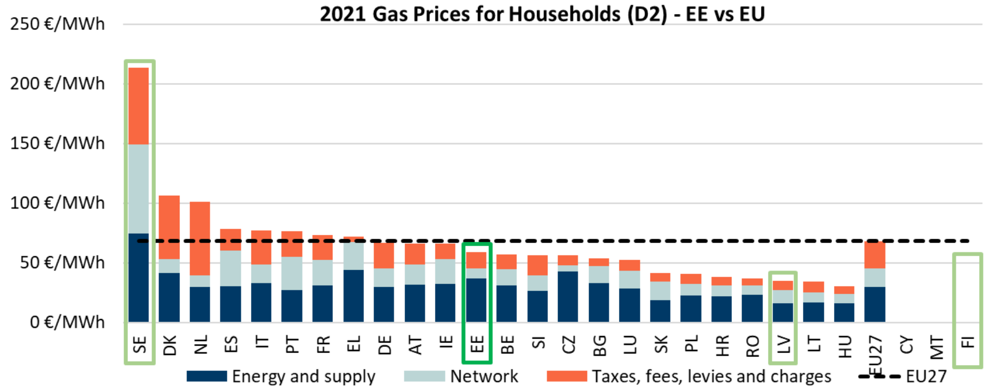
Share of energy costs in total production value in industry and services: DK vs. EU27

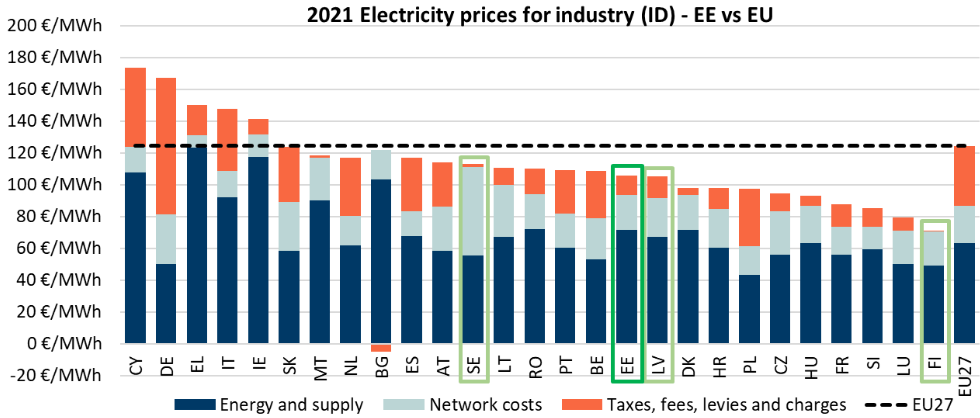


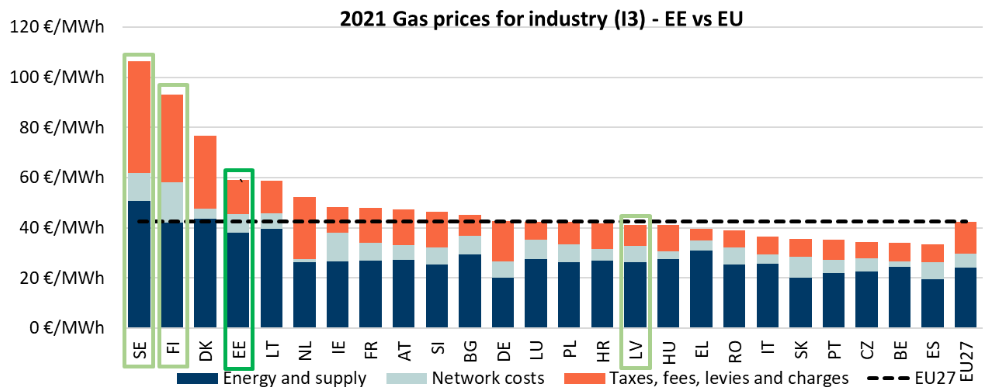


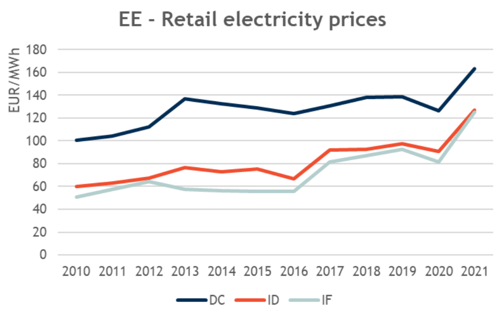
Estonia

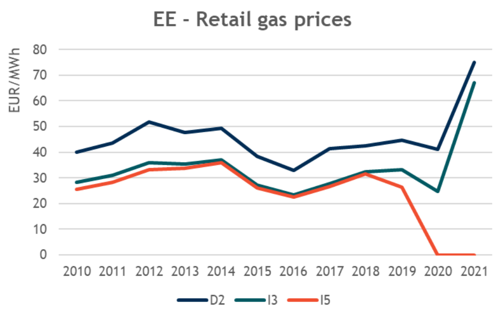

2021 Electricity Prices for Households (DC) - EE vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

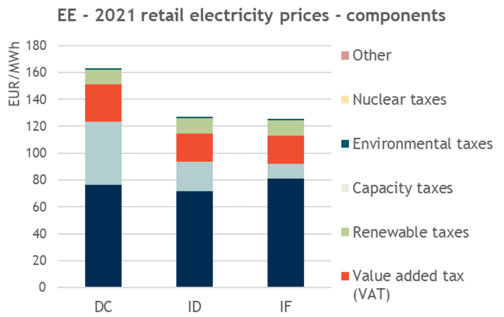

2021 Gas Prices for Households (D2) - EE vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

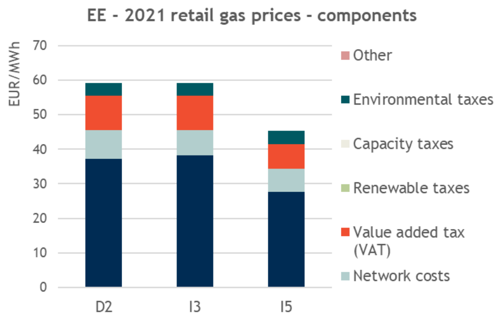

2021 Electricity prices for industry (ID) - EE vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

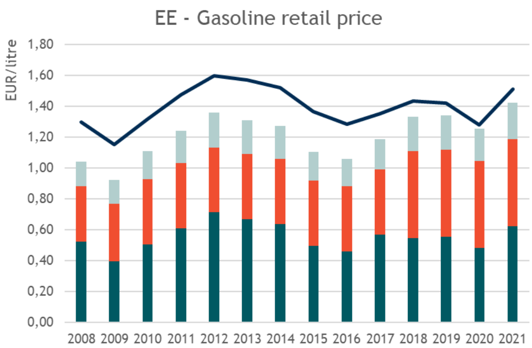

2021 Gas prices for industry (I3) - EE vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

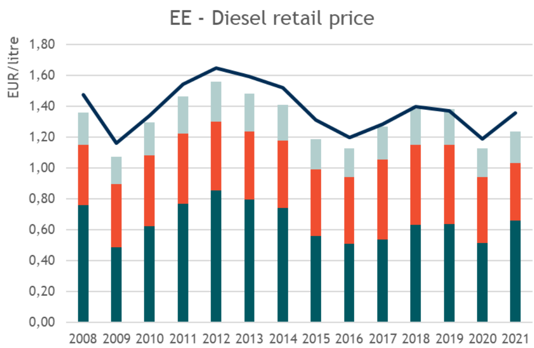

EE - Retail electricity prices
EUR/MWh
180
160
140
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

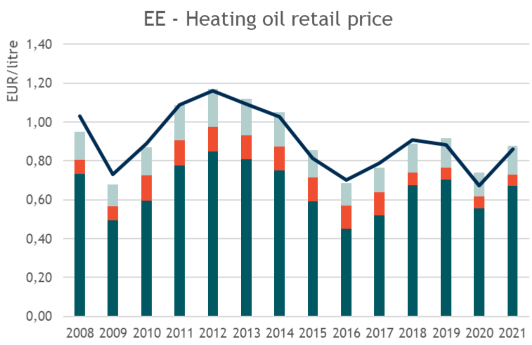

EE - Retail gas prices
EUR/MWh
80
70
60
50
40
30
20
10
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

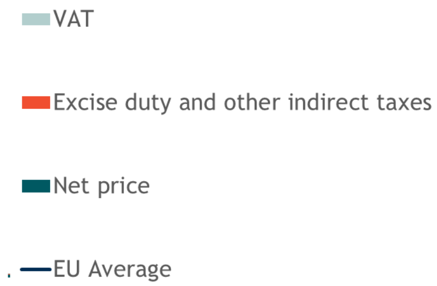

EE - 2021 retail electricity prices - components
EUR/MWh
180
160
140
120
100
80
60
40
20
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


EE - 2021 retail gas prices - components
EUR/MWh
70
60
50
40
30
20
10
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

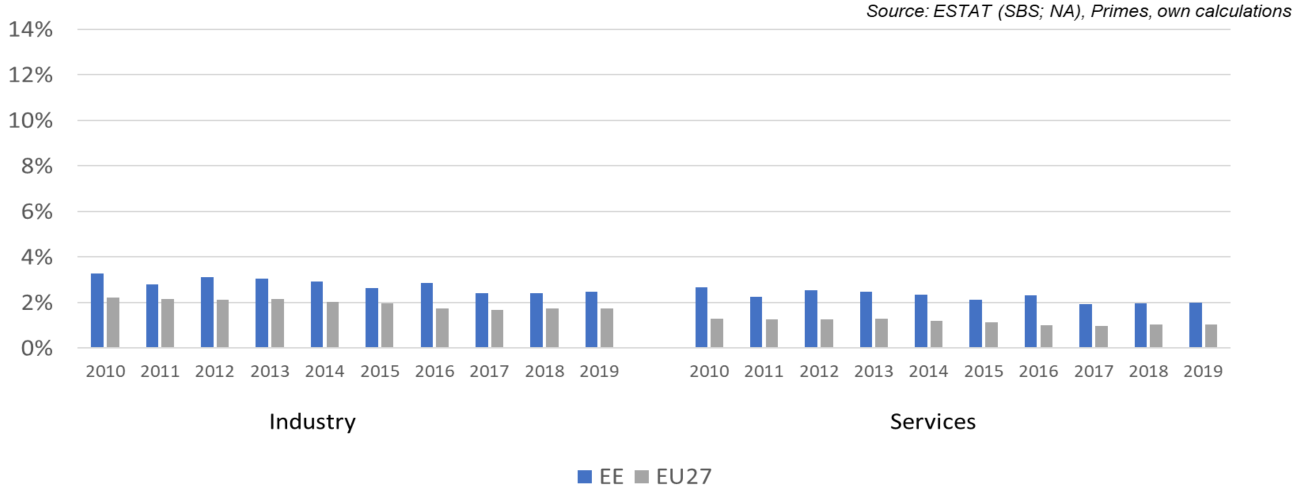

EE - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


EE - Diesel retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

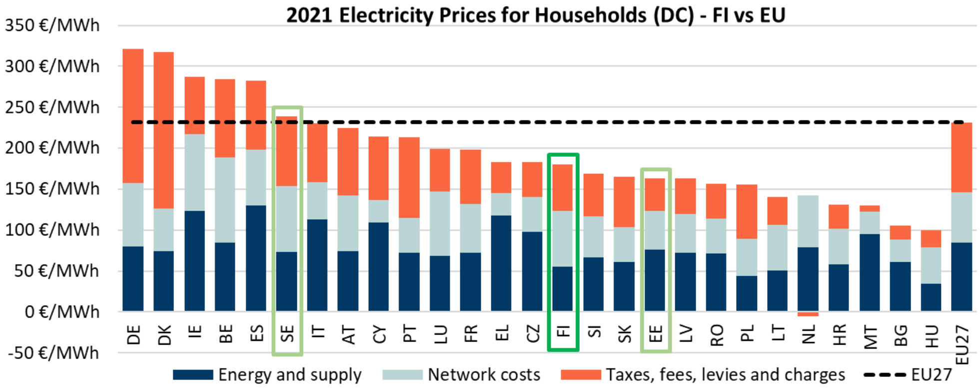

EE - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

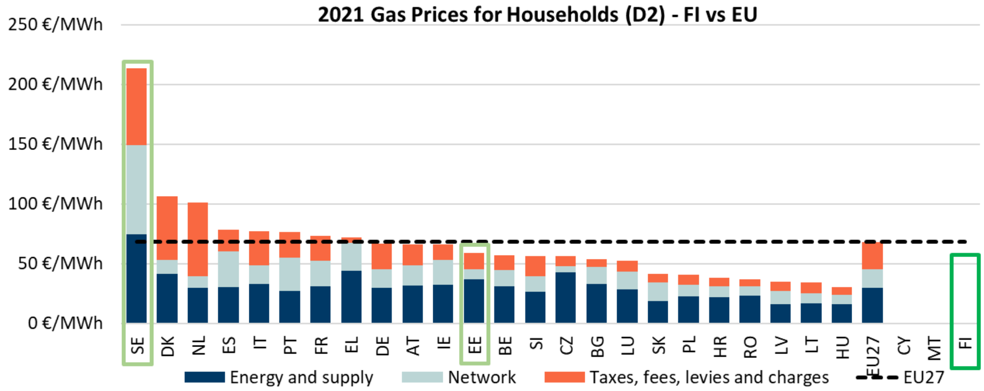

VAT
Excise duty and other indirect taxes
Net price
EU Average

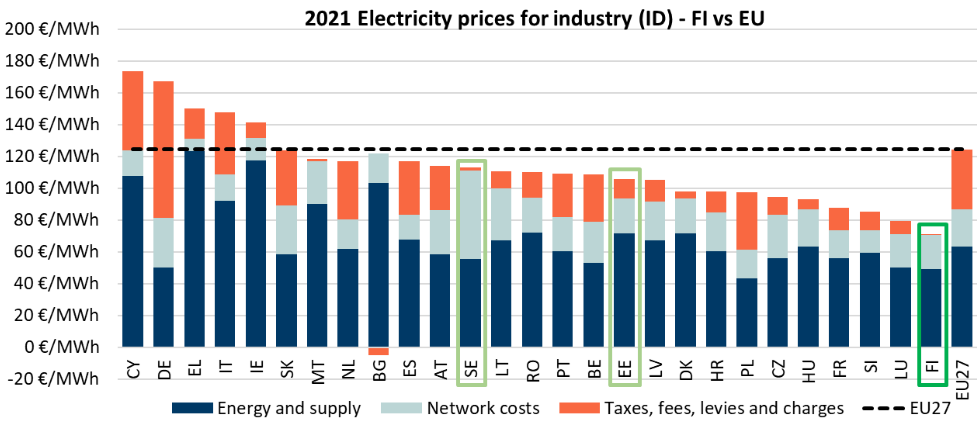
Share of energy costs in total production value in industry and services: EE vs. EU27

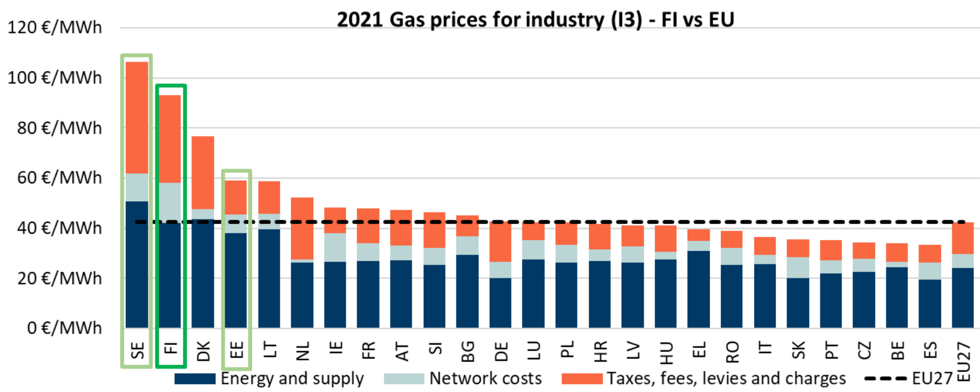


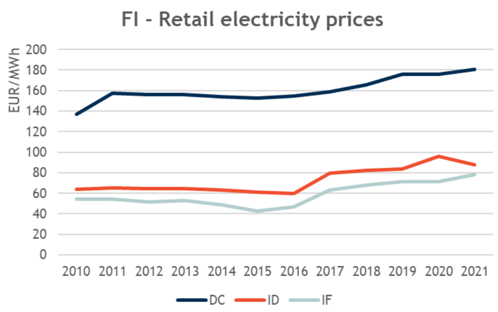
Finland

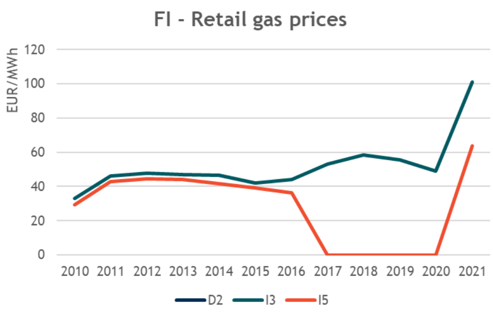

2021 Electricity Prices for Households (DC) - FI vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

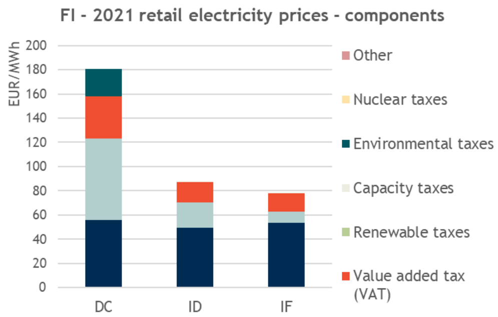

2021 Gas Prices for Households (D2) - FI vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

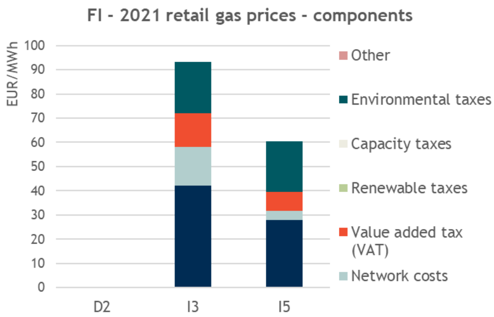

2021 Electricity prices for industry (ID) - FI vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

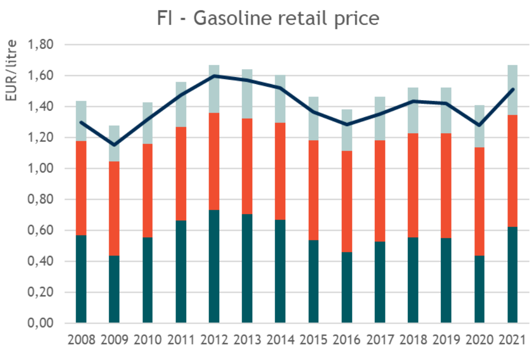

2021 Gas prices for industry (I3) - FI vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

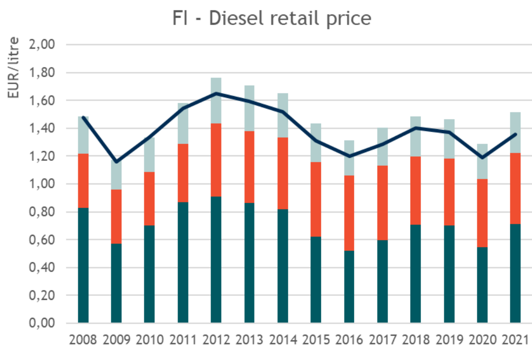

FI - Retail electricity prices
EUR/MWh
200
180
160
140
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

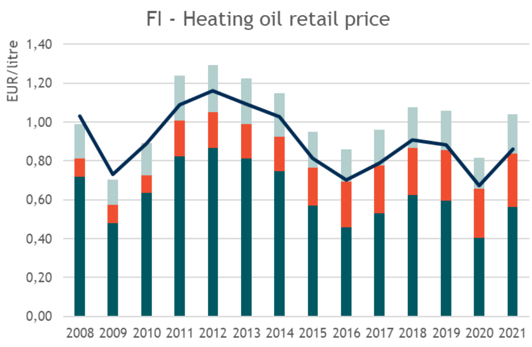

FI - Retail gas prices
EUR/MWh
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

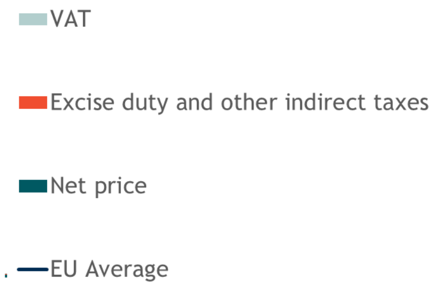

FI - 2021 retail electricity prices - components
EUR/MWh
200
180
160
140
120
100
80
60
40
20
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


FI - 2021 retail gas prices - components
EUR/MWh
100
90
80
70
60
50
40
30
20
10
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

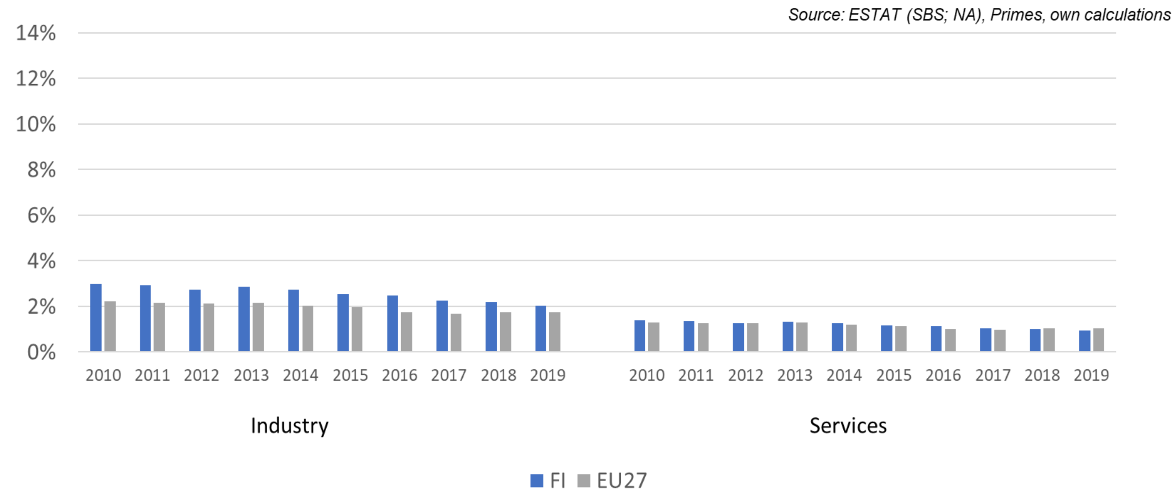

FI - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

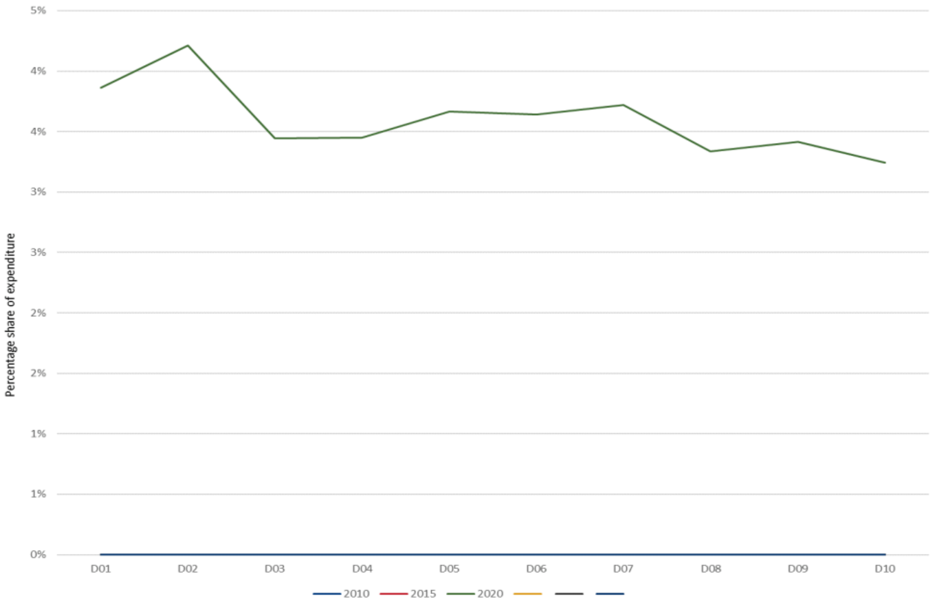

FI - Diesel retail price
EUR/litre
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


FI - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

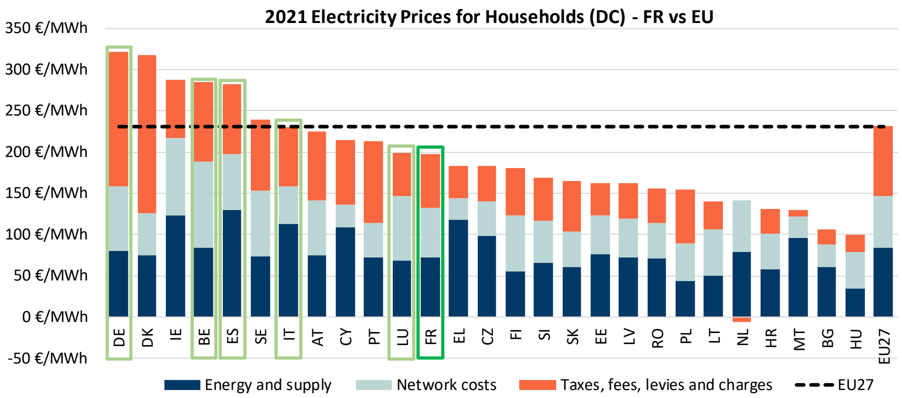

VAT
Excise duty and other indirect taxes
Net price
EU Average

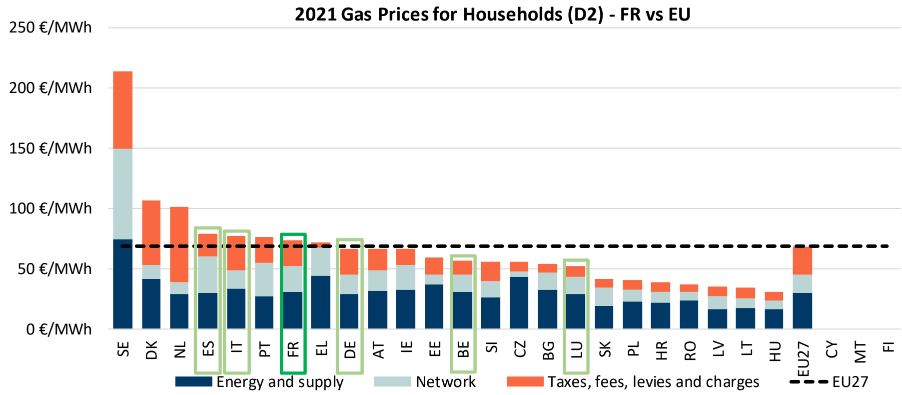
Share of energy costs in total production value in industry and services: FI vs. EU27

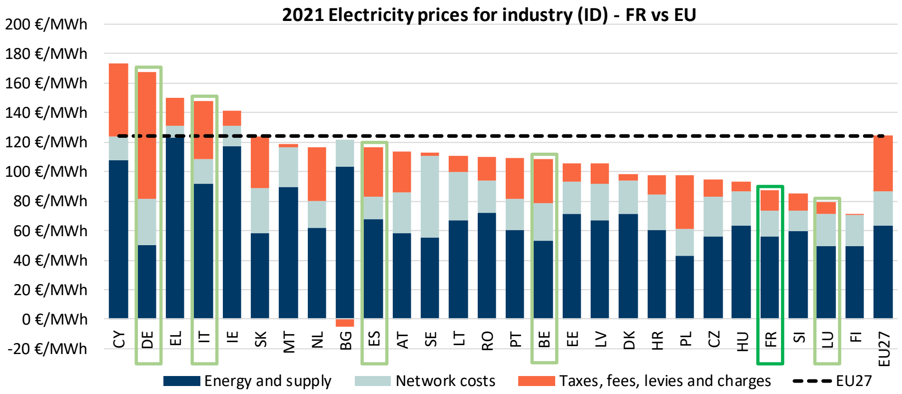


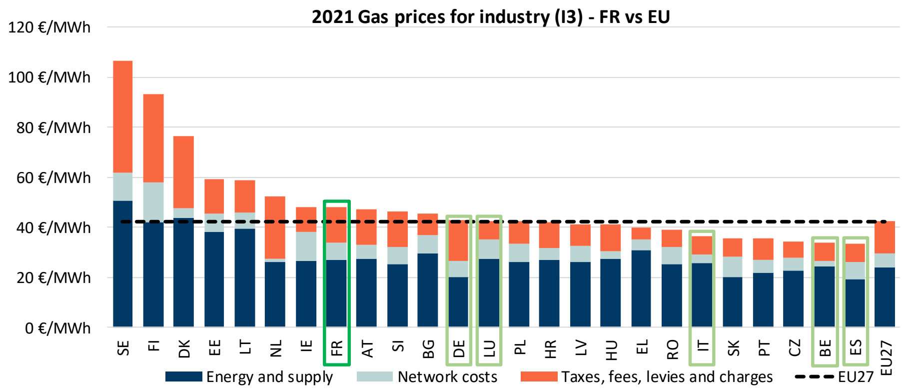


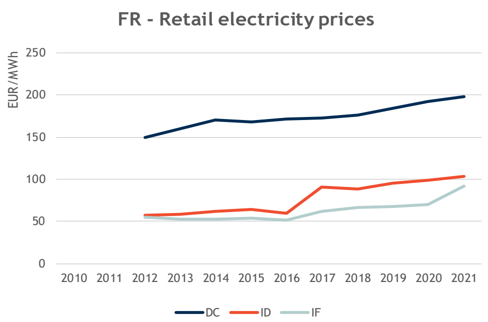
France

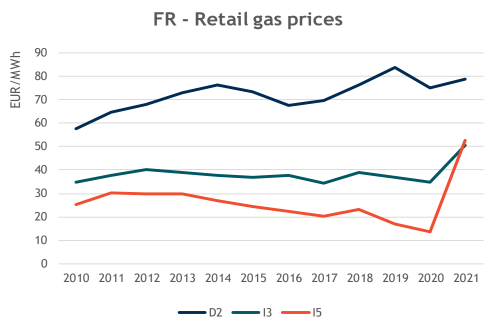

2021 Electricity Prices for Households (DC) - FR vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

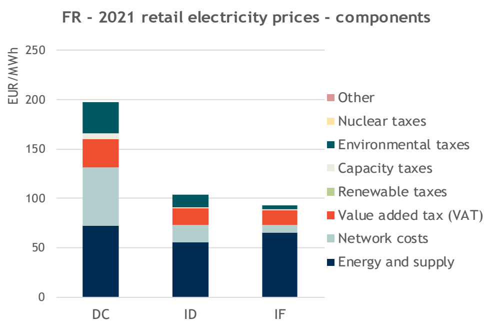

2021 Gas Prices for Households (D2) - FR vs EU
Energy and supply
Network
Taxes, fees, levies and charges
EU27

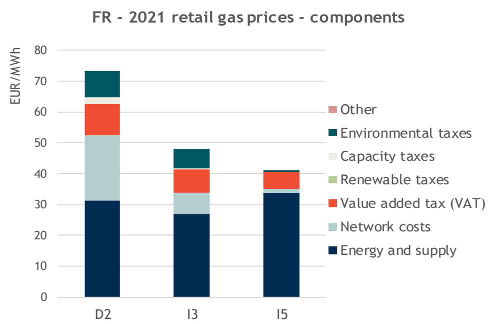

2021 Electricity prices for industry (ID) - FR vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

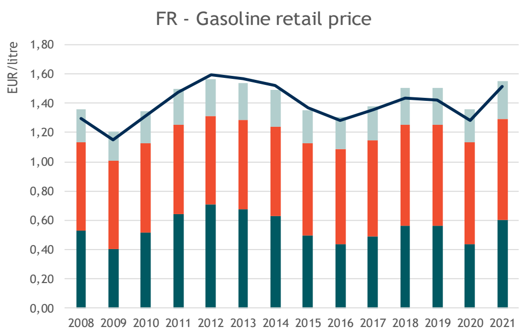

2021 Gas prices for industry (I3) - FR vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

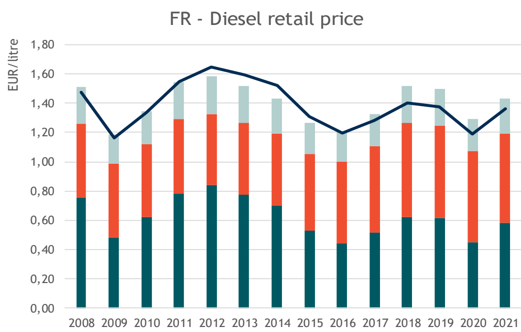

FR - Retail electricity prices
EUR/MWh
0
50
100
150
200
250
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

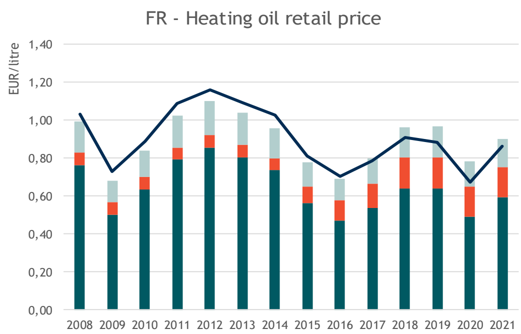

FR - Retail gas prices
EUR/MWh
0
10
20
30
40
50
60
70
80
90
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

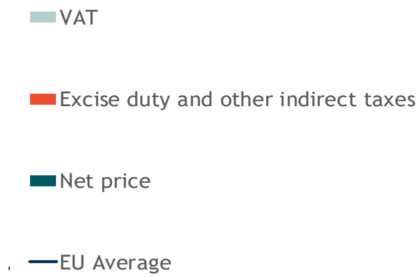

FR - 2021 retail electricity prices - components
EUR/MWh
0
50
100
150
200
250
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply


FR - 2021 retail gas prices - components
EUR/MWh
0
10
20
30
40
50
60
70
80
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply


FR - Gasoline retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

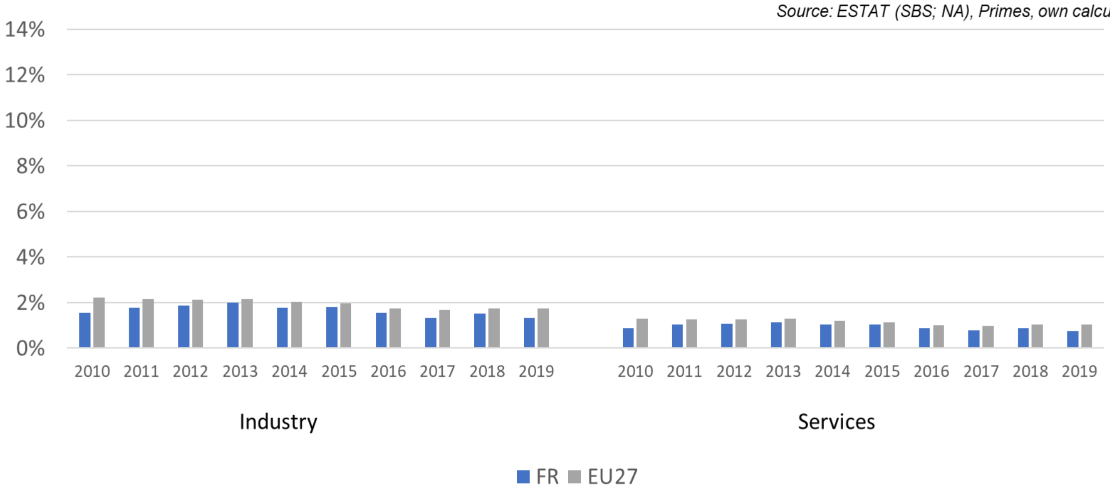

FR - Diesel retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

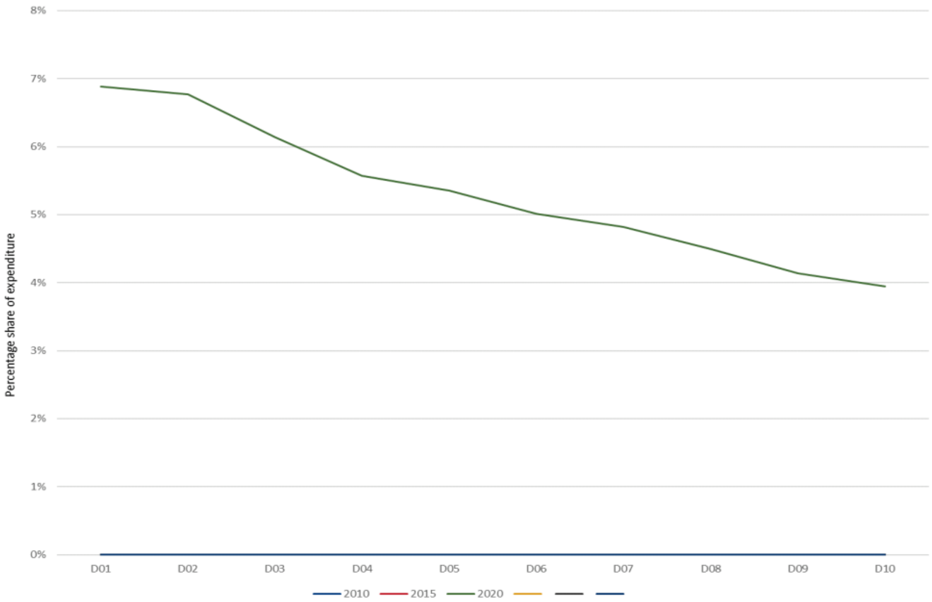

FR - Heating oil retail price
EUR/litre
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


VAT
Excise duty and other indirect taxes
Net price
EU Average

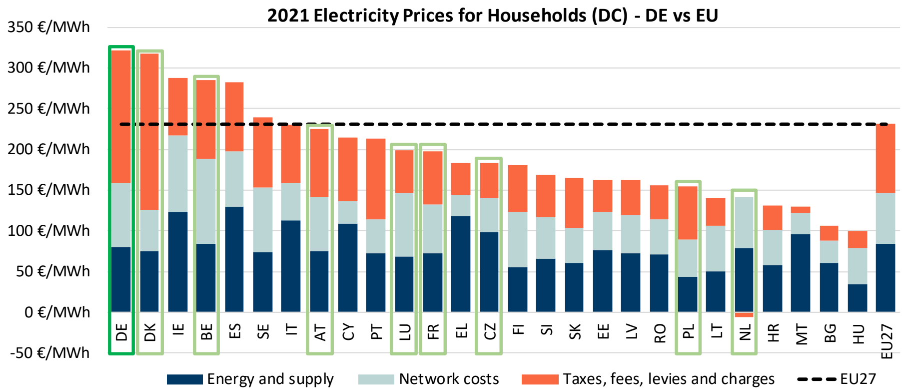
Share of energy costs in total production value in industry and services: FR vs. EU27

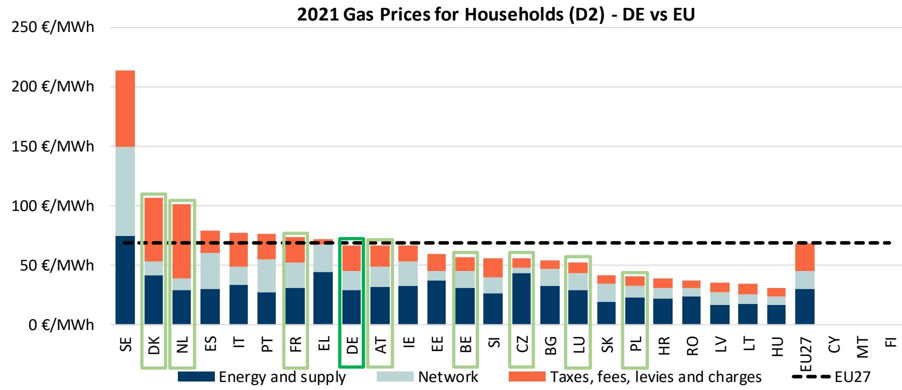
Source: ESTAT (SBS; NA), Primes, own calculations

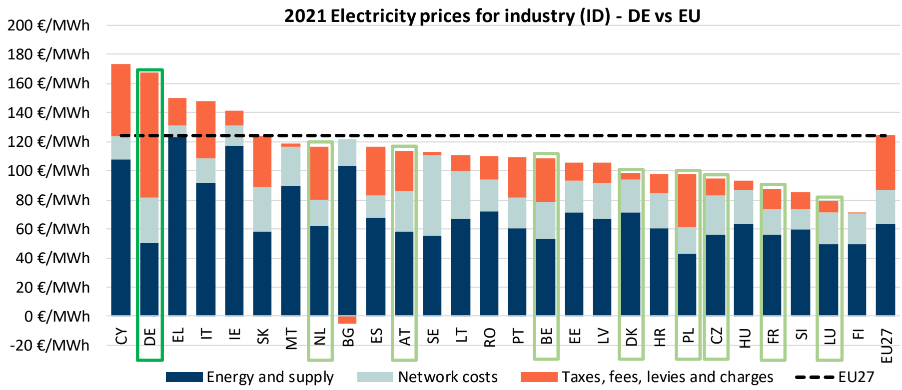


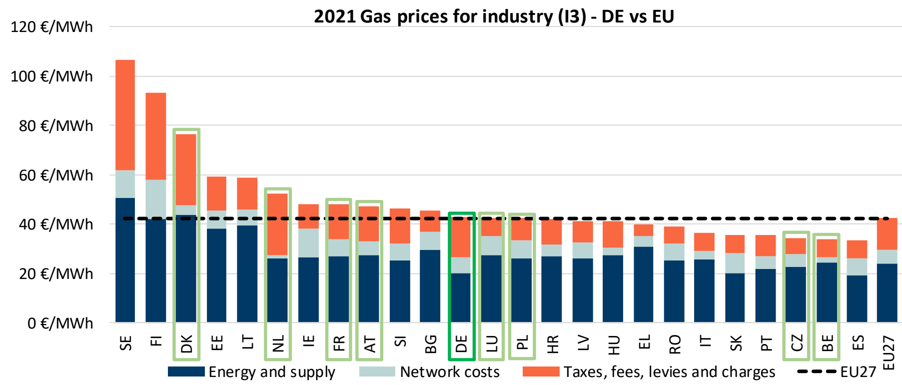


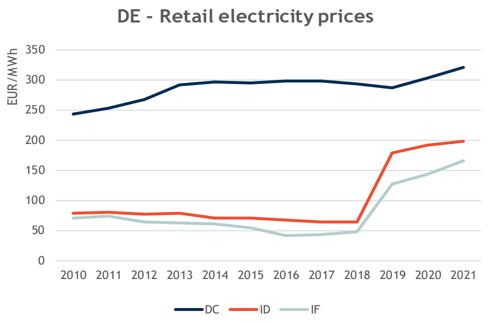
Germany

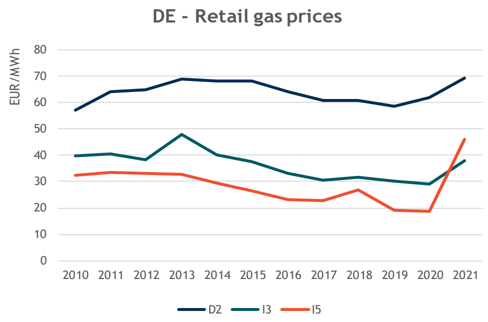

2021 Electricity Prices for Households (DC) - DE vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

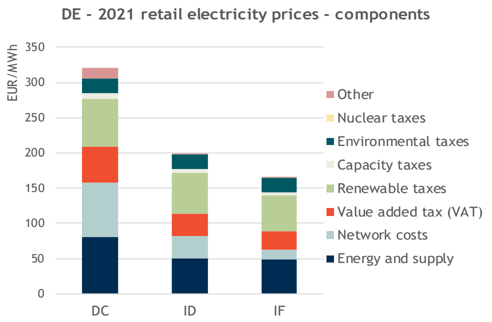

2021 Gas Prices for Households (D2) - DE vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

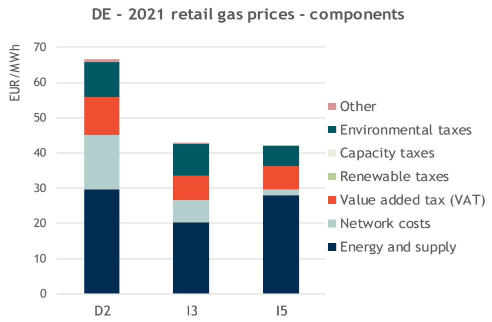

2021 Electricity prices for industry (ID) - DE vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

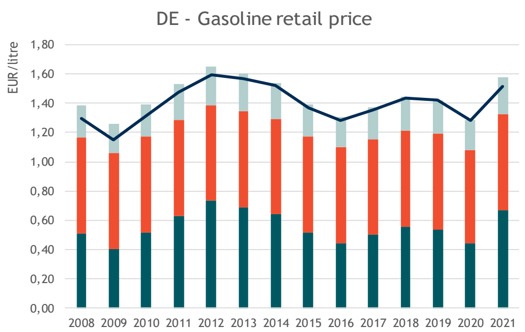

2021 Gas prices for industry (I3) - DE vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

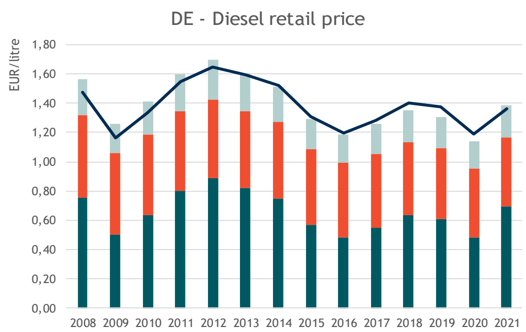

DE - Retail electricity prices
EUR/MWh
DC
ID
IF

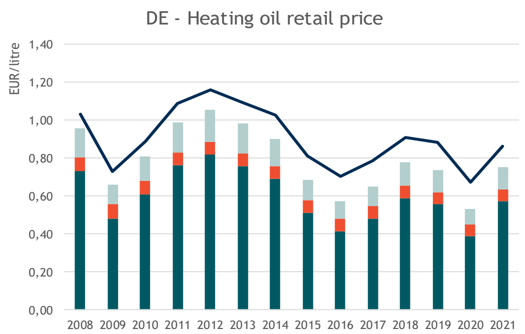

DE - Retail gas prices
EUR/MWh
D2
I3
I5

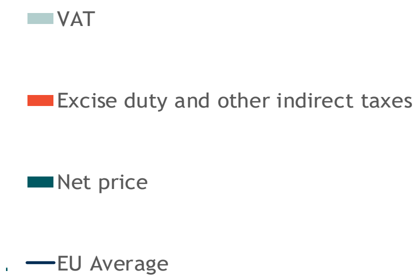

DE - 2021 retail electricity prices - components
EUR/MWh
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply
DC
ID
IF


DE - 2021 retail gas prices - components
EUR/MWh
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply
D2
I3
I5

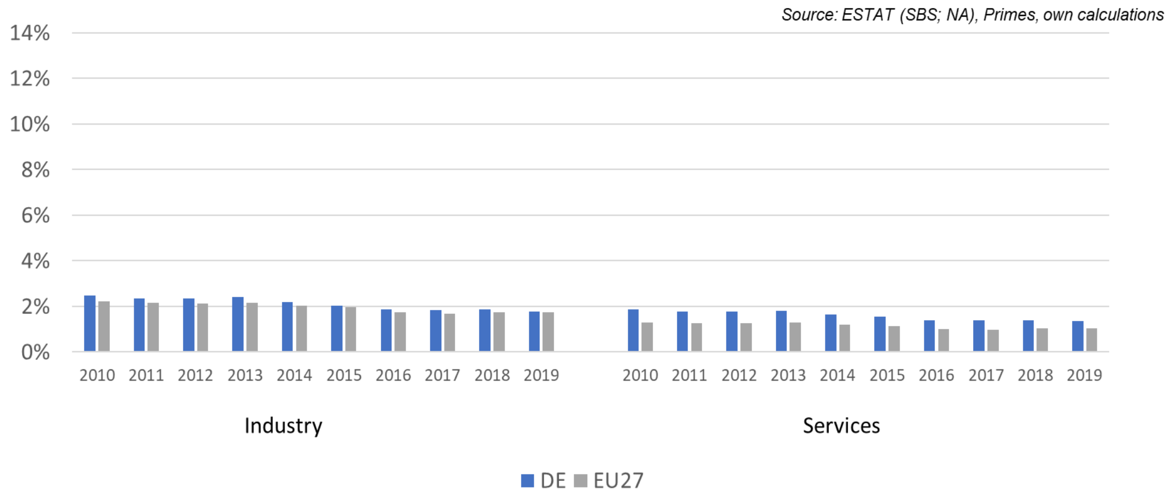

DE - Gasoline retail price
EUR/litre

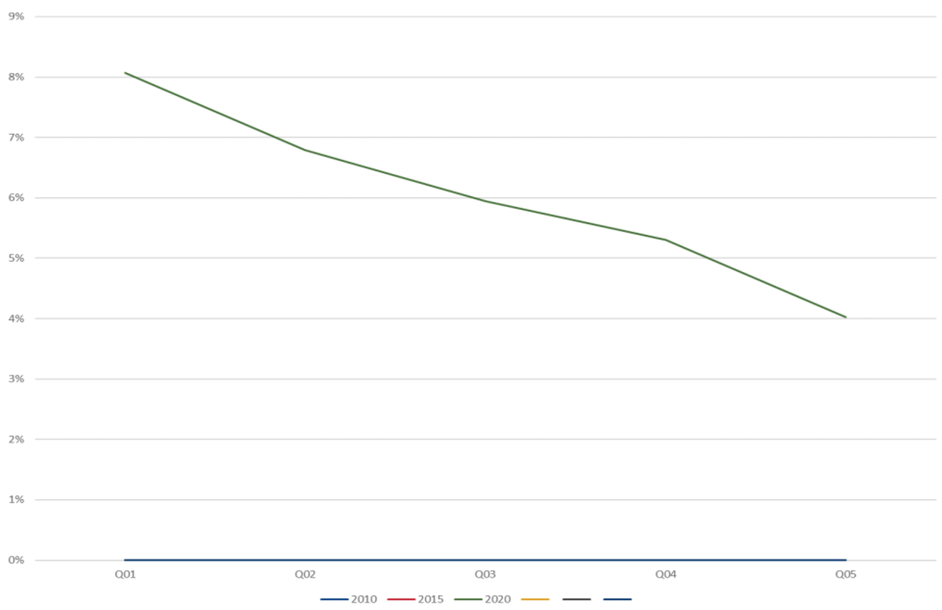

DE - Diesel retail price
EUR/litre


DE - Heating oil retail price
EUR/litre


VAT
Excise duty and other indirect taxes
Net price
EU Average

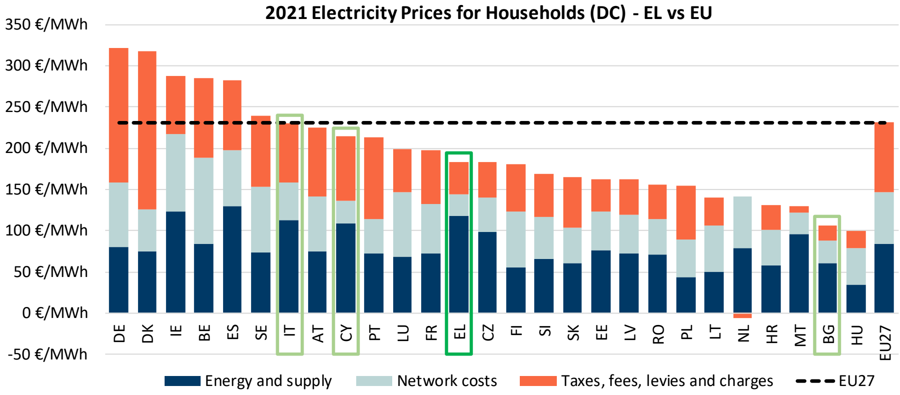
Share of energy costs in total production value in industry and services: DE vs. EU27

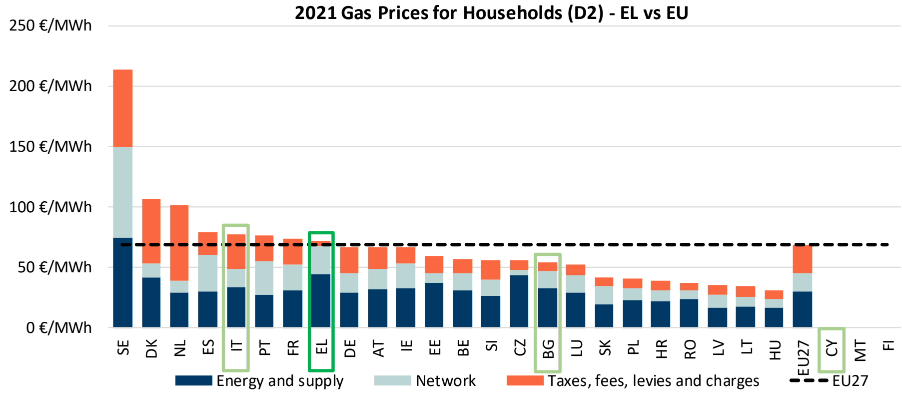


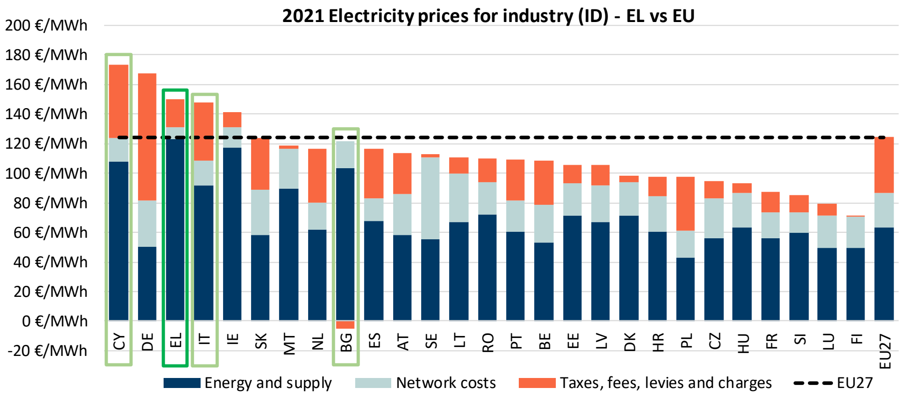


Quintiles

Greece


2021 Electricity Prices for Households (DC) - EL vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - EL vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - EL vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
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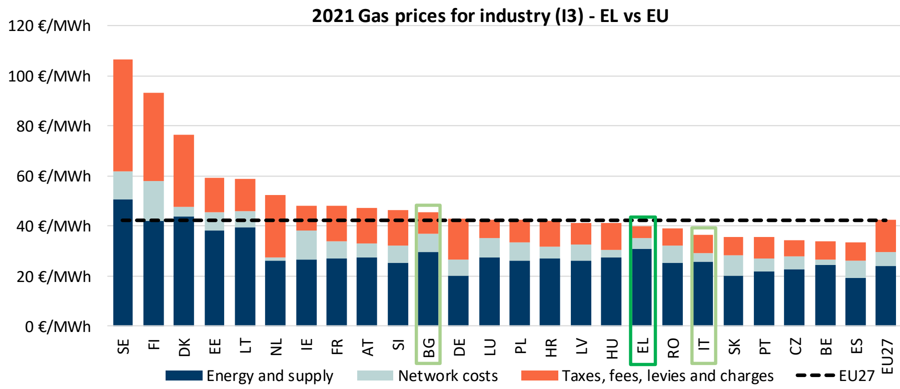
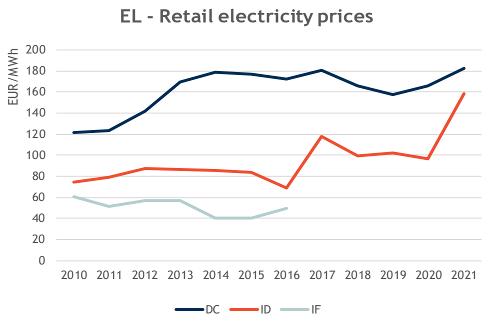
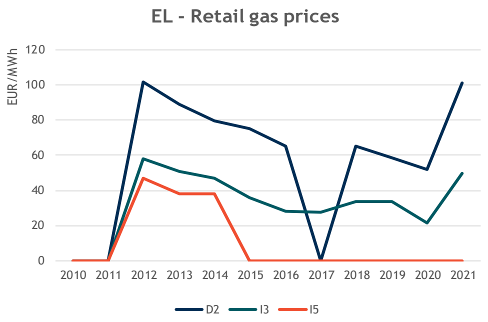
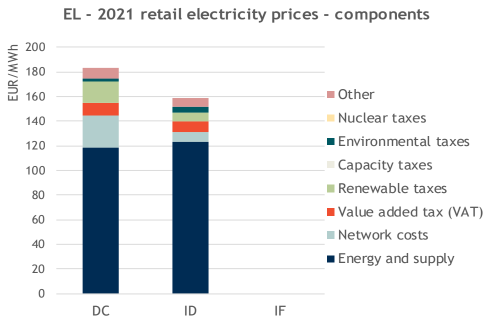
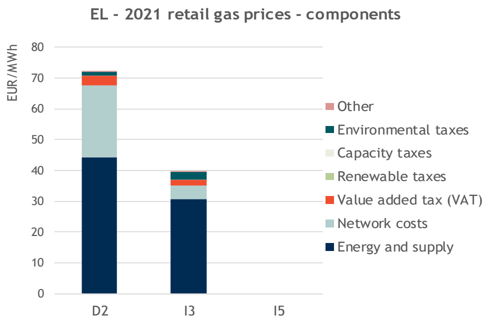
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

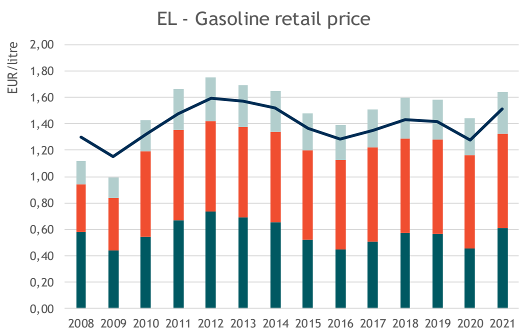

2021 Gas prices for industry (I3) - EL vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

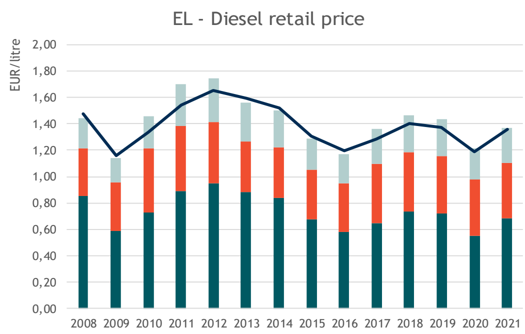


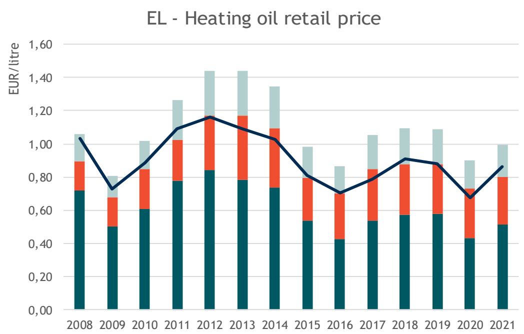


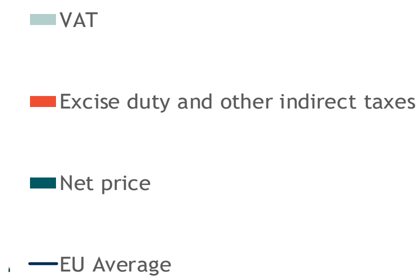






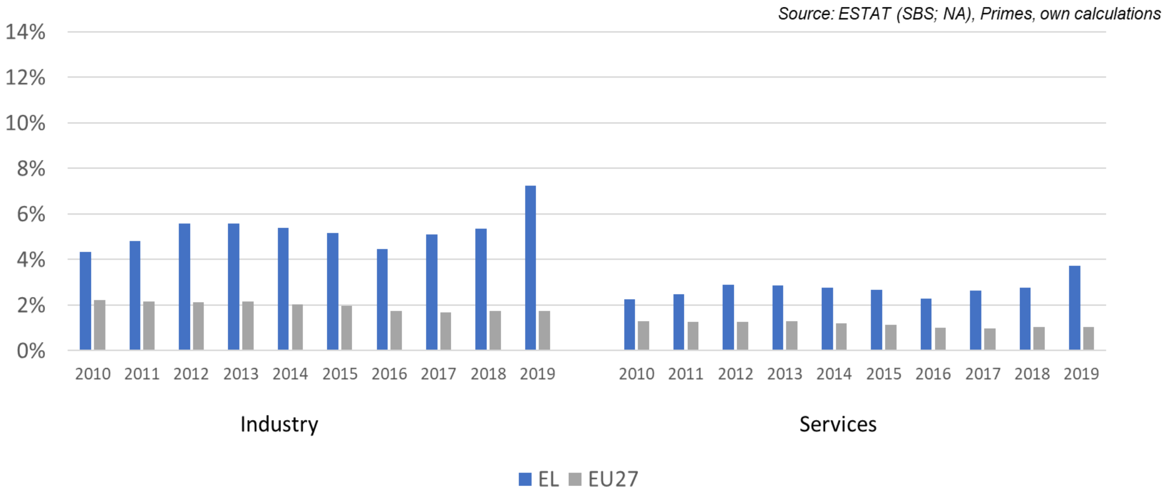


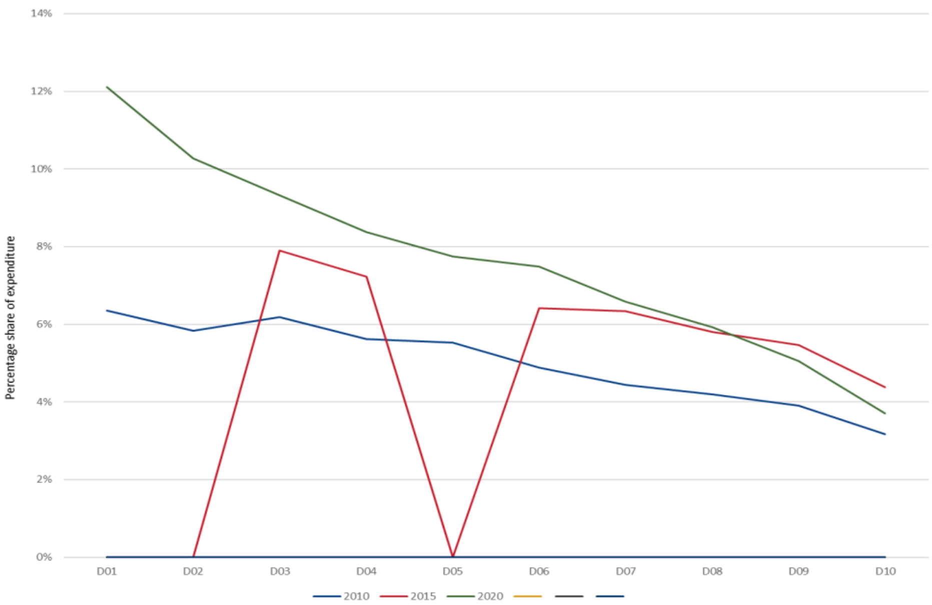




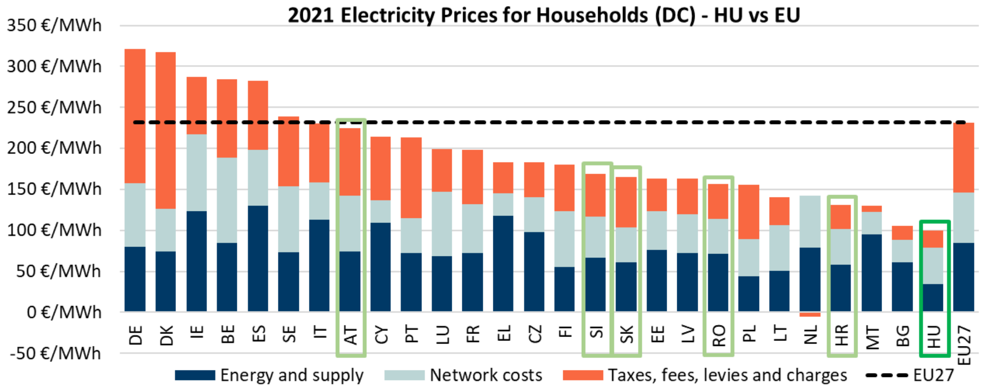
Energy costs for households, industry and services

Share of energy costs in total production value in industry and services: EL vs. EU27

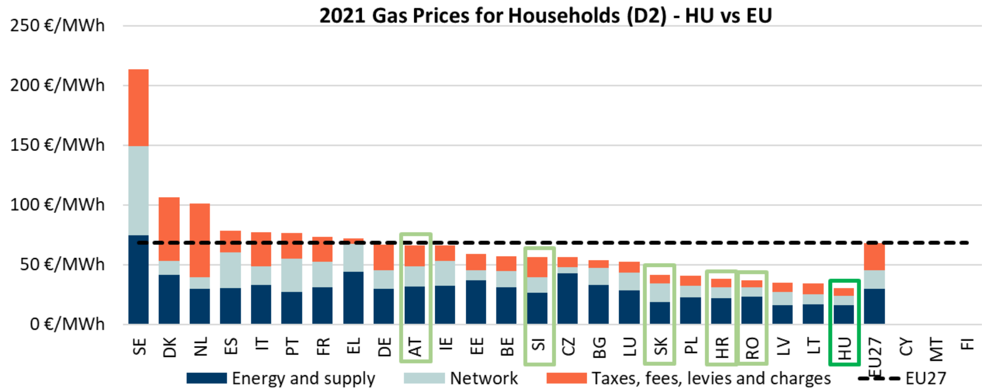




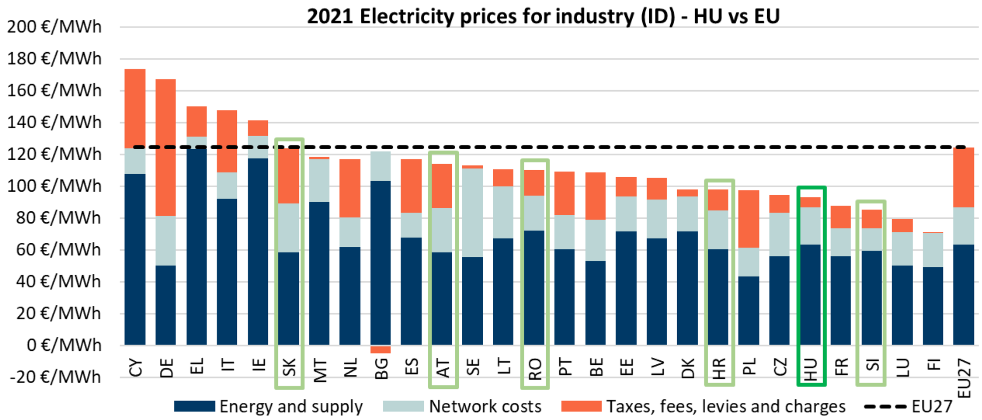
Hungary



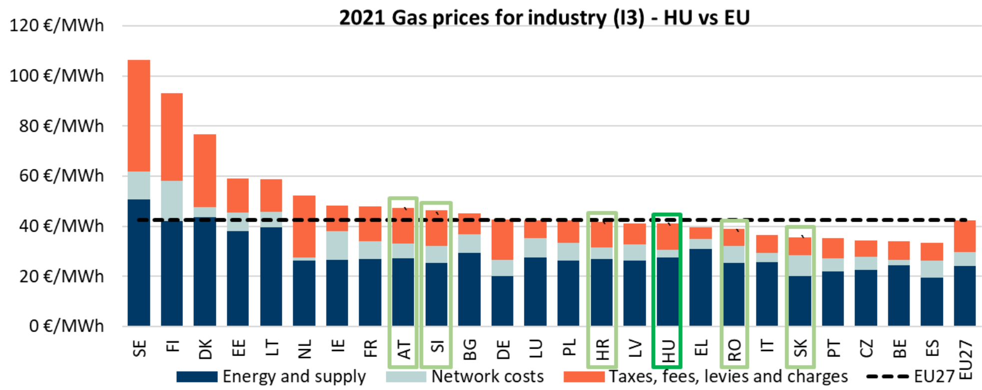
2021 Electricity Prices for Households (DC) - HU vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



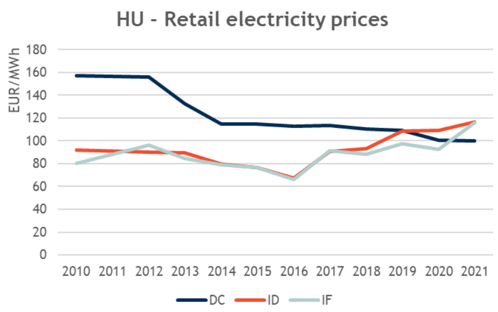
2021 Gas Prices for Households (D2) - HU vs EU
Energy and supply
Network
Taxes, fees, levies and charges
EU27

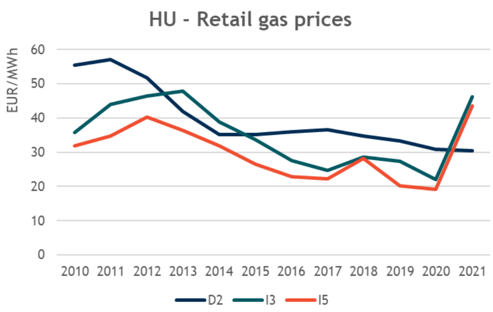


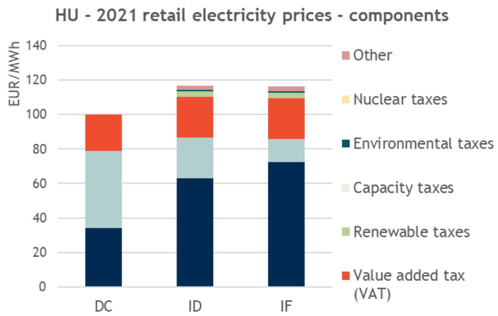
2021 Electricity prices for industry (ID) - HU vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

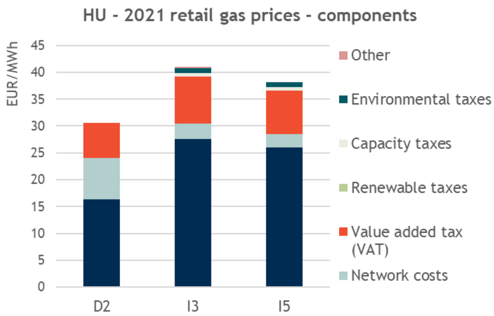


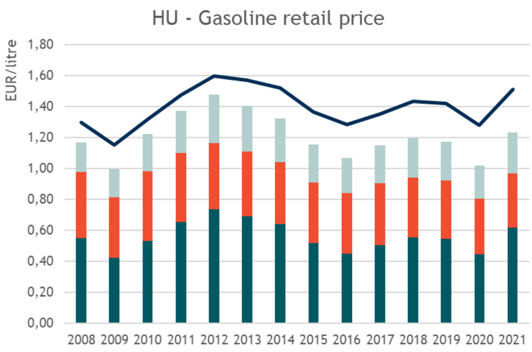
2021 Gas prices for industry (I3) - HU vs EU
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

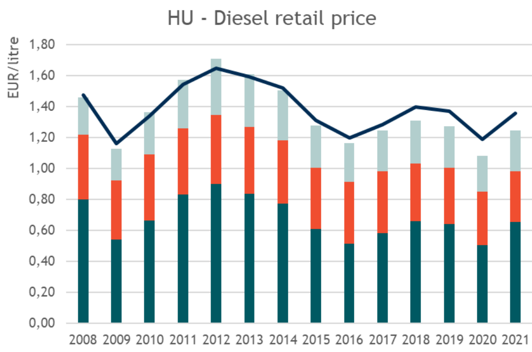


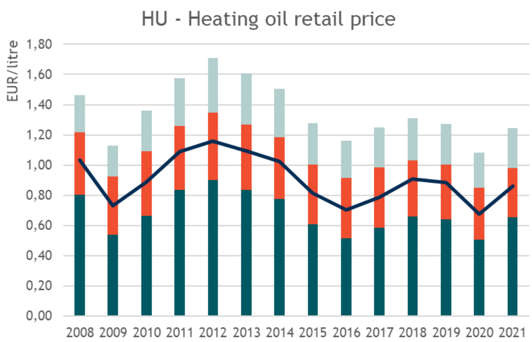


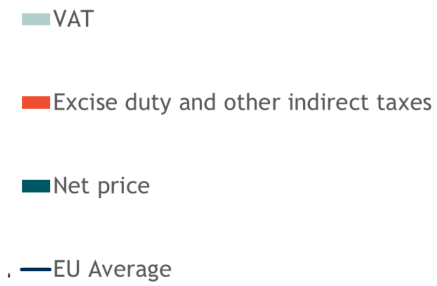








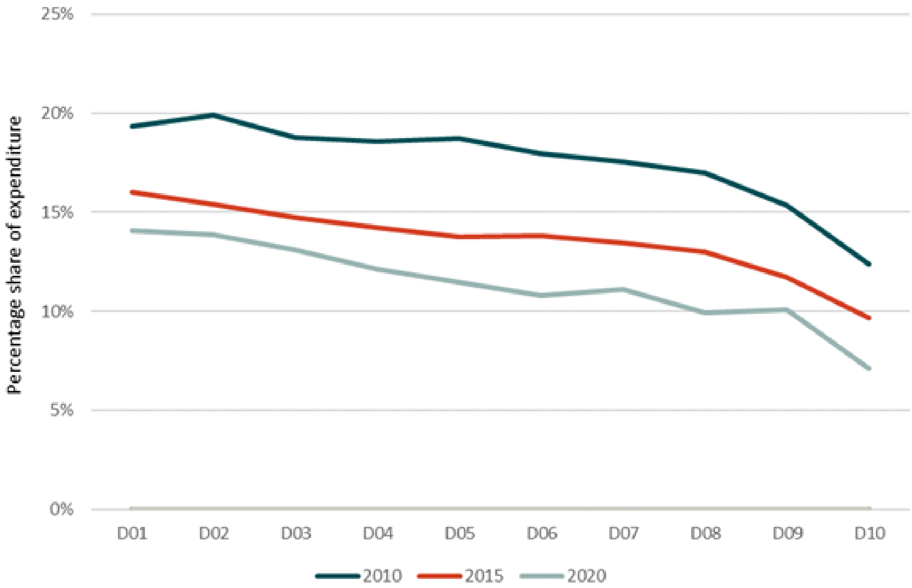




Energy costs for households, industry and services

Energy in household budgets

Share of energy products in household expenditures across income deciles - Hungary

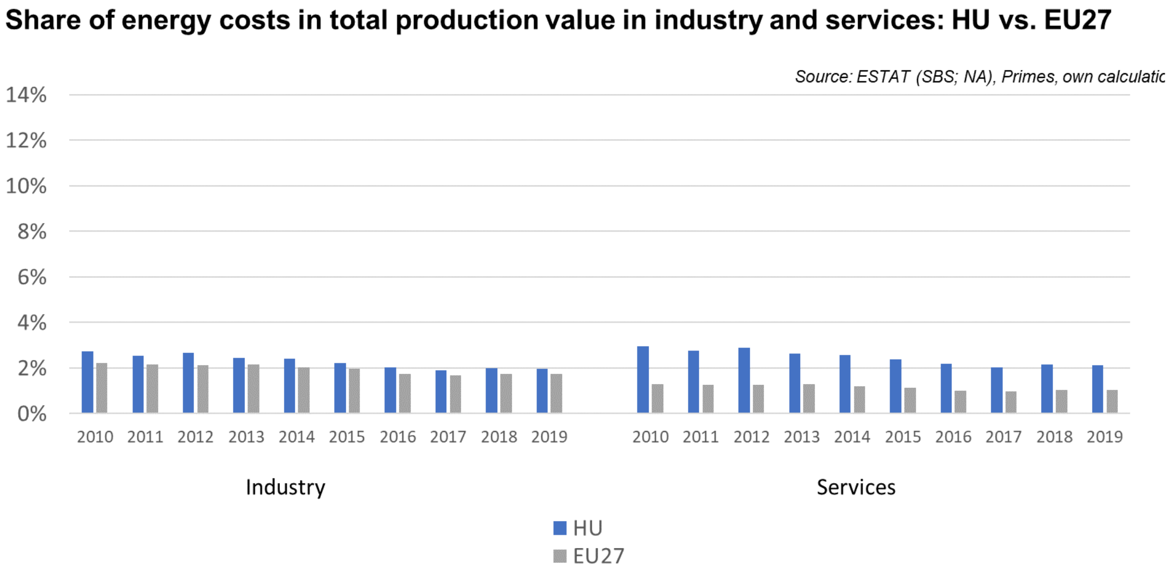


Source: DG ENER ad hoc data collection on household consumption expenditures

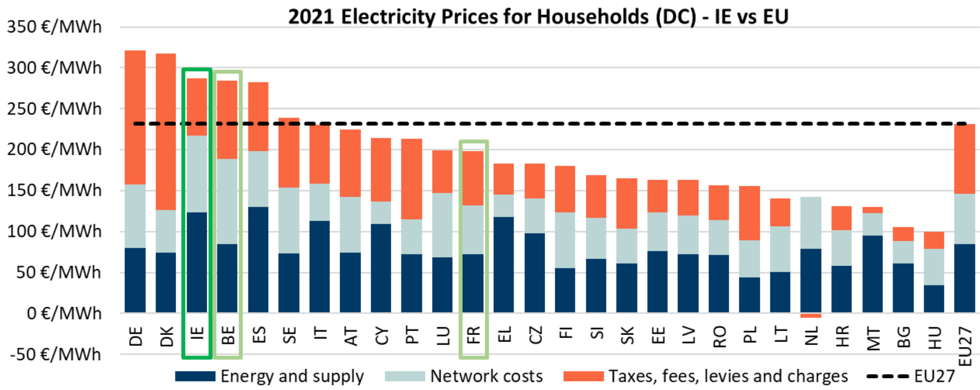
Note: In 2010, households in the lowest income deciles spent around 20% of their total expenditures on energy related expenses. In 2015 and 2020 these shares decreased, to around 16% and 14%. This decreasing trend can be seen across all income deciles. In 2010, middle income households (decile 5) spent around 19% of expenditures on energy; this decreased to 11% by 2020.

This figure includes data on energy expenditures per income group, excluding transport energy expenditures (transport fuels)

Energy costs shares in total production costs



Ireland


2021 Electricity Prices for Households (DC) - IE vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
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0 €/MWh
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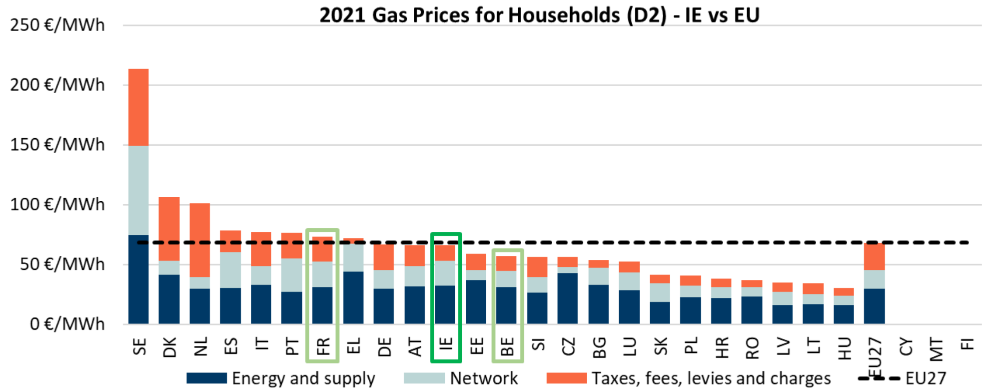
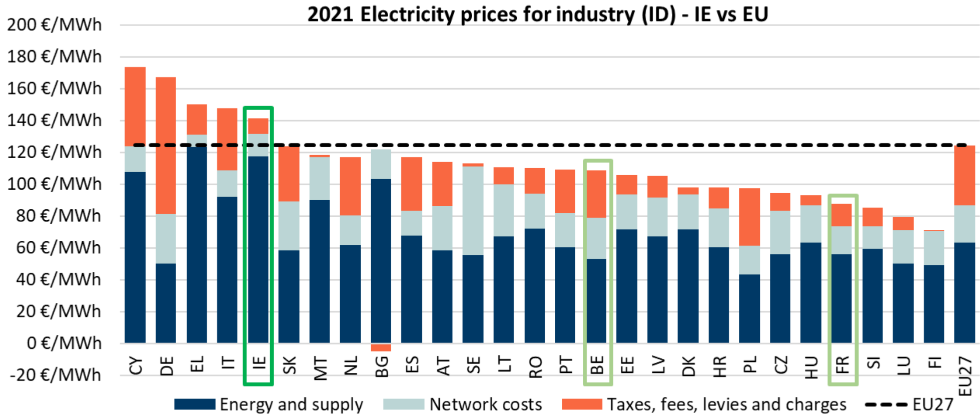
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - IE vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - IE vs EU
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180 €/MWh
160 €/MWh
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80 €/MWh
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CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
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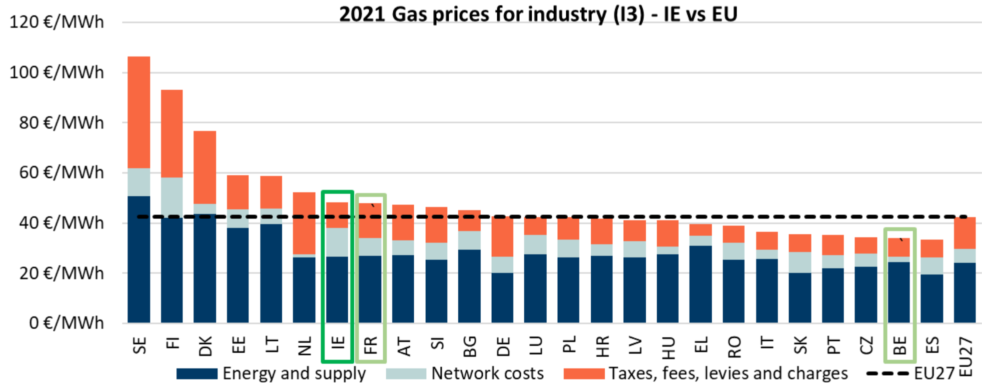
2021 Gas prices for industry (I3) - IE vs EU
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40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
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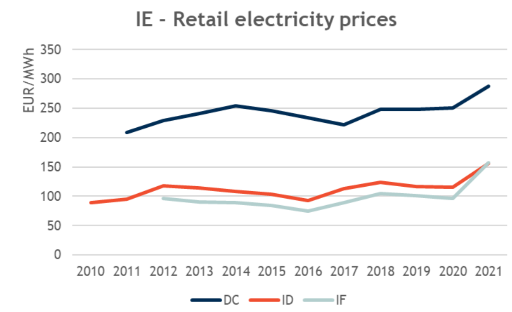
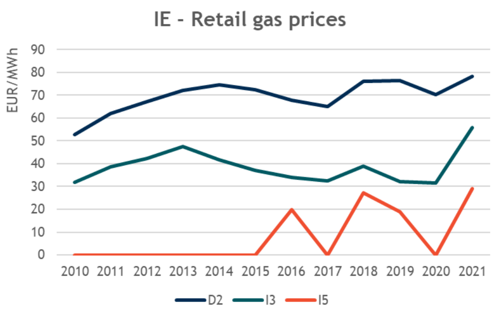
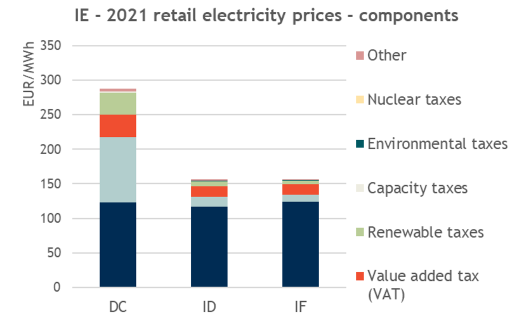
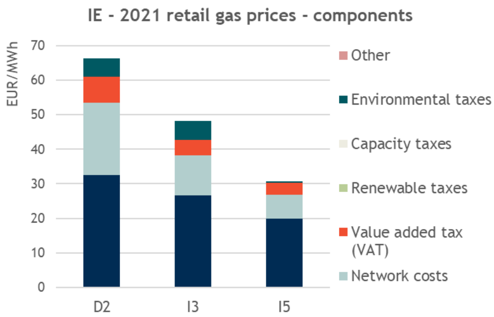
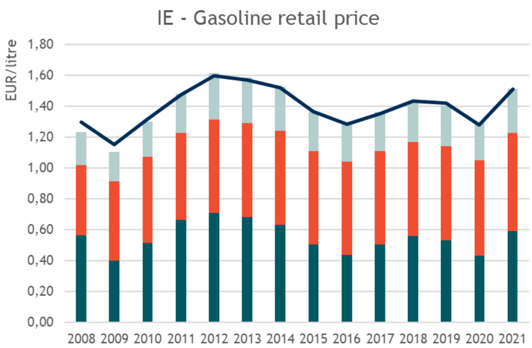
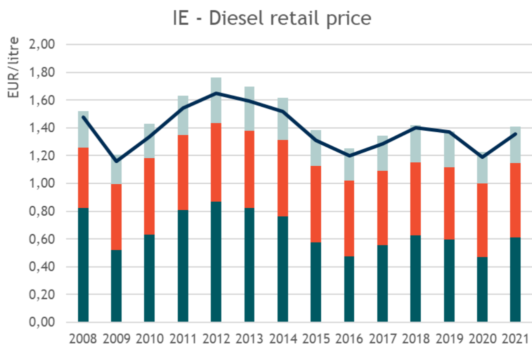


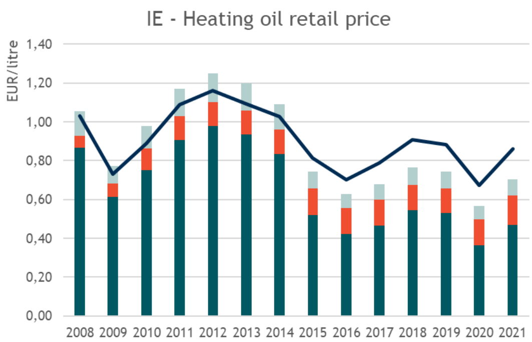


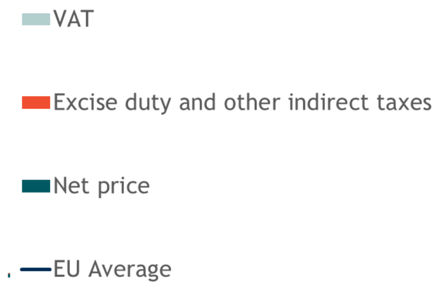






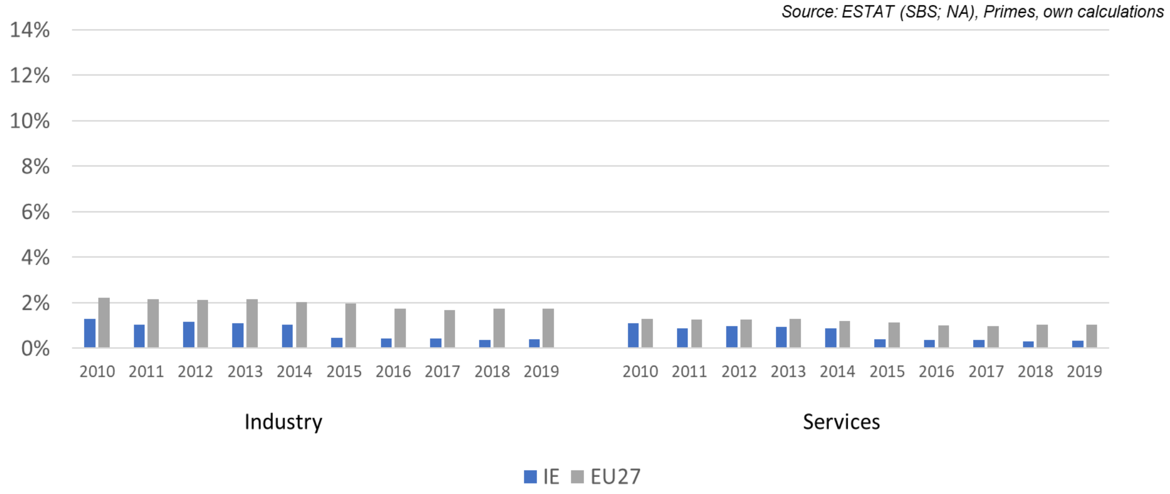


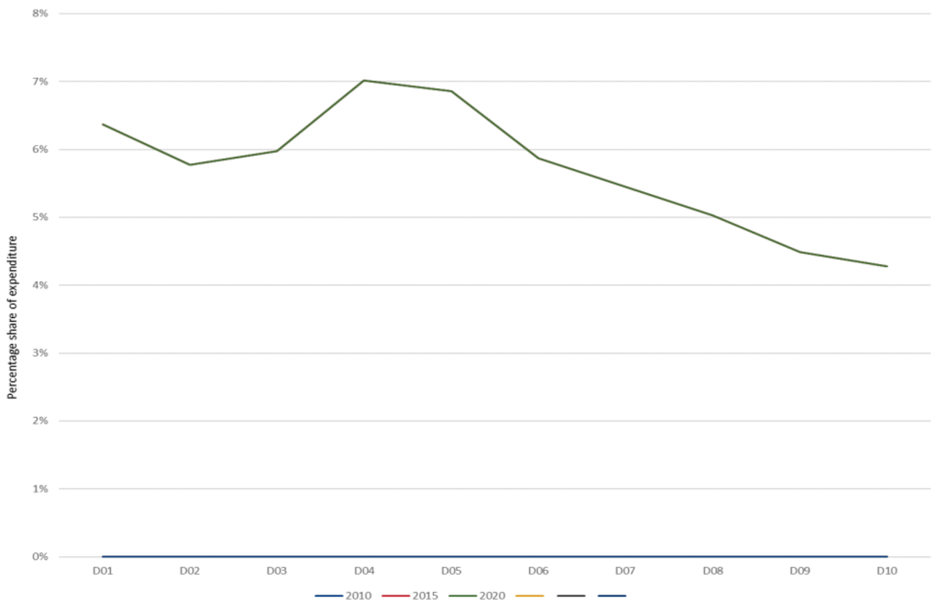




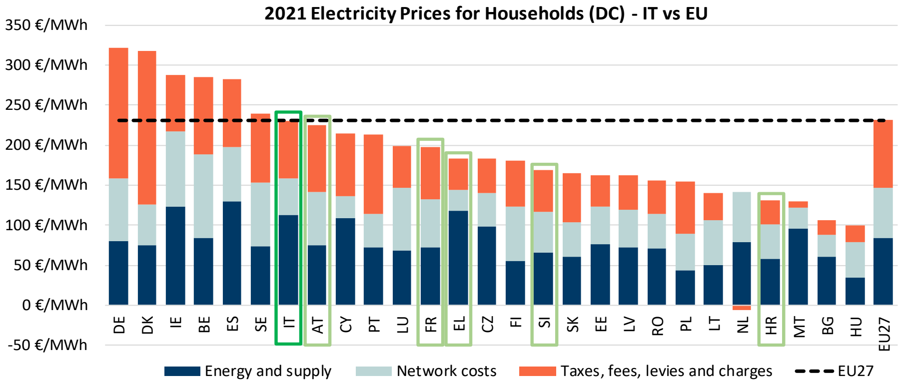
Energy costs for households, industry and services

Share of energy costs in total production value in industry and services: IE vs. EU27





Italy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Energy and supply
Network costs
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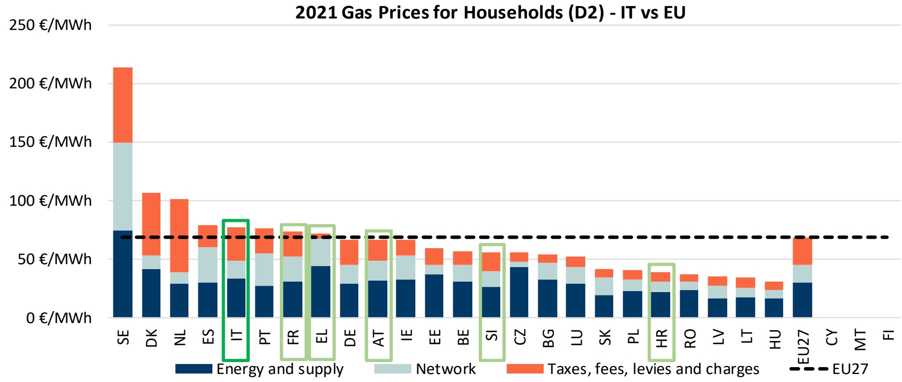
EU27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SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
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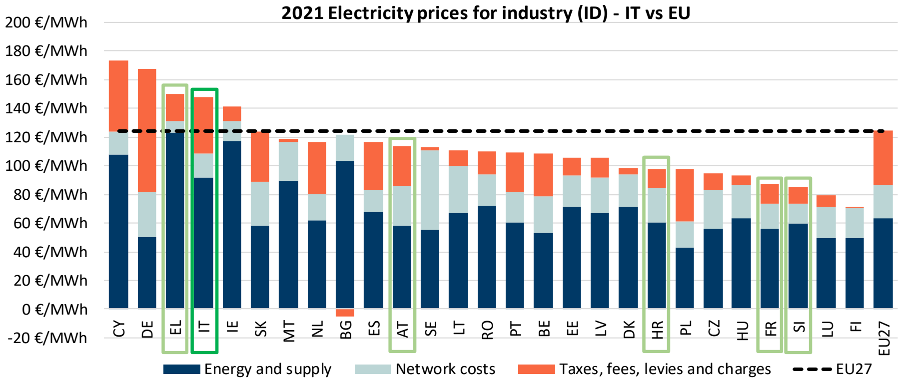
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - IT vs EU
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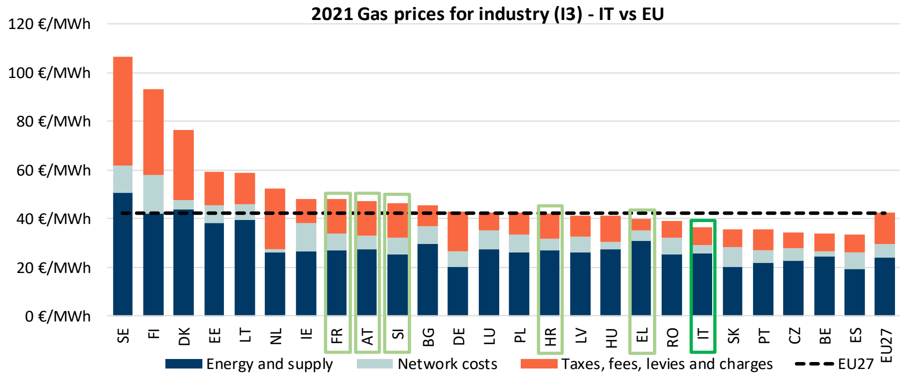
2021 Gas prices for industry (I3) - IT vs EU
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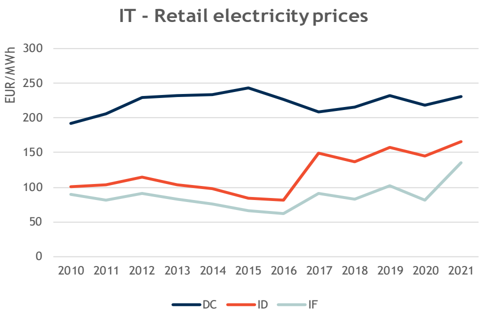
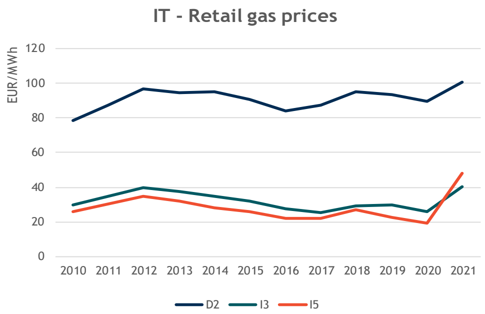
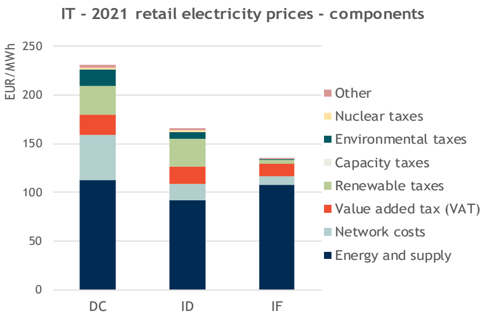
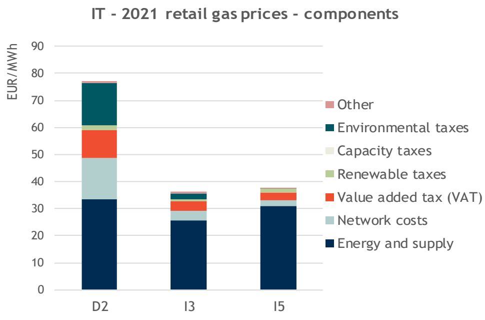

IT - Retail electricity prices
EUR/MWh
DC
ID
IF


IT - Retail gas prices
EUR/MWh
D2
I3
I5


IT - 2021 retail electricity prices - components
EUR/MWh
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
Energy and supply


IT - 2021 retail gas prices - components
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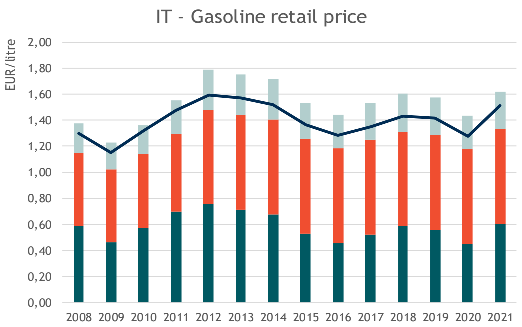
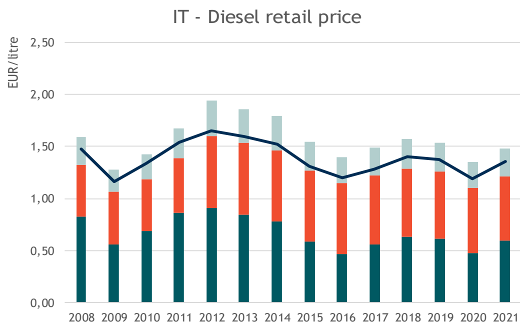
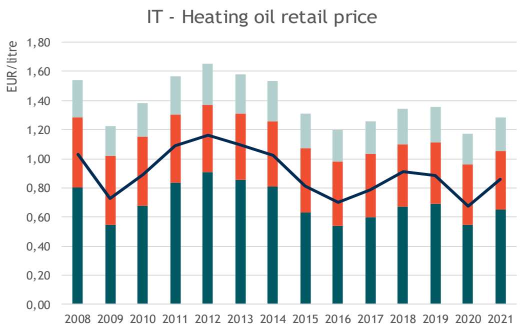
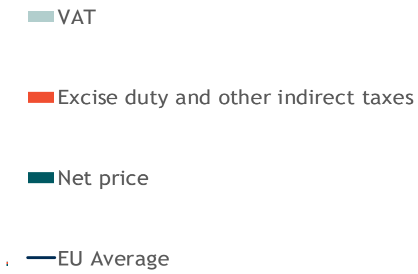
Network costs
Energy and supply

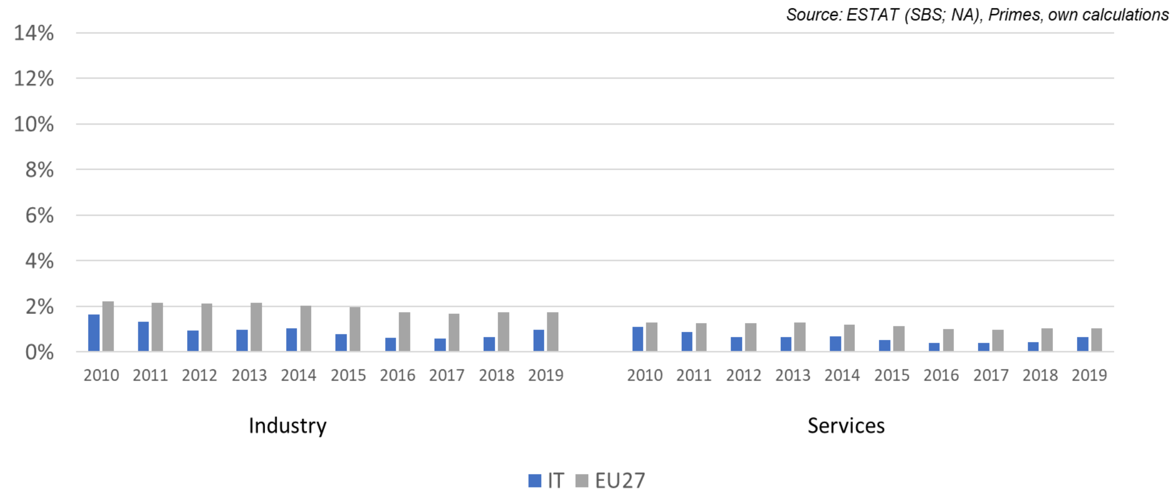

IT - Gasoline retail price
EUR/litre

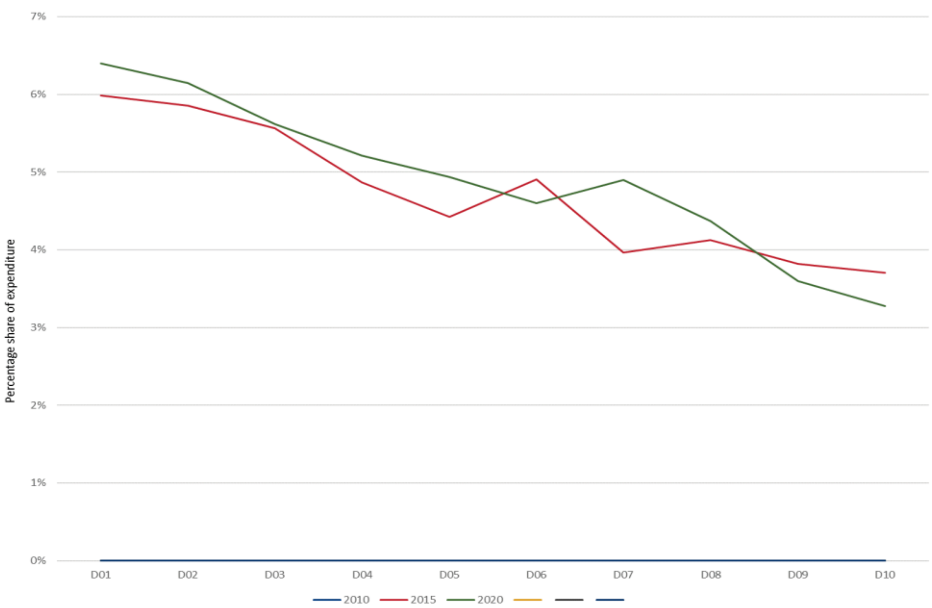

IT - Diesel retail price
EUR/litre


IT - Heating oil retail price
EUR/litre

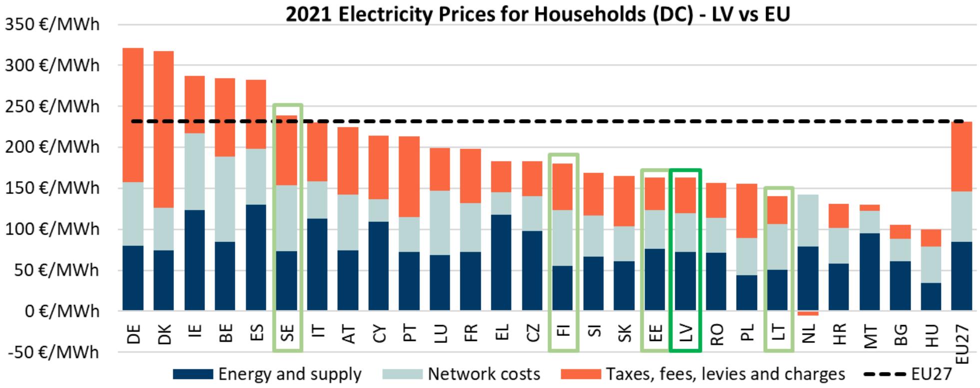

VAT
Excise duty and other indirect taxes
Net price
EU Average

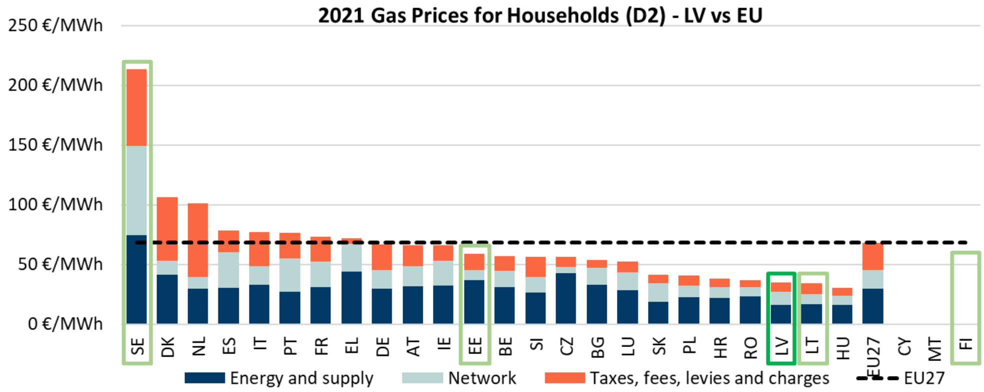
Share of energy costs in total production value in industry and services: IT vs. EU27

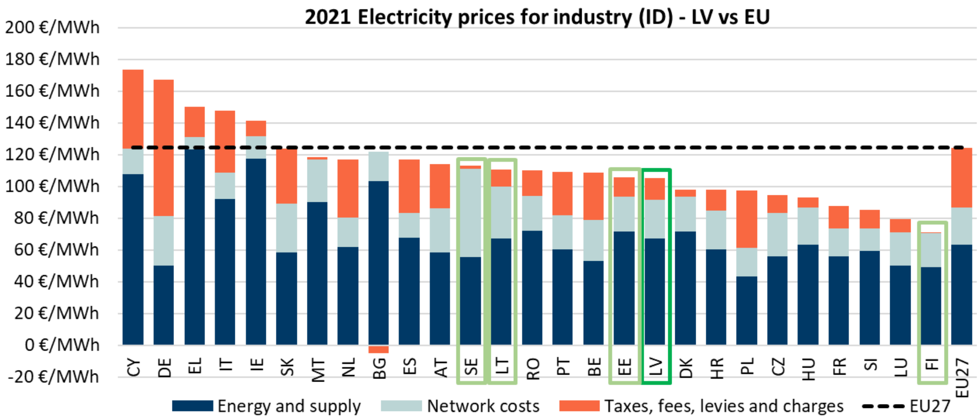


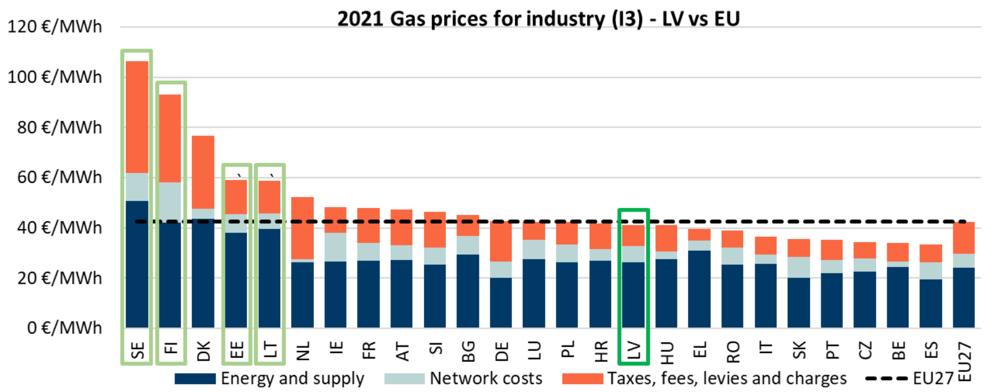


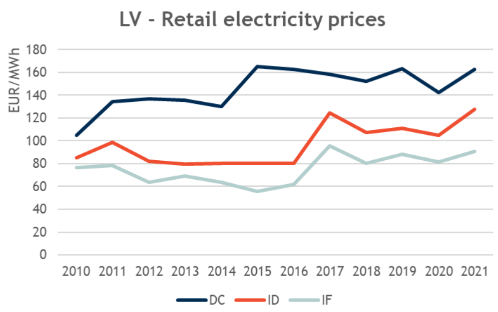
Latvia

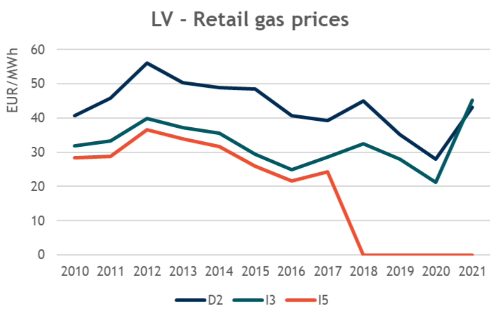

2021 Electricity Prices for Households (DC) - LV vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

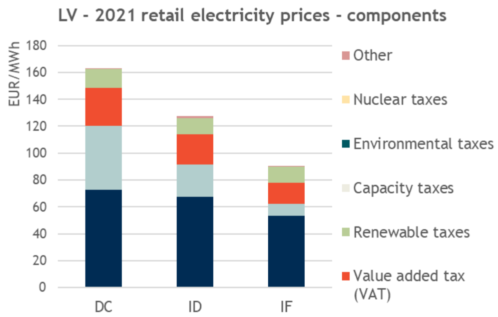

2021 Gas Prices for Households (D2) - LV vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

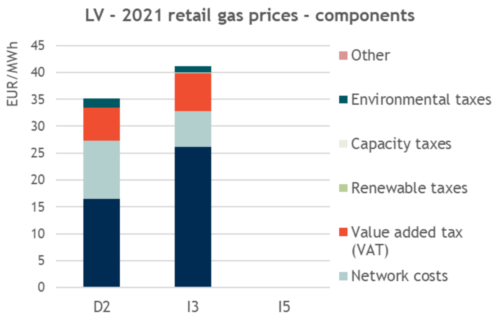

2021 Electricity prices for industry (ID) - LV vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

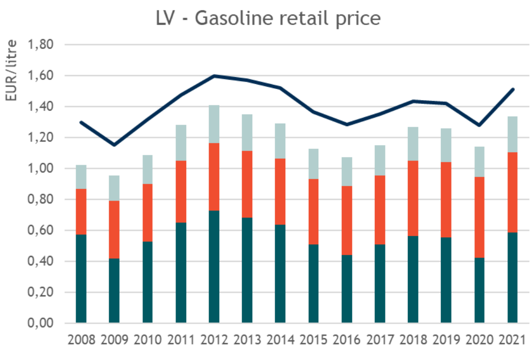

2021 Gas prices for industry (I3) - LV vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

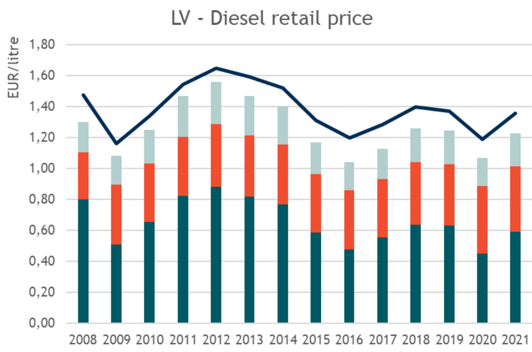

LV - Retail electricity prices
EUR/MWh
DC
ID
IF

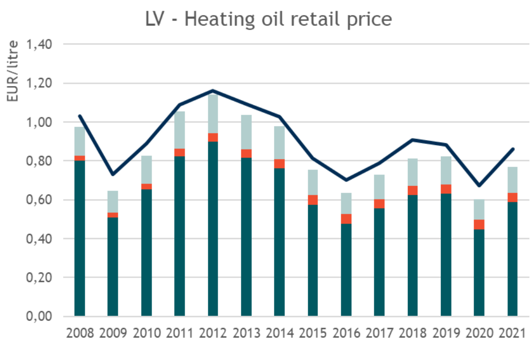

LV - Retail gas prices
EUR/MWh
D2
I3
I5

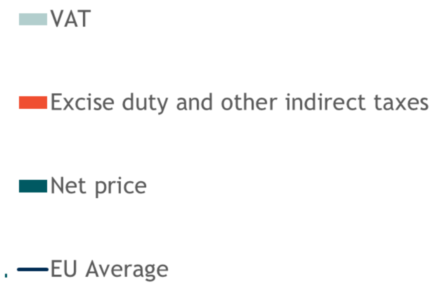

LV - 2021 retail electricity prices - components
EUR/MWh
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


LV - 2021 retail gas prices - components
EUR/MWh
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs


LV - Gasoline retail price
EUR/litre

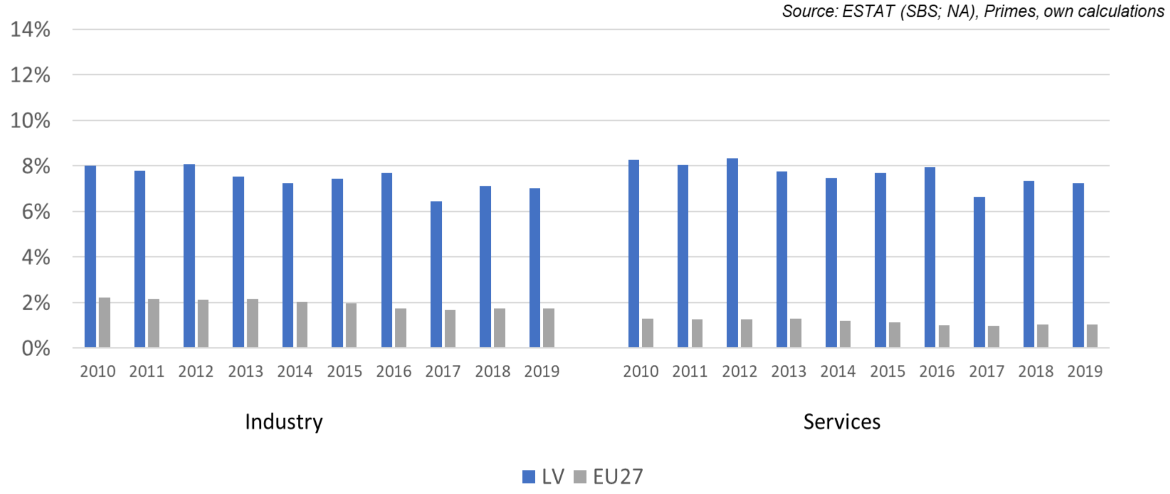

LV - Diesel retail price
EUR/litre

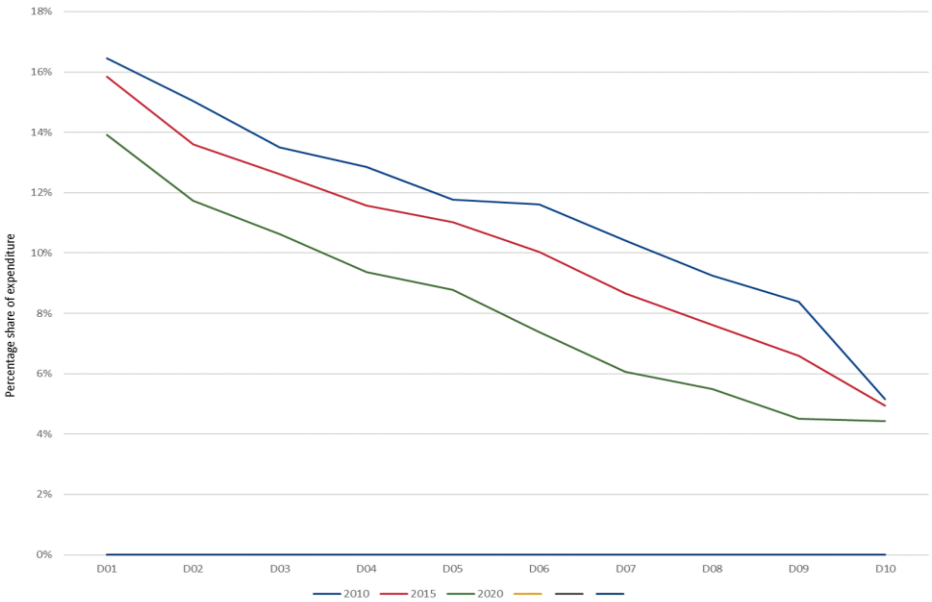

LV - Heating oil retail price
EUR/litre


VAT
Excise duty and other indirect taxes
Net price
EU Average

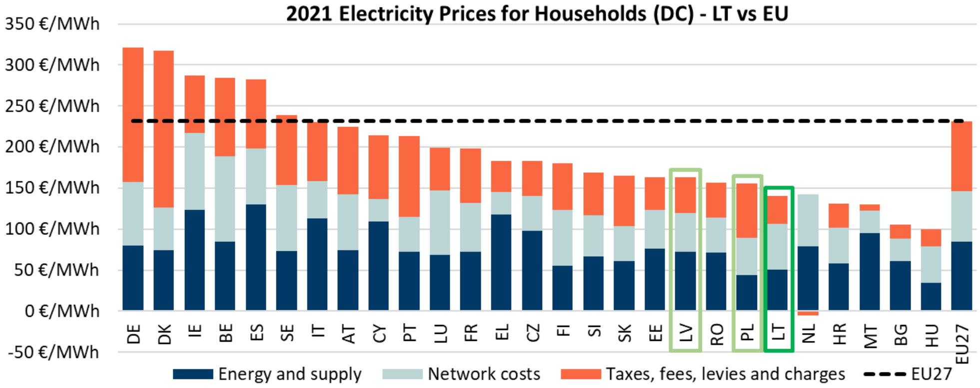
Share of energy costs in total production value in industry and services: LV vs. EU27

Source: ESTAT (SBS; NA), Primes, own calculations

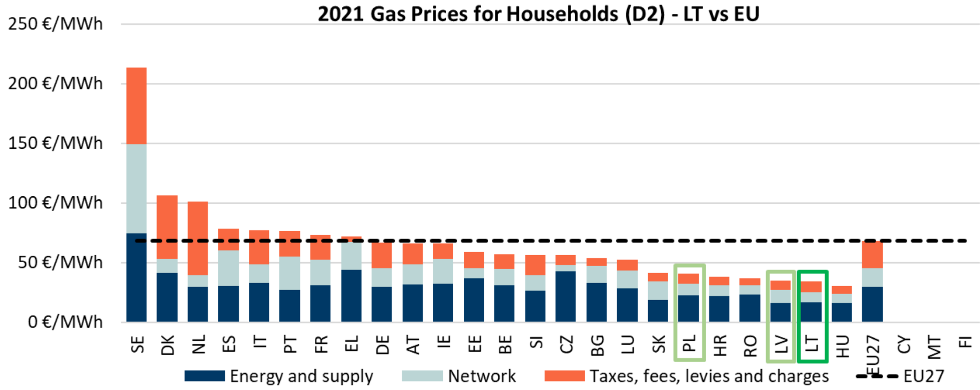




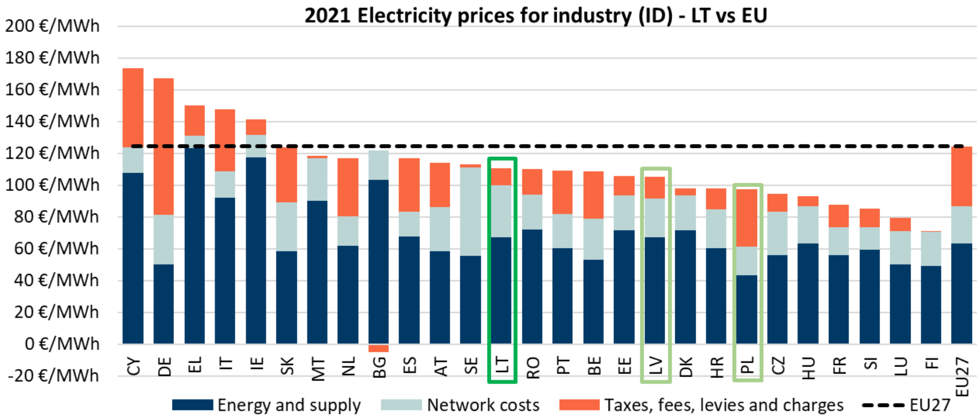
Lithuania



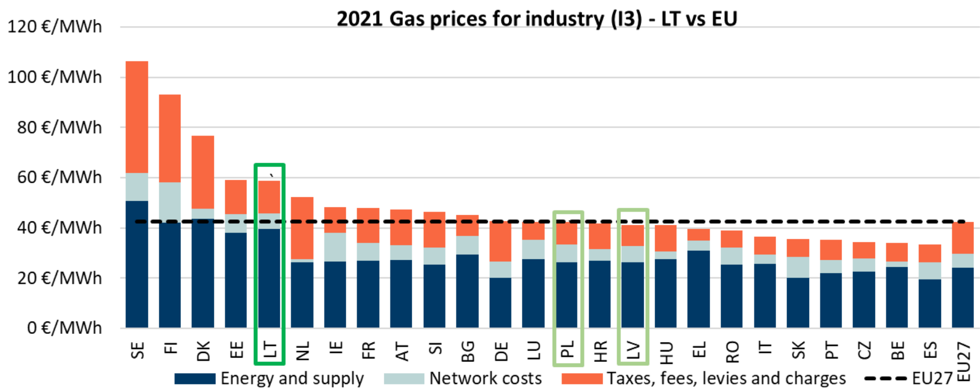
2021 Electricity Prices for Households (DC) - LT vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



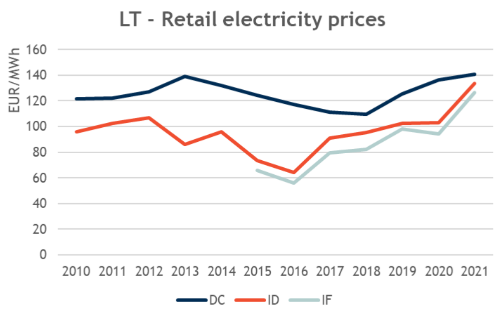
2021 Gas Prices for Households (D2) - LT vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

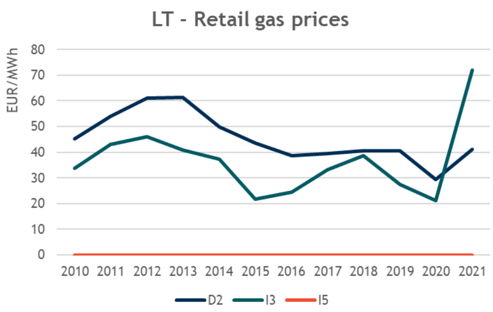


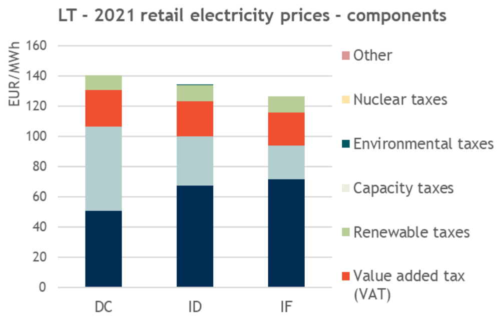
2021 Electricity prices for industry (ID) - LT vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

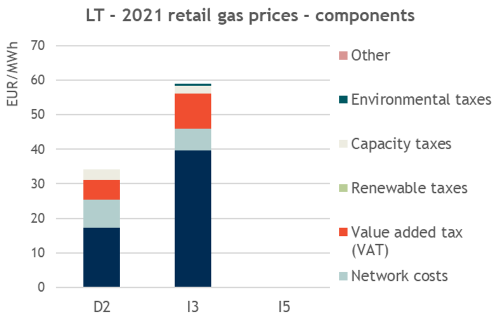


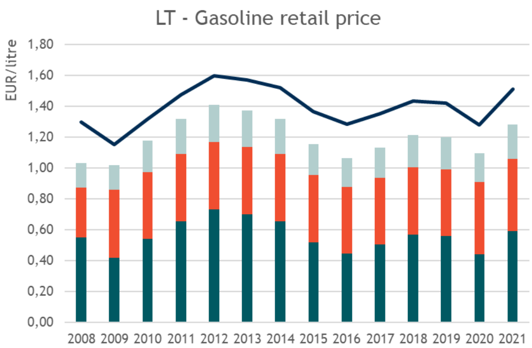
2021 Gas prices for industry (I3) - LT vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

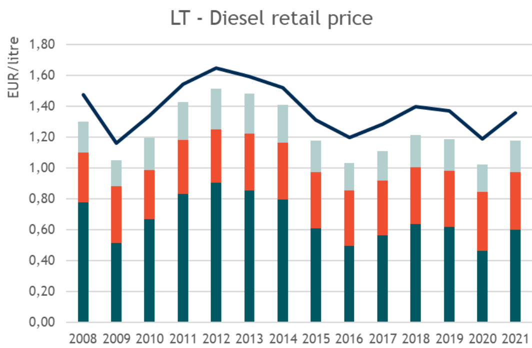

LT - Retail electricity prices
EUR/MWh
DC
ID
IF

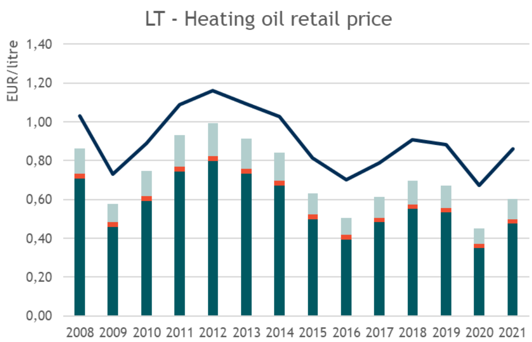

LT - Retail gas prices
EUR/MWh
D2
I3
I5

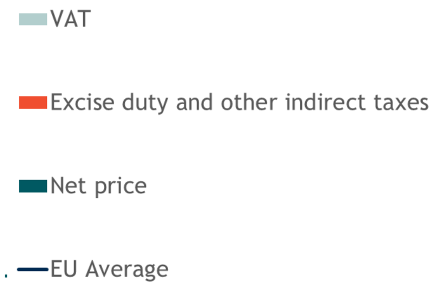

LT - 2021 retail electricity prices - components
EUR/MWh
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


LT - 2021 retail gas prices - components
EUR/MWh
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs


LT - Gasoline retail price
EUR/litre

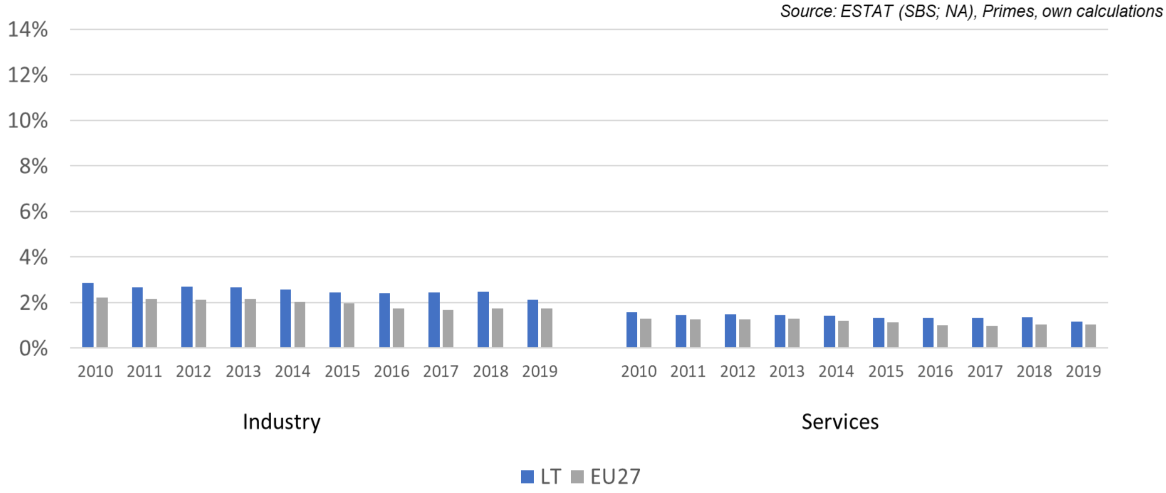

LT - Diesel retail price
EUR/litre

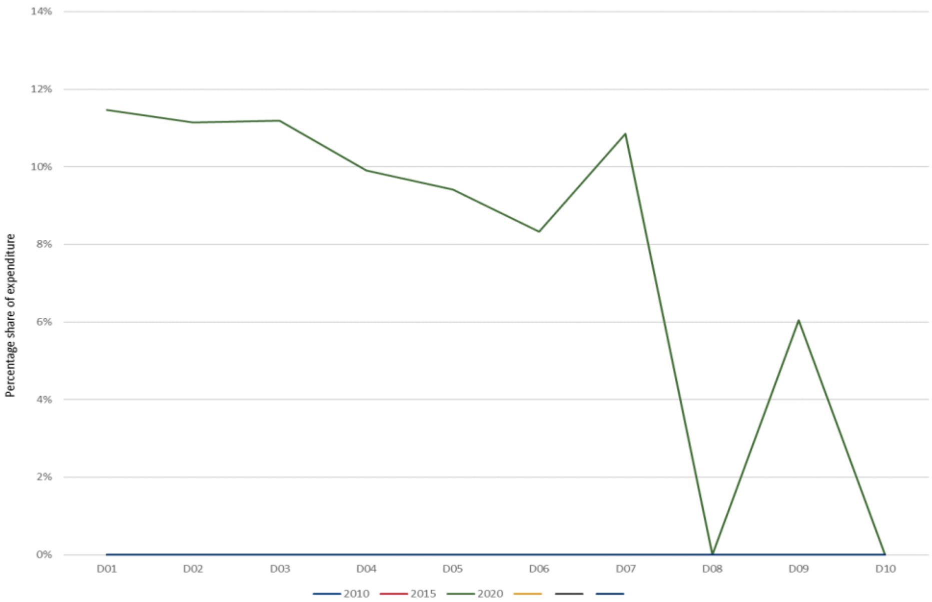

LT - Heating oil retail price
EUR/litre


VAT
Excise duty and other indirect taxes
Net price
EU Average

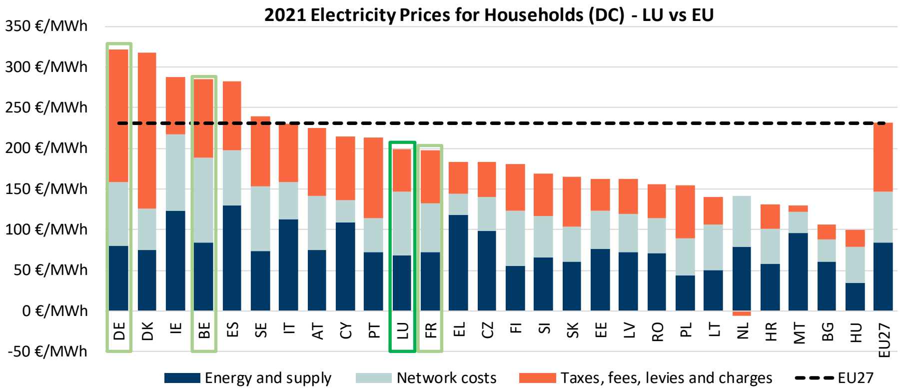
Energy costs for households, industry and services

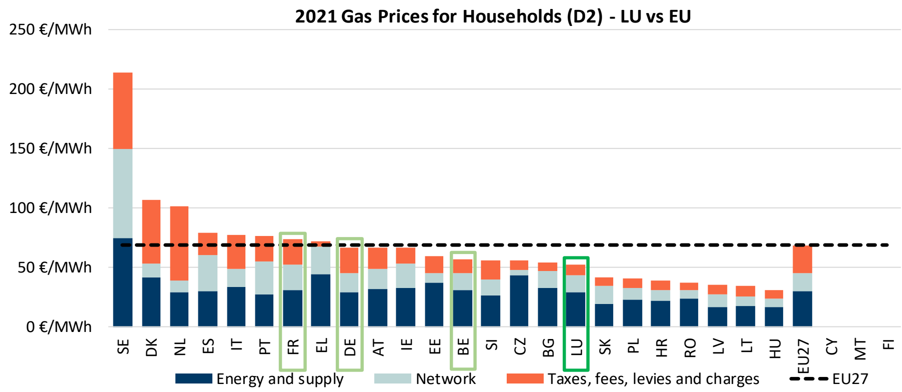
Share of energy costs in total production value in industry and services: LT vs. EU27

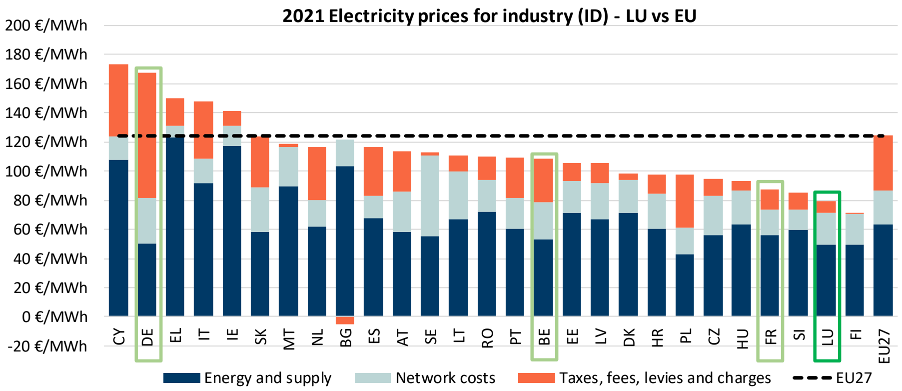




Luxembourg


2021 Electricity Prices for Households (DC) - LU vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - LU vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - LU vs EU
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100 €/MWh
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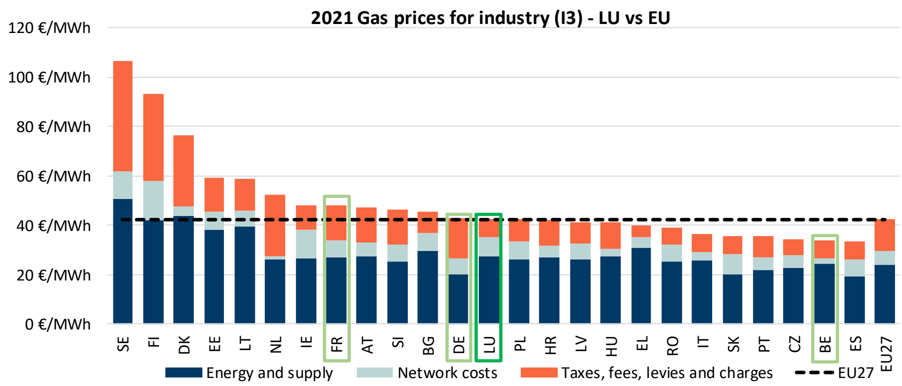
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas prices for industry (I3) - LU vs EU
120 €/MWh
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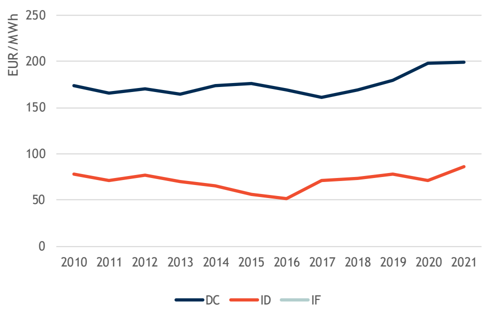
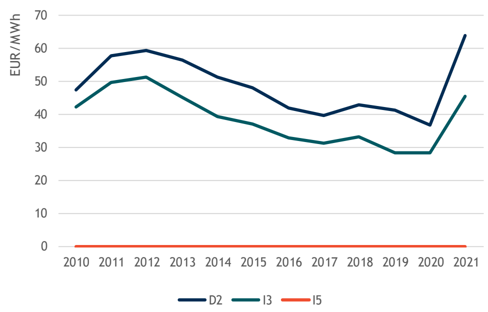
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

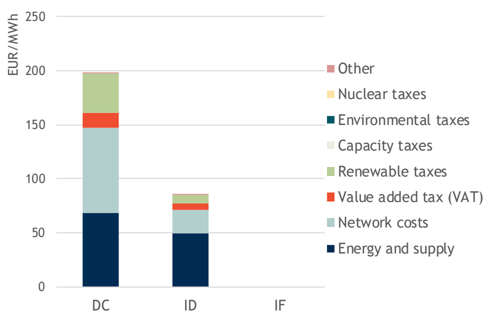
LU - Retail electricity prices



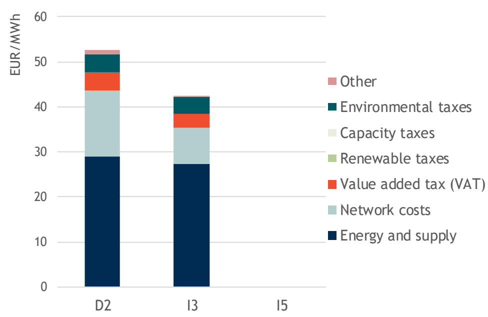
LU - Retail gas prices



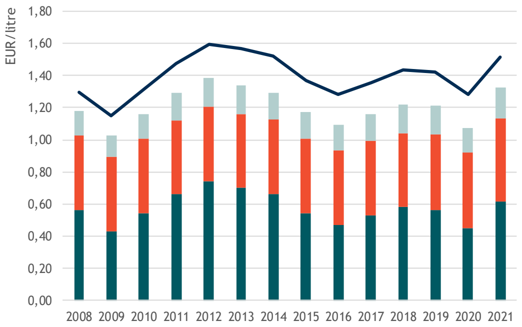
LU - 2021 retail electricity prices - components



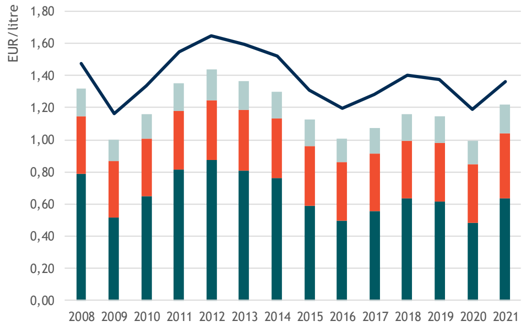
LU - 2021 retail gas prices - components



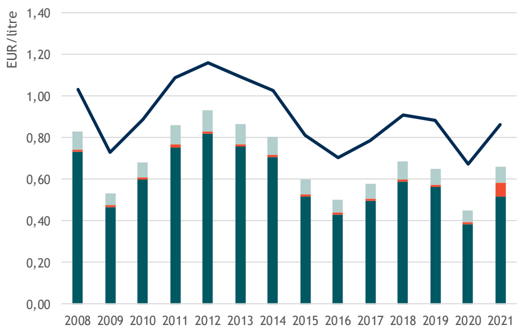
LU - Gasoline retail price



LU - Diesel retail price



LU - Heating oil retail price



VAT

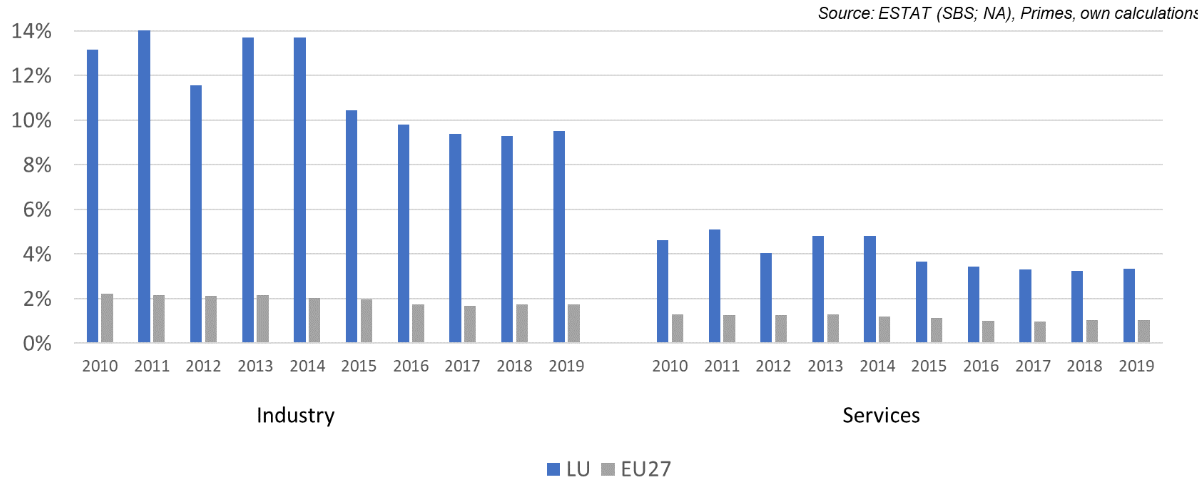
Excise duty and other indirect taxes

Net price

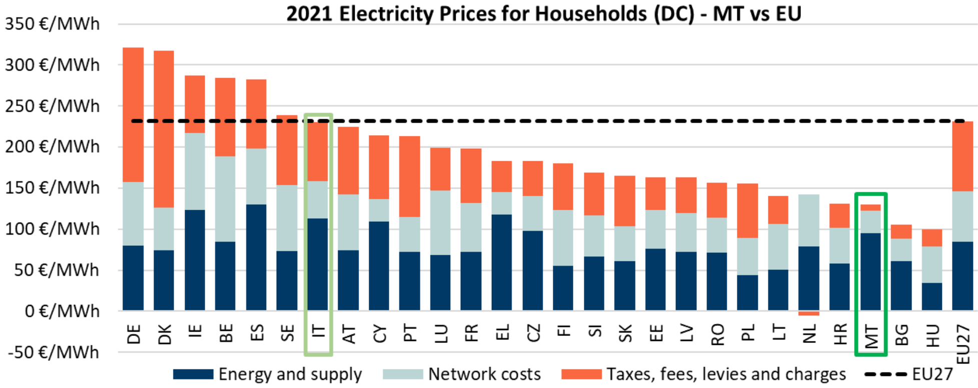
EU Average

Energy costs for households, industry and services

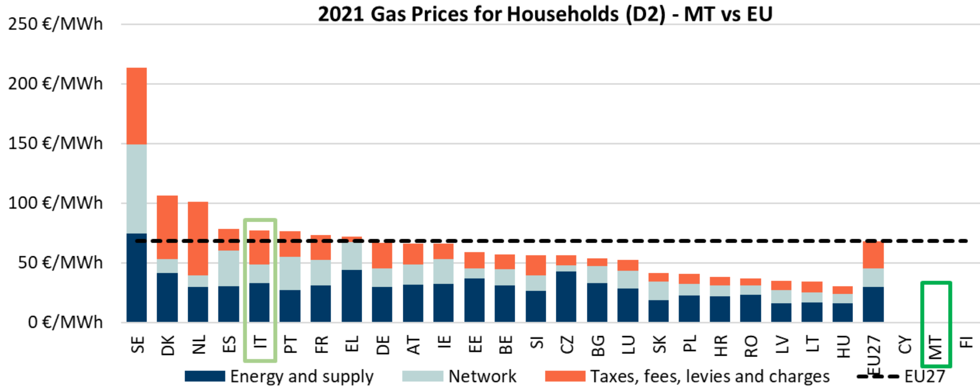
Share of energy costs in total production value in industry and services: LU vs. EU27



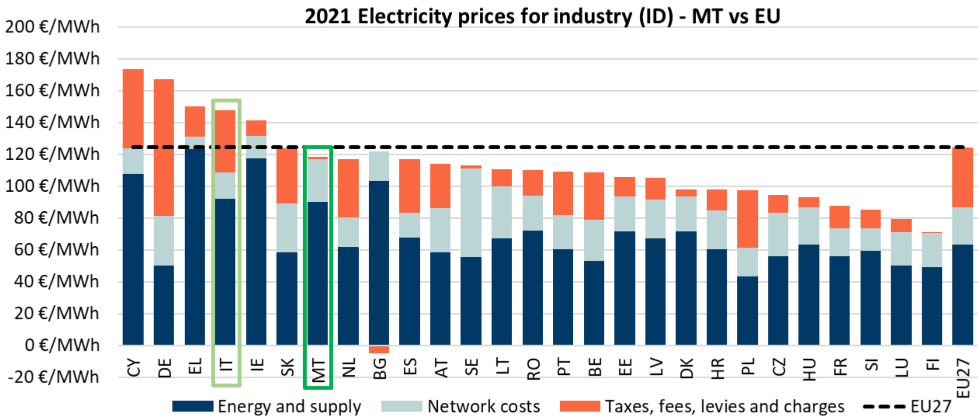
Malta



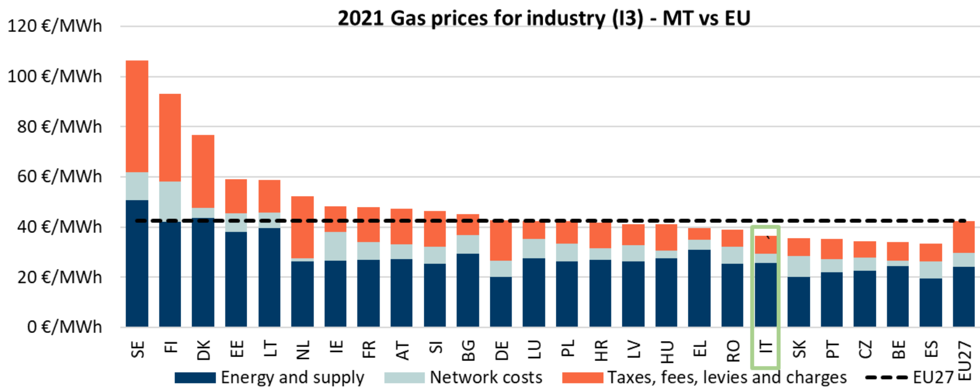
2021 Electricity Prices for Households (DC) - MT vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



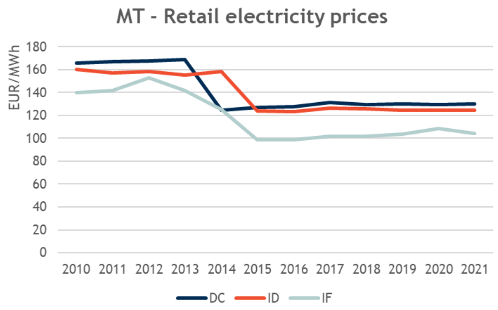
2021 Gas Prices for Households (D2) - MT vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

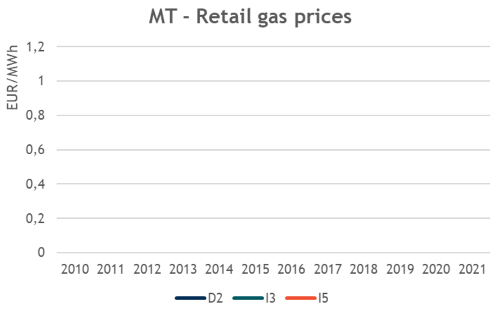


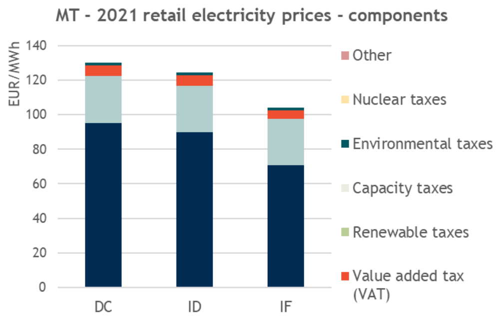
2021 Electricity prices for industry (ID) - MT vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

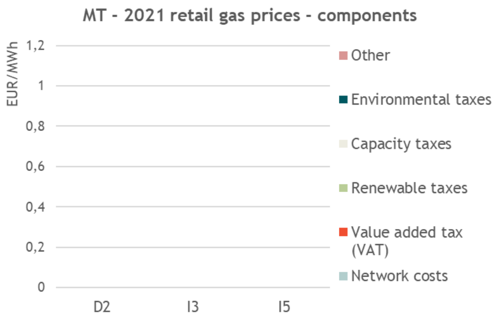


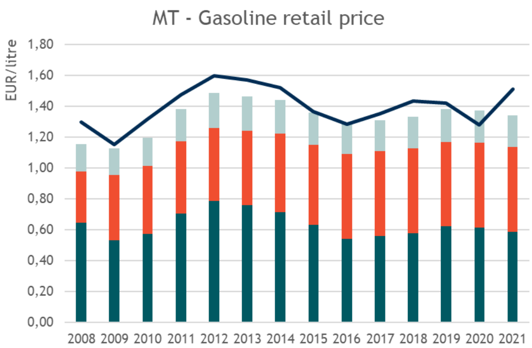
2021 Gas prices for industry (I3) - MT vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

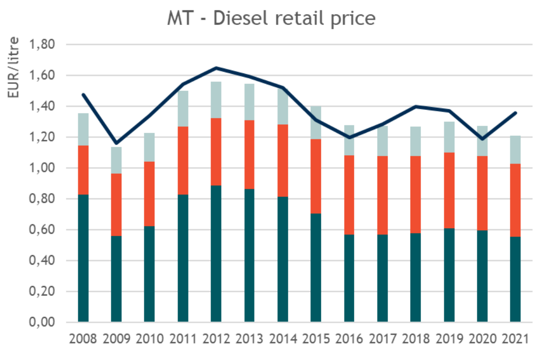

MT - Retail electricity prices
EUR/MWh
180
160
140
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

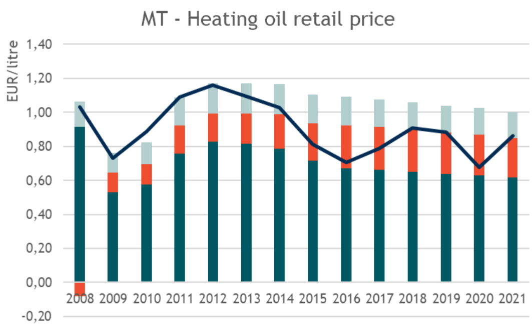

MT - Retail gas prices
EUR/MWh
1,2
1
0,8
0,6
0,4
0,2
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

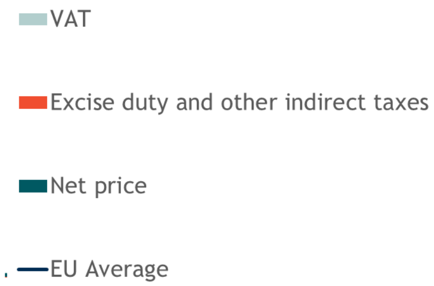

MT - 2021 retail electricity prices - components
EUR/MWh
140
120
100
80
60
40
20
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


MT - 2021 retail gas prices - components
EUR/MWh
1,2
1
0,8
0,6
0,4
0,2
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

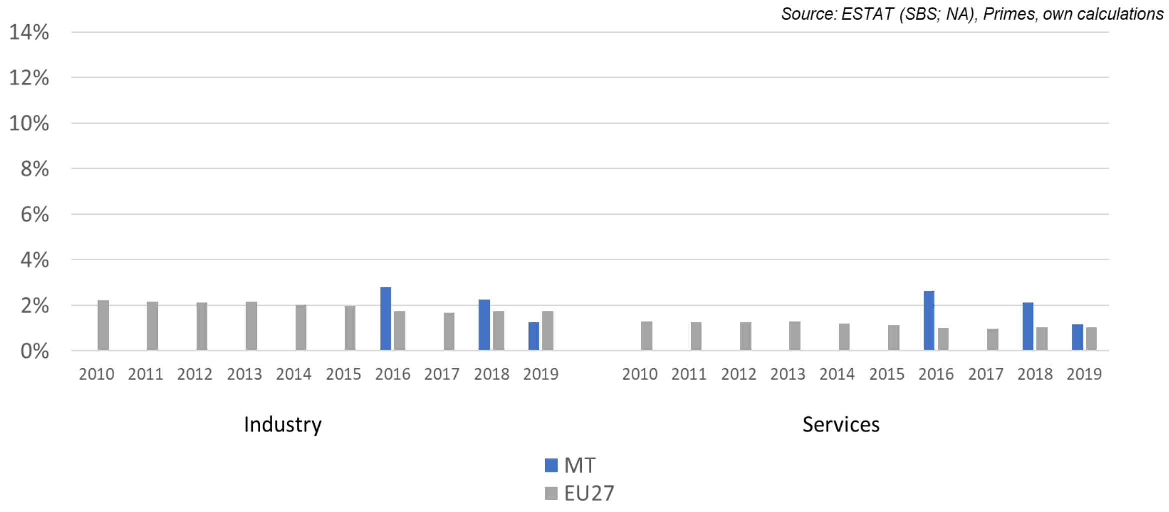

MT - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

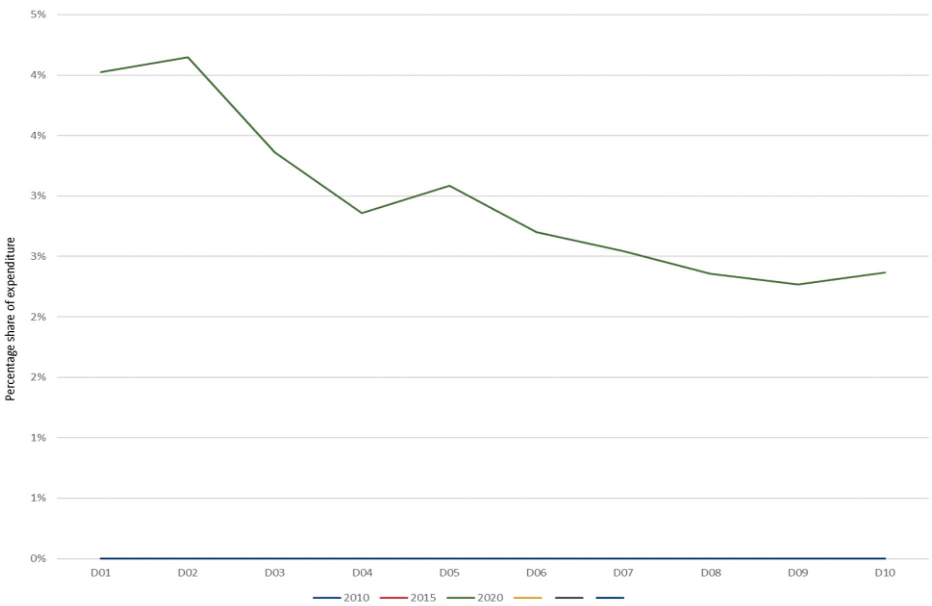

MT - Diesel retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


MT - Heating oil retail price
EUR/litre
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

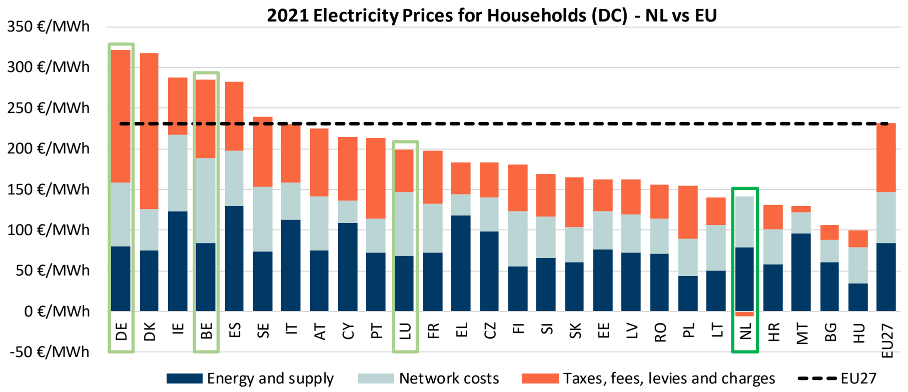

VAT
Excise duty and other indirect taxes
Net price
EU Average

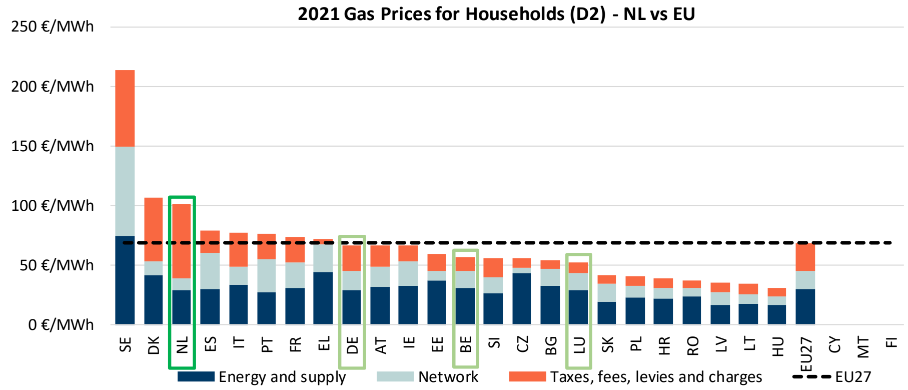
Share of energy costs in total production value in industry and services: MT vs. EU27

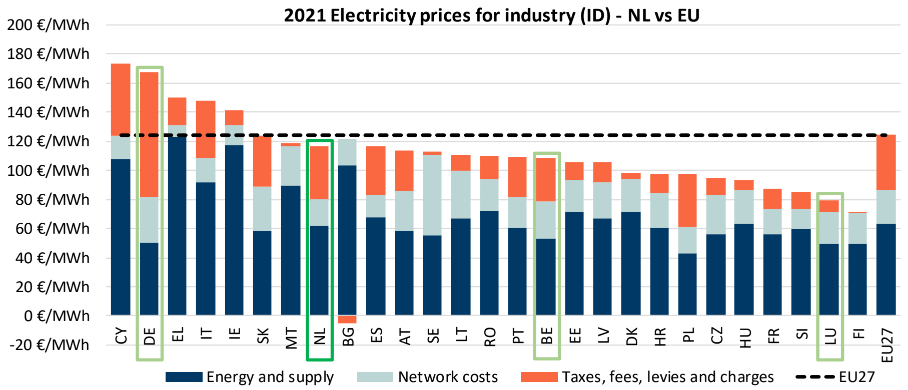


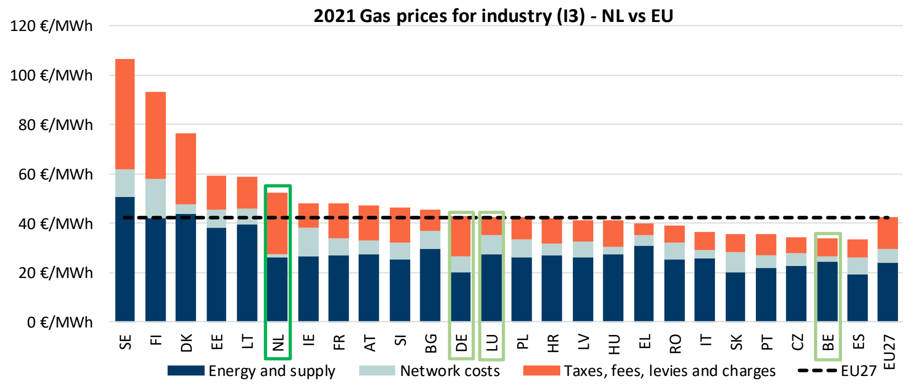


The Netherlands

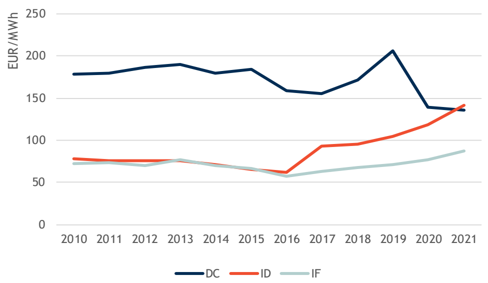




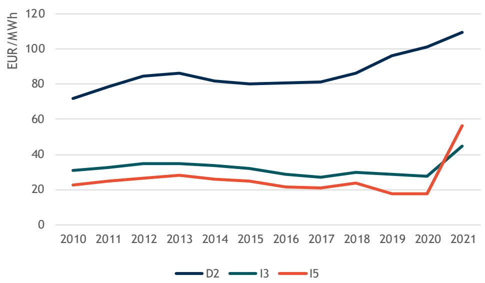




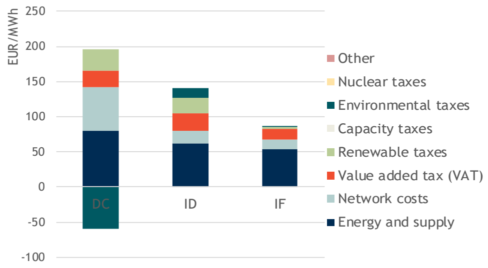
NL - Retail electricity prices



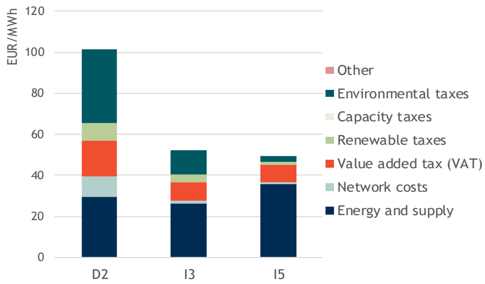
NL - Retail gas prices



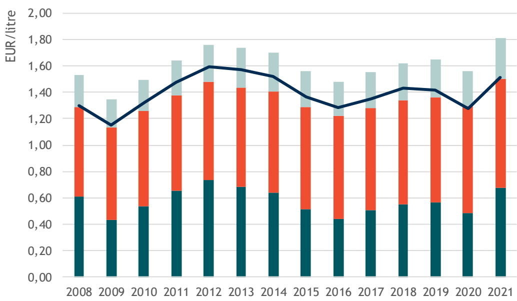
NL - 2021 retail electricity prices - components



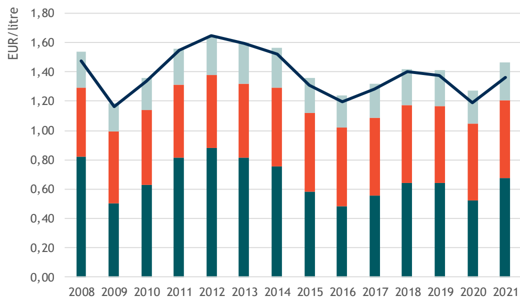
NL - 2021 retail gas prices - components



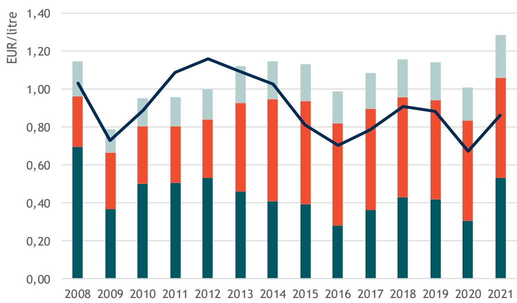
NL - Gasoline retail price



NL - Diesel retail price



NL - Heating oil retail price



VAT

Excise duty and other indirect taxes

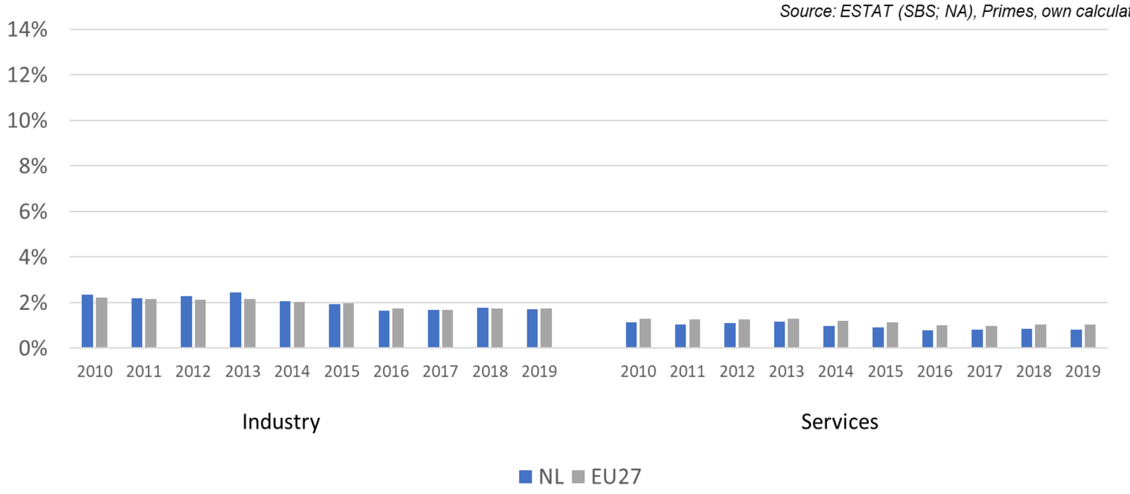
Net price

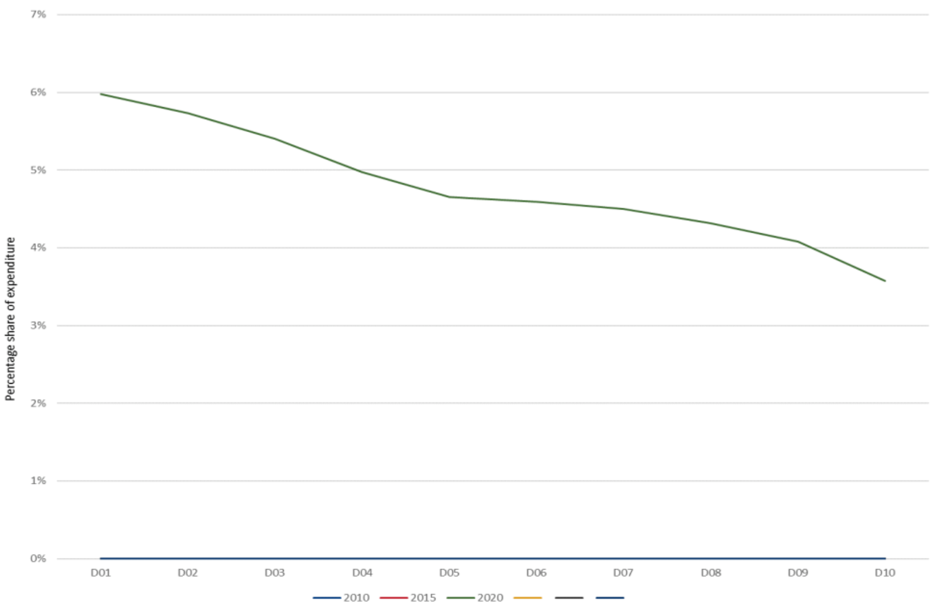
EU Average

Energy costs for households, industry and services

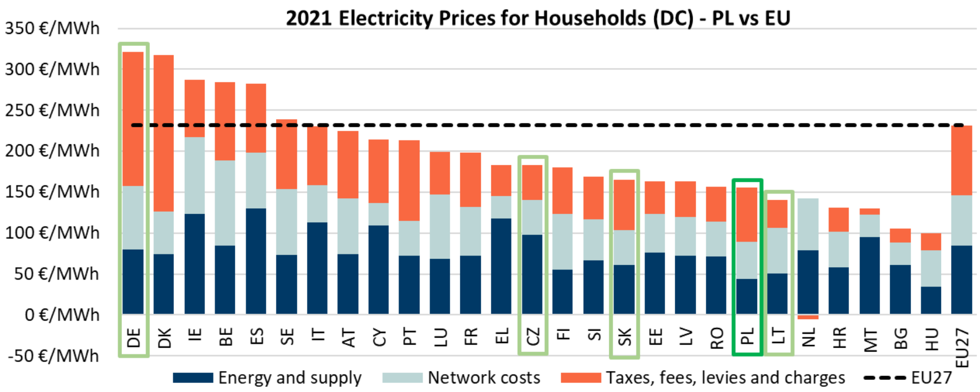
Share of energy costs in total production value in industry and services: NL vs. EU27

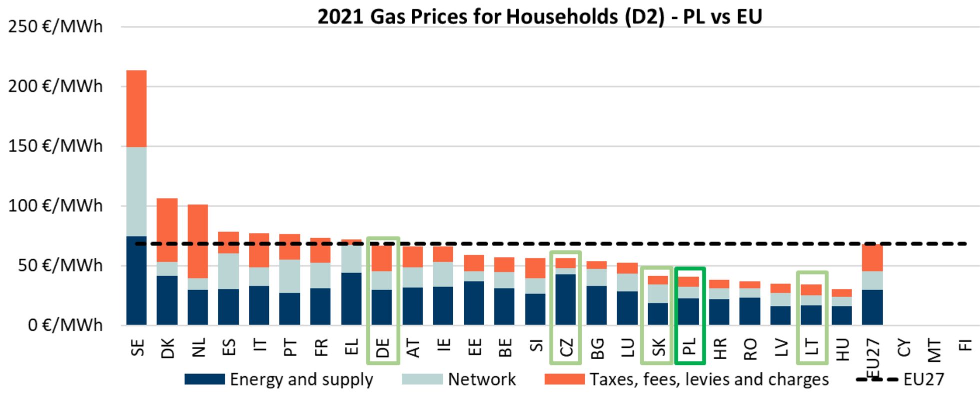
Source: ESTAT (SBS; NA), Primes, own calculations

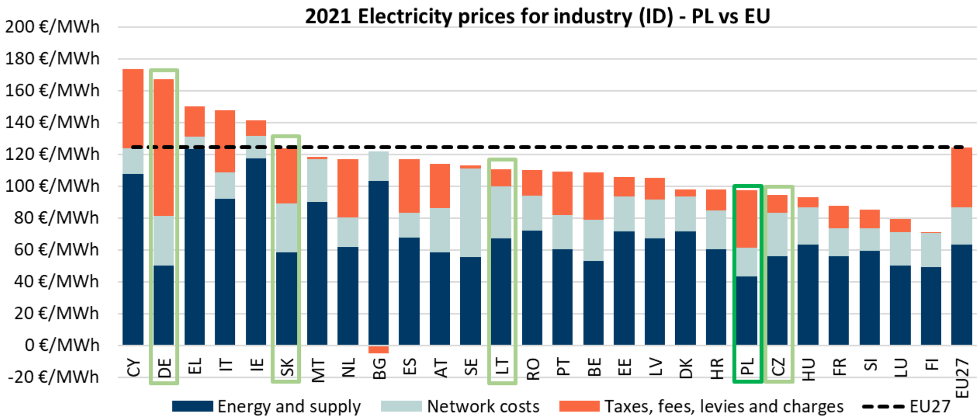


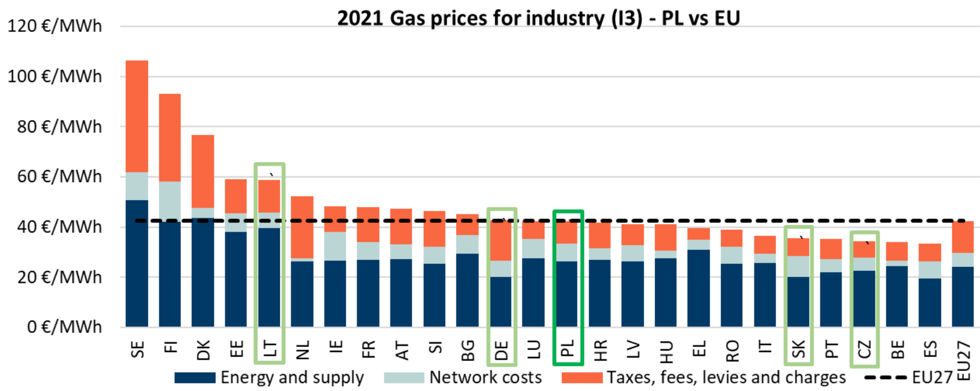


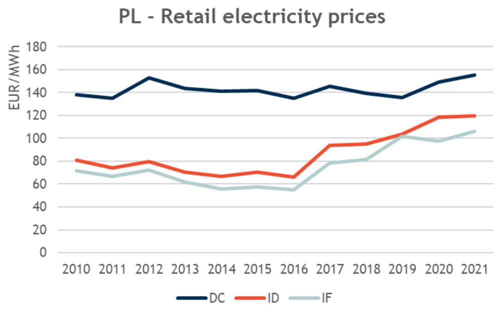
Poland

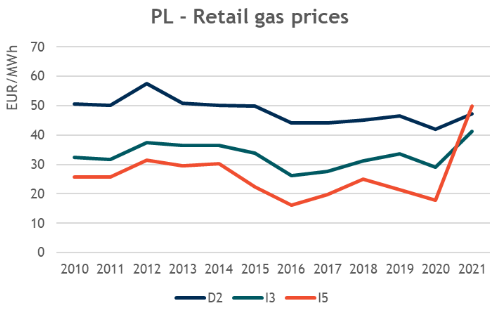

2021 Electricity Prices for Households (DC) - PL vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

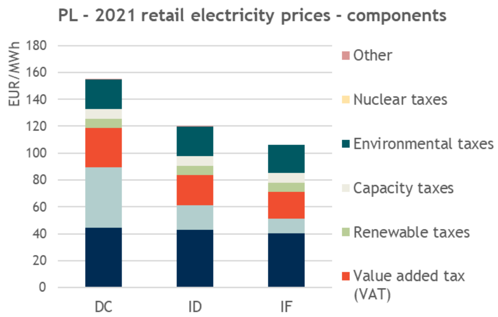

2021 Gas Prices for Households (D2) - PL vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

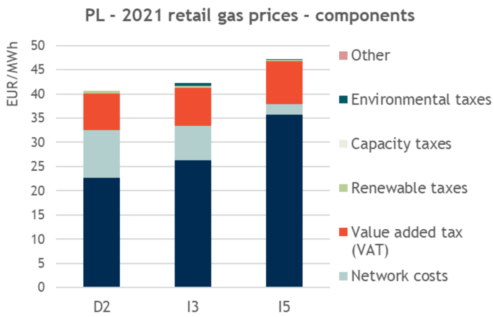

2021 Electricity prices for industry (ID) - PL vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

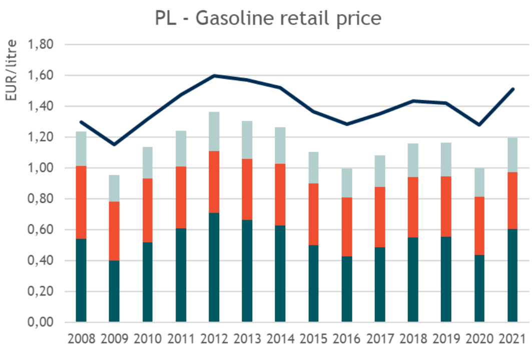

2021 Gas prices for industry (I3) - PL vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

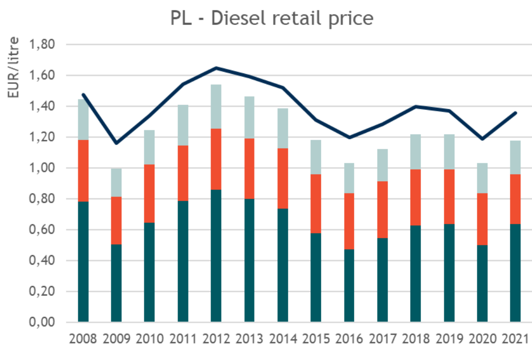

PL - Retail electricity prices
EUR/MWh
DC
ID
IF

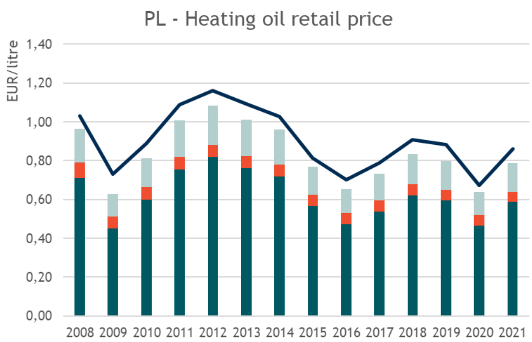

PL - Retail gas prices
EUR/MWh
D2
I3
I5

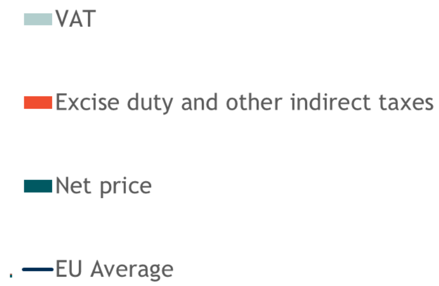

PL - 2021 retail electricity prices - components
EUR/MWh
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
DC
ID
IF


PL - 2021 retail gas prices - components
EUR/MWh
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
D2
I3
I5

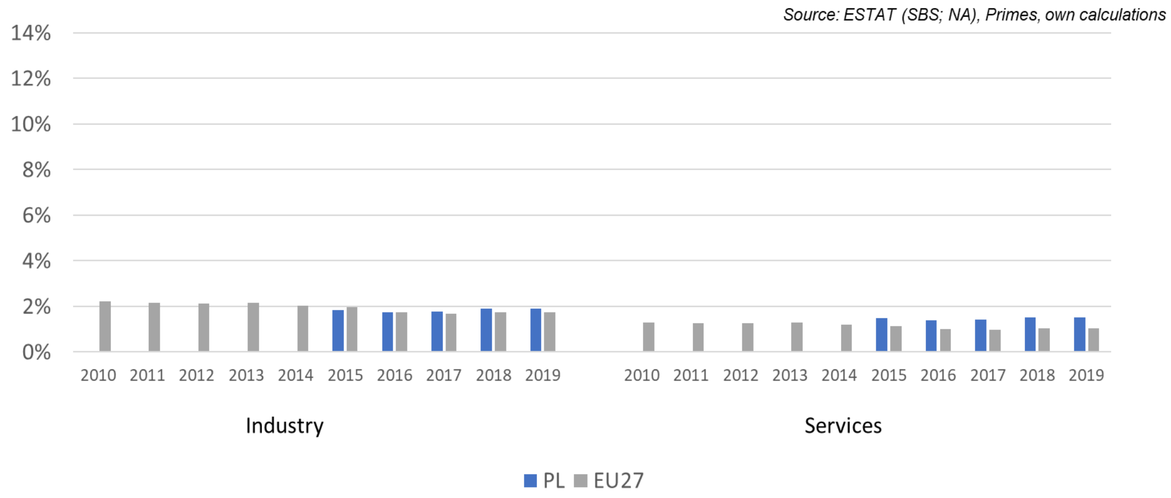

PL - Gasoline retail price
EUR/litre


PL - Diesel retail price
EUR/litre


PL - Heating oil retail price
EUR/litre

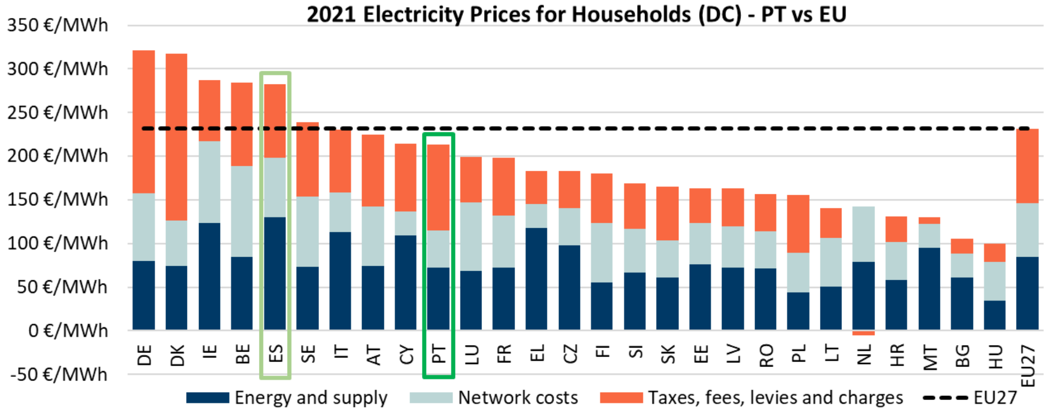

VAT
Excise duty and other indirect taxes
Net price
EU Average

Share of energy costs in total production value in industry and services: PL vs. EU27

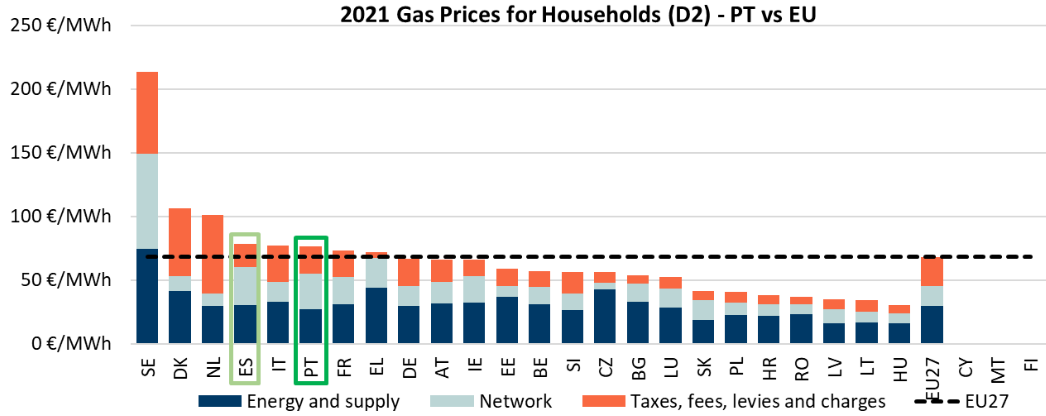


Quintile

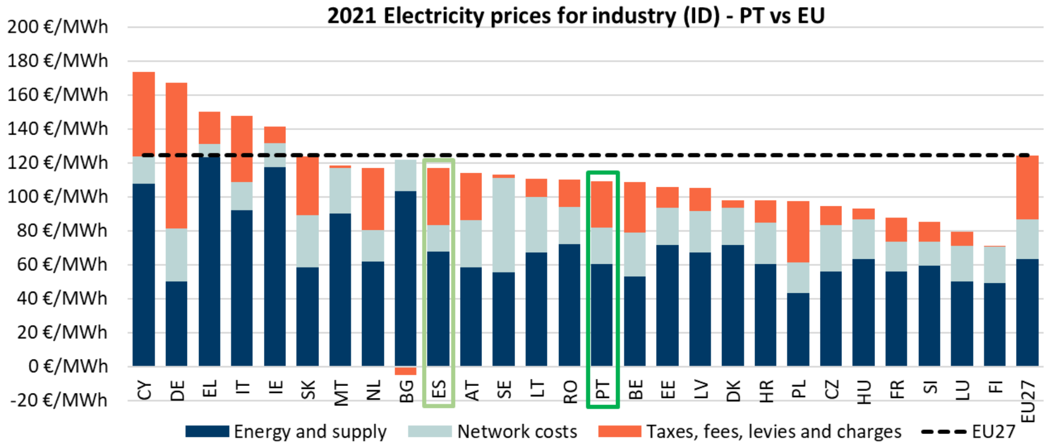
Portugal



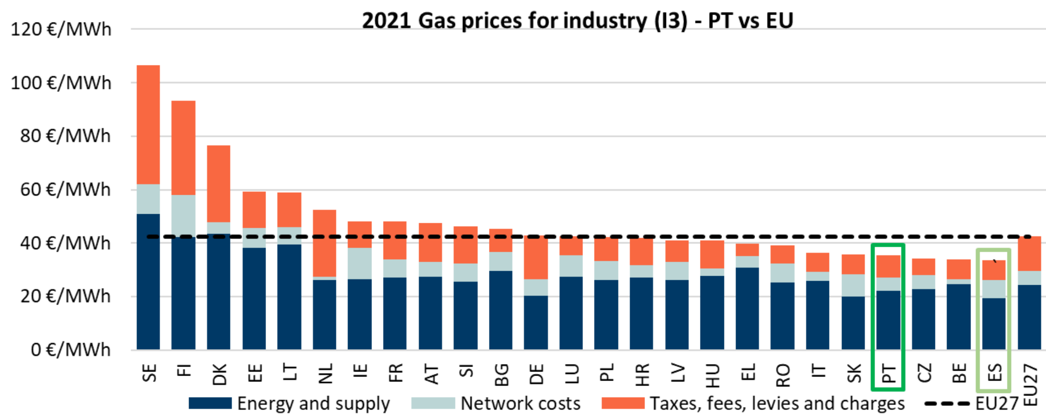
2021 Electricity Prices for Households (DC) - PT vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



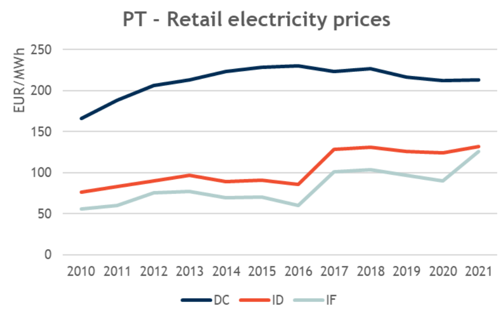
2021 Gas Prices for Households (D2) - PT vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

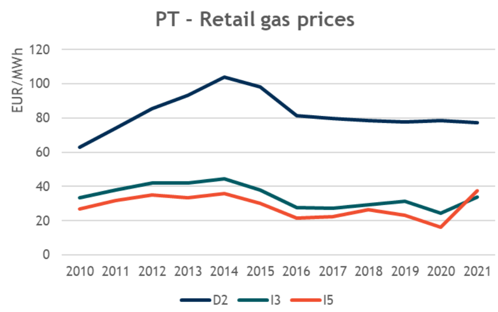


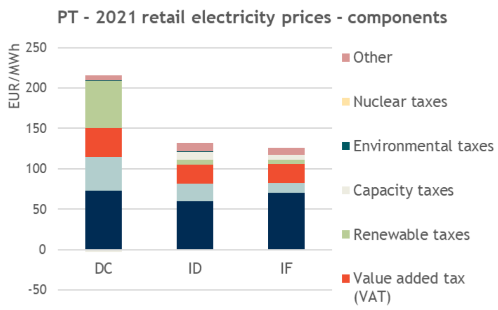
2021 Electricity prices for industry (ID) - PT vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

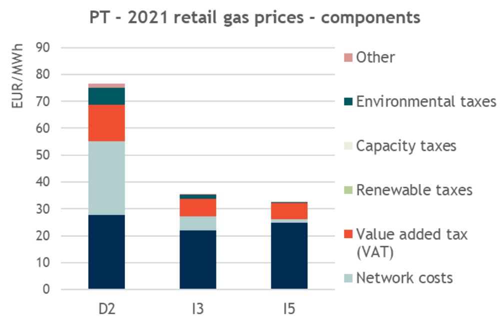


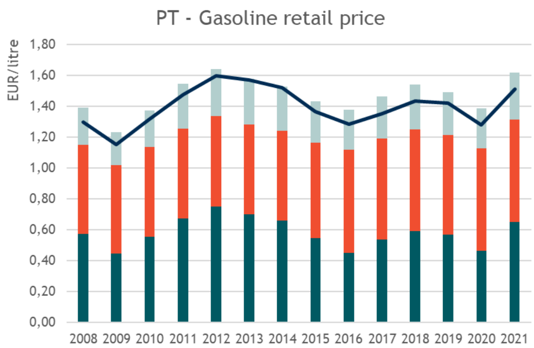
2021 Gas prices for industry (I3) - PT vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

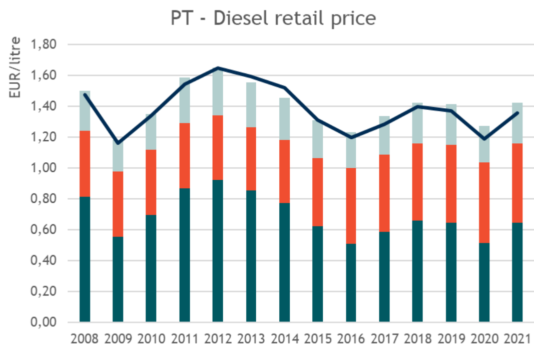


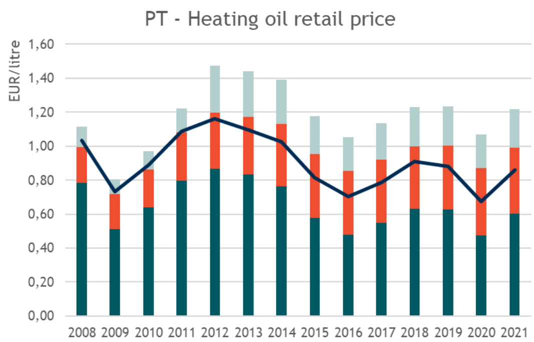


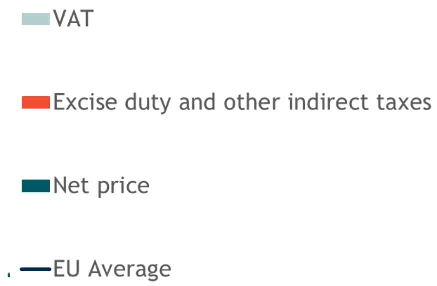






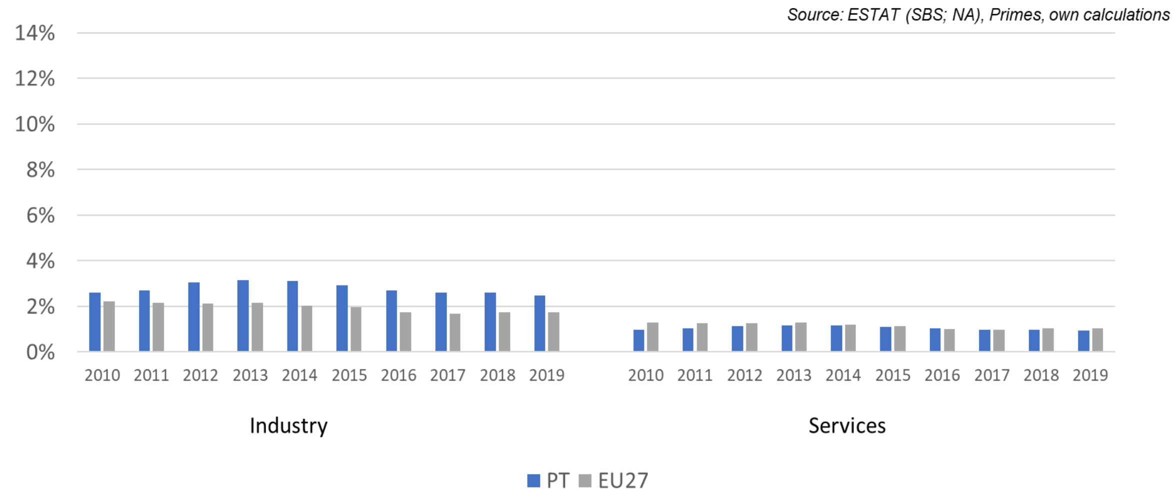


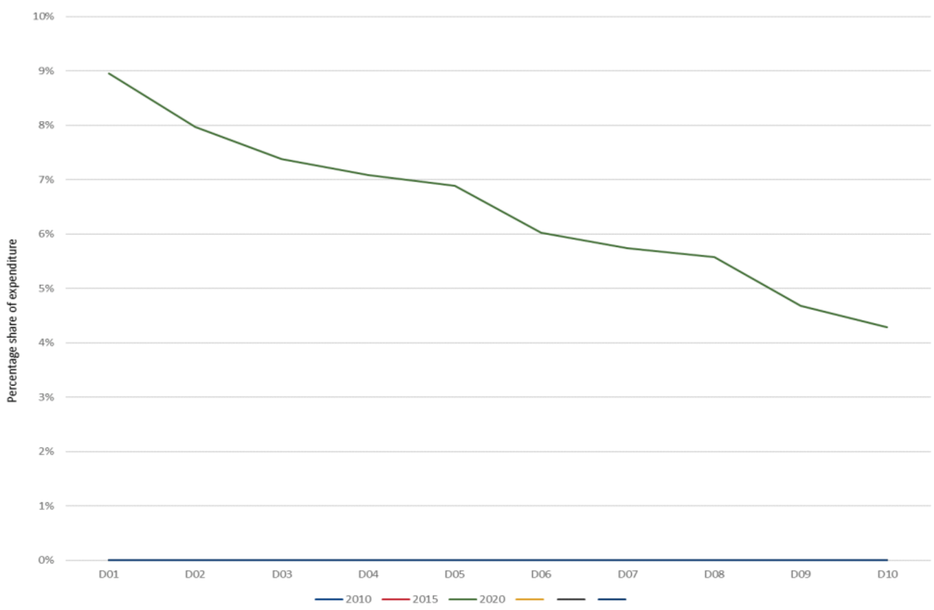




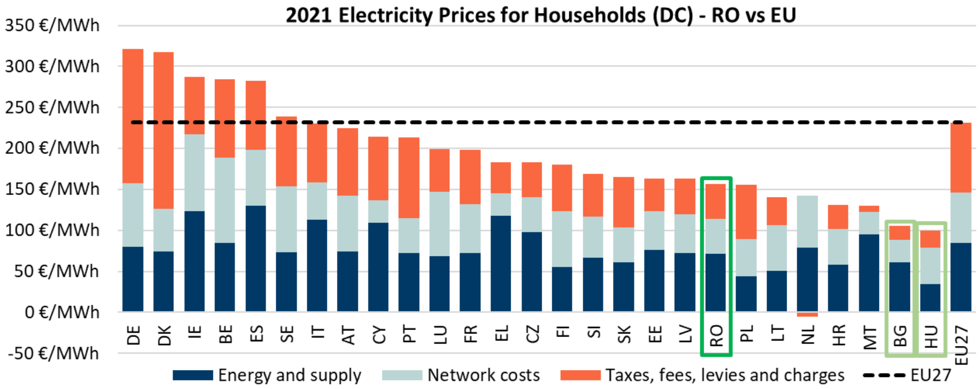
Energy costs for households, industry and services

Share of energy costs in total production value in industry and services: PT vs. EU27

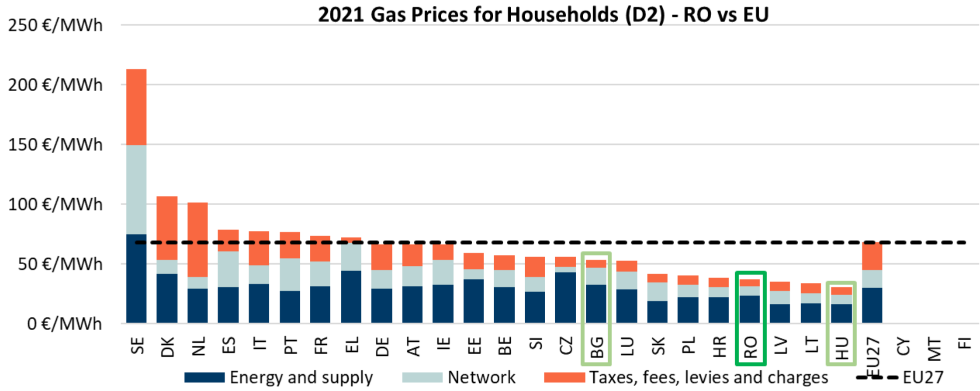




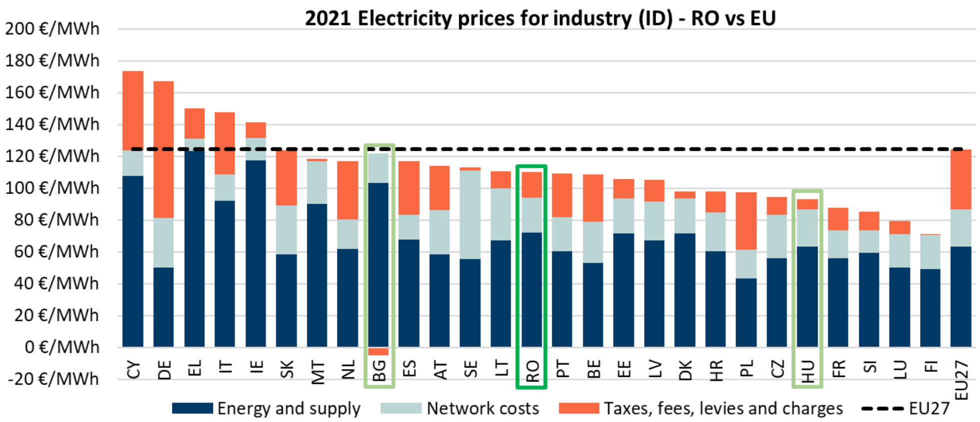
Romania



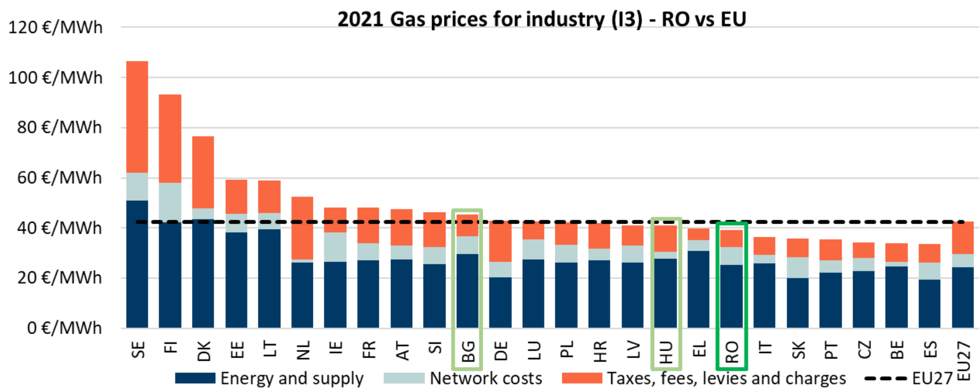
2021 Electricity Prices for Households (DC) - RO vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27



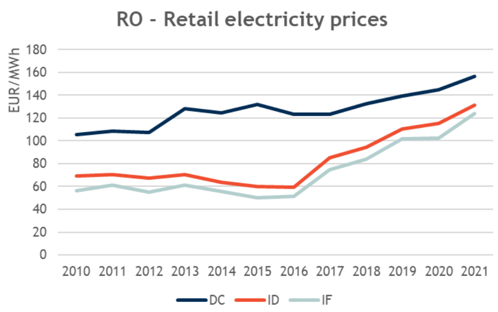
2021 Gas Prices for Households (D2) - RO vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

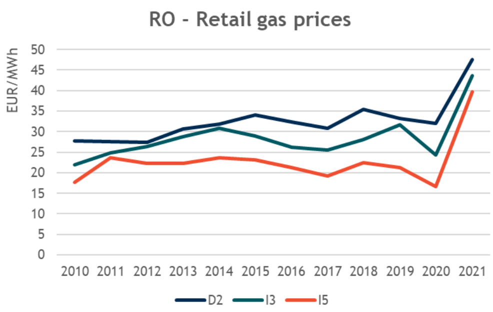


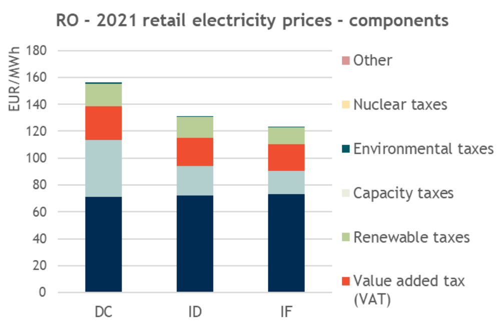
2021 Electricity prices for industry (ID) - RO vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

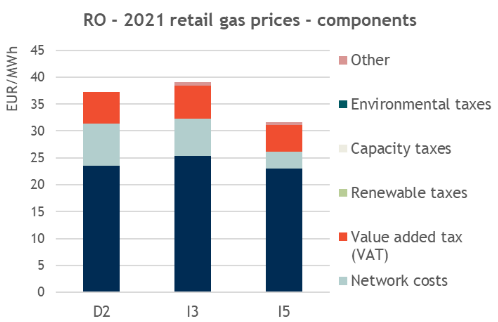


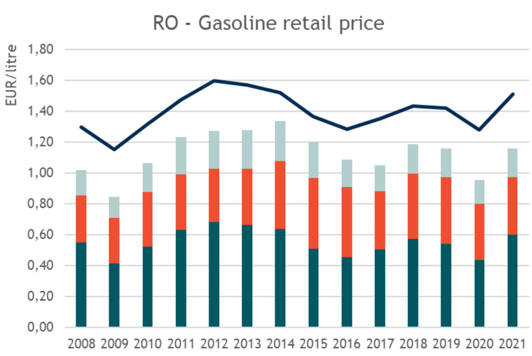
2021 Gas prices for industry (I3) - RO vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

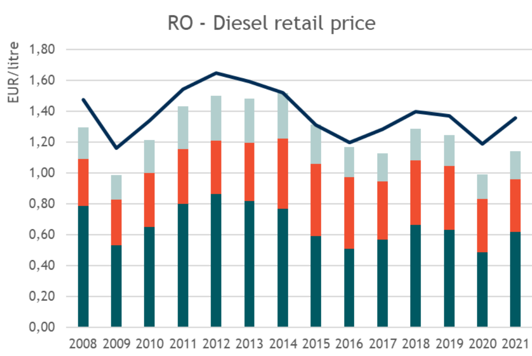


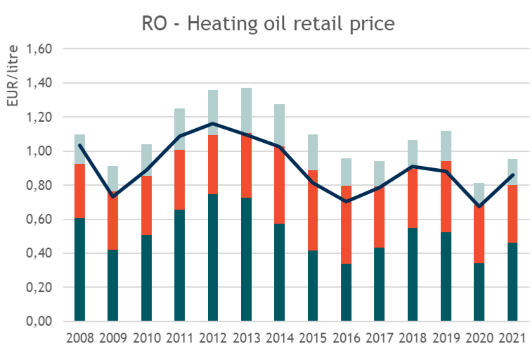


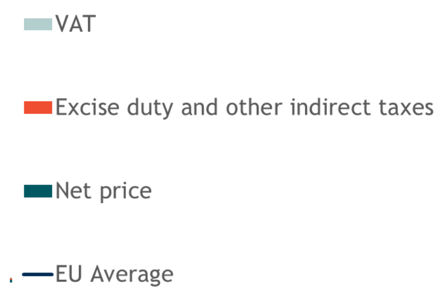








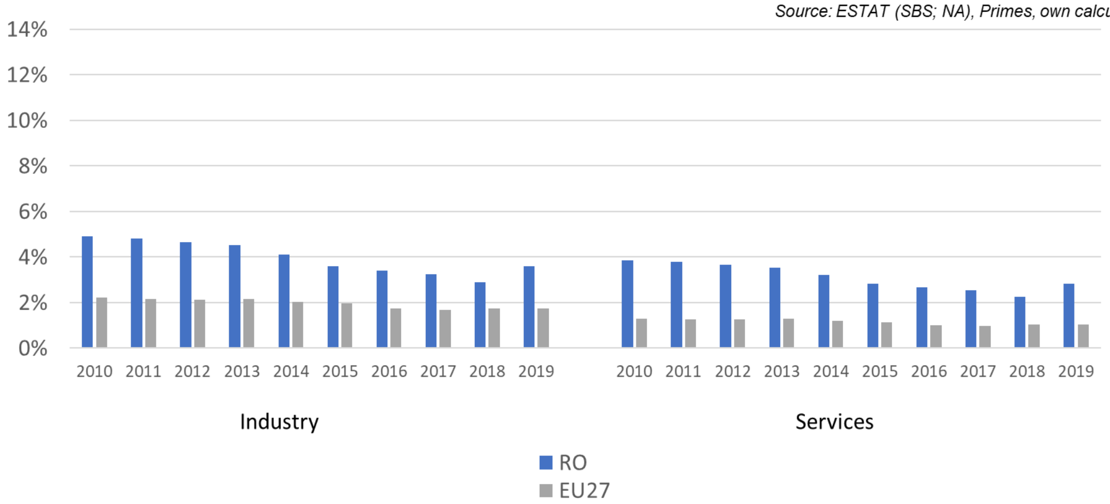


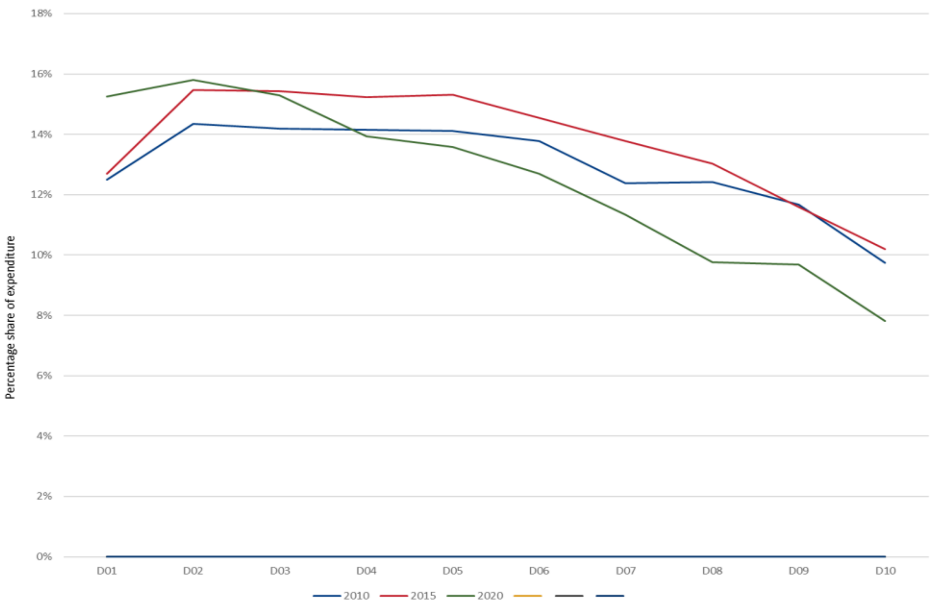


Energy costs for households, industry and services

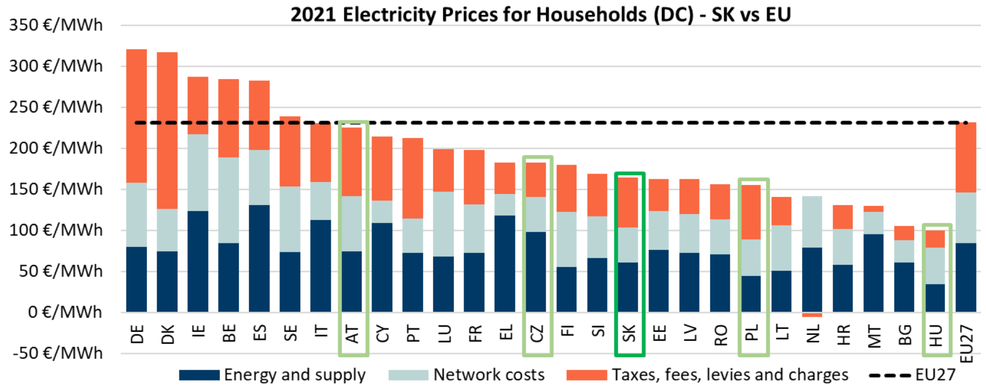
Share of energy costs in total production value in industry and services: RO vs. EU27

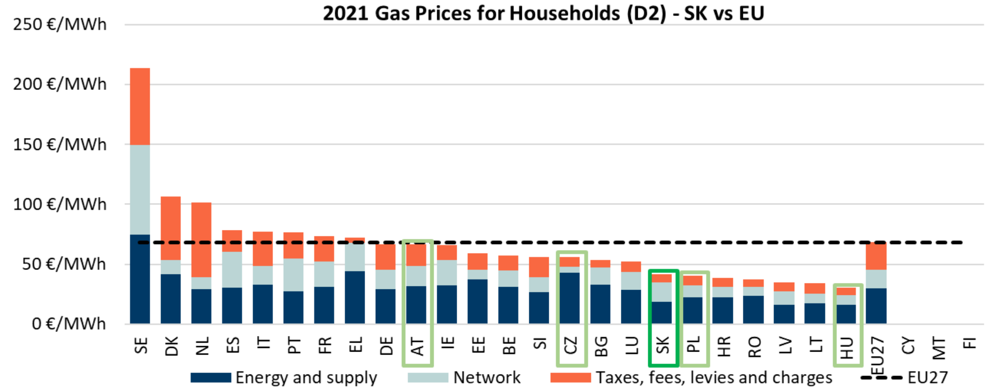
Source: ESTAT (SBS; NA), Primes, own calculations

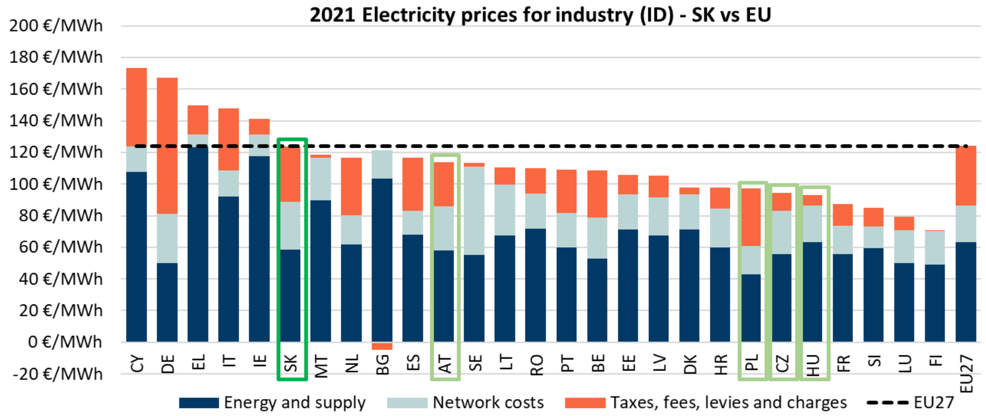


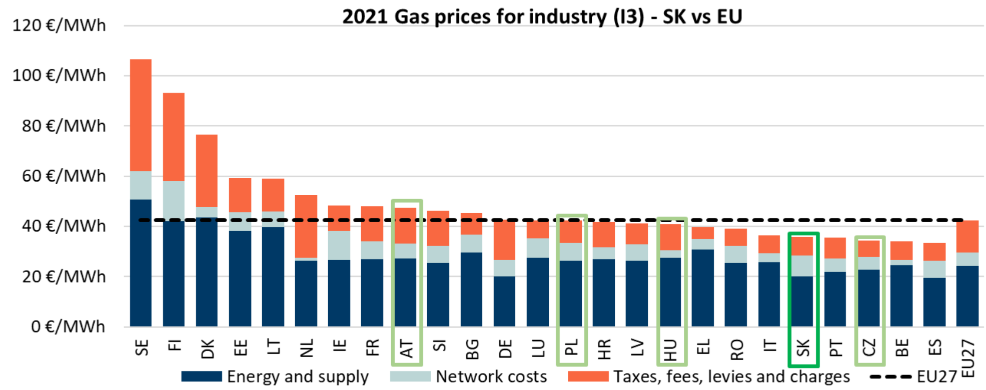


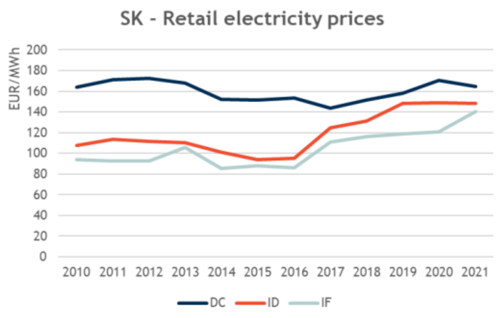
Slovakia

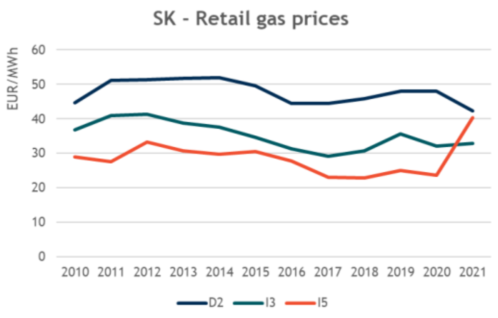

2021 Electricity Prices for Households (DC) - SK vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

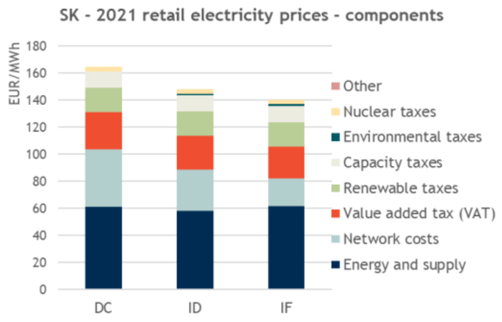

2021 Gas Prices for Households (D2) - SK vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

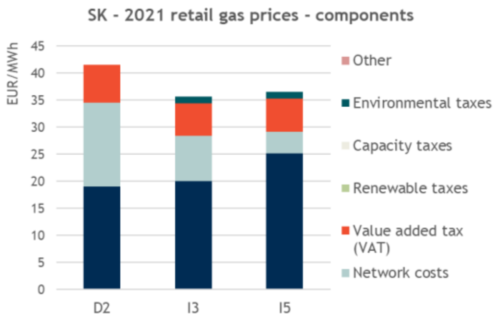

2021 Electricity prices for industry (ID) - SK vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

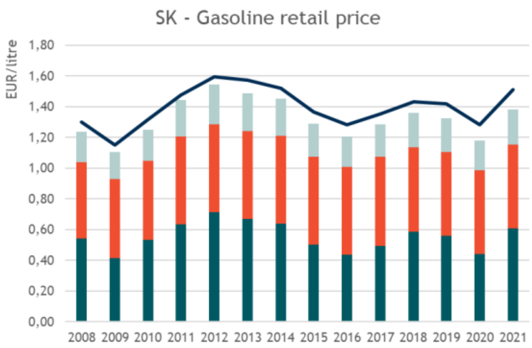

2021 Gas prices for industry (I3) - SK vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, levies and charges
EU27

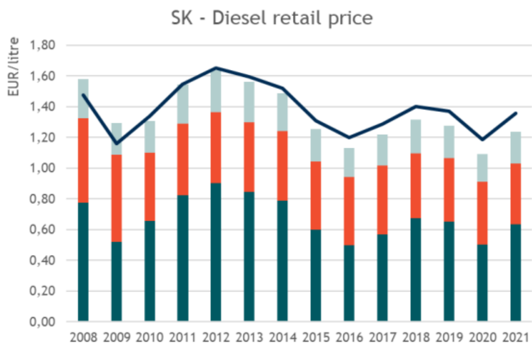


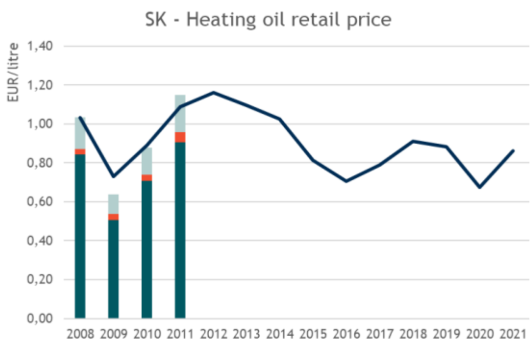


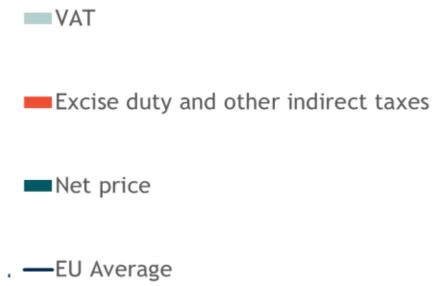






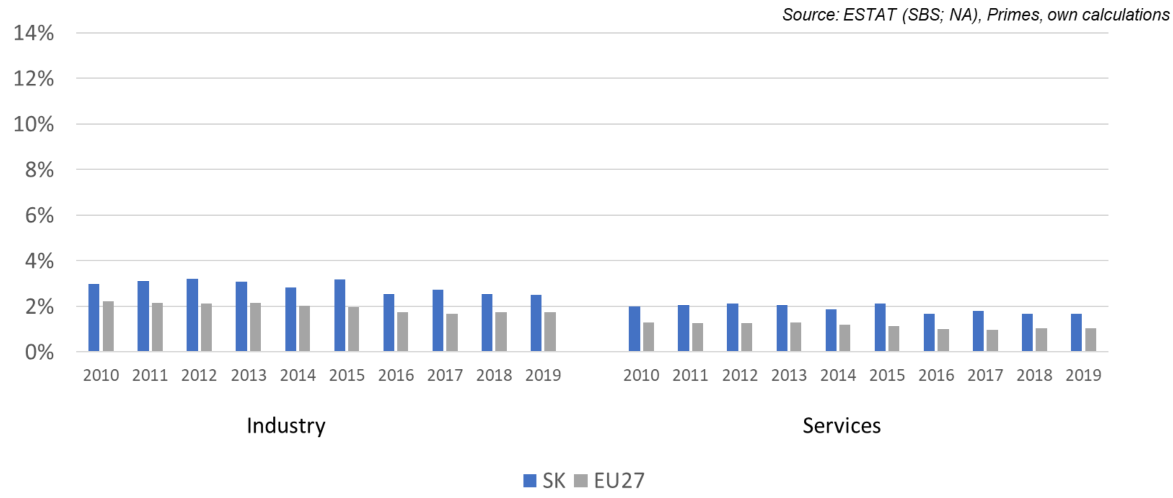


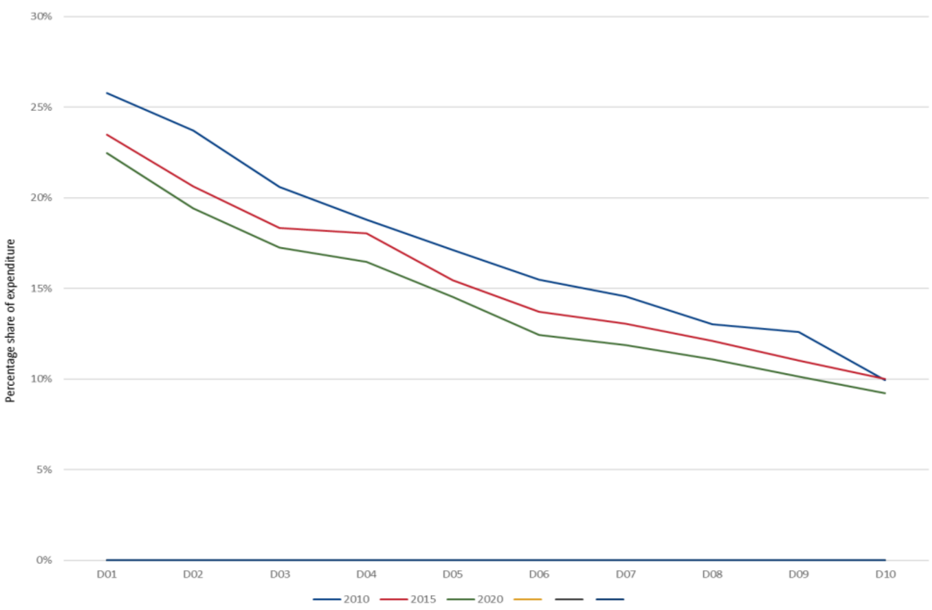




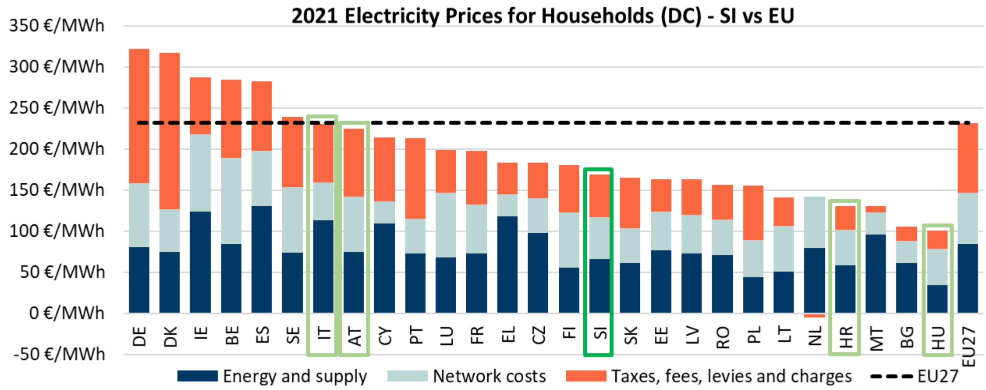
Energy costs for households, industry and services

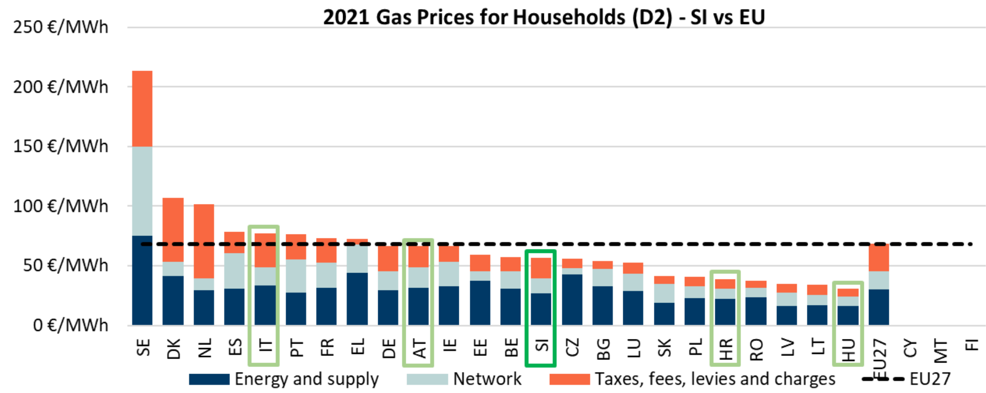
Share of energy costs in total production value in industry and services: SK vs. EU27

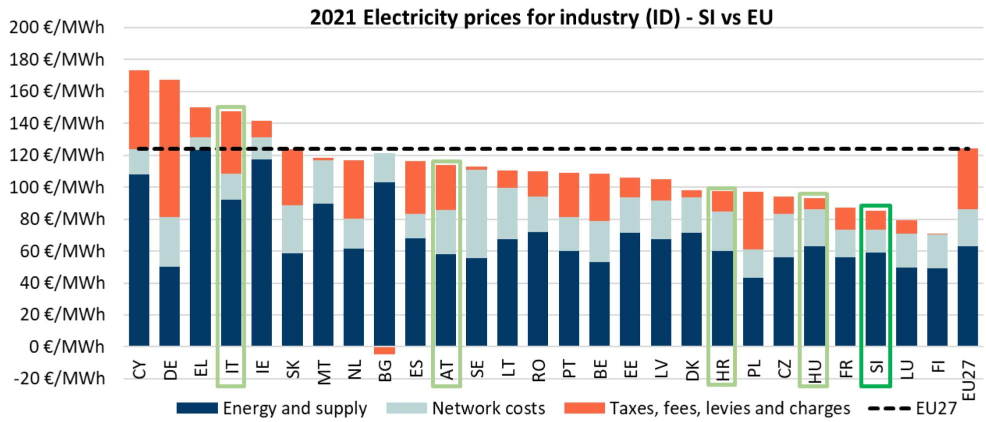


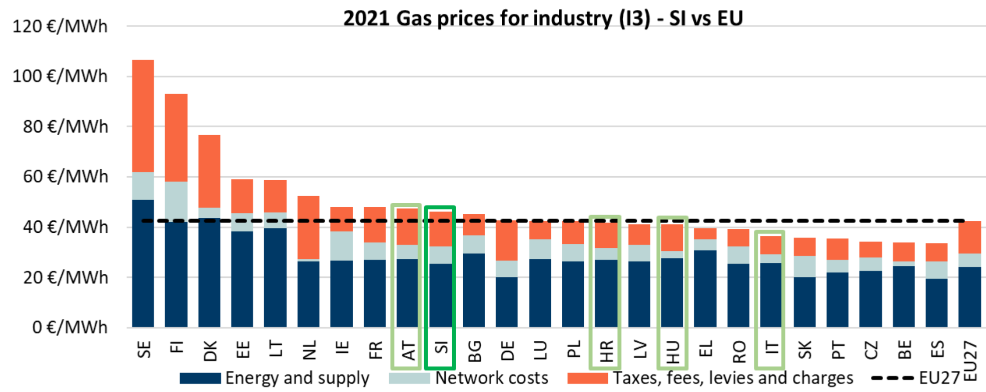


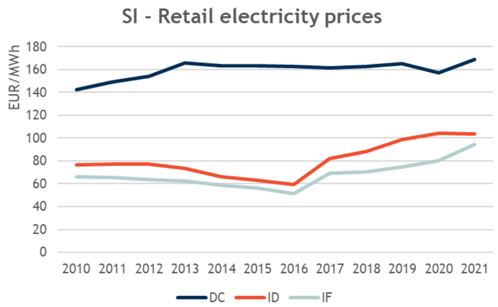
Slovenia

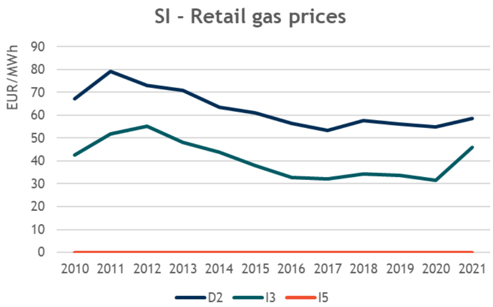

2021 Electricity Prices for Households (DC) - SI vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

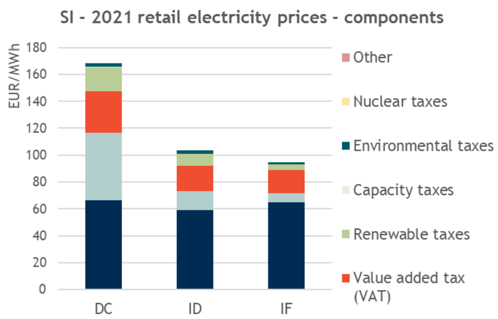

2021 Gas Prices for Households (D2) - SI vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

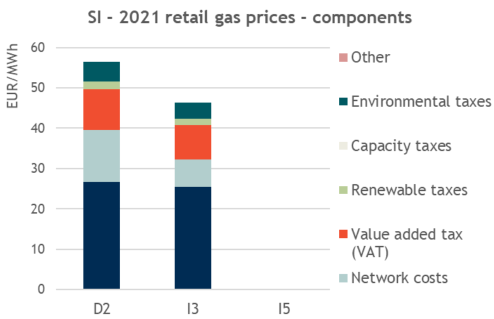

2021 Electricity prices for industry (ID) - SI vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

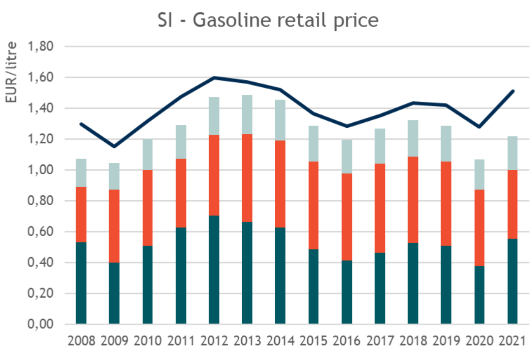

2021 Gas prices for industry (I3) - SI vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

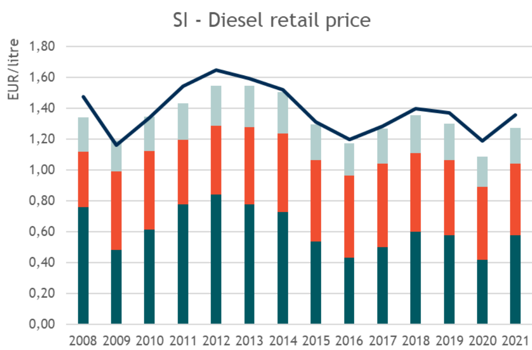


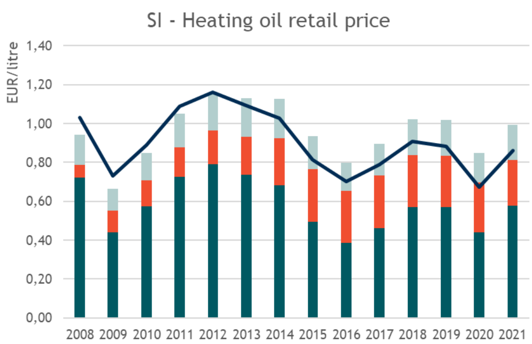


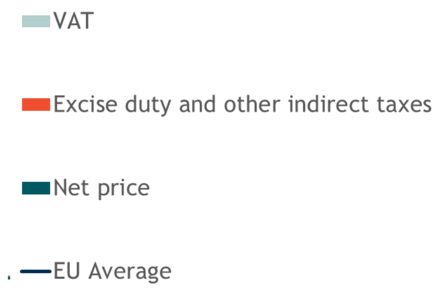






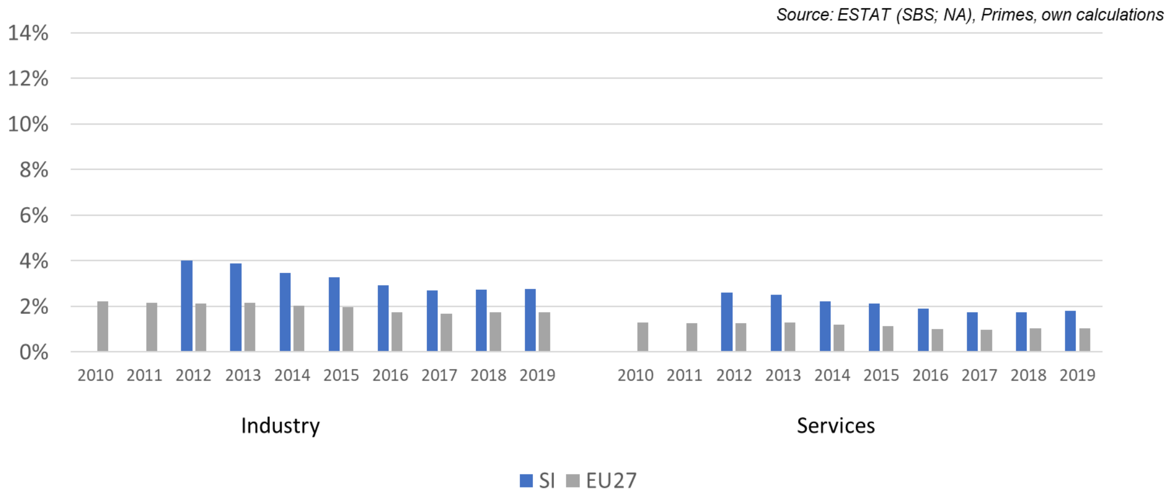




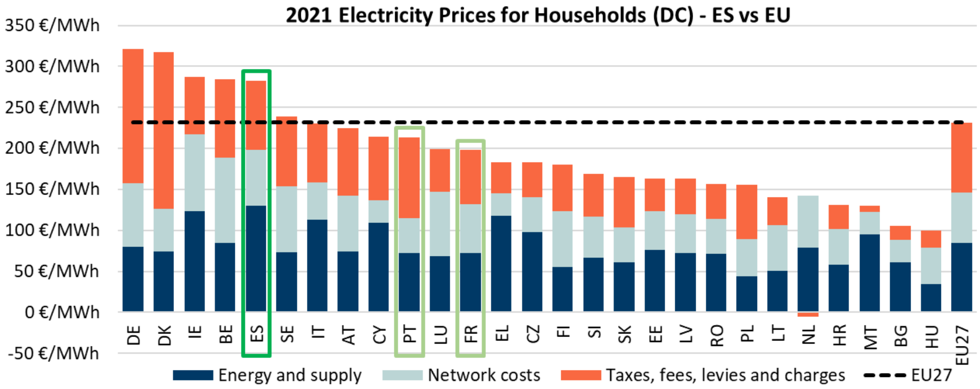


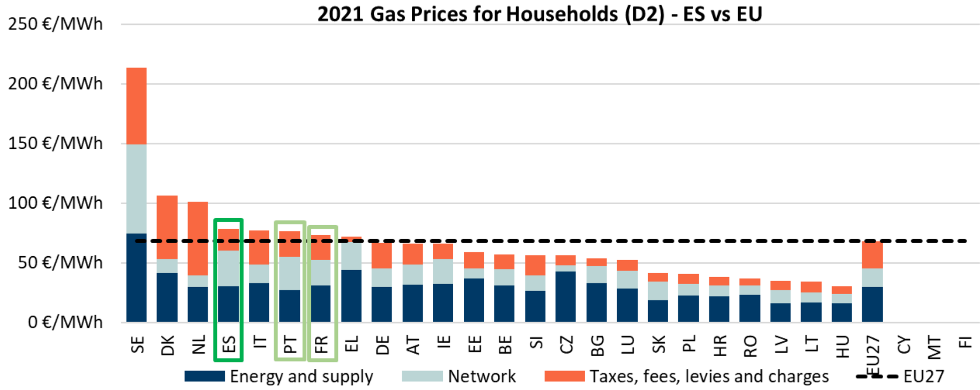
Energy costs for households, industry and services

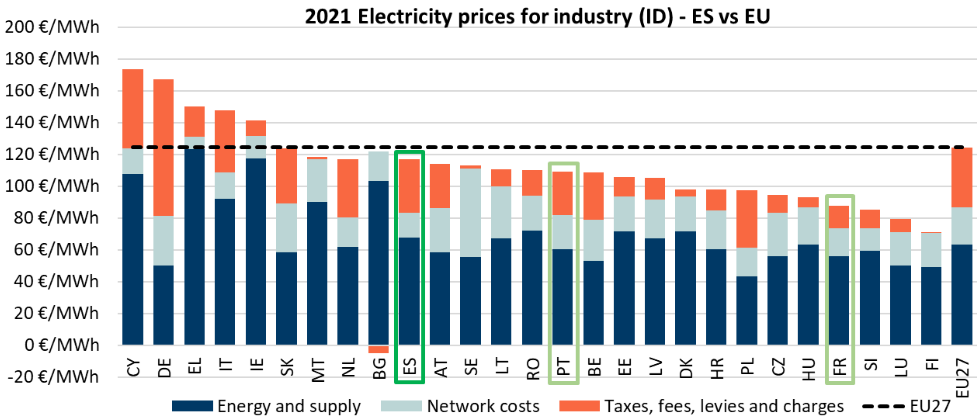
Share of energy costs in total production value in industry and services: SI vs. EU27

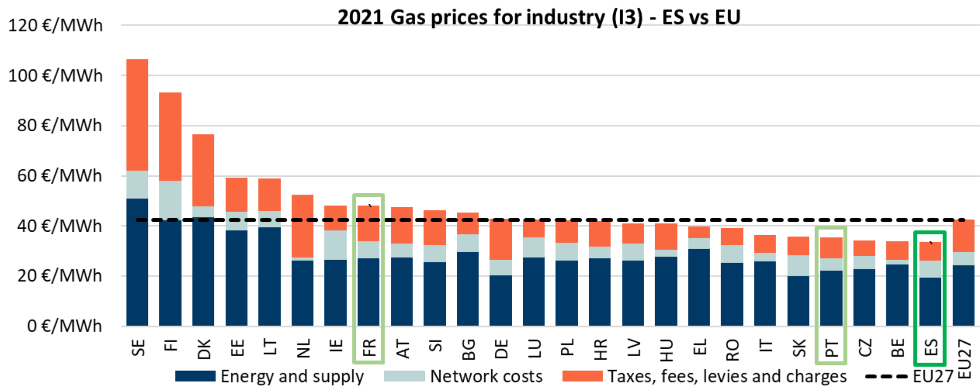


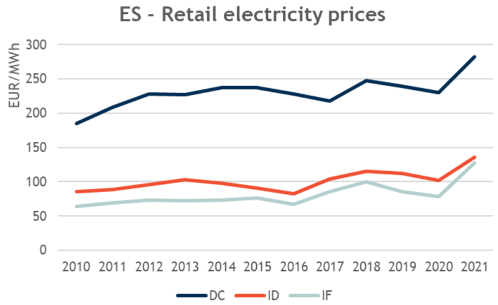
Spain

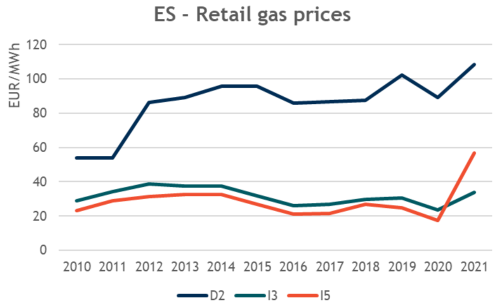

2021 Electricity Prices for Households (DC) - ES vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

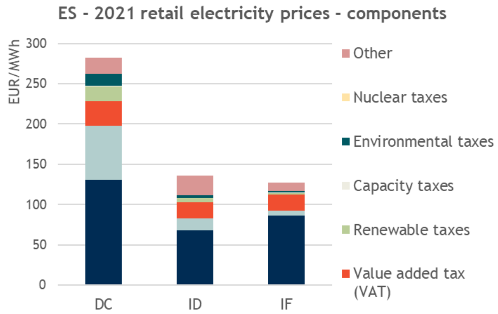

2021 Gas Prices for Households (D2) - ES vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27

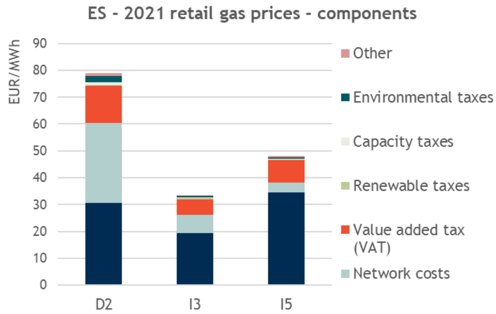

2021 Electricity prices for industry (ID) - ES vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

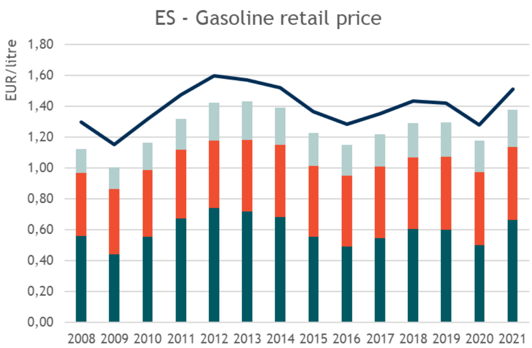

2021 Gas prices for industry (I3) - ES vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

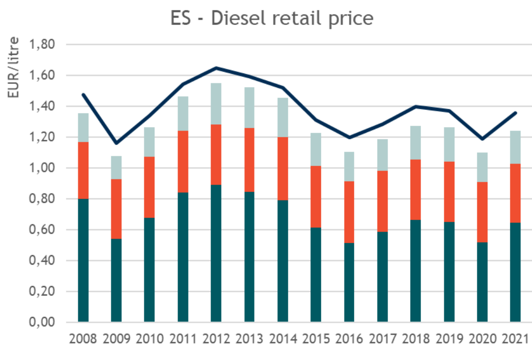

ES - Retail electricity prices
EUR/MWh
DC
ID
IF

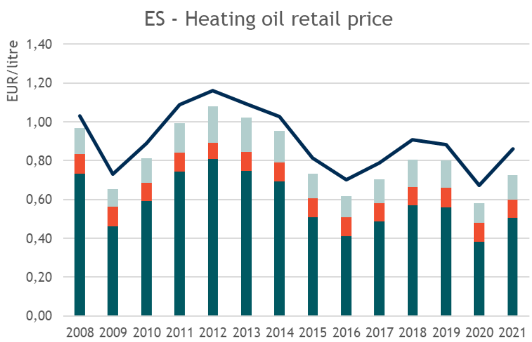

ES - Retail gas prices
EUR/MWh
D2
I3
I5

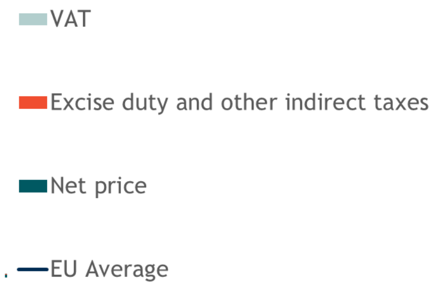

ES - 2021 retail electricity prices - components
EUR/MWh
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
DC
ID
IF


ES - 2021 retail gas prices - components
EUR/MWh
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs
D2
I3
I5

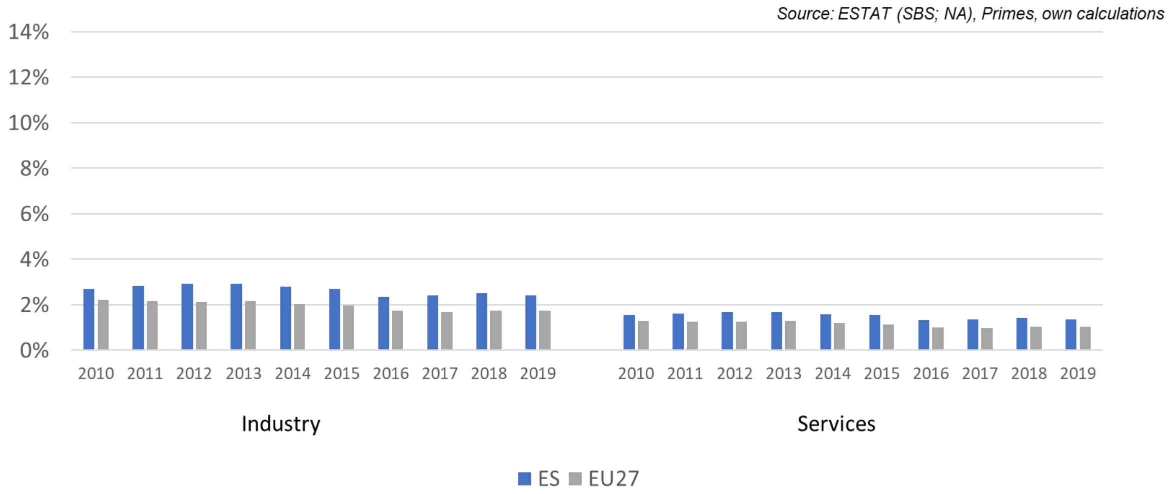

ES - Gasoline retail price
EUR/litre

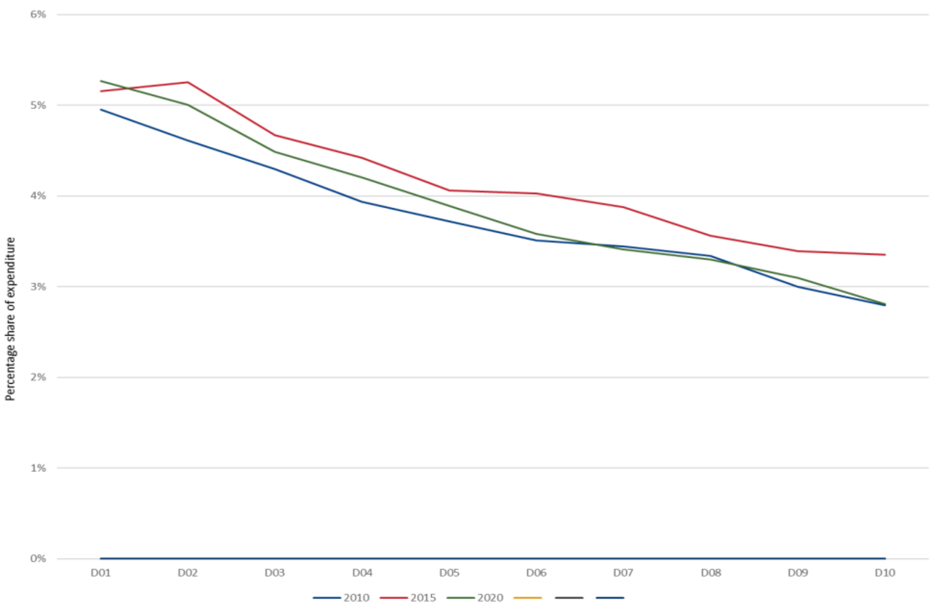

ES - Diesel retail price
EUR/litre


ES - Heating oil retail price
EUR/litre

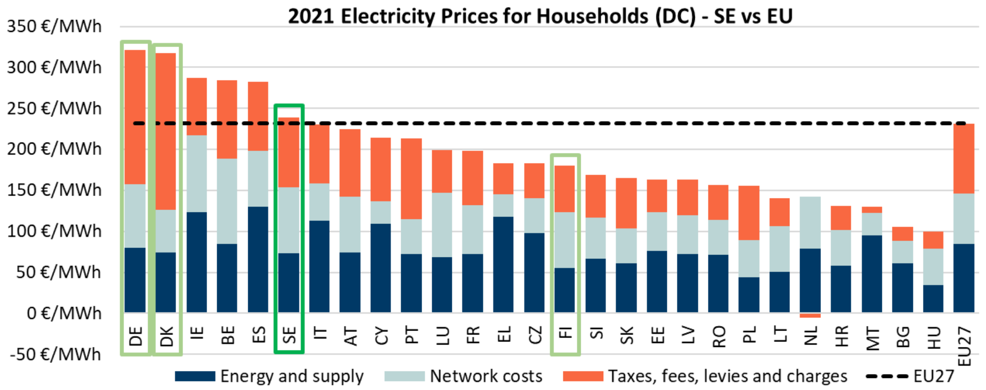

VAT
Excise duty and other indirect taxes
Net price
EU Average

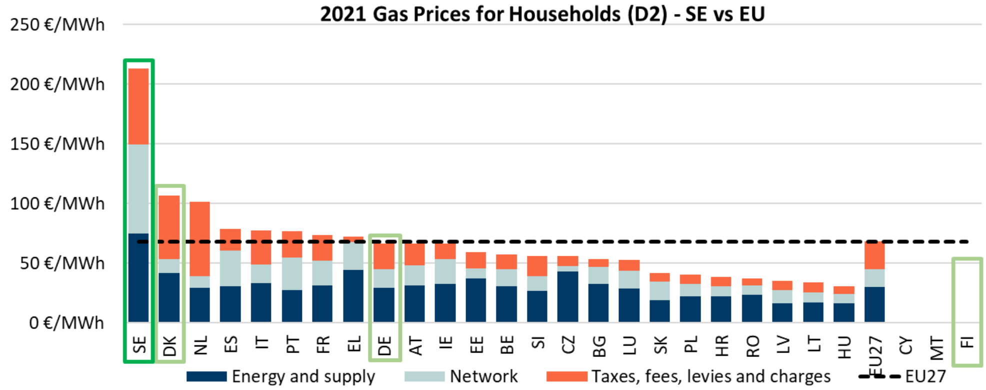
Share of energy costs in total production value in industry and services: ES vs. EU27

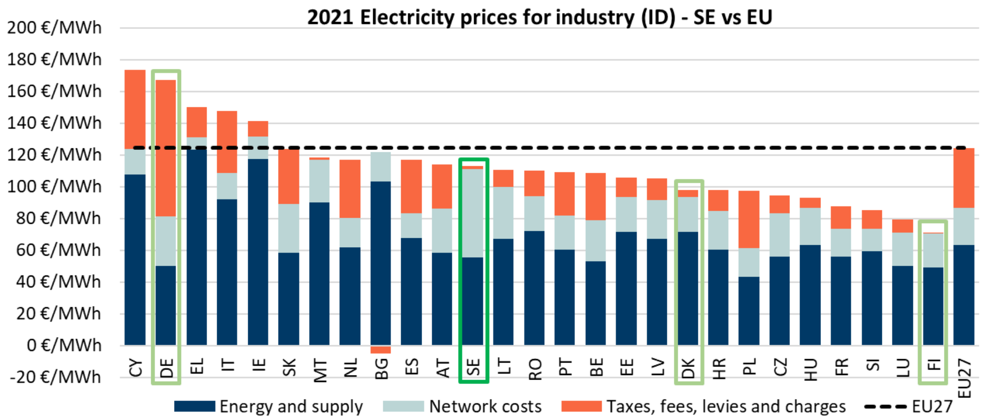




Sweden


2021 Electricity Prices for Households (DC) - SE vs EU
350 €/MWh
300 €/MWh
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
-50 €/MWh
DE DK IE BE ES SE IT AT CY PT LU FR EL CZ FI SI SK EE LV RO PL LT NL HR MT BG HU EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27


2021 Gas Prices for Households (D2) - SE vs EU
250 €/MWh
200 €/MWh
150 €/MWh
100 €/MWh
50 €/MWh
0 €/MWh
SE DK NL ES IT PT FR EL DE AT IE EE BE SI CZ BG LU SK PL HR RO LV LT HU EU27 CY MT FI
Energy and supply
Network
Taxes, fees, levies and charges
EU27


2021 Electricity prices for industry (ID) - SE vs EU
200 €/MWh
180 €/MWh
160 €/MWh
140 €/MWh
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
-20 €/MWh
CY DE EL IT IE SK MT NL BG ES AT SE LT RO PT BE EE LV DK HR PL CZ HU FR SI LU FI EU27
Energy and supply
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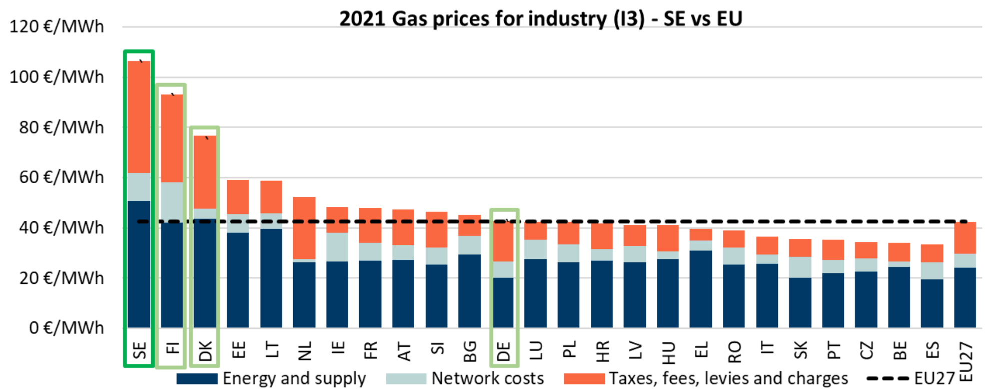
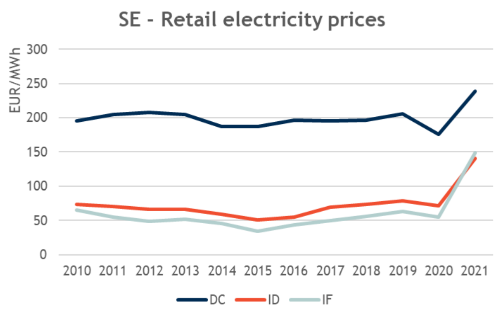
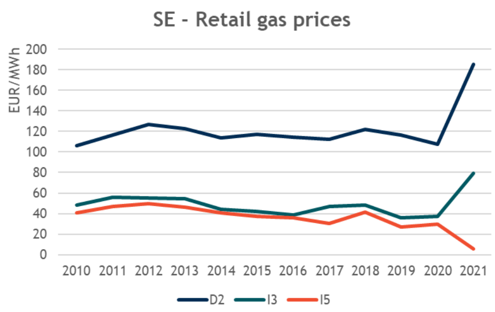
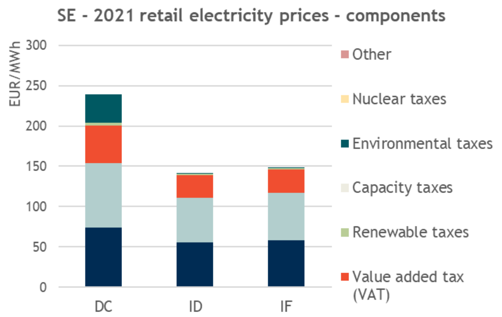
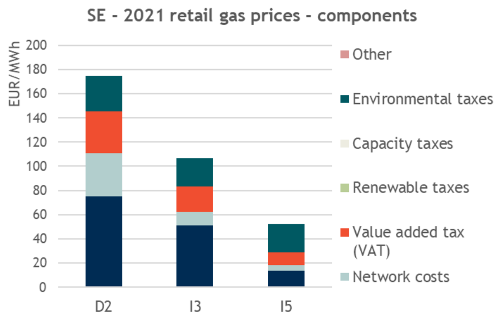
EU27

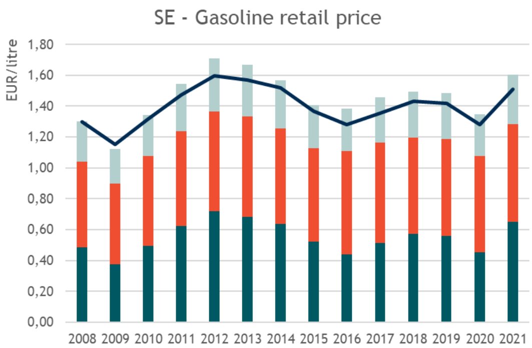

2021 Gas prices for industry (I3) - SE vs EU
120 €/MWh
100 €/MWh
80 €/MWh
60 €/MWh
40 €/MWh
20 €/MWh
0 €/MWh
SE FI DK EE LT NL IE FR AT SI BG DE LU PL HR LV HU EL RO IT SK PT CZ BE ES EU27
Energy and supply
Network costs
Taxes, fees, levies and charges
EU27

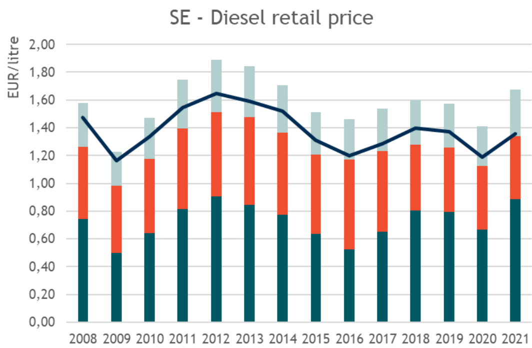

SE - Retail electricity prices
EUR/MWh
300
250
200
150
100
50
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
DC
ID
IF

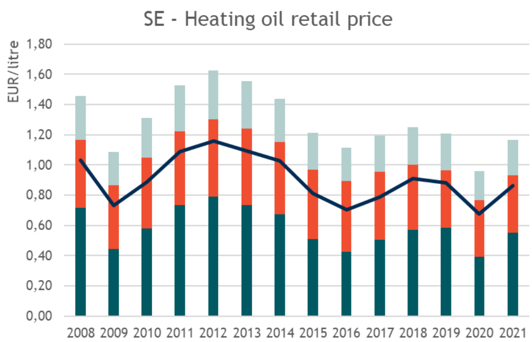

SE - Retail gas prices
EUR/MWh
200
180
160
140
120
100
80
60
40
20
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
D2
I3
I5

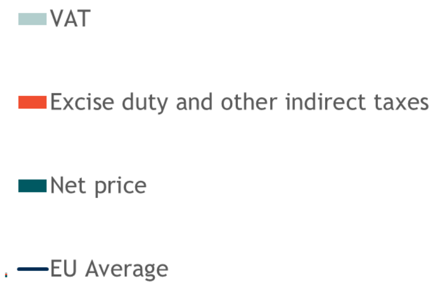

SE - 2021 retail electricity prices - components
EUR/MWh
300
250
200
150
100
50
0
DC
ID
IF
Other
Nuclear taxes
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)


SE - 2021 retail gas prices - components
EUR/MWh
200
180
160
140
120
100
80
60
40
20
0
D2
I3
I5
Other
Environmental taxes
Capacity taxes
Renewable taxes
Value added tax (VAT)
Network costs

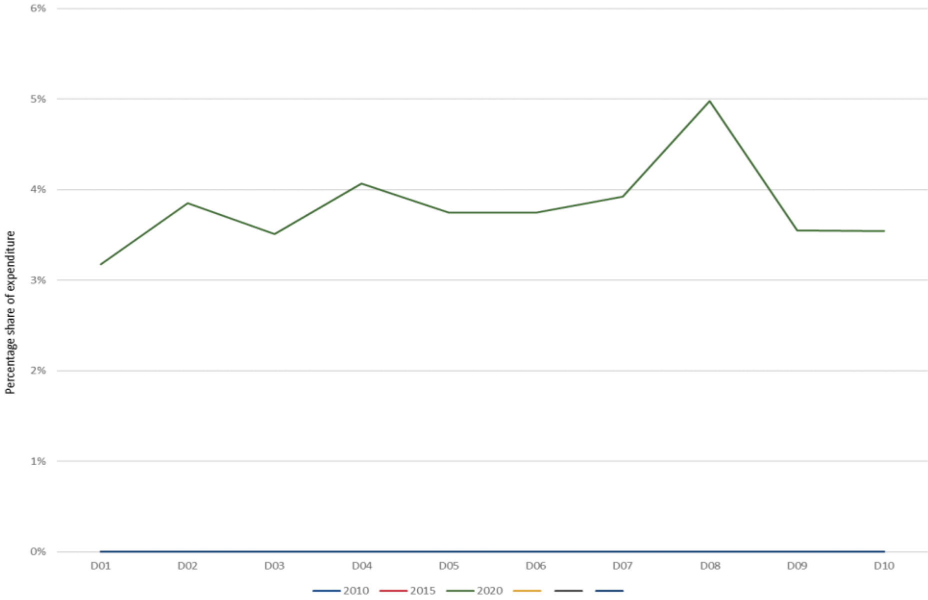

SE - Gasoline retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


SE - Diesel retail price
EUR/litre
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

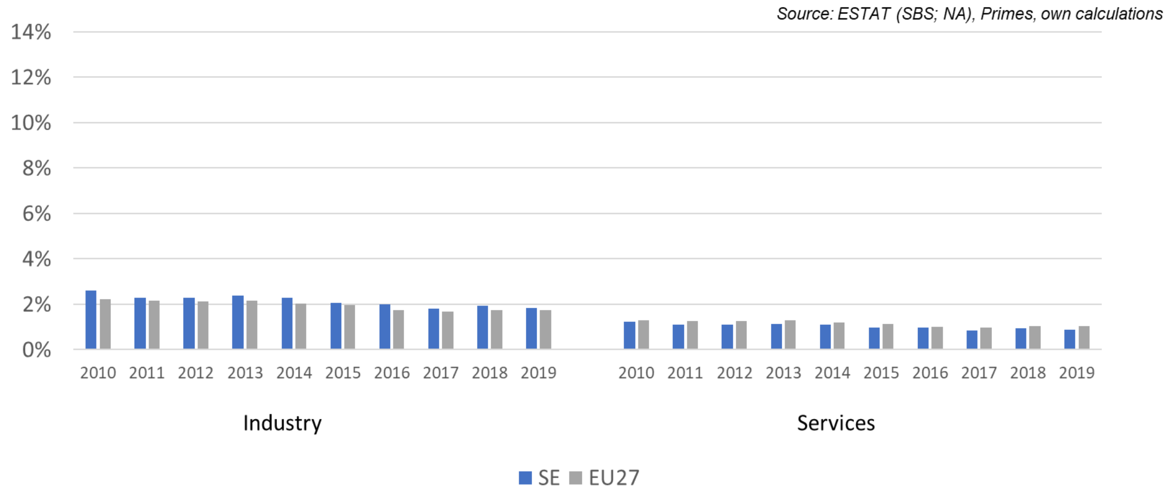

SE - Heating oil retail price
EUR/litre
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


VAT
Excise duty and other indirect taxes
Net price
EU Average

Energy costs for households, industry and services



Share of energy costs in total production value in industry and services: SE vs. EU27



Annex B Selected energy intensive industries

B.1 Aluminium

B.1.1 Introduction

This report has been developed in consultation with the industry association European Aluminium.[1]

Characteristics of the product

The main features of Aluminium are that it is:

- Corrosion free and durable: Aluminium develops a natural oxide layer, protecting it against corrosion and making it virtually maintenance free.
- Light yet strong: Despite its relatively low weight, aluminium has a remarkable strength to weight ratio. As an alloy, aluminium offers similar performance to advanced steels and titanium.
- Highly versatile: Aluminium is light; has a low melting point and is highly ductile. This makes it easy to work with, shape and join adding to its versatility.
- Indefinitely recyclable, with no loss of properties.

Main areas of usage

The main areas of usage for aluminium are:

- Transport (40% of the sector's output): for the light weighting of cars, buses, lorries, trains, trams and ships, leading to better energy efficiency (specifically in usage scenarios of frequent stops and goes) and as the main structural component of air- and spacecraft;
- Construction (25% of the sector's output): for the light weighting of structures, window frames, sun shading devices, fire-proof cladding, protection of insulation materials against rain;
- Packaging (17% of the sector's output): mostly for beverage cans, but with an additional variety of semi-rigid and flexible packaging;
- Consumer goods, such as cooking utensils, electronic devices and bicycles.

NACE codes

The manufacture of aluminium is classified under the following NACE rev.2 code: 24.42 Aluminium production. This includes primary and secondary aluminium production, and semi-manufactured aluminium products.

Stages in the production process

The production processes of aluminium follow the following pattern:

- **Alumina production (aluminium refining):** Pure aluminium oxide, called alumina, is extracted from the ore (called bauxite) via a process called refining, composed of two steps: a digestion process, using caustic soda, which allows the separation of aluminium hydroxide from the so-called "bauxite residue", followed by a calcination step which removes the water content in the hydroxide;
- **Primary aluminium production:** Molten aluminium is extracted from the alumina through the Hall–Héroult electrochemical smelting process, which breaks the strong chemical bond of the aluminium and oxygen atoms using a powerful electric current. This process requires temperatures in excess of 950°C, and a high intensity electrical current. Once the liquid metal is collected it is transferred in the **casthouse**, where it is purified, alloyed to specification and then cast into ingots (also referred to as 'unwrought aluminium').

[1] European Aluminium (2022). Aluminium, the base metal for the green transition. Available at: https://www.european-aluminium.eu/

- **Secondary aluminium production:** aluminium can be recycled by refining or remelting aluminium-bearing scrap and/or aluminium-bearing materials. This process requires a melting furnace operating at temperatures ranging from 700°C to 760°C, mostly using natural gas.[2]
- **Downstream activities:** The unwrought aluminium from primary and secondary aluminium is cast into ingots and used in the production of aluminium alloys.
  - **Flat-rolling:** Aluminium can be rolled into sheets from which aluminium foil and beverage cans are made, as well as parts of car bodies and a vast array or other products.
  - **Extrusion:** Using the forming process of extrusion, the aluminium is shaped in its required form.

Where possible, findings are described per production stage as they have distinct different cost structures and energy intensities.

B.1.2 *Economic situation of the sector*

Geographical distribution

The value chain of aluminium production in the EU is composed by around 600 plants that range from refiners of alumina, primary aluminium producers, producers of rolled and extruded products, and recycling. The majority of these plants produce semi-finished products based on rolling and extrusion operations (see Figure 1 below).

- **Refiners**: There are 5 operational alumina refiners in the EU27. Each is located in a different Member State: Spain, Greece, Ireland, Germany and Romania[3].
- **Primary aluminium:** The number of active aluminium smelters in the EU27 has been decreasing from 26 plants in 2002, down to 12 plants in 2021, located across eight countries: France, Germany, Greece, The Netherlands, Romania, Slovakia, Slovenia and Sweden.[4] There have also been recent announcements of European smelters stopping or cutting down their production output.[5]
- **Secondary aluminium (Recycling):** There are 214 secondary aluminium plants located in the EU. In both the remelter and refiner industries, there are a limited number of smaller and large players.
- **Downstream:** There are 59 rolling mills and 309 extruders in Europe. Germany, Italy and France are the largest producers of semi-finished products in the EU, representing about 62% of the EU's total production in 2017.

Large companies are often vertically integrated, covering refining and remelter industries, primary aluminium, rolling and extruder operations. Primary aluminium and rolling mill plants are mainly owned by multinational companies, while Small and Medium enterprises are more active in operating single extrusion and recycling plants.

[2] ERCST (2021). The aluminium value chain and implications for CBAM design. European Roundtable on Climate Change and Sustainable Transition. Available at: https://ercst.org/wp-content/uploads/2021/08/The-aluminium-value-chain-and-implications-for-CBAM-design.pdf
[3] As of October 2022 the Romanian refinery had stopped production since August 2022.
[4] One smelter in Spain was Idled in 2021. Source: European Aluminium, 'Digital Activity Report 2021-2022'. Available at: https://www.european-aluminium.eu/activity-report-2021-2022/market-overview/
[5] Garcia Perez and Farchy (2022). Europe's top aluminum plant will cut output 22% on energy costs. *Bloomberg*. Available at: https://www.bloomberg.com/news/articles/2022-09-06/europe-s-top-aluminum-plant-will-cut-output-22-on-energy-costs

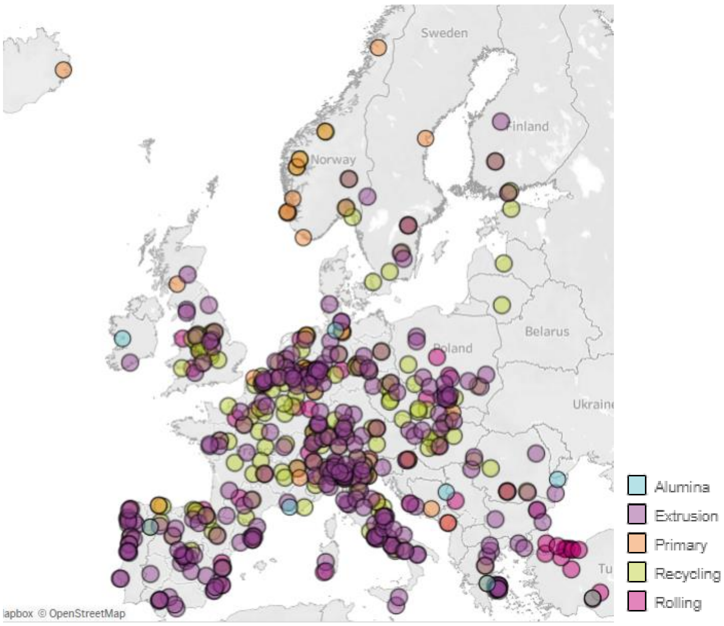


Figure 1: Aluminium production location in Europe.

Source: European Aluminium (2022).[6]

B.1.3 Trade situation of the sector

Metal supply

As described in section B.1.1, the output of both primary and secondary production is unwrought aluminium. Companies in the downstream aluminium sector use both primary and secondary aluminium, depending on the desired types, use and quality of the output.[7] As can be seen from Figure 2 the historic production trends of primary and secondary aluminium in the EU27 are quite different:

- **Primary production** remained relatively steady between 2012 and 2021 at around 2,000 ktonnes, Since October 2021, several European smelters have announced cut-downs of around 850 ktonnes of primary production capacity due to high energy prices. European Aluminium expects EU primary production to be further reduced in 2022 by at least 30% compared to 2021[8], with some of the remaining smelters still facing risk of closure.[9]
- **Secondary aluminium production** in the EU27 surpassed primary aluminium production since 2004. The sector experienced a production peak in 2017, reaching 3,042 ktonnes, declining slightly until 2020, when the sector experienced a steep decline, with production being reduced to 2,600 ktonnes. This decline in production can be attributed to the effects of the COVID-19 crisis, which reduced product demand for downstream plants (and in turn affected demand of unwrought aluminium). Figures for 2021 show a recovery of the sector, with an output of 2,864 ktonnes.

It is worth mentioning that secondary aluminium production is subject to the availability of scrap, which in turn can be linked to the length of the lifetime of the applications in which aluminium is employed. In the case of the EU27, the region is a net exporter of aluminium scrap since 2002, reaching a historical peak of over 1.5 million tonnes in 2021, representing surge of over 30% when compared to 2020. The main destination of EU aluminium scraps is the Asian market (80% of EU exports). India, China and Pakistan are the largest importers of European aluminium scrap.[10]

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[6] European Aluminium (2022). Industry and market data. Available at: https://european-aluminium.eu/about-aluminium/aluminium-industry/

[7] ERCST (2021). The aluminium value chain and implications for CBAM design. European Roundtable on Climate Change and Sustainable Transition. Available at: https://ercst.org/wp-content/uploads/2021/08/The-aluminium-value-chain-and-implications-for-CBAM-design.pdf

[8] European Aluminium (2022). European Aluminium digital activity report. Market overview 2021-2022. Available at: https://www.european-aluminium.eu/activity-report-2021-2022/market-overview/

[9] Reuters (2022). French aluminium smelter to cut output as electricity prices soar. Available at: https://www.reuters.com/markets/commodities/french-aluminium-smelter-cut-output-by-20-due-power-costs-source-2022-09-06/

[10] European Aluminium (2022). European Aluminium digital activity report. Market overview 2021-2022. Available at: https://www.european-aluminium.eu/activity-report-2021-2022/market-overview/

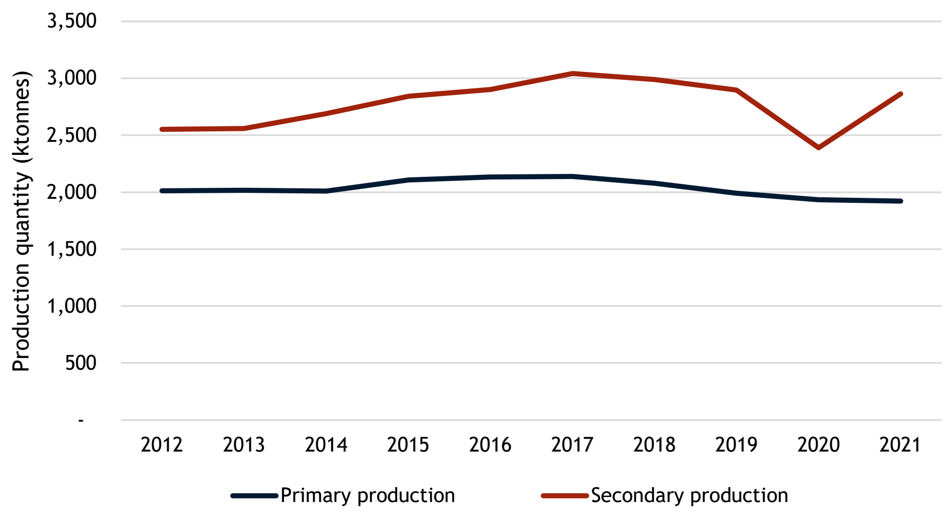

Figure 2: Primary and secondary aluminium production in the EU27, 2012-2021 (thousand tonnes).

Source: Own elaboration based on data provided by European Aluminium.
Notes: Secondary aluminium production refers to casting alloy production.

The EU's consumption of unwrought aluminium is strongly exposed to international trade (see Table 1). The share of internal consumption in the EU market served by extra-EU imports has consistently been above 53%, with a peak at 64% in 2021, showing a strong international competitiveness of non-EU players The main sources of extra EU imports for unwrought aluminium are Norway and Russia, accounting for 26% and 17% of EU27 imports between 2008-2021, with Iceland and the United Kingdom as other major exporters to European countries, accounting for 11% and 6% respectively.

The share of the EU production of unwrought aluminium dedicated to extra-EU exports has also grown, from 6% in 2012 to 14% in 2021.

Table 1: Exposure of the unwrought aluminium sector in the EU27 to international trade.

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross exports (M€)	501	377	447	512	563	480	552	653	711	784	693	719	792	1,206
Gross imports (M€)	9,985	5,186	8,994	10,301	8,735	8,419	9,516	10,117	9,463	11,457	12,837	10,875	8,955	13,229
Production value (M€)	8,506	4,995	7,971	8,296	6,858	7,061	8,031	9,444	8,278	9,339	9,423	8,223	6,799	8,675
Internal consumption (M€)	17,990	9,804	16,518	18,086	15,030	14,999	16,995	18,908	17,029	20,012	21,567	18,379	14,962	20,698
Share of internal consumption served by extra-EU imports	56%	53%	54%	57%	58%	56%	56%	54%	56%	57%	60%	59%	60%	64%
Share of production dedicated to extra-EU exports	6%	8%	6%	6%	8%	7%	7%	7%	9%	8%	7%	9%	12%	14%

Source: Own elaboration based on COMEXT and PRODCOM.
Note: Trade figures refer to HS code 7601 (Aluminium, unwrought). Production figures refer to code 24.42.11 (Aluminium, unwrought).

Downstream aluminium products

As seen in Figure 3, EU27 production of downstream aluminium, namely aluminium flat-rolled products (FRP) and extrusions, have both increased steadily since 2012. In 2020 production of FRP and extrusions dipped, likely due to reduced product demand resulting from the COVID-19 crisis; however, in 2021 the sector's production recovered, reaching 7,635 ktonnes.

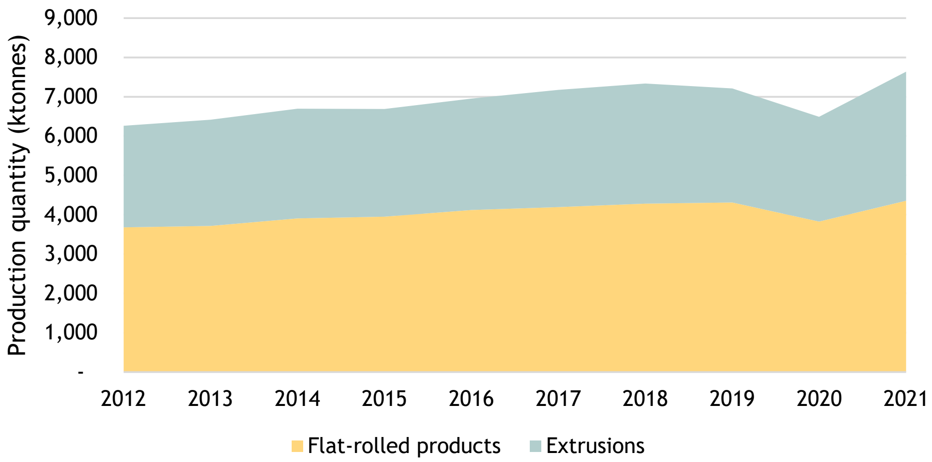

Figure 3: Production of flat-rolled and extrusions aluminium products in the EU27, 2012-2021 (thousand tonnes).

Source: Own elaboration based on data provided by European Aluminium.
Note: in the case of extrusions, production figures include EU27 and UK.

The EU27 is a net importer of flat-rolled and extruded products (Table 2). The share of internal consumption served by extra-EU imports increased from 26% in 2008 to 31% in 2021. FRP account for the largest share of trade of downstream aluminium products, accounting for around a third of exports and imports. The EU27 is a net exporter of FRP products, but since 2015 imports figures have been consistently increasing, almost reaching the level of exports by 2021. On the other hand, the EU27 continues to be a net importer of extrusions, since 2017, imports have significantly increased, but exports remain steady.

Table 2: Exposure of the downstream aluminium sector in the EU27 to international trade.

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross exports (M€)	4,785	3,470	4,015	4,627	4,667	4,739	5,002	5,597	5,470	5,985	6,332	6,147	4,857	5,759
Gross imports (M€)	3,574	2,214	2,918	3,721	3,410	3,369	3,584	4,520	3,979	4,479	4,920	4,782	4,178	5,578
Production value (M€)	14,886	9,459	13,912	16,191	13,785	14,168	14,549	17,724	17,414	19,607	21,320	19,462	18,605	18,455
Internal consumption (M€)	13,675	8,202	12,816	15,285	12,528	12,799	13,131	16,647	15,923	18,101	19,908	18,096	17,926	18,275
Share of internal consumption served by extra-EU imports	26%	27%	23%	24%	27%	26%	27%	27%	25%	25%	25%	26%	23%	31%
Share of production dedicated to extra-EU exports	32%	37%	29%	29%	34%	33%	34%	32%	31%	31%	30%	32%	26%	31%

Source: Own elaboration based on COMEXT and PRODCOM.

Note: Trade figures refer to HS code 7606 for FRP, and HS codes 7604 and 7608 for extrusions. Production figures refer to codes 24.42.22, 24.42.24 and 24.42.26.

As seen in Figure 4 (left) Switzerland was the largest source of EU27 imports of FRP, accounting for 23% of the value of imports during the 2012-2021 period, followed by China (13%), Turkey (12%), Norway (11%) and the UK (11%).

In the case of extrusions, Turkey and China are the largest source of imports in the EU27, with 25% and 20% of the imports value between 2012 and 2021, while Switzerland and Russia accounted for 13% and 7% respectively. According to European Aluminium (2022), this is the result of an anti-dumping case against extrusions from China.[11] For both type of downstream aluminium products, most of the imports source has been shifted to Turkey. Turkey's share of FRP imports increased from 11% in 2019 to 19% in 2021, while for extrusions, its share increased from 24% to 39%.

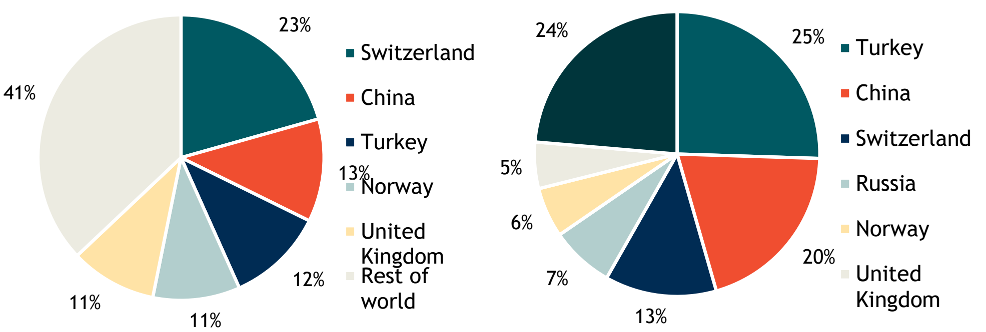

Figure 4: Distribution of imports of flat-rolled products (left) and extrusions (right) of aluminium in the EU27 Member States between 2012 and 2021 (EUR).

Source: IHS data via European Aluminium.

Note: Gross imports refer to trade figures of HS code 7606 for FRP, and HS codes 7604 and 7608 for extrusions.

B.1.4 Sample statistics

The sample consists of 39 installations in Europe (EU27).The sample is spread across 13 Member States with installations. Due to confidentiality reasons, the countries included in the sample cannot be delineated. The regional spread of the surveyed plants was as follows: 22 plants in the North Western Europe (NWE)[12] region, 10 plants in the Central Eastern Europe (CEE)[13] region and 8 in the Southern Europe

[11] European Aluminium (2022). European Aluminium digital activity report. Market overview 2021-2022. Available at: https://www.european-aluminium.eu/activity-report-2021-2022/market-overview/

[12] North Western Europe (NWE): Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden.

[13] Central Eastern Europe (CEE): Lithuania, Romania, Bulgaria, Czech Republic, Hungary, Estonia, Latvia, Slovakia and Poland.

(SE)[14] region (see Table 3) [15] Most of the questionnaire received belong to downstream plants from the NWE region. Moreover, two primary aluminium plants reported having also recycling activities, since they couldn't provide disaggregated data for each activity they were classified as primary aluminium.

Table 3: Aluminium production plants participating in the survey.

Geographical regions	*Questionnaires collected*	Primary aluminium	Secondary aluminium	Downstream (rolling & extrusion)
North Western Europe (NWE)	*22*	3	2	17
Central Eastern Europe (CEE)	*9*	1	1	7
Southern Europe (SE)	*8*	2	2	4
Total	***39***	**6**	**5**	**28**
Share of production output in 2021	***N/A***	**54%**	**25%**	**27%**

In terms of representativeness, the sampled plants account for 54% of the primary aluminium output in the EU27 in 2021, 25% of the secondary aluminium production output, and 27% in the case of the downstream aluminium sector.[16]

It should be noted that in the case of primary aluminium plants, most plants reported figures considering both electrolysis and casthouse operations. Moreover, at least one plant reported aggregated figures for both primary and secondary activities.
Table 4 describes the ranges of installed capacity from the 38 plants that provided information on annual production capacity of aluminium. For confidentiality reasons it is not possible to present production capacities for individual plants in the sample.

Table 4: Plant capacity range of the sample.

Capacity range (thousand tonnes/year)	Share of plants in sample
<100	57.9%
100-200	28.9%
>200	13.2%

Source: Own elaboration with data from aluminium companies.

B.1.5 Competitiveness of the sector

Primary aluminium

[14] Southern Europe (SE): Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, and Spain.
[15] There were also 2 questionnaire received for plants in the non-EU NWE region (UK, Switzerland, Iceland and Norway), and 2 Alumina refining plants located in EU27 Member States, however they were excluded from the analysis as at least three plants from three different companies are required in order to provide an average for the region.
[16] Based in production output figures shared by European Aluminium.

Table 5 presents an overview of indicators used in this section to analyse the competitiveness of the primary aluminium sector. The indicators that are calculated using the simple averages of the plants for which the information is available, with more plants providing data on their energy costs, than on their Key Performance Indicators (Production costs, Gross operating surplus, Turnover). As a consequence, the calculated indicators ' energy costs as a share of production costs', and ' energy costs as a share of turnover' can be significantly different from the shares calculated by the single average costs per tonne presented in the table.

Table 5: Overview of simple averages energy costs as a share of production costs, and energy costs as a share of turnover for the sampled Primary aluminium plants (€/tonne, EU) - Simple averages.

Indicator	2016	2017	2018	2019	2020	2021	2022Q1*
Electricity cost (EUR/tonne)	557	521	628	528	483	753	1396
Natural gas cost (EUR/tonne)	25	27	36	31	28	68	214
Other production costs (EUR/tonne)	1207	1334	1673	1926	2034	2582	5012
Gross operating surplus (EUR/tonne)	286	393	84	-228	-284	226	N/A
Turnover (EUR/tonne)	2075	2275	2421	2258	2261	3630	N/A
Electricity costs as a share of production costs	37.6%	34.0%	32.5%	28.4%	25.3%	32.2%	49.1%
Natural gas costs as a share of production costs	1.7%	1.5%	1.5%	1.3%	1.1%	2.1%	4.0%
Energy costs as a share of production costs	39.3%	35.5%	34.0%	29.6%	26.4%	34.3%	53.1%
Energy costs as a share of turnover	34.4%	28.3%	33.6%	33.4%	32.0%	34.5%	N/A

Source: Own elaboration based on data from aluminium

Note: based on the answers from three plants in 2016, 4 in 2017, 5 in the period of 2018-2021, and three for 2022Q1. There were more questionnaire replies available for the calculation of electricity and natural gas costs in €/tonne (up to five answers per year). Consequently, the presented indicators energy costs as a share of production costs, and energy costs as a share of turnover do not necessarily match the averages of the individual components of the production costs presented in this table.

Energy costs represent a substantial fraction of production costs and of turnover for the primary aluminium plants in the sample: between 30% and 39.3% of production costs, and between 33% and 34.5% of turnover. From 2016 to 2017 included, the sector's average gross operating surplus was in the range of 393 €/tonne in 2017. From 2018 to 2020, average profitability sharply declined (gross operating surplus changes from 84 €/tonne in 2018 to -284 €/tonne in 2020. This could be due to a combination of three factors:

- Differences in the sample composition, with more plants providing data for 2018-2021 than for 2016-2017.
- In parallel, average energy costs as a share of primary aluminium production costs followed a decreasing trend during the 2016-2020 period, going from 38.7% in 2016, to 33.0% in 2020.
- Global prices for aluminium, as determined by the London Metal Exchange (LME) were in decline from 2018 to 2020 (see Figure 6). Aluminium is a globally traded commodity and its prices are internationally set at the LME, so the output prices that primary aluminium producers receive is primarily determined by the LME price.

In 2021, the average energy costs as a share of production costs increased to 33.9%, caused by an increase of average shares of both electricity and natural gas costs. Electricity is the main input for primary aluminium production, with electricity cost accounting for an average of 32.2% of production costs in 2021. For the first quarter of 2022 energy as a share of production costs were reported to reach 52.1% on average, the highest share of all the period analysed. Natural gas costs, even though less prominent than electricity, also rose in 2021 and reached an average share of 2.1% of production costs.

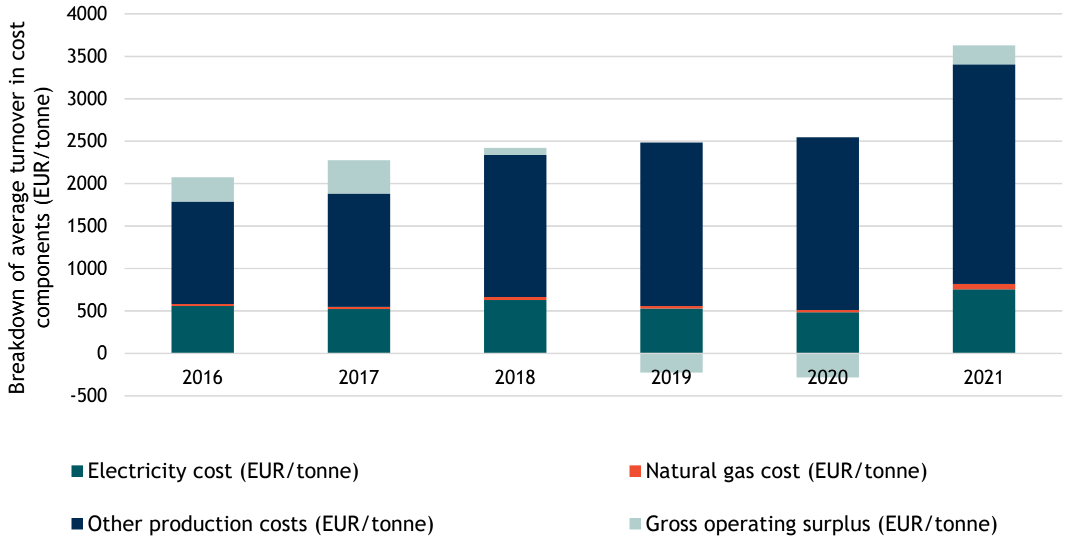

Figure 5: Simple averages of energy costs, other production costs and Gross Operating Surplus of the primary aluminium industry (€/tonne, EU), simple averages.

Source: Own elaboration with data from aluminium companies.

Note: based on the answers from 3 plants in 2016, 4 in 2017, 5 in the period of 2018-2021, and 3 for 2022Q1.

Preliminary figures for the first quarter of 2022 show that average energy costs per tonne have increased in 85% compared to 2021, and other production costs have almost doubled as well (on average, a 98% increase). At the same time, the average turnover per tonne of product also doubled, coinciding with the record-high prices reached for aluminium in 2021 and the first half of 2022. Three plants provided preliminary figures on Gross operating surplus and Turnover for 2022Q1, with large differences across them, resulting in a positive simple average Gross operating surplus.

Figure 6: LME Aluminium price (USD $/tonne, daily average), 2015-2022.

Source: Markets Insider (2022).[17]

There seems to be no correlation between the turnover and other production costs. The data from the sample plants show that, while energy costs over 2017-2020 were relative stable, the rapidly rising production costs other than energy over the same period led to a drop in GOS to even negative values in 2019 and 2020. This indicates that on average, the sample plants are unable to pass on other production costs into their product prices.

Considering that:

- the energy costs represent an important fraction, accounting for an average of %34 of the total production costs of the companies in the sample;
- the energy costs per tonne increased sharply between 2019 and 2021, while turnover per tonne has not increased at the same rate as energy and other production costs.
- The aluminium product prices are linked to the LME price, which depends on demand and offer. Companies in the sector are not able to adjust their product prices to energy or other production costs (such as raw material costs).
- the high reliance on extra-EU imports on unwrought aluminium between 2016 - 2021 has taken place in times of volatile energy costs and gross operating profits per tonne;

We can conclude that energy costs have:

- contributed negatively to deteriorating of the sector's profitability from 2019 to 2021; and
- in 2021 the rising energy costs contributed to the reduced production output of European primary aluminium, however, domestic European production of secondary aluminium increased. This was

[17] Markets Insider (2022). Aluminium Commodity. Available at: https://markets.businessinsider.com/commodities/aluminum-price

also reflected in comments made by several surveyed plants, which indicated closing their electrolysis department and running their casthouses with recycled aluminium and scraps (see section B.1.6 below).

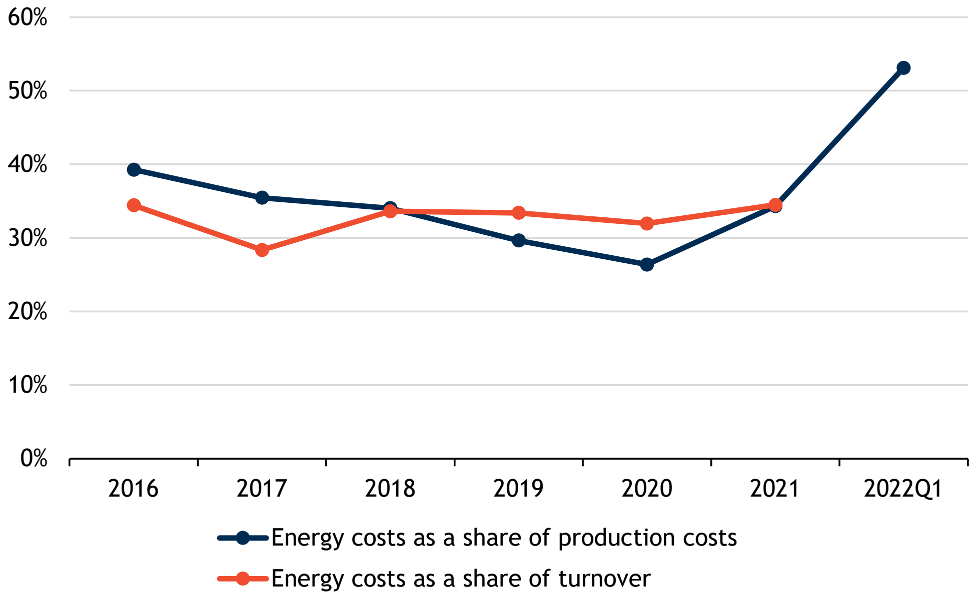

Figure 7: Energy costs as a share of production costs vs energy costs as a share of turnover for the primary aluminium industry (€/tonne, EU), simple averages.

Source: Own elaboration with data from aluminium companies.
Note: based on the answers from 3 plants in 2016, 4 in 2017, 5 in the period of 2018-2021, and 3 for 2022Q1.

Secondary aluminium

Due to the low number of secondary aluminium plants providing information about their KPI indicators (Production costs, Gross operating surplus, turnover, etc.) it is not possible to provide estimates for the average energy costs as a share of production costs, nor as a share of turnover.

Energy costs per tonne of output were relatively stable between 2016 and 2018, but have been increasing since 2019. Natural gas costs account for most of the energy costs of the secondary aluminium sector. In 2021, the sector faced a high increase of natural gas costs per tonne of output, up to €31.53. Notably, the increase in natural gas costs per tonne of output was less pronounced for the sampled secondary aluminium plants than those observed for the sampled primary aluminium plants. This can be attributed to differences in their type and duration of contracts, as well as more plants from the secondary aluminium sector reporting using on-site gas storage and investing in demand flexibility for gas (see section B.1.7).

Table 6: Overview of simple averages energy costs as a share of production costs, and energy costs as a share of turnover for the sampled Primary aluminium plants (€/tonne, EU) - Simple averages.

Indicator	2016	2017	2018	2019	2020	2021	2022Q1*
Electricity cost (EUR/tonne)	9	9	9	11	12	16	26
Natural gas cost (EUR/tonne)	29	23	26	31	27	32	62
Energy costs (EUR/tonne)	38	33	35	42	39	48	88

Source: Own elaboration based on data from aluminium
Note: based on the answers from 4 plants in 2016-2018, and 5 plants in 2019-2022Q1.

Downstream (Rolling & extrusion)

Table 7 below presents an overview of indicators used in this section to analyse the competitiveness of the secondary aluminium sector. As stated in the primary and secondary aluminium sections, figures presented are simple averages for plants in the sample that provided sufficient data to calculate each indicator. As a consequence, the indicators shown for energy costs as a share of production costs, and energy costs as a share of turnover do not necessarily match the simple averages of the individual components of the production costs presented in the table (i.e. electricity costs per tonne, natural gas costs per tonne, personnel and other production costs per tonne, etc.).

Table 7: Overview of simple averages for energy costs as a share of production costs, and energy costs as a share of turnover for the sampled downstream aluminium plants (€/tonne, EU) - Simple averages.

Indicator	2016	2017	2018	2019	2020	2021	2022Q1
Electricity cost (EUR/tonne)	73.92	71.99	70.48	75.96	84.62	90.38	152.02
Natural gas cost (EUR/tonne)	31.45	28.45	29.80	30.98	30.61	39.54	93.32
Personnel cost (EUR/tonne)	482.57	523.25	511.32	581.39	573.51	560.77	568.30
Other production costs (EUR/tonne)	2,301.13	2,524.71	2,681.55	2,841.29	2,715.68	3,010.02	3,811.38
Gross operating surplus (EUR/tonne)	676.19	780.28	837.62	840.63	901.22	968.47	N/A
Turnover (EUR/tonne)	3,565.25	3,928.68	4,130.77	4,370.25	4,305.65	4,669.17	N/A
Electricity costs as a share of production costs	2.8%	2.4%	2.4%	2.4%	2.9%	3.1%	4.2%
Natural gas costs as a share of production costs	1.2%	1.0%	1.0%	1.0%	1.2%	1.4%	2.6%
Energy costs as a share of production costs	4.0%	3.4%	3.4%	3.5%	4.1%	4.4%	6.6%
Energy costs as a share of turnover	3.0%	2.5%	2.4%	2.6%	2.8%	2.9%	N/A

Source: Own elaboration based on data from aluminium
Note: based on the answers from 17 plants in 2016, 18 in 2017, 19 in 2018, 21 in 2019, 23 in the period of 2020-2021, and 22 for 2022Q1. There were more questionnaire replies available for the calculation of electricity and natural gas costs in €/tonne (at least 22 answers each year). As a consequence, the presented indicators energy costs as a share of production costs, and energy costs as a share of turnover do not necessarily match the averages of the individual components of the production costs presented in this table.

The simple average of the Gross operating surplus of the plants surveyed in the questionnaire has been increasing between 2016 and 2021. The perceived improvement in the profitability of the downstream plants being surveyed is essentially due to a rise in the selling price (turnover per tonne). The selling price shows the same trend as the other production costs (such as the cost of input materials), which represents the largest proportion in the total production cost, by far. This could indicate that the selling price is largely determined by the other production costs. While the share of energy costs in the total production costs have been rising in the recent years, they remain significantly smaller than the GOS and personnel and other production costs per tonne of product. The impact of the rising energy prices on the competitiveness of the downstream plants therefore primarily exhibited through the rising costs of aluminium input material.

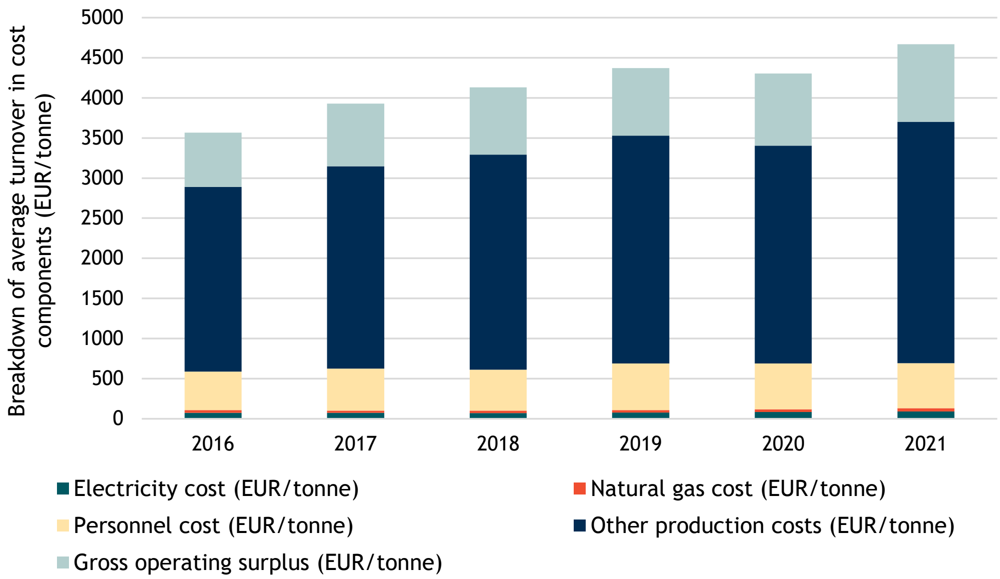

Figure 8: Energy costs, other production costs and Gross Operating Surplus of the downstream aluminium industry (€/tonne, EU), simple averages.

Source: Own elaboration with data from aluminium companies.
Note: based on the answers from 17 plants in 2016, 18 in 2017, 19 in 2018, 21 in 2019, 23 in the period of 2020-2021, and 22 for 2022Q1.

From 2016 to 2019, energy costs accounted for a small fraction of production costs and of turnover: on average they accounted for 3.5% of production costs and 2.5% of turnover for the plants in the sample. Since 2020, the rise in electricity and natural gas prices (see section B.1.7) have increased energy costs for downstream aluminium plants and their role in the sector's profitability. Preliminary figures for the first quarter of 2022 show that energy costs accounted for an average of 6.6% of production costs and 4.2% of turnover of the sampled plants (see Figure 9).

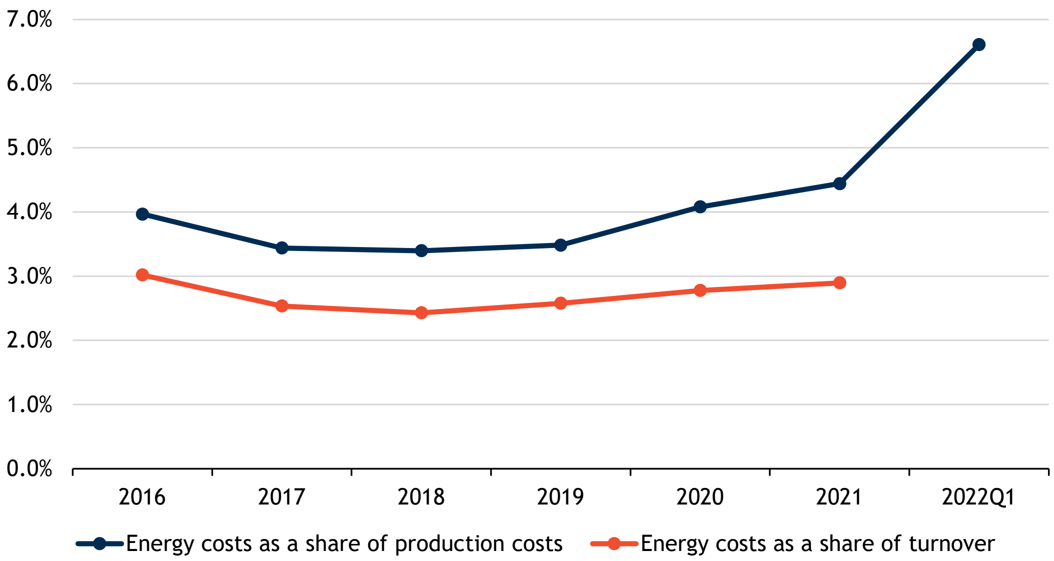

Figure 9: Energy costs as a share of production costs vs energy costs as a share of turnover for the downstream aluminium industry (€/tonne, EU), simple averages.

Source: Own elaboration with data from aluminium companies.
Note: based on the answers from 17 plants in 2016, 18 in 2017, 19 in 2018, 21 in 2019, 23 in the period of 2020-2021, and 22 for 2022Q1.

The operating costs of downstream plants are dominated by 'other costs' (such as the supply of raw material). According to ECRST (2022)[18] , the purchase of unwrought aluminium accounts for at least 50% of downstream transformers' total production costs. Consequently, the profitability of downstream plants is highly affected by the international markets the price of unwrought aluminium. However, the range of products in the downstream aluminium is very broad, and the profitability of companies is also dependent on the markets where the companies operate (i.e. their products' added value).

B.1.6 Consequences of COVID-19 crisis and Russian invasion in Ukraine for the aluminium sector

The majority of the aluminium plants participating in the survey reported that the **COVID-19 crisis** impacted negatively due to increased energy prices (both for electricity and natural gas). Some plants also reported a reduced availability of personnel from April to July 2020 due to the COVID-19 crisis, which resulted in reduced production during that period. In the case of the downstream segment, rolling and extrusions plants reported facing reduced customer demand, namely from the automotive and aerospace sectors.

After the start of the **Russian invasion in Ukraine**, the price of energy products rose even further, together with increased tensions in the supply chain of raw materials causing shortages and inflation of prices:

- Aluminium plants are facing increased prices of Alumina (linked to the London Metal exchange); coke & pitch, magnesium, silicium and manganese.

[18] ERCST (2021). The aluminium value chain and implications for CBAM design. European Roundtable on Climate Change and Sustainable Transition. Available at: https://ercst.org/wp-content/uploads/2021/08/The-aluminium-value-chain-and-implications-for-CBAM-design.pdf

- As a consequence, downstream plants are affected by the reduced European production of primary and secondary aluminium, as well as facing procurement issues (for those that previously relied on sourcing from Russian companies)
- Downstream plants also reported increased transport and logistics costs, including low availability of truck drivers.

In order to stay afloat during the ongoing crisis, **the aluminium plants participating in the survey have adopted the following measures**:

- Primary aluminium plants:
  - Curtailments of primary aluminium production: since September 2021, plants reported reducing or completely halting their electrolytic aluminium furnaces to reduce their levels of electricity consumption. Some companies of primary aluminium production also reported cutting-down or completely shutting down their alumina production (refining).
  - To continue its casthouse operations, some primary aluminium plants reported they are now only using scrap. Secondary aluminium uses more natural gas for smelting than the liquid primary aluminium from the electrolysis department. Most notably, the natural gas costs for all primary aluminium plants were below 10% for previous years, but they rapidly increased in 2021 and the first quarter of 2022, with natural gas prices rising much faster than electricity prices (see section B.1.8).
  - Optimisation of logistics and flows in the casthouse to decrease furnace standby times,
- Secondary aluminium and downstream aluminium plants: companies reported raising their product sale prices as a measure to deal with the increased prices of energy, raw material, transport and logistics. For downstream plants, this has further reduced their product’s demand.
- All segments of aluminium’s value chain:
  - In order to reduce personnel costs, companies had to lay-off part of their personnel, or introduced mandatory unpaid leaves for employees. Some aluminium companies publicly announced that complete shutdown decisions resulted in the lay-off of the majority of their staff, with only small groups of employees remaining to perform essential tasks.[19]
  - Other measures reported included a reduction of the planned level of investments to minimum levels, and other measures to reduce costs and expenses at all levels of the plants (e.g. grouping employees to reduce space-heating costs).

In the following sections, the evolution of energy prices and costs, and the energy intensity plants in the different segments of the aluminium value chain are discussed in more detail.

B.1.7 Evolution of energy prices

Electricity prices

Primary and secondary aluminium sector

The primary aluminium sector in the EU experienced relatively stable electricity prices in the 2016-2020 period, going from €43.65/MWh in 2016 to €37.14/MWh in 2020.This period was followed by an increase in 2021 to €56.79/MWh. For the first quarter of 2022, the sector experienced a sharp increase of the electricity price, which was on average €153.68/MWh.

[19] ALDEL – DAMCO (2022). Damco is shutting down production due to high energy costs and continued uncertainty about government support for energy-intensive industries. Available at: https://aldel.nl/1055-2/

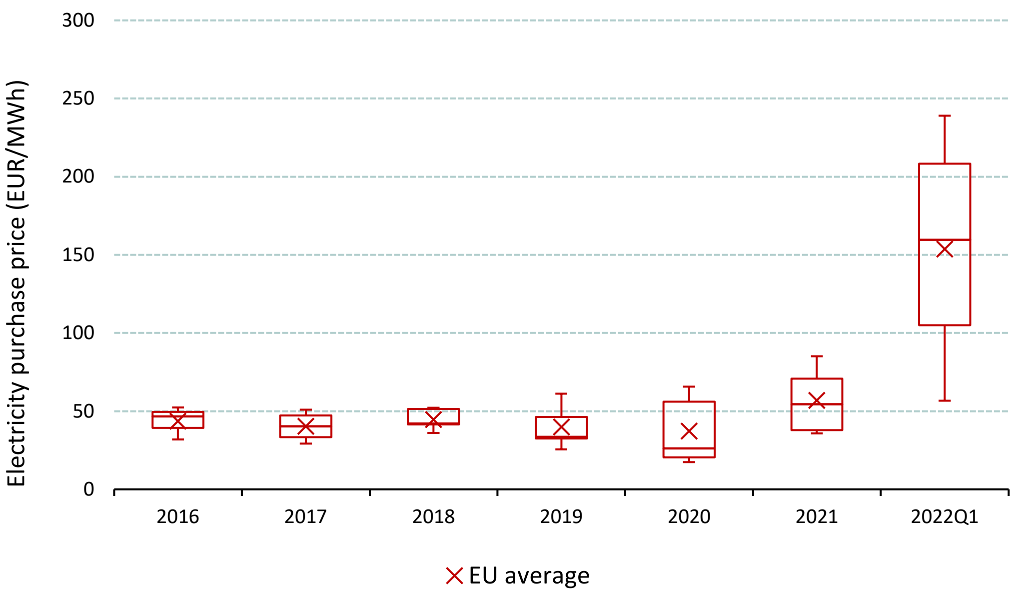

Figure 10: Electricity prices for primary aluminium plants (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 3 plants in 2016, 4 plants in 2017, 5 plants in 2018 -2021, and from 4 plants in 2022Q1.

The secondary aluminium sector experienced higher prices than those of the primary aluminium sector during the analysed period. For primary aluminium plants, it is crucial to secure electricity supply at a reasonable cost. A possible explanation for this is the type of electricity contracts[20] used by the two sectors: The majority of primary aluminium plants reported currently having contracts with a set rate per unit of energy for electricity; whereas none of the secondary aluminium plants indicated having fixed contracts for electricity (see Box 1-1 below). Most of the plants in the secondary aluminium sector have short-term contracts of variable rates, exposing them more to market price fluctuations. Although this is the current status (as of June 2022), this could be an indication of the different strategies followed by the plants in the two sectors in previous years.

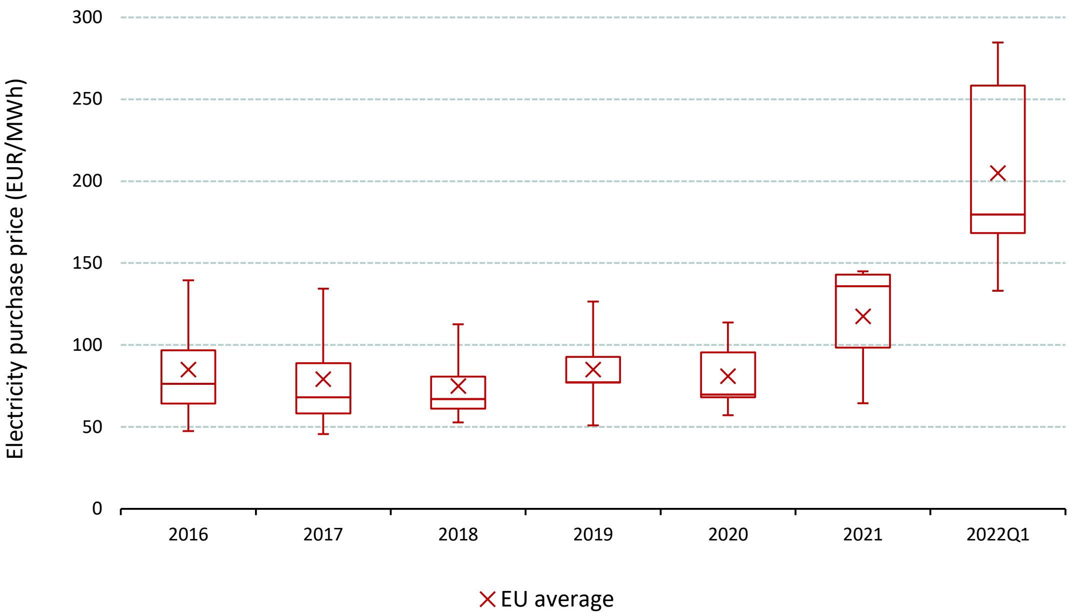

Figure 11: Electricity prices for secondary aluminium plants (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 4 plants in 2016 -2018, and from 5 plants in 2019 - 2022Q1.

[20] For this study, electricity and natural gas contracts were classified as follows: Fixed contract: when a set rate per energy unit (e.g. Euro/kWh) is charged for the fixed term of the contract. Energy bill is charged based on energy usage. Variable contract: when the rate per unit is linked to market activity, and could therefore be subjected to changes throughout the contract period. A combination of fixed and variable contract combines fixed rates (usually to hedge against typically volatile periods), and variable rates (which can be structured around peak, non-peak or around the clock prices).

Table 8: Descriptive statistics for electricity prices paid by sampled EU primary and secondary aluminium plants (€/MWh) – simple averages.

Electricity prices (€/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	43.65	40.25	44.67	39.82	37.14	56.79	153.68
Secondary aluminium - EU	84.85	79.05	74.84	84.93	80.82	117.32	204.81

Source: Own elaboration with data from aluminium companies.

Box 1: Electricity contracts of the primary and secondary aluminium sector

For the primary aluminium sector, 80% of the sampled plants provided details about their type and duration of electricity contracts with energy providers. For those who provided details, an overview about their electricity contracts of the sampled plants (as of June 2022) is summarised below:

- 80% of the plants reported having fixed electricity contracts, making them less susceptible to the recent price hikes (they had the lowest electricity prices of the sample in 2021). However, for half of these plants their fixed contracts are set to expire in one year or less, exposing them to market electricity prices.
- 40% of the plants reported having variable contracts, half of which also indicated it will expire in less than one year.
- 20% of the plants indicated having a combined electricity contract, which is due to expire in less than one year.

Table 9: Overview of the type of electricity contracts (fixed/variable/combined) of sampled primary aluminium producers, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed duration	40%	40%	0%
Electricity contract variable duration	20%	20%	0%
Electricity contract combined duration	20%	0%	0%
	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed remaining	40%	40%	0%
Electricity contract variable remaining	20%	20%	0%
Electricity contract combined remaining	20%	0%	0%

Source: Own elaboration based on answers from aluminium companies.

In the case of the secondary aluminium sample, 80% of plants provided details about their type and duration of electricity contracts with energy providers. Their split (as of June 2022) is the following:

- 60% of the plants indicated having a variable electricity contract with a duration of one year or less.
- 40% of the plants reported having a combined electricity contract, with remaining duration of more than 1 year.

Table 10: Overview of the type of electricity contracts (fixed/variable/combined) of sampled secondary aluminium producers, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed duration	0%	0%	0%
Electricity contract variable duration	60%	0%	0%
Electricity contract combined duration	0%	40%	0%
	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed remaining	0%	0%	0%
Electricity contract variable remaining	60%	0%	0%
Electricity contract combined remaining	0%	40%	0%

Source: Own elaboration based on answers from aluminium companies.

Downstream sector

The electricity prices for downstream aluminium plants in the EU were relatively stable between 2016 and 2018, at a price round €89/MWh, however, they have been on an increasing trend since 2019, going from an average of €101.54/MWh in 2019 to €119.2/MWh in 2021. Figures for the first quarter of 2022 show that average electricity prices rose up to €171.68/MWh.

Due to the sample composition, the EU averages follows the behaviour of the plants in the NWE region, which make up for more than half of the sample.

- The plants in the NWE were able to maintain relatively stable electricity prices between 2020 and 2021, going from €115.58 to €118/MWh. Around 76% of the plants in the NWE region had lower electricity prices in 2021 than in 2020, the majority of them also reported having fixed or a combined contract (of fixed and variable prices), which could have moderated the impact of rising electricity prices in 2021. However, half of these plants also reported their contracts are expiring in less than a year.
- In the case of the CE region, electricity prices in 2021 increased by 26%, going from €86.97/MWh to €116.94/MWh, placing them at the same level of prices in the NWE region. More than half of the plants in the region reported having a variable contract, which would have kept them exposed to market price changes. Only one of the plants in the sample (from the CE region) having a PPA for electricity in place, this plant had one of the lowest reported electricity prices of the region during 2020-2022Q1.
- For plants in the SE region the prices of electricity by 14%, going up to €128.24/MWh, and the highest electricity prices of the regions in the EU. Half of the plants actually reported lower electricity prices in 2021 than those of 2020, due to having a fixed electricity contract in place (which as of June 2022 was set to expire in less than a year).

Plants in the NWE region reported an increase in the electricity prices to €148/MWh in 2022Q1, an increase of 21% when compared to 2021. For plants in the CE and SE region, the increase in their reported electricity costs was of 41% for both, going up to €201.42/MWh and €222.95/MWh respectively.

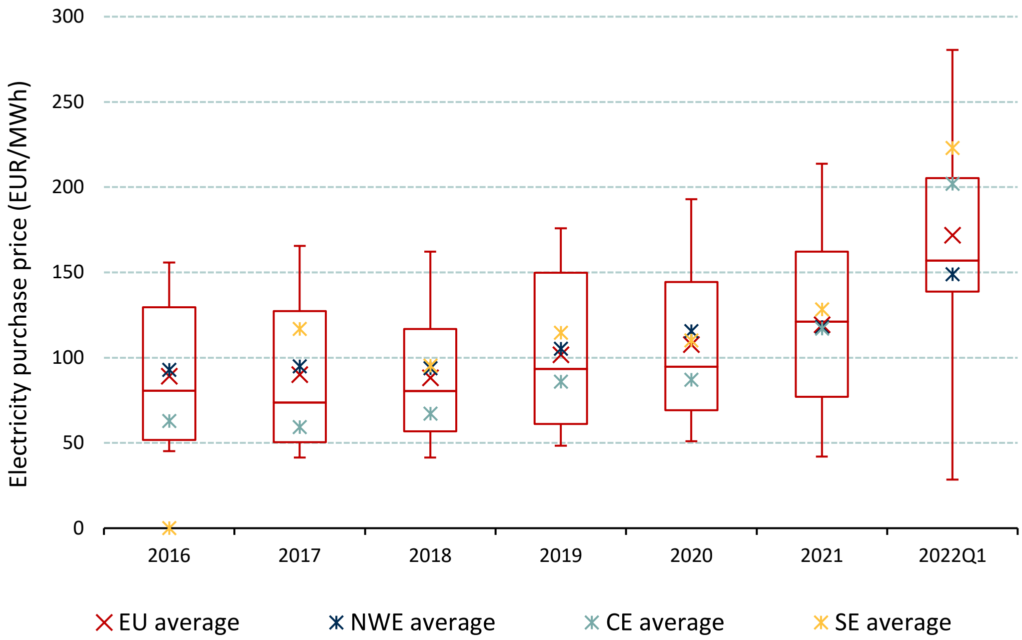

Figure 12: Electricity prices for downstream aluminium plants (EUR/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.

Notes: based in answers from 21 plants in 2016, 23 plants for 2017 -2018, 27 plants in 2019, 28 plants in 2020-2021, and 27 plants in 2022Q1.

Table 11: Average electricity prices of sampled downstream aluminium plants (EUR/MWh) - simple averages.

Natural gas prices (EUR/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
EU average	89.13	90.01	88.16	101.54	107.63	119.20	171.68
NWE average	92.81	94.89	93.78	105.15	115.58	118.00	148.94
CE average	62.86	59.31	67.11	85.86	86.97	116.94	201.94
SE average		116.76	95.17	114.51	110.03	128.24	222.95

Source: Own elaboration with data from aluminium companies.

Box 2: Electricity contracts of the downstream aluminium sector

In the downstream aluminium sector, 86% of the sampled plants provided information about their electricity contracts. From the four plants that did not provide any information about contracts, three are located in the CE region, and one in the NWE region.

- 17% of the plants reported having fixed electricity contracts, for all of them their contract will expire in one year or less.
- 21% of the plants reported having variable electricity contracts. For 17% of the plants the contracts will end within a year, while for 4% they will end in more than a year.
- 67% of the plants reported having a combined electricity contract (with a mix of fixed and variable prices). For 29% their contract will expire within a year, while 38% it will expire in more than a year.

Table 12: Overview of the type of electricity contracts (fixed/variable/combined) of sampled downstream aluminium plants, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	**>1 year**	**Indefinite**
Electricity contract fixed duration	8%	8%	0%
Electricity contract variable duration	13%	8%	0%
Electricity contract combined duration	4%	63%	0%
	Share of plants answering the question		
	1 year or less	**>1 year**	**Indefinite**
Electricity contract fixed remaining	17%	0%	0%
Electricity contract variable remaining	17%	4%	0%
Electricity contract combined remaining	29%	38%	0%

Natural gas prices

Primary and secondary aluminium

The primary aluminium sector in the EU experienced increased natural gas prices going from €20.09/MWh in 2016 to €24.78/MWh in 2018.This period was followed by a decrease down to €17.48/MWh in 2020. In 2021, natural gases increased to almost twice the levels of 2016, reaching an average of €39.17/MWh. The sector has experienced further increases of natural gas prices during the first quarter of 2022, up to an average of €80.19/MWh.

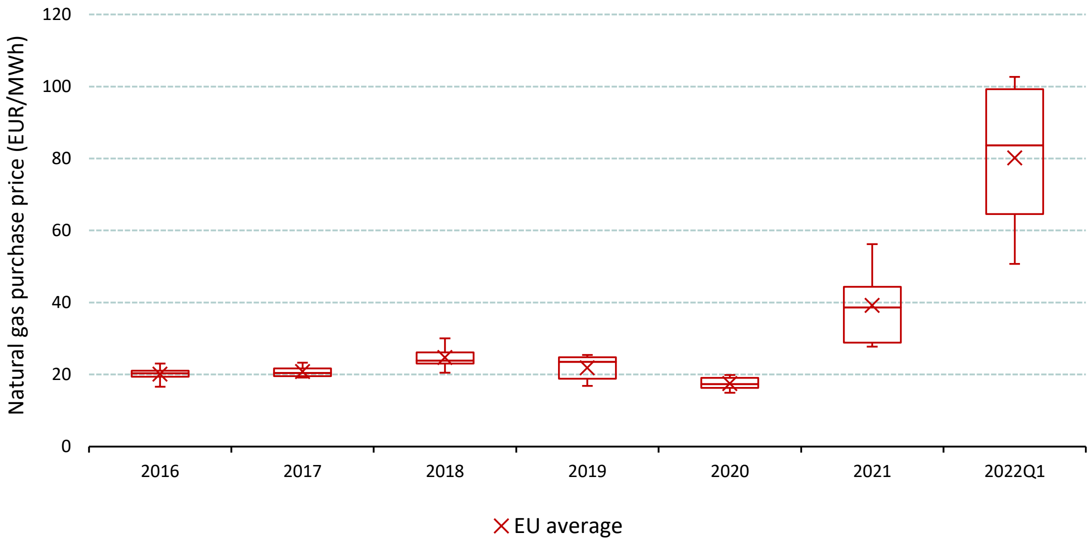

Figure 13: Natural gas prices for primary aluminium plants (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 4 plants in 2016 -2018, and from 5 plants in 2019 - 2022Q1.

In the case of secondary aluminium, natural gas prices oscillated between €22.62/MWh in 2016 to €22.16/MWh in 2020, before rising to €26.33/MWh in 2021. For the first quarter of 2022, the average price paid was €22.16/MWh. When compared to primary aluminium, secondary aluminium had higher natural gas prices during 2019 and 2020, however during 2021 and 2022Q1 primary aluminium experienced prices significantly higher than those of secondary aluminium. Some of the secondary aluminium plants with the lowest natural gas prices had fixed or combined contracts with durations of more than a year, onsite gas storage, and/or invested in demand flexibility for gas. On the other hand, from the primary aluminium sample, only one plant benefited from onsite gas storage and combined contracts for natural gas, which was reflected in having lower prices than the rest of the plants in the sample.

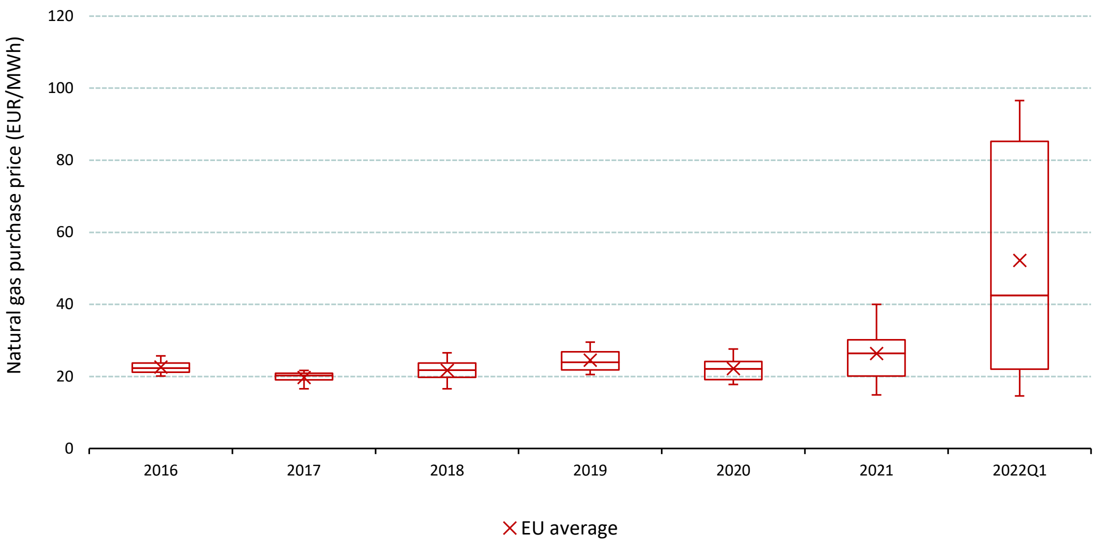

Figure 14: Natural gas prices for secondary aluminium plants (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 4 plants in 2016 and 2017, 5 plants in 2018 -2021, and from 4 plants in 2022Q1.

Table 13: Descriptive statistics for natural gas prices paid by sampled primary and secondary aluminium plants (€/MWh) - simple averages.

Natural gas prices (€/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	20.09	20.81	24.72	21.88	17.48	39.17	80.19
Secondary aluminium - EU	22.62	19.71	21.69	24.54	22.16	26.33	52.19

Source: Own elaboration with data from aluminium companies.

Box 3: Natural gas contracts of the primary and secondary aluminium sector

80% of the primary aluminium plants provided details about their type and duration of natural gas contracts. As of June 2022, the overview of these plants was the following:

- There were no plants with fixed contracts for natural gas;
- 25% of the sample had a variable contract for natural gas, which will expire in one year or less;
- 75% of the sampled plants reported having a combined contract, of which 50% have a contract with a duration of one year or less.

Table 14: Overview of the type of natural gas contracts (fixed/variable/combined) of sampled primary aluminium plants, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed duration	0%	0%	0%
Natural gas contract variable duration	0%	25%	0%
Natural gas contract combined duration	50%	25%	0%
	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed remaining	0%	0%	0%
Natural gas contract variable remaining	25%	0%	0%
Natural gas contract combined remaining	25%	50%	0%

In the case of secondary aluminium sector, all the surveyed plants plants provided information about their type of natural gas contracts, which as of June 2022 were:

- 20% of the plants in the sample had a fixed contract for natural gas, which will still be in place for over a year;
- 60% of the plants have a variable contract for natural gas, which will expire in one year or less;
- 20% of the plants have a combined contract for natural gas, which will still be in place for over a year.

Table 15: Overview of the type of natural gas contracts (fixed/variable/combined) of sampled secondary aluminium plants, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed duration	0%	20%	0%
Natural gas contract variable duration	60%	0%	0%
Natural gas contract combined duration	0%	20%	0%
	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed remaining	0%	20%	0%
Natural gas contract variable remaining	60%	0%	0%
Natural gas contract combined remaining	0%	20%	0%

Downstream aluminium

Between 2016 and 2018, the natural gas prices for downstream plants in the EU were relatively stable, at an average of €27/MWh in 2018, with prices in the sample ranging between €19 and €39/MWh. From 2019 to 2021 natural gas prices increased to an average of €32.48/MWh

In 2019 and 2020 natural gas prices increased to an average of €29.43/MWh, the sample showed larger variations, with prices ranging from €14.5/MWh to €84/MWh. The variation could be partly explained by a change in the sample size, which increased from 22 plants in 2018 to 25 plants in 2019 and 27 plants in 2020. Some of the newly added plants reported natural gas prices significantly higher than those of the rest of the sample.

The variations in the regional averages in 2018, 2019 and 2020 can also be attributed to the changes in the sample composition: up to 2018 average natural gas costs were higher for plants in the NWE region, but in 2019 prices in the CE region surpassing those in the NWE, before decreasing again in 2020. By 2020, the plants in the NWE region the highest natural gas prices, at an average of € 32.69/MWh, followed by plants in the CE region, at €25.83/MWh.

In 2021, the average natural gas prices for downstream plants in the EU increased slightly to €32.38/MWh. 12 out of the 27 plants reported lower natural gas prices in 2021 in 2020 most of which are located in the NWE region and only three from the CE region. This resulted in in reduced gas prices in 2021 for the NWE region, and a moderate increase for the CE region and for the EU as a whole. The increase of natural gas prices from 2020 to 2021 was steeper for the plants in the SE region. The average price for plants in the SE region went up to €34.76/MWh 2021.

In the first quarter of 2022, the natural gas prices increased for all regions, but not in the same order of magnitude. Plants in the NWE region, accounting for more than half of the sample increased by 87% from 2021 to 2022Q1, while for plants in the SE and CE regions prices increased by 136% and 142% respectively.

- A couple of the plants in the NWE region reported having fixed natural gas contracts in place (as of June 2022), while the majority reporting having combined contracts. The use of fixed and combined are a possible explanation for the lower increase of natural gas price experienced by the plants in the NWE region, compared to the plants in the CE and SE regions.
- The natural gas price for plants in the SE region was on average €71.38/MWh in 2022Q1, the three plants in the SE region that shared details about their type of contracts had each a different type: fixed, variable and combined, and for the three the natural gas prices increased in between €43 and €55/MWh.
- In the case of plants in the CE region, a third of them reported having combined contracts, however their average natural gas prices were still greatly impacted, going up to €82/MWh.

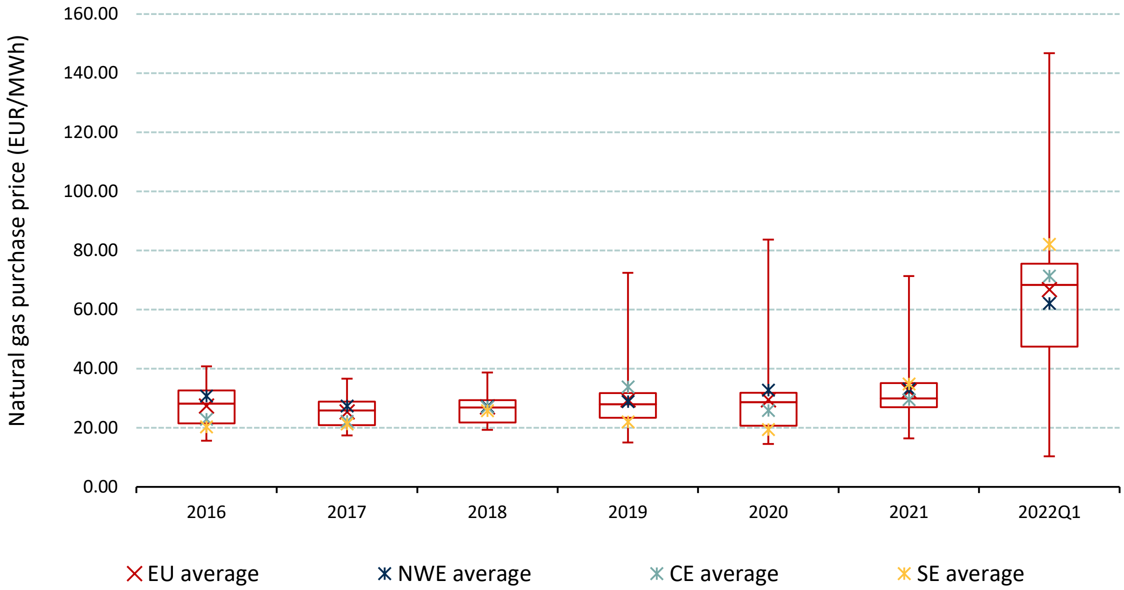

Figure 15: Natural gas prices for downstream aluminium plants (EUR/MWh) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.

Notes: based in answers from 21 plants in 2016, 22 plants for 2017 -2018, 25 plants in 2019, 27 plants in 2020-2021, and 25 plants in 2022Q1.

Table 16: Average natural gas prices of sampled downstream aluminium plants (EUR/MWh) - simple averages.

Natural gas prices (EUR/MWh)	2016	2017	2018	2019	2020	2021	2022Q1

EU average	27.37	25.33	26.99	29.39	29.43	32.38	66.72
NWE average	30.72	27.32	27.28	28.81	32.69	33.12	62.09
CE average	22.91	22.17	26.93	33.81	25.83	29.54	71.38
SE average	20.32	21.31	25.74	21.99	19.37	34.76	82.07

Source: Own elaboration with data from aluminium companies.

Box 4: Natural gas contracts of the downstream aluminium sector.

In the case of downstream aluminium plants, 86% of the surveyed plants provided details about their type and duration of natural gas contracts.

- Fixed contracts: 21% of the plants reported having fixed natural gas contracts, 4% of the plants indicated it will expire in one year or less, while 17% reported they will expire in more than one year, exposing them to market prices.
- Variable contracts: 17% of the plants reported having a variable contract, which will expire in less than a year.
- Combination of fixed and variable contracts: The majority of the plants (63% of the sample) reported having a combined natural gas contract. 25% indicated their combined contract will expire within a year, and 38% indicated it will be in place for more than 1 year.

Table 17: Overview of the type of natural gas contracts (fixed/variable/combined) of sampled downstream aluminium plants, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed duration	8%	13%	0%
Natural gas contract variable duration	13%	4%	0%
Natural gas contract combined duration	21%	42%	0%

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Natural gas contract fixed remaining	4%	17%	0%
Natural gas contract variable remaining	17%	0%	0%
Natural gas contract combined remaining	25%	38%	0%

B.1.8 Evolution of energy costs

Electricity costs

Primary and secondary aluminium

Figure 16 shows that the average electricity cost per tonne of output in EU primary aluminium plants decreased slightly from €557.5/tonne in 2016 to €483.26/tonne in 2020 and increased up to €753.35/tonne in 2021. The reduction of electricity costs in 2020 can be attributed to a reduction of electricity prices during that year, as noted in Section 1.1.7 above.

Preliminary figures for 2022Q1 point out that electricity costs per tonne of output have increased to almost twice the 2021 figures, with an average of €1396.10/tonne This is in line with the behaviour of electricity prices in €/MWh.

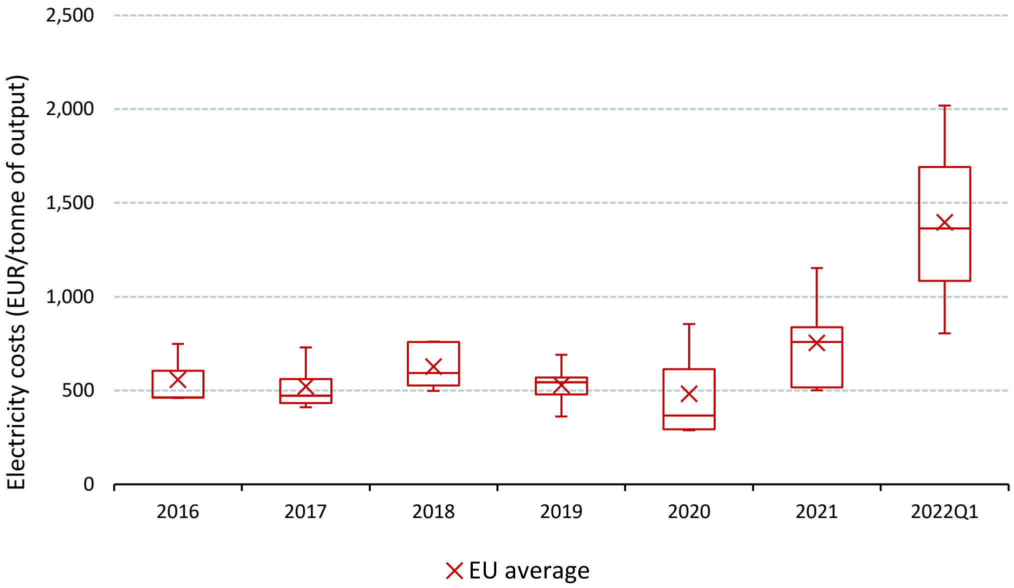

Figure 16: Electricity costs for primary aluminium plants (€/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 3 plants in 2016, 4 plants in 2017, 5 plants in 2018 -2021, and from 3 plants in 2022Q1.

When compared to primary aluminium plants, secondary aluminium plants have relatively low electricity costs per tonne of output (see Table 18 below). During 2016-2018 these somewhat stable, oscillating between €8.9 and 9.5/tonne. Since 2019, they have been increasing, going from €11.08/tonne in 2019 to €16.03/tonne in 2021 and increased up to €25.78/tonne in the first quarter of 2022.

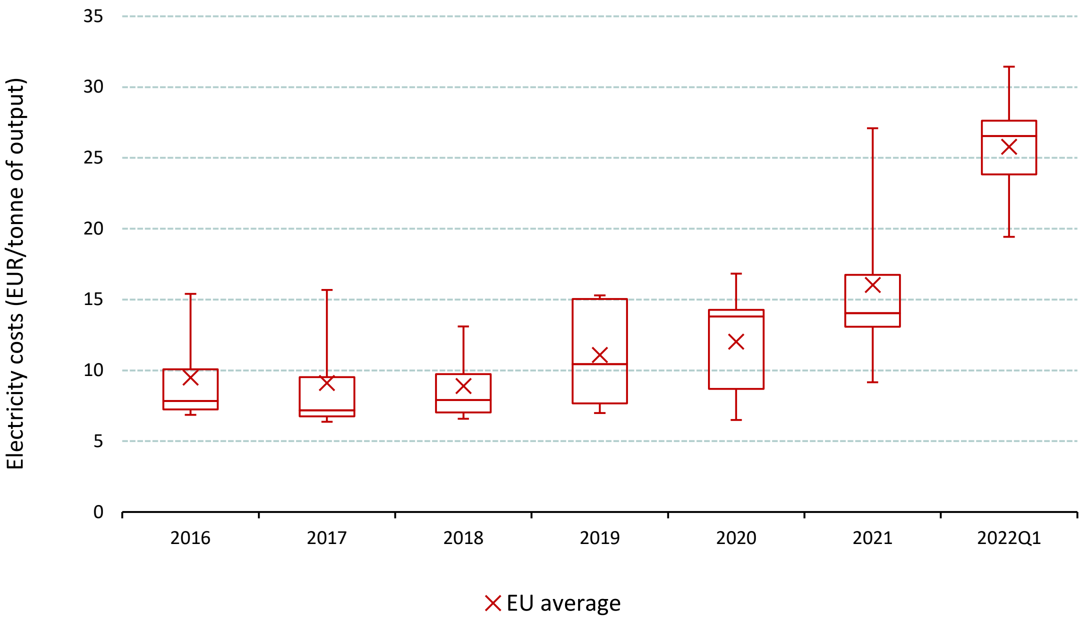

Figure 17: Electricity costs for secondary aluminium plants (€/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from four plants in 2016 -2018, and from five plants in 2019 - 2022Q1.

Table 18: Descriptive statistics for electricity costs paid by sampled EU primary and secondary aluminium plants (€/tonne) - simple averages.

Electricity costs (€/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	557.49	521.41	627.63	528.45	483.26	753.35	1396.10
Secondary aluminium - EU	9.48	9.10	8.87	11.08	12.02	16.03	25.78

Source: Own elaboration with data from aluminium companies.

Downstream aluminium

The average electricity costs for downstream aluminium plants in the EU increased from €72.92/tonne of output in 2016 to €75.96/tonne of output in 2019, followed by a sharp increase up to €90.38/MWh in 2021. For 2022Q1, the sampled plants reported further increases in their electricity costs, reaching €152/MWh in average.

Up until 2019, plants in the NWE region faced higher electricity costs, followed by plants in the SE region, while plants in the CE region had on average the lowest electricity costs of the three regions. Since 2020, this changed, with plants in the SE region facing lower electricity costs than those in the CE region. This could be explained by a change in the composition of the sample, with two plants reporting figures from 2020 onwards, one of which from the SE region.

Between 2020 and 2021, the average electricity costs for plant in the NWE region were the only ones to decrease, since plants experienced stable electricity prices (see section B.1.7) combined with a reduced electricity intensity. For 2022Q1, the electricity costs for the region increased due to the combination of an increase in both electricity prices and electricity intensity.

Plants in the CE region reduced their electricity intensity to the lower levels of the period. Electricity prices in 2021 increased by 26%, going from €86.97/MWh to €116.94/MWh, at the same level of prices in the NWE region.

For plants in the SE region the prices of electricity by 14%, going up to €128.24/MWh, the highest electricity prices of the regions in the EU.

Plants in the NWE region reported an increase in the electricity prices to €148/MWh in 2022Q1, an increase of 21% when compared to 2021. For plants in the CE and SE region, the increase in their reported electricity costs was of 41% for both, going up to €201.42/MWh and €222.95/MWh respectively.

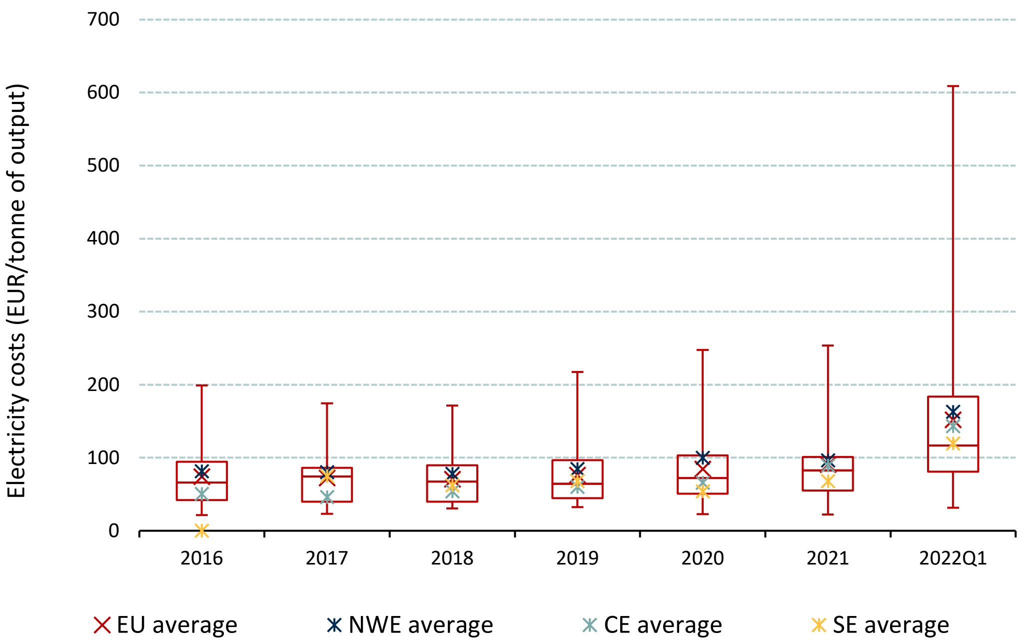

Figure 18: Electricity costs for downstream aluminium plants (EUR/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 21 plants in 2016, 23 plants for 2017 -2018, 26 plants in 2019, 28 plants in 2020-2021, and 27 plants in 2022Q1.

Table 19: Average electricity costs of sampled downstream aluminium plants (EUR/tonne) - simple averages.

Electricity costs (EUR/tonne)	2016	2017	2018	2019	2020	2021	2022Q1

EU average	73.92	71.99	70.48	75.96	84.62	90.38	152.02
NWE average	81.49	80.14	77.70	84.61	99.74	96.21	162.82
CE average	50.40	45.78	53.96	59.77	65.60	89.16	143.14
SE average	N/A	74.92	61.97	67.62	53.61	67.71	119.44

Source: Own elaboration with data from aluminium companies.

Natural gas costs

Primary and secondary aluminium

Figure 19 show an increase in the natural gas costs per tonne of output borne by primary aluminium smelters in the EU in €/tonne. On average, plants across the EU increased their natural gas costs per tonne of output from €24.82/tonne in 2016 to €36.34/tonne in 2018 and decreased slightly to €27.77/tonne in 2020. In 2021, natural gas costs rose up to €214.24/tonne. This increase was likely due to an increase in natural gas prices, paired with an increased intensity of natural gas per tonne of output in 2021 (see section B.1.9 for a discussion of energy intensity of the sector).

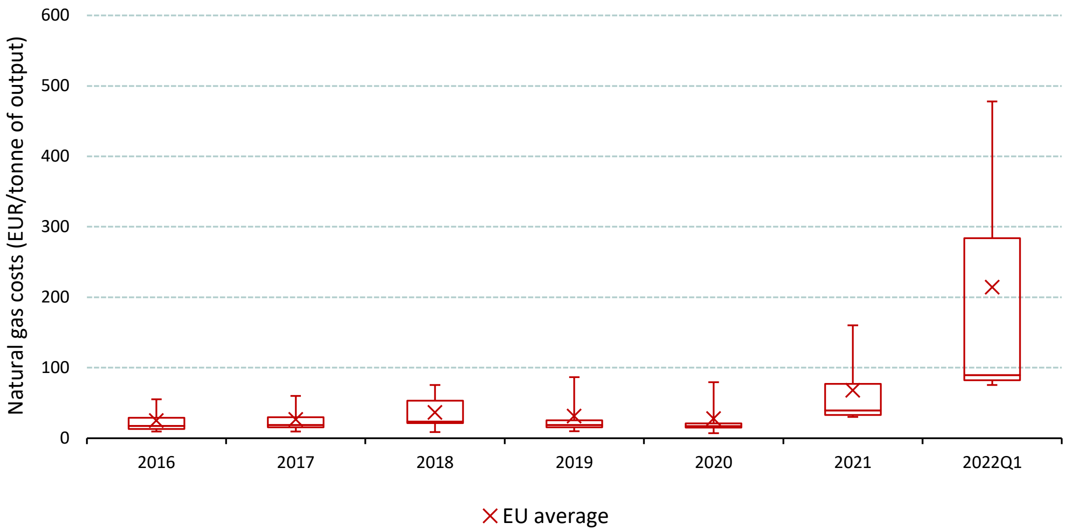

Figure 19: Natural gas costs for primary aluminium plants (€/tonne) - Box plots and simple averages

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 4 plants in 2016 and 2017, 5 plants in 2018 -2021, and from 3 plants in 2022Q1.

In the case of secondary aluminium plants, natural gas costs per tonne of output did not follow a particular trend; they oscillated from €28.63/tonne in 2016 to €27.09/tonne in 2020. In 2021, the sector faced higher natural gas costs per tonne of output, up to €31.53. Notably, the increase of natural gas costs per tonne of output in 2021 was less severe for secondary aluminium than those of primary aluminium. This can be explained by:

- the sharp increase in natural gas intensity (see section B.1.9 for more details) resulting from the curtailments reported by primary aluminium producers (see section B.1.6).
- the lower natural gas price observed in secondary aluminium plants (see section B.1.7), indicating the presence of energy contracts.

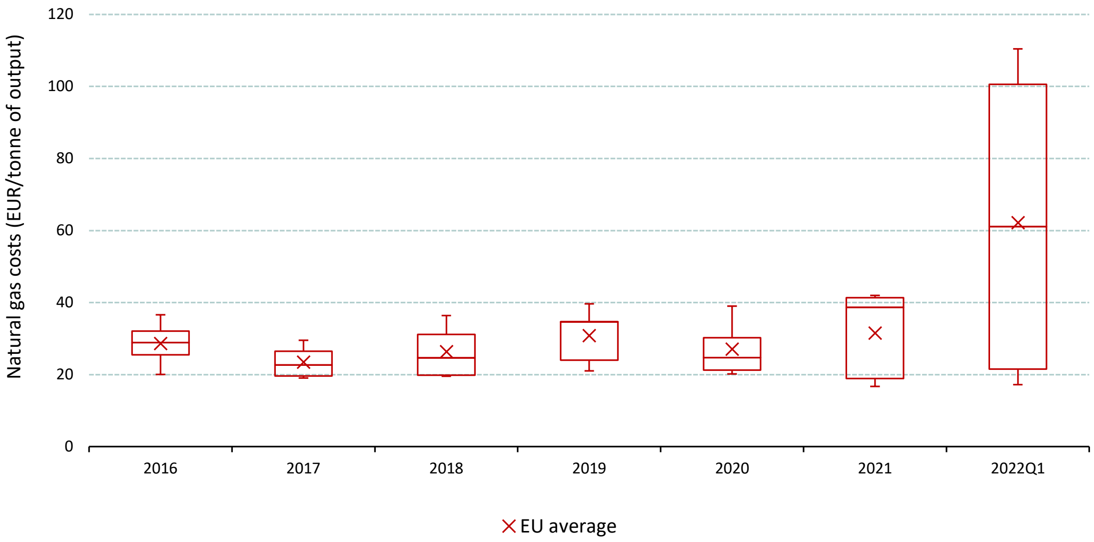

Figure 20: Natural gas costs for secondary aluminium plants (€/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from four plants in 2016 -2018, and from five plants in 2019 - 2022Q1.

Table 20: Average natural gas costs paid by sampled EU primary aluminium plants (€/tonne) - simple averages.

Natural gas costs (€/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	24.82	26.65	36.34	31.15	27.77	67.87	214.24
Secondary aluminium - EU	28.63	23.48	26.33	30.81	27.09	31.53	62.19

Source: Own elaboration with data from aluminium companies.

Downstream aluminium

The average costs of natural gas for downstream aluminium plants in the EU followed a decreasing trend from 2016 to 2020. It went from €31.45/tonne in 2016 to €30.61/MWh in 2020. In 2021 the natural gas costs rose up to €39.54/tonne, while for 2022Q1 preliminary figures show a sharp increase of up to €93.32/tonne (see Figure 21 and Table 21).

Plants located in the NWE region had on average the lowest natural gas costs, which can be attributed to their lower natural gas intensity. In 2021, their natural gas intensity increased, but their moderate increase of natural gas prices allowed them to maintain stable natural gas costs, at €32.38/tonne.

Plants in the SE had the highest natural gas costs during the whole period analysed. In 2021, the range of regional average went up to €65.19/tonne. This is in line with the rise of natural gas prices of the SE region (see section B.1.7) and their increased natural gas intensity (see B.1.9).

For the CE region, natural gas costs also rose sharply during the same period, up to €104.63/tonne, even though the natural gas intensity of plants in the CE region decreased from 2020-2021 (see section B.1.9). Therefore, we can conclude that the increase of costs was mainly caused by their increased natural gas prices.

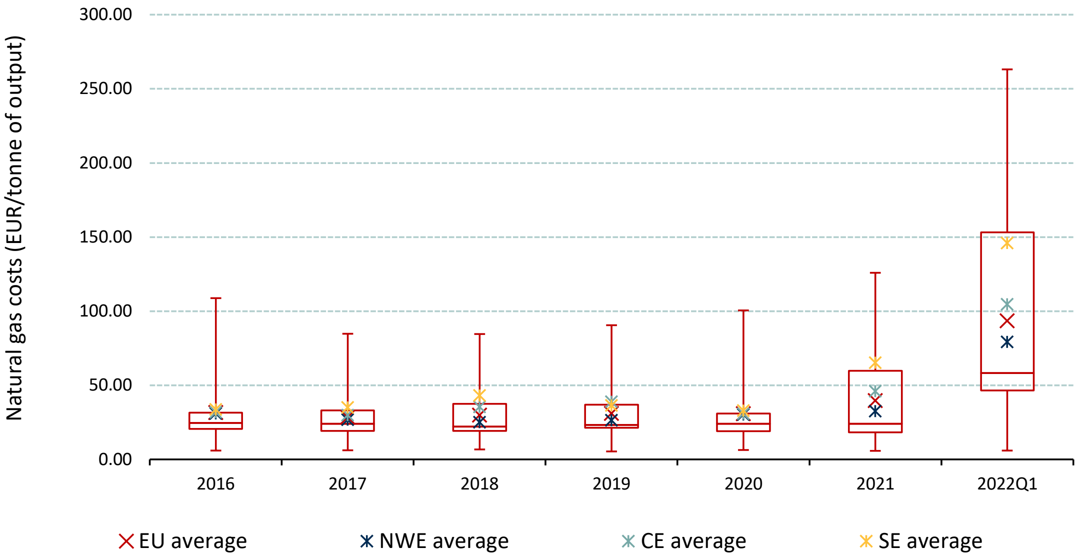

Figure 21: Natural gas costs for downstream aluminium plants (EUR/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.

Notes: based in answers from 21 plants in 2016, 22 plants for 2017 -2018, 25 plants in 2019, 27 plants in 2020-2021, and 25 plants in 2022Q1.

Table 21: Average natural gas costs of sampled downstream aluminium plants (EUR/tonne) - simple averages.

Natural gas costs (EUR/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
EU average	31.45	28.45	29.80	30.98	30.61	39.54	93.32
NWE average	30.88	26.60	24.99	26.28	30.16	32.38	79.22
CE average	31.69	29.79	35.32	38.81	30.73	45.92	104.63
SE average	33.52	34.89	43.07	36.26	32.91	65.19	145.87

Source: Own elaboration with data from aluminium companies.

B.1.9 Energy intensity

Electricity intensity

Primary and secondary aluminium

For primary aluminium, **electricity intensity remained relatively constant between 2016 and 2020, oscillating at around 14.21 MWh/tonne of output.** The EU average electricity intensity peaked in 2018, at 14.43 MWh/tonne of output, while in 2021 it went down to 13.97 MWh/tonne of output. Some plants reported reducing their electrolytic aluminium production, and feeding their casthouses with purchases of secondary aluminium and scraps. In this scenario, more natural gas is consumed to compensate for the lack of heat of the liquid aluminium coming from the electrolysers. The decreased average EU electricity intensity for the preliminary figures of 2022Q1, at 13.0 MWh/tonne of output can be attributed to the lower sample size, with fewer plants from the NWE region providing data for this period.

Plants in the NWE region reported higher electricity intensity than the EU average, with an average of 15.62 MWh/tonne of output during the same period. It should be noted that electricity consumption is closely linked to the level of usage of capacity; therefore curtailed plants face higher inefficiencies in their process.

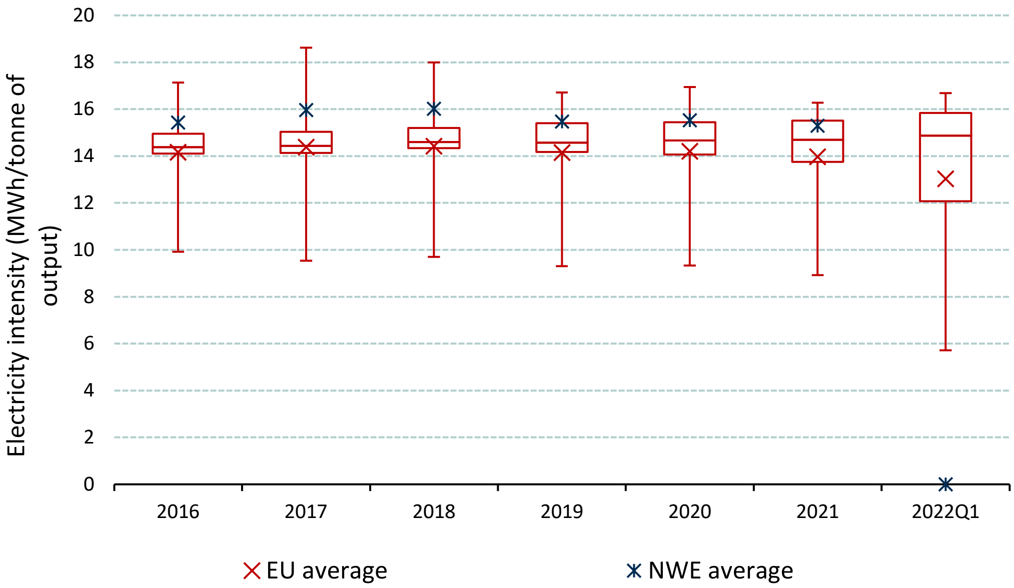

Figure 22: Electricity intensity for primary aluminium plants (MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from six plants in 2016 -2021, and from four plants in 2022Q1.

The electricity intensity for secondary aluminium plants in the EU was stable from the 2016-2018 period, at 0.12 MWh/tonne of output. In 2020, the electricity intensity peaked at 0.15 MWh/tonne, but decreased to 0.14 MWh/tonne in 2021. Preliminary figures for 2022Q1 show it further decreased, down to 0.13 MWh/tonne.

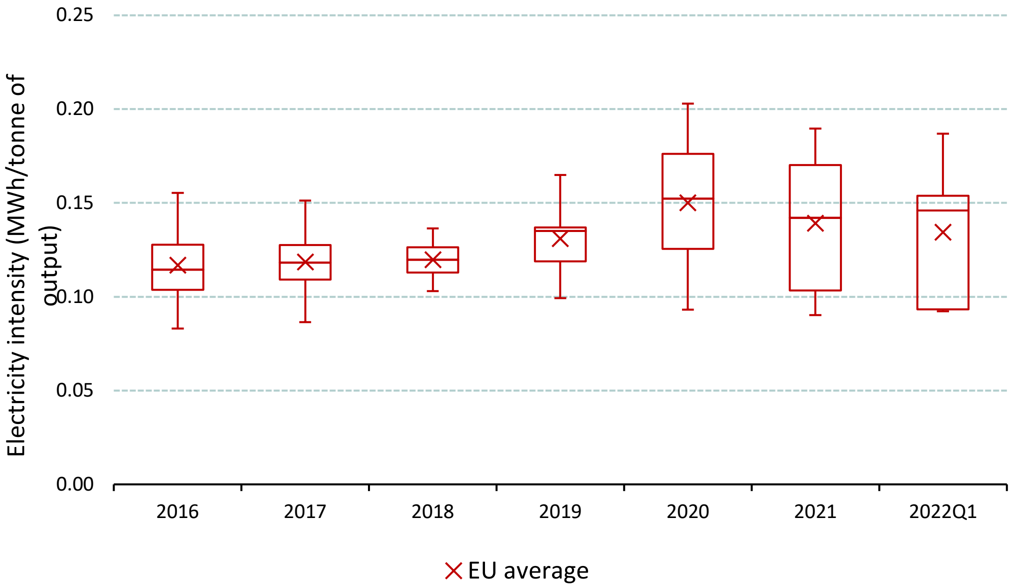

Figure 23: Electricity intensity for secondary aluminium plants (MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 4 plants in 2016 -2018, and from 5 plants in 2019 - 2022Q1.

Table 22: Average electricity intensity of sampled primary and secondary aluminium plants (MWh/tonne) - simple averages.

Electricity intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	14.16	14.38	14.43	14.15	14.20	13.97	13.03
Primary aluminium - NWE	15.43	15.96	16.02	15.48	15.53	15.29	N/A
Secondary aluminium - EU	0.12	0.12	0.12	0.13	0.15	0.14	0.13

Source: Own elaboration with data from aluminium companies.

Downstream aluminium

In the case of downstream aluminium activities, the average electricity intensity of extrusion and rolling European plants followed a decreasing trend, from 0.95 MWh/tonne of output in 2016 to 0.88 MWh/tonne in 2021. During the first quarter of 2022, the electricity intensity increased slightly, up to 0.92 MWh/tonne.

Plants in the NWE region had in average higher electricity intensity than those of the CE and SE counterparts. Between 2020 and 2021, the average electricity intensity of NWE downstream plants decreased from 1.05 to 0.99 MWh/tonne, but preliminary figures for 2022Q1 show that the average electricity intensity of plants in this region increased considerably, peaking up at 1.11 MWh/tonne.

On the other hand, the plants in the CE and SE regions reduced their electricity intensity in the same period. Plants in the CE region reduced their average electricity intensity from 0.82 MWh/tonne in 2020 to 0.80/MWh in 2021, but reported a considerable reduction for 2022Q1, down to 0.68/MWh. Plants in the SE region have the lowest average electricity intensity, at 0.56/MWh in 2020, and down to 0.53 MWh/tonne in 2022Q1.

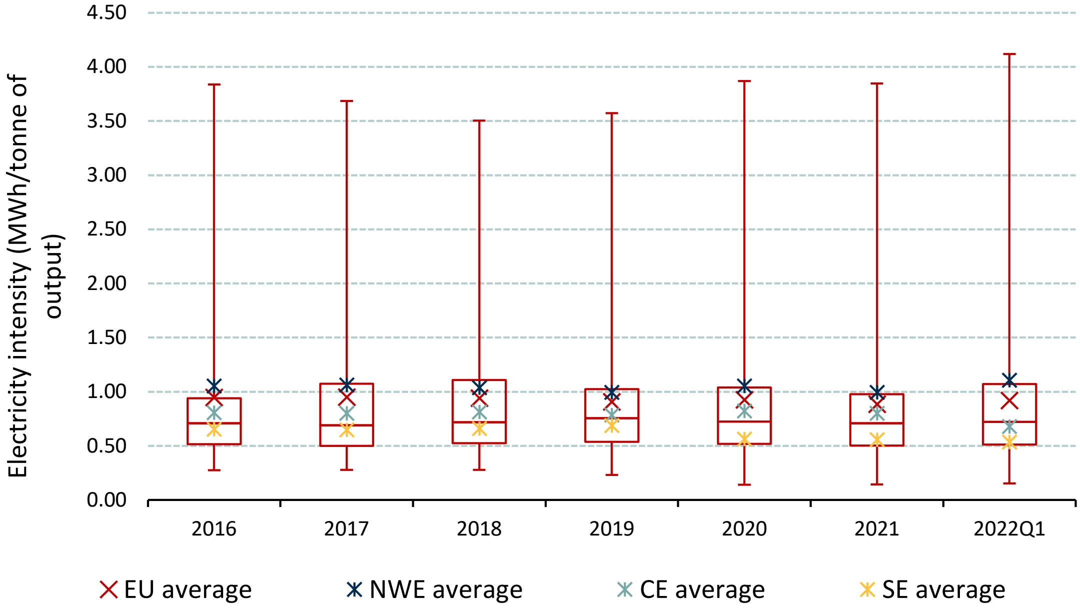

Figure 24: Electricity intensity for downstream aluminium plants (MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 23 plants in 2016 -2018, 27 plants in 2019, and from 28 plants in 2020 - 2022Q1.

Table 23: Average electricity intensity of sampled downstream aluminium plants (MWh/tonne) - simple averages.

Electricity intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
EU average	0.95	0.95	0.94	0.90	0.92	0.88	0.92
NWE average	1.05	1.06	1.04	0.99	1.05	0.99	1.11
CE average	0.81	0.80	0.81	0.78	0.82	0.80	0.68
SE average	0.65	0.65	0.66	0.69	0.56	0.56	0.53

Source: Own elaboration with data from aluminium companies.

Natural gas intensity

Primary and secondary aluminium

Figure 25 and Table 24 indicate natural gas intensity of primary aluminium production at the EU level was maintained stable, ranging between 1.44 to 1.55 MWh/tonne between 2016 and 2020. The NWE region initially decreased its natural gas intensity in years 2016 to 2020, but in 2021, it reported an increase up to 1.6 MWh/tonne. The natural gas intensity of primary aluminium smelters in the EU reached 3.44 MWh/tonne in the first quarter of 2022, which could indicate the switch from using primary aluminium to the use of more scraps, as mentioned above. Moreover, restarting electrolytic cells that have been idled requires natural gas to heat them up.

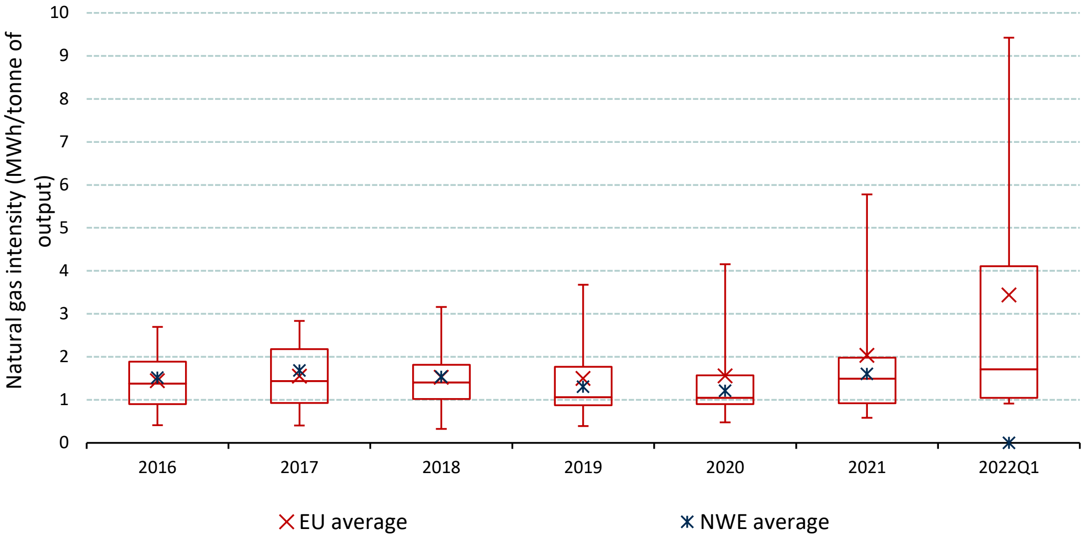

Figure 25: Natural gas intensity of primary aluminium producers(MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from six plants in 2016 -2021, and from four plants in 2022Q1.

The natural gas intensity of secondary aluminium production has remained relatively stable during the 2016-2021 period. It followed a decreasing trend, going from 1.26 MWh/tonne in 2016 to 1.20 MWh/tonne in 2018. In 2018 it increased again to 1.25 MWh/tonne, decreasing to 1.20 MWh/tonne in 2021, with preliminary figures for 2022Q1 suggesting a further decrease to 1.19 MWh/tonne.

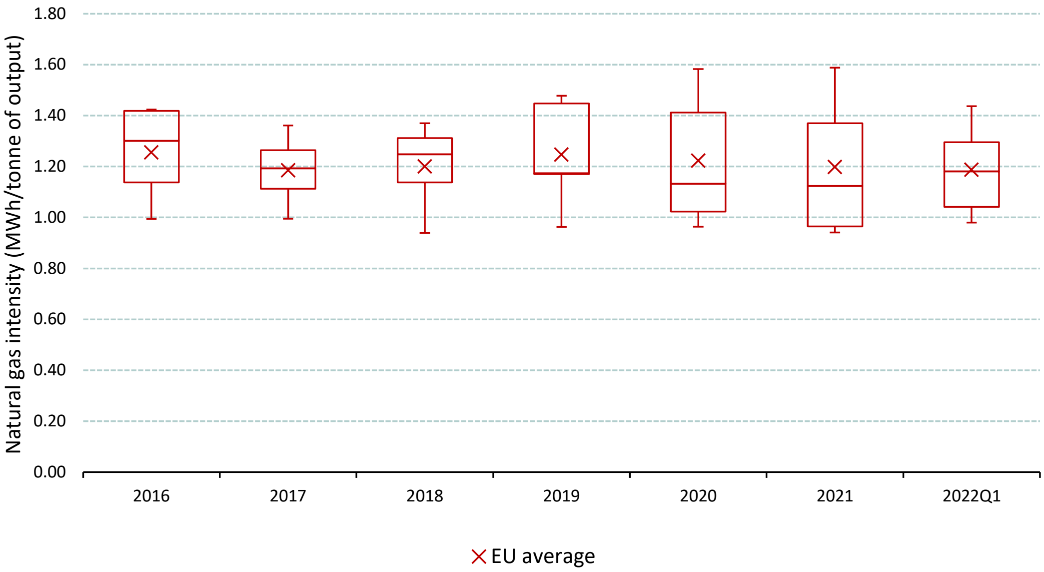

Figure 26: Natural gas intensity of secondary aluminium producers (MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from four plants in 2016 -2018, and from five plants in 2019 - 2022Q1.

Table 24: Averages of natural gas intensity of sampled EU primary and secondary aluminium plants (MWh/tonne) - simple averages.

Natural gas intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
Primary aluminium - EU	1.44	1.55	1.52	1.50	1.55	2.04	3.44
Primary aluminium - NWE	1.52	1.68	1.54	1.30	1.21	1.60	N/A
Secondary aluminium - EU	1.26	1.19	1.20	1.25	1.22	1.20	1.19

Source: Own elaboration with data from aluminium companies.

Downstream aluminium

The natural gas intensity for downstream aluminium plants in the EU initially followed a decreasing trend, going from 1.24 MWh/tonne in 2016 to 1.18 MWh/tonne in 2018. Since 2019, this has changed to an increasing trend, going from 1.22 MWh/tonne in 2019 to 1.27 MWH/tonne in 2021. For 2022Q1, preliminary figures show an increase in the natural gas intensity up to 1.40 MWh/tonne.

From 2016 to 2021 the natural gas intensities of downstream aluminium plants was the opposite than those from electricity: plants in the NWE region had in average lower natural gas intensity, followed by plants in the CE, while plants in the SE were the most natural gas intensive. In recent years, the natural gas intensity of plants in the CE region has been relatively stable; in 2021, the region's average was at the same level as in 2018, at 1.43 MWh/tonne. Contrary to the other EU regions, the preliminary figures for 2022Q1 show the natural gas intensity of plants in the CE decreased down to 1.31 MWh/tonne.

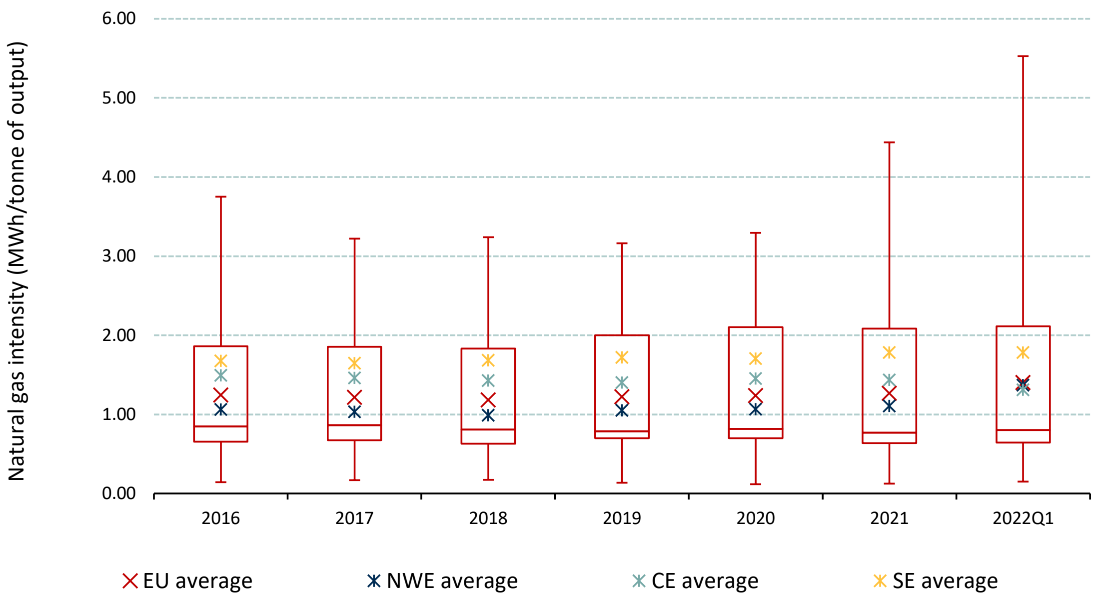

Figure 27: Natural gas intensity of downstream aluminium producers (MWh/tonne) - Box plots and simple averages.

Source: Own elaboration with data from aluminium companies.
Notes: based in answers from 22 plants in 2016 -2018, from 26 plants in 2019, and from 27 plants in 2020 - 2022Q1.

Table 25: Averages of natural gas intensity of sampled EU downstream aluminium plants (MWh/tonne) - simple averages.

Natural gas intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
EU average	1.24	1.21	1.18	1.22	1.24	1.27	1.40
NWE average	1.06	1.03	0.99	1.05	1.07	1.11	1.37
CE average	1.49	1.46	1.43	1.40	1.45	1.43	1.31
SE average	1.67	1.65	1.68	1.72	1.70	1.78	1.78

Source: Own elaboration with data from aluminium companies.

B.2 Ferro-Alloys and Silicon

B.2.1 Introduction

This section is based on the Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries[21] published by the European Commission, JRC, European Integrated Pollution Prevention and Control (IPPC) Bureau (EIPPCB).

This report has been developed in consultation with EuroAlliages, the Association of European Ferro-alloy Producers.

Characteristics of the product

Ferro-alloys are master alloys that contain some iron and one or more non-ferrous metals as alloying elements. Silicon metal is produced in the same metallurgical process as ferro-silicon. Ferro-alloys are used for various purposes in steelmaking, enabling alloying elements such as chromium, silicon, manganese, nickel, vanadium and molybdenum to be safely and economically introduced into metallurgical processes, thus giving certain desirable properties to the alloyed metal. These include increased corrosion resistance, strength, hardness, wear resistance and electrical conductivity. Ferro-alloys are also widely used to remove impurities from steel, especially oxygen and sulphur.

The importance of ferro-alloys increased with the progress of steel metallurgy, which demanded diversified alloying elements to achieve better controlled quantities in purer and more advanced steel qualities. The ferro-alloy industry has become a key supplier of the steel industry.

Silicon metal is used as an alloying element in the manufacturing of aluminium, in the silicone and electronic industries, and in the manufacturing of solar cells.

Ferro-alloys are usually classified in two groups:

- bulk ferro-alloys (ferro-chrome, ferro-silicon together with silicon metal, ferro-manganese, silico-manganese and ferro-nickel), which are produced in large quantities in electric arc furnaces. The questionnaire answered by industry during the present study and presented in B.2.4 to B.2.4 below, covers these bulk ferro-alloys (except ferro-nickel);
- special ferro-alloys (ferro-titanium, ferro-vanadium, ferro-tungsten, ferro-niobium, ferro-molybdenum, ferro-boron, alloyed or refined ferro-silicon, silicon metal and ternary/quaternary alloys) which are produced in which are produced in varying quantities, with silicon metal and ferro-silicon increasingly produced in bulk.

Bulk ferro-alloys are primarily used in steelmaking and steel or iron foundries, with nickel and chromium also substantially used in the aerospace industry. The uses of special ferro-alloys are far more varied, and the proportion used in steelmaking has diminished over recent years in favour of those used in the aluminium and chemical industries, especially silicon products.

Main areas of usage

According to the Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries, the areas of usage for ferro-alloys depend upon the nature of the ferro-alloy:

- Ferro-chrome, along with nickel (ferro-nickel), is the major alloying element in the production of stainless steel. Stainless steel is used in a wide variety of areas, many related to consumer products and white goods, as well as applications requiring significant corrosion resistance;
- Ferro-silicon is primarily used to remove oxygen from molten steel. It can also be used as a reducing agent in steel, and adds electrical conductivity to certain specialised steel grades;

[21] Cusano et al. (2017). Best Available Techniques (BAT) Reference document for the non-ferrous metals industries. *JRC science for policy report*. Available at: https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC107041_NFM_bref2017.pdf

- Silicon metal is important as an alloying element in aluminium and for the production of silicones, electronic products and solar applications;
- Ferro-manganese and silico-manganese are mostly used to desulphurise steel, and to improve its strength, hardness and wear resistance;
- Ferro-vanadium increases the tensile strength and the high-temperature strength of carbon steel even if small amounts are added. Vanadium alloyed steel is therefore used for high-speed cutting tools;
- Tungsten increases the high-temperature strength and wear resistance of steel. Such steel (high-speed steel) is needed to produce high-speed cutting tools that can be used up to temperatures of about 600 ºC. Tungsten will also increase a number of other properties of the steel, such as the hardness, yield strength and the ultimate tensile strength;
- Ferro-titanium increases yield strength and reduces the cracking tendency;
- Ferro-boron increases the hardenability, creep resistance and hot workability of steel because boron-alloyed steel is oxidation-resistant up to 900 ºC;
- Ferro-niobium improves the corrosion resistance and weldability of steel and especially prevents the inter-crystalline corrosion of stainless chrome-nickel steel.

NACE codes

The manufacture of ferro-alloys is classified under the following NACE rev.2 code: 24.10 Manufacture of basic iron and steel and of ferro-alloys.

The manufacture of silicon is classified under NACE rev.2 code: 20.13 Manufacture of other inorganic basic chemicals

However, the NACE 4 -digit level cannot adequately picture the specificities of the ferro-alloys and silicon industry.

Stages in the production process

The processes to manufacture ferro-alloys all follow all the same pattern:

- The metallic ore, an oxide, is reduced into a ferrous alloy in an chemical reaction at high temperature performed in an electric arc furnace, by mixing it with iron and a "reducing agent", generally carbon (in the form of pure metallurgic coke) for carbon-rich ferro-alloys, but sometimes silicon or aluminium for certain special alloys. This process, also called smelting is energy-intensive:
- The reduction of the oxide, because of the high temperatures needed to melt it with the electric arc, and because the "reduction" chemical reaction consumes large amounts of energy.

The energy consumption per tonne of metal differs greatly from one ferro-alloy to another. One reason is the difference in the chemical bonding strengths to oxygen for different elements in the ore (and hence the energy needed to break that bond during the chemical reaction) and the temperature required for the chemical reactions to proceed. Silicon, for instance, has both a higher bonding energy and requires higher process temperatures than manganese. Other reasons are variations in the metal content of the ore or concentrate and the final product, and the metal yield that it is possible to obtain for different ferro-alloys.

B.2.2 Economic situation of the sector

The summed production values of ferro-alloys (specifically, bulk ferroalloys not including minor alloys) and silicon are depicted in the Figure 28 below. The production value of ferro-alloys dropped sharply in 2009 before recovering in 2010. From 2010-2013, production values of ferro-alloys and silicon oscillated at around 1.5 billion. Between 2014-2018 production values grew, ranging between 2.5 and 2.8 billion

Euros. Figures for 2019-2021 are not publicly available, as data was only available for ferro-alloys production of Spain and Finland.

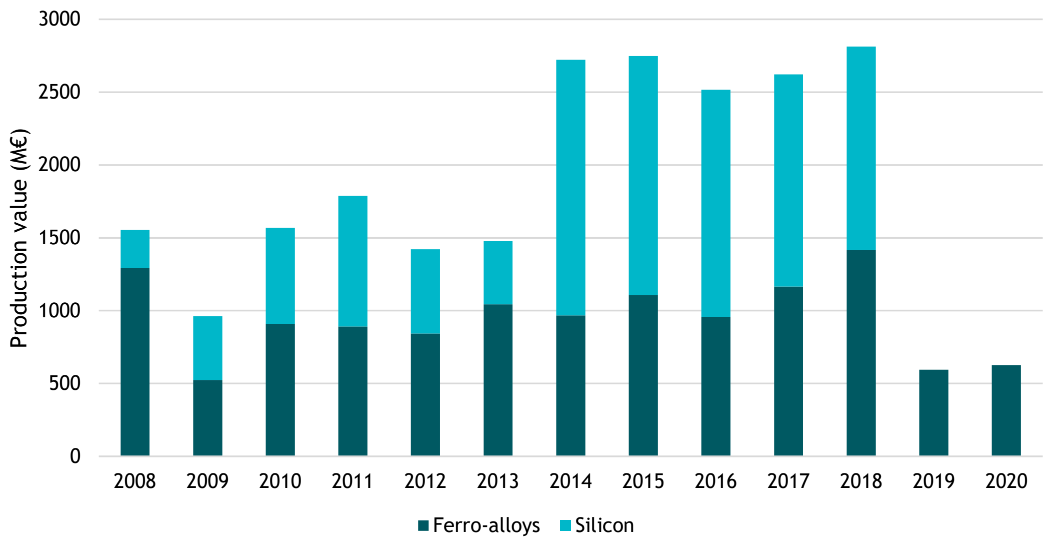

Figure 28: Trends in production value of ferro-alloys and silicon in the EU27 (M€).

Source: Own elaboration based on PRODCOM.

Note: production values figures for 2019 and 2020 were only available for Spain and Finland (ferro-alloys), while values were zero for all countries in the case of silicon in the same years.

Concerning production output, figures shared by Euroalliages show a decreasing trend for production of ferro-alloy and silicon since years 2017, with production output decreasing to 588 ktonnes by 2020; around 60% of the production levels of 2017 (see Figure 29). In 2021, production output slightly recovered reaching 754 ktonnes. In particular, ferroalloys production (including FeSi, SiMn, HCFeMn and MCFeMn) decreased from 951 ktonnes in 2017 to 754 ktonnes in 2021, while silicon production went from a range of 190-230 ktonnes in 2017 to a range of 150-190 ktonnes in 2020.

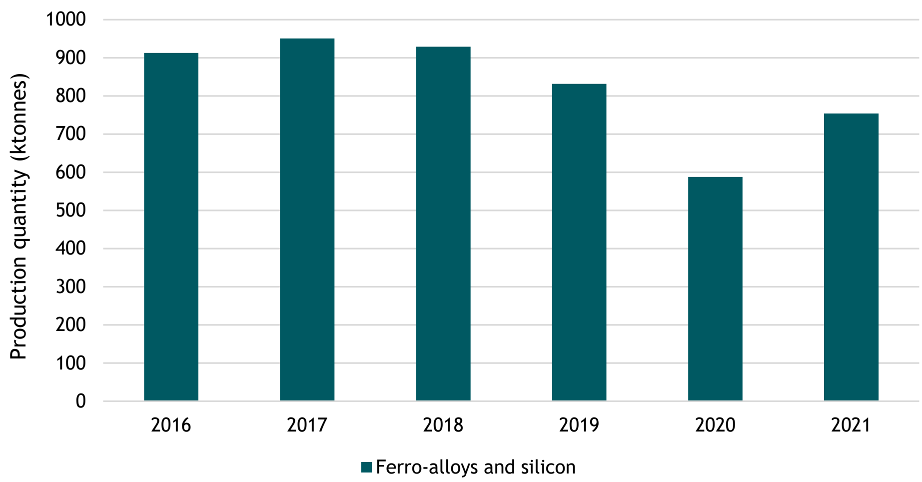

Figure 29: Trends in production quantity of ferro-alloys and silicon in the EU27 Member States (thousand tonnes).

Source: own elaboration based on data shared by Euroalliages.

According to Euroalliages, production value for ferro-alloys is concentrated in Finland and Spain, and to a lower extent in France, Sweden, Slovakia, and Germany. Consequently, companies in the EU ferro-alloys and silicon sector are also concentrated in a limited number of Member States, with most active furnaces located in France, Germany, Slovakia, Spain and Poland.

B.2.3 Trade situation of the sector

The EU27 is a net importer of both ferro-alloys and silicon and does not cover its needs with internal production. According to COMEXT data, trends in the imports and exports of ferro-alloys followed a decreasing trend between 2008-2016. After 2016 they started to slowly increase until 2018, before decreasing sharply to 1,930 million Euros in 2020. By 2021 imports sharply increased to over 3,000 million Euros. Exports of ferro-alloys remained steady between 2008-2021, gradually reaching their highest point of 762 million Euros in 2018. Afterwards, ferro-alloy exports dropped to 575 million Euros in 2021.

Silicon imports and exports both fell in 2009; imports grew steadily until 2015 before dropping in 2016 and 2017. Imports rose again in 2018, reaching 643 million Euros. By 2020 imports dropped again to 501 million Euros, but rose to 569 million Euros in 2021. Silicon exports have oscillated since 2010, with relatively lower values (~36 million Euros) in 2013, 2014, 2018, and 2019, and relatively higher values (~55 million Euros) in 2015, 2016, 2017 and 2020. In 2021 silicon exports reached a historical peak of 72 million Euros.

For both ferro-alloys and silicon, the international trade situation of the EU is that of external dependency: a very large fraction of the internal market needs are covered by extra-EU imports, whereas exports to extra-EU countries remain at a fraction of these extra-EU imports.

Figure 30: Trends in trade balance of ferro-alloys in the EU27 Member States (M€).

Source: COMEXT (2022).

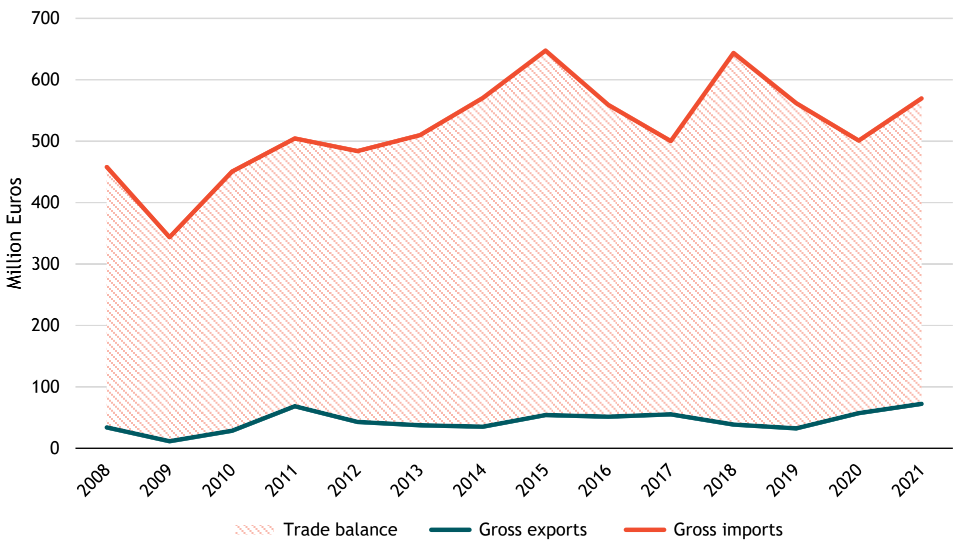

Figure 31: Trends in trade balance of silicon in the EU27 Member States (M€).

Source: COMEXT (2022).

The EU ferro-alloys sector is very exposed to international trade. Production value figures are unreliable for years 2019 -2021, but based on years 2008-2018, the share of internal consumption in the EU market served by extra-EU imports was on average around 87%. Additionally, the share of the EU production dedicated to extra-EU exports rose from 35% to 65% between 2008-2010 before levelling out to ~55% between 2011-2018.

Table 26: Exposure of ferro-alloys in the EU27 to international trade.

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross exports (M€)	450	340	587	518	639	545	553	487	450	602	711	641	475	575
Gross imports (M€)	5,787	2,205	3,844	4,184	3,512	2,672	2,726	2,756	2,289	2,906	3,169	2,533	1,930	3,087
Production value (M€)	1,292	524	910	891	843	1,044	967	1,108	958	1,165	1,417	595	626	-
Internal consumption (M€)	6,630	2,389	4,167	4,558	3,717	3,171	3,140	3,377	2,797	3,469	3,875	2,487	2,081	N/A
Share of internal consumption served by extra-EU imports	87%	92%	92%	92%	95%	84%	87%	82%	82%	84%	82%	102%	93%	N/A
Share of production dedicated to extra-EU exports	35%	65%	65%	58%	76%	52%	57%	44%	47%	52%	50%	108%	76%	N/A

Source: COMEXT (2022) and PRODCOM (2022).
Note: production value figures are incomplete for years 2019-2021, with available data only for Spain and Finland.

The EU silicon sector is likewise highly exposed to international trade, with the share of internal consumption served by exports oscillating between 27%-67% between 2008-2018. On average, 5% of EU-produced silicon has been dedicated to exports. There are no production value figures for years 2019-2021.

Table 27: Exposure of silicon in the EU27 to international trade.

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross exports (M€)	34	11	28	68	43	37	35	54	51	55	38	32	57	72
Gross imports (M€)	458	343	451	504	484	510	570	647	559	500	643	562	501	569
Production value (M€)	263	438	660	897	579	434	1,756	1,640	1,559	1,456	1,396	-	-	-
Internal consumption (M€)	686	770	1,083	1,333	1,020	906	2,291	2,233	2,067	1,901	2,000	N/A	N/A	N/A
Share of internal consumption served by extra-EU imports	66.7%	44.6%	41.6%	37.8%	47.4%	56.3%	24.9%	29.0%	27.0%	26.3%	32.2%	N/A	N/A	N/A
Share of production dedicated to extra-EU exports	12.9%	2.6%	4.3%	7.6%	7.4%	8.6%	2.0%	3.3%	3.3%	3.8%	2.8%	N/A	N/A	N/A

Source: Data provided by Euroalliages and AlloyConsult (2020).COMEXT (2022) and PRODCOM (2022).
Note: production value figures are not available for years 2019-2021.

The main extra-EU sources of ferro-alloy imports during the 2008-2020 period were South Africa, Norway, Brazil and the United Kingdom which together account for around 69% of imports; the main extra-EU export destinations for ferro-alloys were the United States and the United Kingdom, which account for 55% of exports.

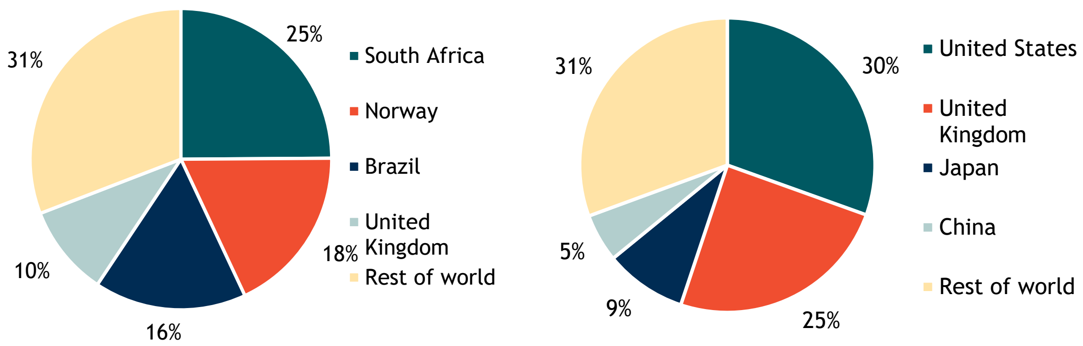

Figure 32: Distribution of imports (left) and exports (right) of ferro-alloys in the EU27 Member States.

Source: COMEXT (2022).
Notes: based on average import/export levels between 2008-2021.

The main provider of silicon imports is Norway, which accounted for 51% of EU27 imports between 2008-2021, followed by China and Brazil, accounting for 16% each. The main destinations for exports are the United Kingdom and the United States, which receive 80% of EU silicon exports.

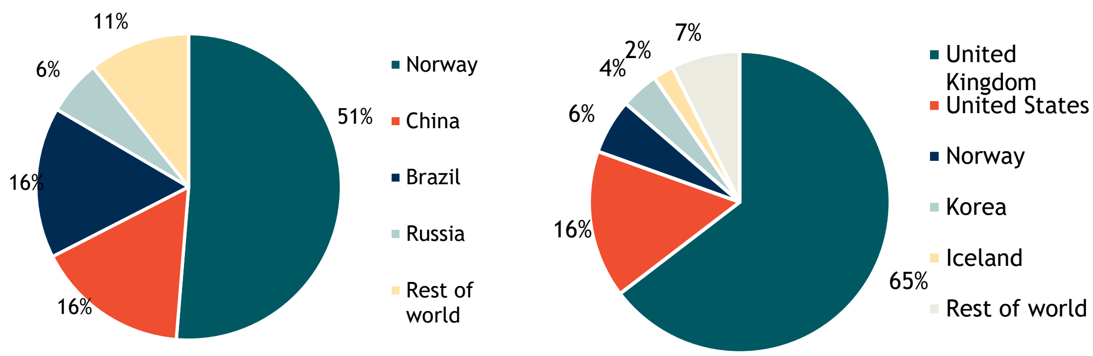

Figure 33: Distribution of imports (left) and exports (right) of silicon in the EU27 Member States.

Source: COMEXT (2020).
Notes: based on average import/export levels between 2008-2021.

B.2.4 Sample statistics

The sample consists of six installations in Europe (EU27) out of the 21 installations in the EU. The sample is spread across four Member States with installations in the EU. Due to confidentiality reasons, the countries included in the sample cannot be delineated. The product spread of the surveyed plants was as follows: three plants producing Ferro-alloys (FeSi, FeCr), two plants producing silicon metal and one producing Manganese alloys (FeMn and SiMn) (see Table 28). [22]

[22] There were also 2 questionnaire received for plants in the non-EU NWE region, however these were excluded from the analysis as at least three plants from three different companies are required in order to provide an average for the region.

Table 28: Ferro-alloys and silicon plants participating in the survey

Geographical regions	Questionnaires collected
Ferro-alloys	3
Silicon metal	2
Manganese alloys	1
Total	6

In terms of representativeness, the sample accounts for 64% of the EU27 production output of ferro-alloys and silicon in 2021.[23]

Table 28 describes the ranges of installed capacity from the 6 plants that provided information on annual production capacity of ferro-alloys and silicon. For confidentiality reasons it is not possible to present production capacities for individual plants in the sample.

Table 29: Plant capacity range of the sample.

Capacity range (thousand tonnes/year)	Share of plants in sample
<100	50%
100-200	33%
>200	17%

Source: Own elaboration with data from ferro alloys companies.

B.2.5 Competitiveness

Table 30 presents an overview of the indicators used in this section to analyse the competitiveness of the ferro-alloys and silicon sector.

Table 30: Overview of energy costs as a share of production costs, and energy costs as a share of turnover (€/tonne, EU) - Simple averages.

Indicator	2016	2017	2018	2019	2020	2021	2022Q1
Electricity cost €/tonne	305.31	339.20	331.61	335.79	336.94	658.02	1213.92
Natural gas cost €/tonne	0.32	0.58	0.69	0.80	0.53	0.45	0.70
Personnel costs €/tonne	125.69	114.23	113.77	156.22	158.23	145.46	175.96
Other production costs €/tonne	616.71	636.31	634.32	648.44	710.06	860.34	926.84
Gross operating surplus €/tonne	156.07	389.92	293.13	93.72	123.64	261.70	N/A
Turnover €/tonne	1,204.11	1,480.25	1,373.52	1,234.96	1,329.40	1,925.97	N/A
Electricity costs as a share of production costs	29.3%	32.0%	31.8%	27.7%	27.6%	37.9%	49.4%
Natural gas costs as a share of production costs	0.03%	0.05%	0.07%	0.05%	0.04%	0.02%	0.02%
Energy costs as a share of production costs	29.3%	32.0%	31.8%	27.7%	27.6%	37.9%	49.5%
Energy costs as a share of turnover	26.5%	23.9%	23.7%	27.0%	26.9%	34.5%	N/A

Source: Own elaboration based on data from ferro-alloys and silicon companies.

Notes: The figures in this table presents the EU simple average, considering the information shared by 4 plants from 2016-2019, and 6 plants from 2020-2022Q1 on their electricity and natural gas costs, as well as the total operational production costs and turnover, weighted by their production output.

Profitability and market trends

The profitability of the ferro-alloys and silicon sector increased between 2016 and 2018, essentially due to a rise in the selling price (turnover per tonne). The market for ferro-alloys (and steel) receded again in 2019, when profitability of the sector shrank to its lowest value, at €93.72 / tonne of output (see Figure 34). The reported Turnover and GOS of the ferro-alloys and silicon plants surveyed show a clear correlation in years 2016- 2020: when the simple average turnover/tonne of product was relatively high, the simple average GOS/tonne was also high and vice-versa. This suggests ferro-alloy and silicon producers are price takers, with difficulties to adapt their prices to changes in their cost structure.

[23] Based on EU27 production output figures provided by Euroalliages.

The average turnover per tonne of product also significantly increased in 2021. This price increase was the result of a shortage of supply in the European market, particularly in the first half of 2021.[24] In the second half of 2021, energy costs and the cost of raw materials (other production costs) for the ferro-alloys sector substantially increased. Market reports show that this led to a further decrease in supply in Europe with the high energy costs causing plants to temporarily shut down, putting a further squeeze on the supply. As a result, product prices for ferro-alloys increased as exhibited by the higher turnover per tonne of product in Table 30. This enabled the sampled plants to achieve a higher GOS despite increase in production costs in 2021, particularly electricity costs.

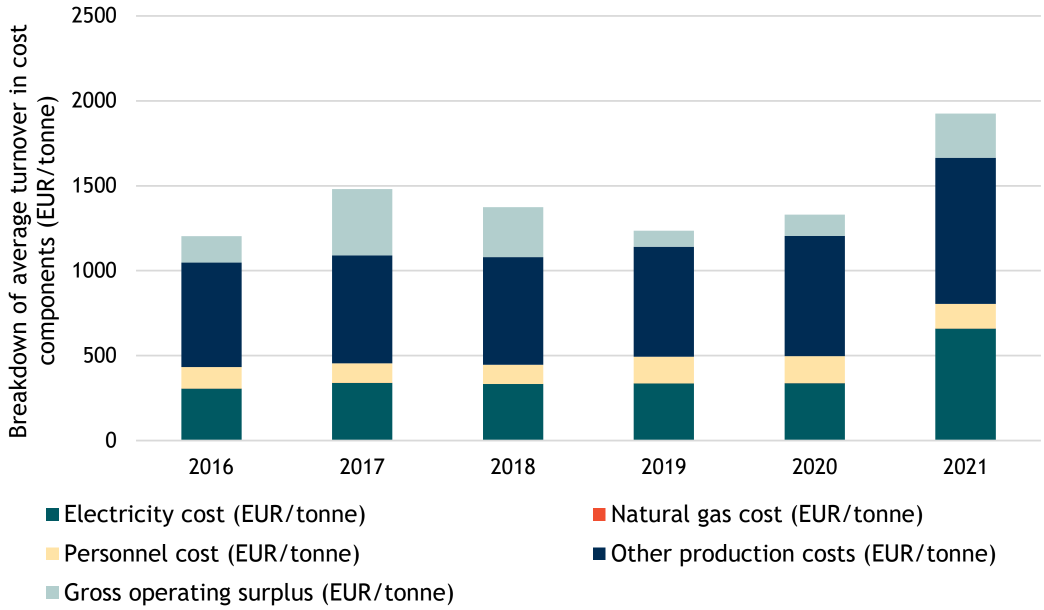

Figure 34: Energy costs, other production costs and Gross Operating Surplus of the ferro-alloys and silicon industry (€/tonne, EU), simple averages.

Source: Own elaboration with data from ferro-alloys and silicon companies.
Note: based on the answers from 4 plants from 2016 - 2018, and 6 plants from 2019-2021.

The share of energy costs compared to production costs for the sector has increased considerably since 2020. Electricity costs essentially account for the energy costs of the ferro-alloys and silicon sector. Natural gas costs are negligible (~0.1% of production costs). The average electricity costs of the surveyed plants remained relatively stable up to 2020, but almost doubled in 2021 to €658/tonne (see section B.2.8). This increase in the electricity price contributed to the reduced profitability of the sector, despite a simultaneous rise in selling prices from 1,329 €/tonne in 2020 to 1,926 €/tonne in 2021, or of 597 €/tonne (see the figure below).

Preliminary figures for 2022 show that electricity costs almost doubled again during the first quarter of the year, compared to 2021. However, in contrast to 2021, ferro-alloys market prices plummeted instead, resulting in production costs being higher than market prices. Market reports support the findings from the questionnaire: ferro-alloy prices were inflated in 2021 due to uncertainties over supply chain disruptions, while price plummeted in 2022Q1, influenced by an increased availability of cheaper Chinese supply in the European market .[25]

Ferro-alloys manufacturers view energy costs as key determinants of product competitiveness. They believe that even minimal increases in energy costs would threaten the competitiveness of EU plants which are already struggling to keep their costs as low as possible.

[24] Metalshub (2021). 2021 ferroalloys price overview. Available at: https://www.metals-hub.com/blog/2021-ferroalloys-price-overview/#:~:text=The%20FeSi%20price%20index%20is,supply%20on%20the%20spot%20market.
[25] Argus (2022). Chinese alloy weighs on EU FeSi, poses risk to FeCr. Published on 21 May 2022. Available at: https://www.argusmedia.com/en/news/2336837-chinese-alloy-weighs-on-eu-fesi-poses-risk-to-fecr

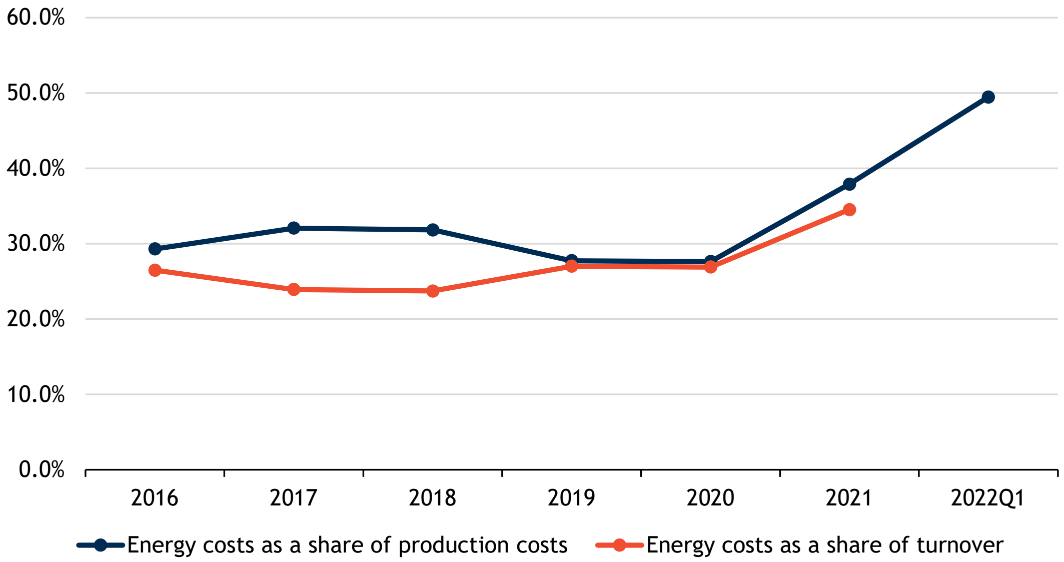

Figure 35: Energy costs as a share of production costs and as a share of turnover for the ferro-alloys and silicon industry, simple averages.

Source: Own elaboration with data from ferro-alloys and silicon companies.
Notes: This figure presents the EU simple average, considering the information shared by 4 plants from 2016 - 2018, and 6 plants from 2019-2022Q1 on their electricity and natural gas costs, as well as the total operational production costs and turnover, weighted by their production output.

B.2.6 Consequences of COVID-19 crisis and Russian invasion in Ukraine for the ferro-alloys and silicon sector

The majority of the ferro-alloys and silicon plants participating in the survey reported that the COVID-19 crisis impacted them negatively due to increased electricity prices. The COVID-19 was felt differently by the surveyed plants: some plants reported not having impacts in their production output due to the pandemic, while others reported reducing their production output due to a combination of high energy and raw material prices, together with reduced product demand.

Similarly to other non-ferrous sectors (e.g. the aluminium sector), since the start of the Russian invasion in Ukraine, the price of energy products rose even further for the ferro-alloy producers, together with increased tensions in the supply chain of raw materials causing shortages and inflation of prices.

Ukraine and Russia are direct or indirect sources of raw materials and ferro-alloy products. Since the start of the war, ferro-alloy prices skyrocketed due to concerns of supply chain disruptions for these materials. Some plants reported increasing their stock of raw materials and searching for alternatives in case future material shortages. This contributed to the price increase of ferro-alloys observed in the turnover per tonne of produced in the surveyed plants in Section B.2.4.

In 2022Q1 the situation has stabilized and ferro-alloy prices began to plummet, reaching a point below production costs. At the same time, the energy prices continued to soar due to the conflict in Ukraine. This situation caused some of the surveyed plants to drastically reduce their production output.

According to Euroalliages, the consequences of the 2022 energy prices are dramatic. A survey conducted with Euroalliages members at the beginning of September 2022 indicates that 27% of the silicon and ferro-alloys production capacities have already been curtailed in the EU27. In terms of the number of furnaces having closed down, these curtailments affect 40 % of the furnaces in the EU. Since the completion of the survey, curtailments have increased.

B.2.7 Energy prices

Electricity price

Electricity prices in €/MWh paid by EU ferro-alloys producers on average increased between 2016-2021, with preliminary figures for the first quarter of 2022 estimating it reached €156.77/MWh (Table 8, Figure 10). These electricity price include the following price components: network costs - Transmission System Operator (TSO) and Distribution System Operator (DSO) - if applicable, levies, taxes, interruptability discounts and CO2 retributions but excluding VAT. As it can be observed Figure 10, a significant share of the sampled plants experienced higher electricity prices than the sample average calculated from 2016 to 2021, these varied from 25% to 50% of the sampled plants during the observed period.

Of the surveyed plants, two plants seemed to be moderately affected by the surge of electricity prices in 2021, likely due to their procurement strategy: these plants reporting having an electricity contract of combined fixed and variable rates (see Box 5 below). One of these plants also reported demand-side flexibility investments. Notably, the plant reporting the highest electricity prices of 2021 and 2022Q1 had a fixed contract in placed for electricity, and also reported demand-side flexibility investments.

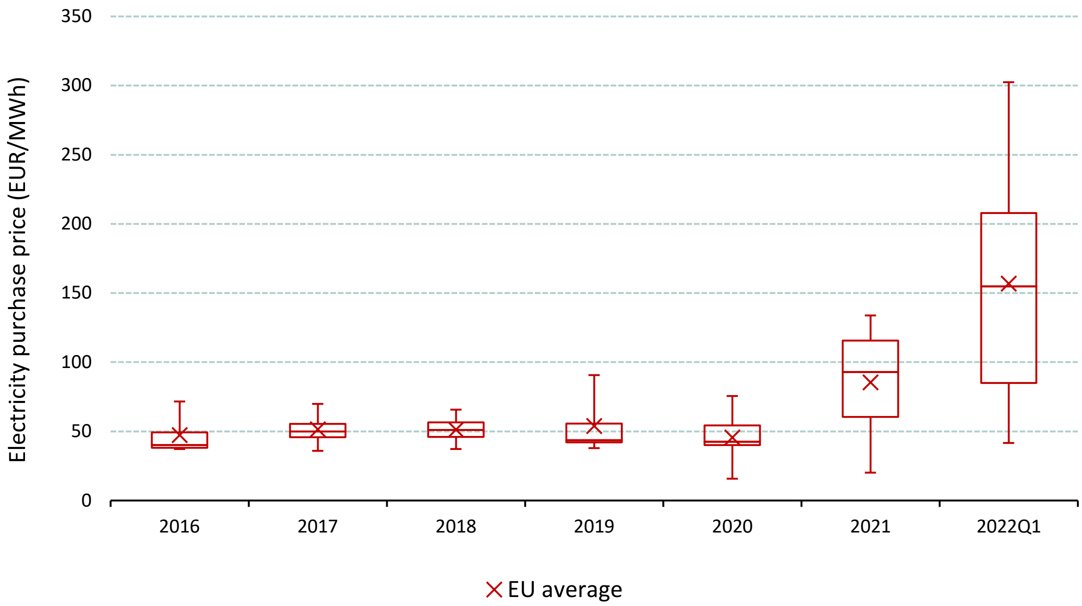

Figure 36: Electricity prices (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from ferro-alloys companies.
Note: based on the answers from 4 plants from 2016 - 2019, and 6 plants from 2020-2022Q1.

Table 31: Descriptive statistics for electricity prices paid by sampled EU ferro-alloys and silicon producers (€/MWh) - simple averages.

Electricity prices (€/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
EU average	47.23	51.33	51.26	53.91	45.55	85.41	156.77
Share of plants above sample average	25%	25%	50%	25%	33%	50%	50%

Source: Own elaboration with data from ferro-alloys companies.

Box 5: Electricity contracts of the ferro-alloy sector

For the ferro-alloy and silicon producers, 83% of the sampled plants provided details about their type and duration of electricity contracts with energy providers. For those who provided details, an overview about their electricity contracts of the sampled plants (as of June 2022) is summarised below:

- 20% of the plants reported having fixed electricity contracts, which will expire in one year or less. In theory should make them less susceptible to the recent price hikes. Nevertheless, this plant reported the highest electricity prices of the sample in 2021.
- 40% of the plants reported having variable contracts, which will expire in less than one year.

- 40% of the plants indicated having a combined electricity contract, for one plant this is due to expire in less than one year. Notably, these plants also reported the lowest electricity prices in 2021 and 2022Q1.

Table 32: Overview of the type of electricity contracts (fixed/variable/combined) of sampled primary ferro-alloy and silicon producers, the duration of these contracts and the remaining duration as of June 2022.

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed duration	20%	0%	0%
Electricity contract variable duration	40%	0%	0%
Electricity contract combined duration	0%	40%	0%

	Share of plants answering the question		
	1 year or less	>1 year	Indefinite
Electricity contract fixed remaining	20%	0%	0%
Electricity contract variable remaining	40%	0%	0%
Electricity contract combined remaining	20%	20%	0%

Source: Own elaboration based on answers from ferro-alloy companies.

Natural gas prices

We received a low number of responses on information about natural gas purchases: from the sample, four plants provided figures on volumes of natural gas purchased, their prices and costs. However, four of these did not report any consumption of natural gas (nor reported natural gas costs).[26] Due to this, it is not possible to show an average natural gas prices for the Ferro-alloys and silicon plants in the EU.

B.2.8 Evolution of energy costs

Electricity costs

On average, EU producers of ferro-alloys and silicon faced a significant increase in electricity costs in recent years, going from €305.31 per tonne of production output in 2016 to €658.02 per tonne in 2021 (cf. Figure 37 and Table 33). Reported figures for the first quarter of 2022 show electricity costs increased further, going up to €1213.92/tonne of output.

Throughout this period, 50% of the sample had higher electricity costs per tonne than the calculated average, although for the first quarter of 2022, this share went down to 33%.

None of the sampled plants reported self-producing electricity, therefore, electricity costs are directly derived from the prices of electricity and the electricity intensity per tonne of output. With the current sample it was not possible to distinguish patterns of electricity costs based on the type of products:

- One silicon metal producer had significantly higher costs than the rest of the plants, due to their high electricity prices, combined with high electricity intensity. The other silicon metal producer with similar electricity intensity experienced lower costs, due to managing to secure low electricity prices.
- Two of the ferro-alloy producers were amongst the higher electricity cost range, with both having high electricity intensity and high electricity prices. On the other hand, the third ferro-alloy plant reported the lowest electricity costs of the sample, due to a combination of low electricity intensity and securing low electricity prices.

[26] Four plants reported having no consumption of natural gas between 2020-2022Q1.

Euroalliages indicated that the electricity costs of silicon and ferro-alloys producers have increased even further after Q1 of 2022 as they are being affected by the soaring wholesale prices. Wholesale prices reached a new peak in Q2 on 22 August 2022 with prices almost doubling between Q1 and Q2 2022.

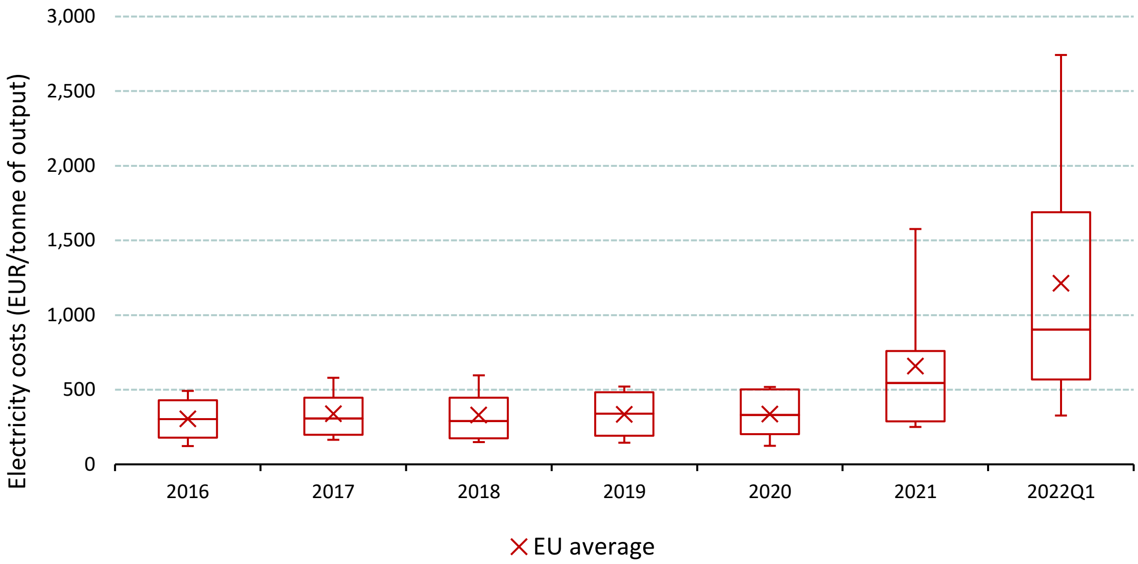

Figure 37: Electricity costs - Box plots and simple averages.

Source: Own elaboration with data from ferro-alloys companies.
Note: based on the answers from 4 plants from 2016 - 2019, and 6 plants from 2020-2022Q1.

Table 33: Electricity costs (€/tonne) - Simple averages.

Electricity costs (EUR/tonne)	2016	2017	2018	2019	2020	2021	2022Q1
Europe average	305.31	339.20	331.61	335.79	336.94	658.02	1,213.92
Share of plants above sample average	50%	50%	50%	50%	50%	50%	33%

Source: Own elaboration with data from ferro-alloys companies.

Natural gas costs

Due to the low number of plants reporting natural gas consumption (see section B.2.7) it is not possible to show box-plots figures of costs borne by producers of ferro-alloys and silicon in the EU in €/tonne.

On average, natural gas costs for ferro-alloy and silicon producers ranged between €0.58 and €0.70/tonne between 2020-2022Q1 (see Table 33).I It should be noted that from the sample of 6 plants, 4 reported they had no consumption of natural gas (which is accounted for as €0/tonne when calculating the EU average).

This seems to be in line with the trend observed in the previous iteration of the study on energy prices and costs (2020),[27] which concluded that natural gas costs of ferro-alloys and silicon plants in the EU were at an average €1.1 /tonne in 2019, following a decreasing trend caused by a decrease in natural gas intensity.

Table 34: Natural gas costs (€/tonne) - Simple averages.

Natural gas costs (EUR/tonne)	2017	2018	2019	2020	2021	2022Q1
Europe average	0.58	0.69	0.80	0.53	0.45	0.70

Source: Own elaboration with data from ferro-alloys companies.

B.2.9 *Energy intensity*

[27] European Commission, Directorate-General for Energy, Rademaekers, K., Smith, M., Demurtas, A., et al. (2020) Study on energy prices, costs and their impact on industry and households : final report. Available at: https://data.europa.eu/doi/10.2833/49063

Electricity intensity

The electricity intensity (MWh/tonne) of EU ferro-alloys and silicon metal production did not significantly vary between 2016 and 2019. However, from 2020-2022Q1 the electricity intensity showed a stepwise increase as can be seen in Figure 38 and Table 35. Electricity intensity increased from 6.56 MWh/tonne in 2019 to 8.18 MWh/tonne in 2021 and the first quarter of 2022 (simple averages). The change in electricity intensity from 2019 to 2020 – 2022Q1 can be explained by a change in the sample composition: two plants with high intensities provided data only from 2020 onwards (one silicon metal plant and one ferro-alloy plant). The rest of the plants in the sample slightly increased their electricity intensity between 2019 and 2021.

The values for electricity intensity reported by companies are remarkably spread, suggesting that the electricity intensity of plants in the sample highly depend on the type of product manufactured. On average, electricity intensity of silicon metal producers are amongst the plants with higher values than the EU average. Ferro-alloys tend to have lower electricity intensities, ranging between 4.7 and 8.9 MWh/tonne. This is in line with the chemical properties of the ferro-alloys mentioned above (Section B.2.1).

Note that Silicon is amongst the most electro-intensive products with 11.87 MWh/t product, as outlined in the Communication of the European Commission on the Electricity consumption efficiency benchmarks[28]

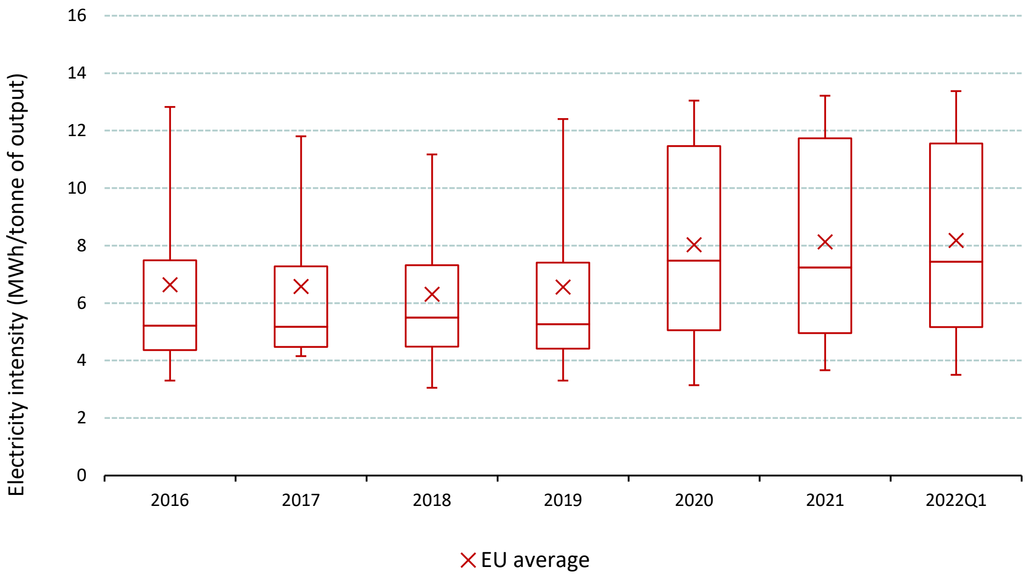

Figure 38: Electricity intensity (MWh/tonne) - Box plots and simple averages

Source: Own elaboration with data from ferro-alloys and silicon companies.
Note: based on the answers from 4 plants from 2016 – 2019, and 6 plants from 2020-2022Q1.

Table 35: Electricity intensity (MWh/tonne) - Simple averages.

Electricity intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2202Q1
Europe average	6.64	6.58	6.30	6.56	8.03	8.13	8.18
Share of plants above sample average	25%	25%	25%	25%	50%	50%	50%

Source: Own elaboration with data from ferro-alloys and silicon companies.

Natural gas intensity

Estimates from the previous study on energy prices and costs (2020)[29] showed that the natural gas intensity of ferro-alloys and silicon production in the EU was in average 0.03 MWh/tonne in 2019.

[28] Communication from the Commission of 21.09.2021 supplementing the Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2021/C 528/01)
[29] European Commission, Directorate-General for Energy, Rademaekers, K., Smith, M., Demurtas, A., et al. (2020) Study on energy prices, costs and their impact on industry and households : final report. Available at: https://data.europa.eu/doi/10.2833/49063

Due to the low number of plants with natural gas consumption (see section B.2.7) it is not possible to present estimate box plots figures for natural gas intensity of ferro-alloys and silicon plants in the EU. The natural gas intensity of the sampled plants was much lower than their electricity intensity, ranging between 0.01 MWh/tonne and 0.02 MWh/tonne.

Table 36: Natural gas intensity (MWh/tonne) – Simple averages.

Natural gas intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	2202Q1
Europe average	0.01	0.01	0.02	0.02	0.01	0.01	0.01

Source: Own elaboration with data from ferro-alloys and silicon companies.

B.3 Zinc

B.3.1 *Introduction*

Zinc usage in industry is mostly used to galvanise other metals, in particularly steel, to prevent oxidation and corrosion through the formation of a very robust and corrosion-resistant protective barrier, zinc hydroxide.

Zinc combines into very ductile alloys (e.g. zamak, brass and bronze). Zinc casting alloys (for e.g. zinc-aluminium alloys) are strong, durable, and cost-effective materials. It is often used to make thin diecast mechanical pieces, which can be produced faster, and at lower processing costs. Another important usage of zinc is in the production a brass, an alloy constituting zinc and copper. Brass is used in the manufacturing of communication equipment and water valves.

In addition, zinc sheets are also used in the construction industry, for roofing and cladding of buildings. It is also used to produce wires which are widely used for construction, handicraft, product packaging etc. Another usage of zinc is in chemical compounds—zinc oxide is used as a vulcanising agent in the production of rubber tyres and as a white pigment used in paints.

Zinc is also an important material in the supply of renewables – it is used in offshore wind masts to prevent corrosion and in the steel support structures of solar panels which galvanised with zinc. Zinc production is mainly supplied by electricity and to a lesser extent, by natural gas and diesel oil.

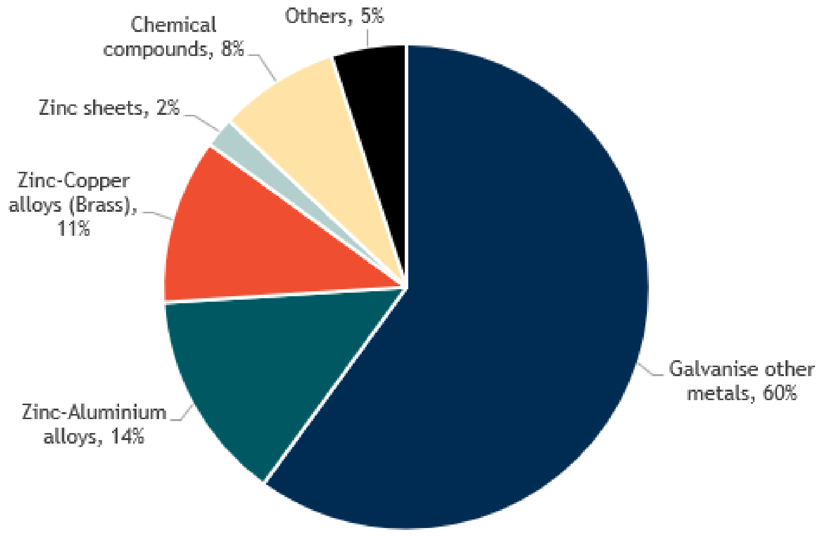

Figure 39: Main usages of zinc - share of world-wide applications in tonnes.

Source: International Zinc Association (2015).

NACE codes

The manufacture of zinc is classified under the following NACE rev.2 code: 24.43 Lead, zinc and tin production.

Stages in the production process

- **Concentration** of zinc sulphide, the most common natural zinc ore, using the froth flotation method;
- **Roasting** is an exothermic process of transforming the concentrated natural ore, i.e. zinc sulphide, concentrates at high temperatures (850°C to 950°C) into zinc oxide concentrates, called "zinc calcine";

- **Leaching** purifies the calcine by treating it with sulphuric acid to convert the zinc within into soluble zinc sulphates while many impurities remain insoluble;
- **Cementation** further purifies the zinc sulphate, by precipitation of the ions of impurity metals (copper, cobalt, nickel or cadmium) that were dissolved during leaching;
- **Electrolysis** transforms the zinc sulphate solution eventually into high-purity zinc metal. The depleted acid electrolyte returns to the leaching process.

Among these, the only energy-intensive stage of the process is the electrolysis. Although the roasting process takes place at high temperatures, it is exothermic, i.e. more energy is generated than consumed

B.3.2 Economic situation of the sector

The production quantity of zinc has remained at around 2 million tonnes between 2010 and 2021. Production quantity was under 2 million tonnes during 2010 and 2012, as it was recovering from depression as a result of a temporary closure of a large zinc plant in 2009. Peak production in this period was at 2.13 million tonnes in 2015, although production quantity decreased by 4%, reaching 2.04 million tonnes in 2017. In 2018, the production quantity increased by 3% as compared to the previous year, due to the realisation of smaller debottlenecking investments to reduce the capex part of the capital intensive process for generating better profit margins. Since then, production quantity has been on a slightly decreasing trend, falling 2% between 2018 and 2021 from 2.11 to 2.07 million tonnes.

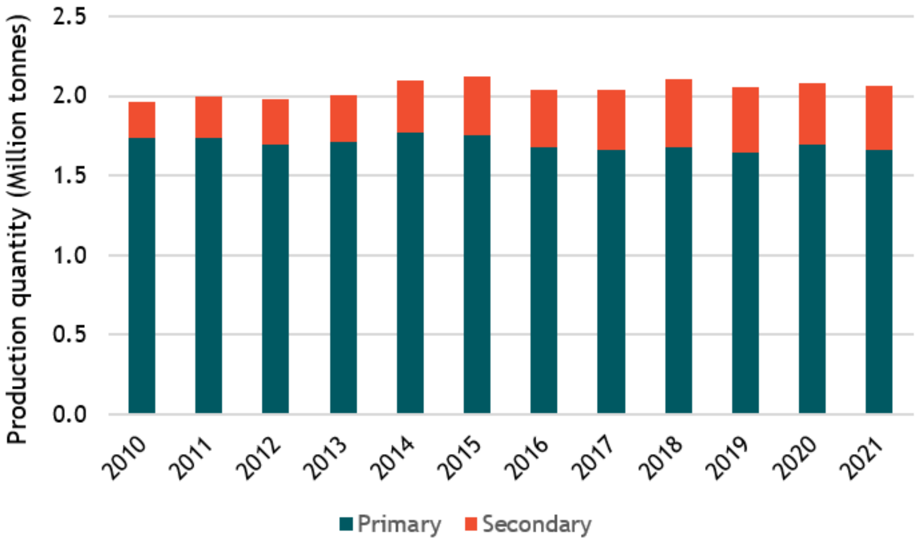

Figure 40: Trends in production quantity of zinc in the EU27 Member States (million tonnes).

Source: Data from International zinc lead study group (IZLSG, 2022).

Based on production quantity data from IZLG (2022) for the period of 2011 to 2021, 64% of all EU zinc production is concentrated in four Member States, namely Spain (24%), Finland (15%), the Netherlands (13%) and Belgium (12%). France, Germany, Italy and Poland each contributed 8% of the total production quantity within EU27, with Bulgaria contributing to 4%.

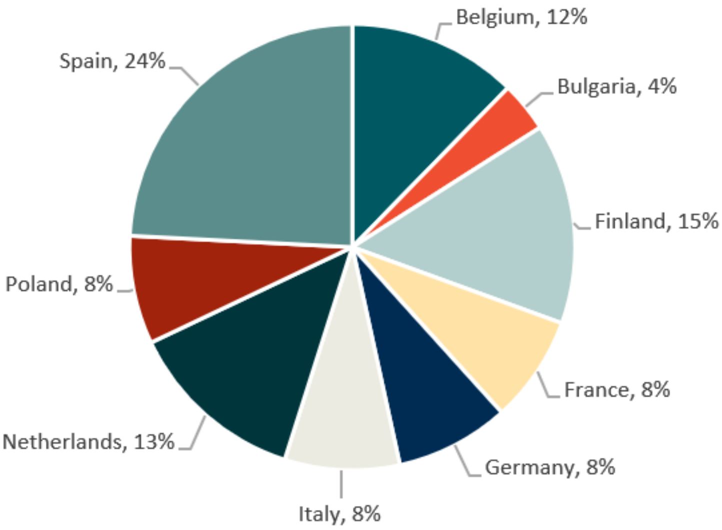

Figure 41: Distribution of production quantity of zinc in the EU27 Member States.

Source: Data based on International zinc lead study group (IZLSG, 2022).

Production value of zinc has been on an increasing trend from 3.2 billion euros in 2010 to 3.8 billion euros in 2021. The production value of zinc in the EU27 reached a peak of 4.2 billion euros in 2017. Thereafter, it decreased by about 20% between 2017 and 2020, before increasing again by strongly increased over the last few years, at almost constant production volumes. This is due to an increase in the internationally-traded price of zinc metal.

Figure 42: Trends in production value of zinc in the EU27 (M€).

Source: Own elaboration based on IZLSG data on production volumes and the yearly average London Metal Exchange (LME) cash price as reported in the IZLSG database.

B.3.3 Trade situation of the sector[30]

The EU27 trade volume of Zinc has remained relatively stable between 2010 and 2021. Overall, the EU 27 has been a net exporter by a small margin of zinc from 2010 to 2021, where gross imports were only higher than gross exports between the years 2010 and 2011 and 2015 and 2016. The trends in trade value generally mirrors that of the trade volume, except in 2017, where there was a sharp increase in the LME cash price.

[30] In the 2020 edition of this report of the zinc sector, the trade balance has been analysed based on data from UN COMTRADE whereas production data came from IZLSG. For consistency and in consultation with the International Zinc Association, the trade balance and production data in this report have been based on the numbers from IZLSG.

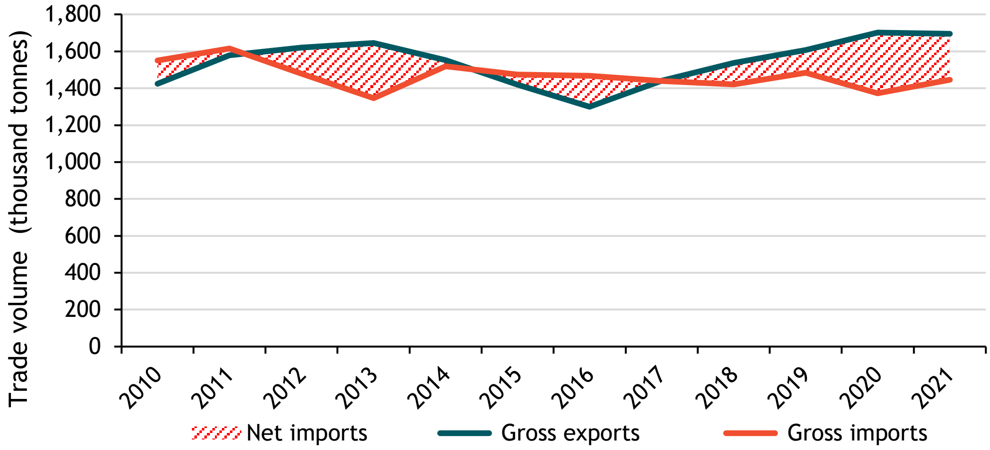

Figure 43: Trends in trade balance of zinc in the EU27 Member States (thousand tonnes).

Source: IZLSG (2022).
Note: these trade figures describe extra-EU27 trade only and exclude EU27 internal trade.

Figure 44: Trends in trade balance of zinc in the EU27 Member States (million euros).

Source: IZLSG (2022).
Note: these trade figures describe extra-EU27 trade only and exclude EU27 internal trade.

The EU zinc sector is strongly exposed to international trade. The share of internal consumption in the EU market served by extra-EU imports has consistently been above 70%, with the exception in 2015 and 2016, where it fell to its lowest of 66.5%. The market share of extra-EU imports in the EU internal market has increased by 12.9% from 72.6% to 82% between 2010 and 2021, showing a strong international competitiveness of EU players.

Table 37: Exposure of zinc in the EU27 to international trade.

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross exports (M€)	2 310	2 724	2 600	2 655	2 452	2 284	2 200	2 963	2 918	2 870	2 731	3 095
Gross imports (M€)	2,516	2,787	2,372	2,171	2,401	2,370	2,485	2,961	2,699	2,650	2,203	2,640
Production value (M€)	3,181	3,443	3,173	3,235	3,316	3,419	3,449	4,198	4,007	3,666	3,344	3,774
Internal consumption (M)	3,387	3,507	2,945	2,751	3,264	3,505	3,734	4,196	3,788	3,446	2,816	3,319
Share of internal consumption served by extra-EU imports	74.3%	79.5%	80.6%	78.9%	73.5%	67.6%	66.5%	70.6%	71.3%	76.9%	78.2%	79.5%
Share of production dedicated to extra-EU exports	72.6%	79.1%	81.9%	82.1%	74.0%	66.8%	63.8%	70.6%	72.8%	78.3%	81.7%	82.0%

Source IZLSG (2022).

Notes: Production and trade volumes (tonnes) converted to euros using yearly average LME cash price as reported in the IZLSG database.

B.3.4 Sample statistics

The sample considered in this analysis consists of five installations, all of which are located within EU27. The sample is spread across five Member States with installations which together account for about 50% of zinc's production value in the EU27. Due to confidentiality reasons, the countries included in the sample cannot be delineated. The regional spread of the plants included in this sample statistics includes five plants in the North Western Europe (NWE)[31] region, see Table 28.[32]

Table 38: Zinc plants included in the sample statistics

Geographical regions	Questionnaires collected
North Western Europe (NWE)	5
Total	5

Table 38 describes the ranges of installed capacity from the five plants that provided information on annual production capacity of zinc. For confidentiality reasons it is not possible to present production capacities for individual plants in the sample.

Table 39: Plant capacity range of the sample.

Capacity range (thousand tonnes/year)	Share of plants in sample
<200	40%
200-400	60%
>400	0%

Source: Own elaboration with data from zinc companies.

B.3.5 Competitiveness of the sector

Table 30 presents an overview of the indicators used in this section to analyse the competitiveness of the zinc sector. The indicators are first calculated per plant for which the information is available and subsequently averaged. The indicators 'energy costs as a share of production costs', and ' energy costs as a share of turnover' presented in the table can therefore be significantly different from the shares if they would be calculated using the average values per tonne presented in the table. Due to a lack of data on the natural gas cost for years before 2020, we are unable to produce the earlier figures in the table below.

Table 40: Overview of energy costs as a share of production costs, and energy costs as a share of turnover (€/tonne, NWE region) - simple averages.

Indicator	2020	2021	2022Q1
Electricity cost (EUR/tonne)	135.77	195.14	277.63
Natural gas cost (EUR/tonne)	5.08	16.70	33.95
Personnel cost (EUR/tonne)	164.29	162.84	216.14
Other production costs (EUR/tonne)	680.99	691.24	N/A
Gross operating surplus (EUR/tonne)	390.98	418.50	N/A
Turnover (EUR/tonne)	1377.11	1484.42	N/A
Electricity costs as a share of production costs	20.3%	27.4%	N/A
Natural gas costs as a share of production costs	0.7%	1.9%	N/A
Energy costs as a share of production costs	20.9%	29.0%	N/A
Energy costs as a share of turnover	14.6%	19.8%	N/A

Source: Own elaboration based on data from zinc companies.

[31] Countries in the North Western Europe (NWE) region includes Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden.

[32] There were also questionnaires received from a plant in the Southern Europe region (Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, and Spain), and one from a non-EU NWE region. However, this was excluded from the analysis as at least three plants from three different companies are required in order to provide an average for the region.

Profitability

The surveyed zinc production companies experienced an increase of 7.8% in the turnover per tonne of product between 2020 and 2021. At the same time, the production costs for the same period increased overall by 8.1%, which is contributed by an increase in electricity costs (+43.7%) and natural gas costs (+228.5%). Between 2021 and Q1 2022, production costs have also seen an increasing trend, with electricity costs increasing by 142.3%, gas by 203.3% and personnel costs by 132.7%. The other production costs also show an increase between 2021 and Q1 2022, but the data cannot be shown due to confidentiality reasons. The overall increase in production costs is also related to the fact that zinc plants have been running at a relatively constant cost, but are now producing lower volumes of output.

The gross operating surplus increased by about 7% between 2020 and 2021 (Table 30 and Figure 34). This increase coincides with the record high prices reached for zinc in 2021 (and the first half of 2022) not seen since 2006.[33]

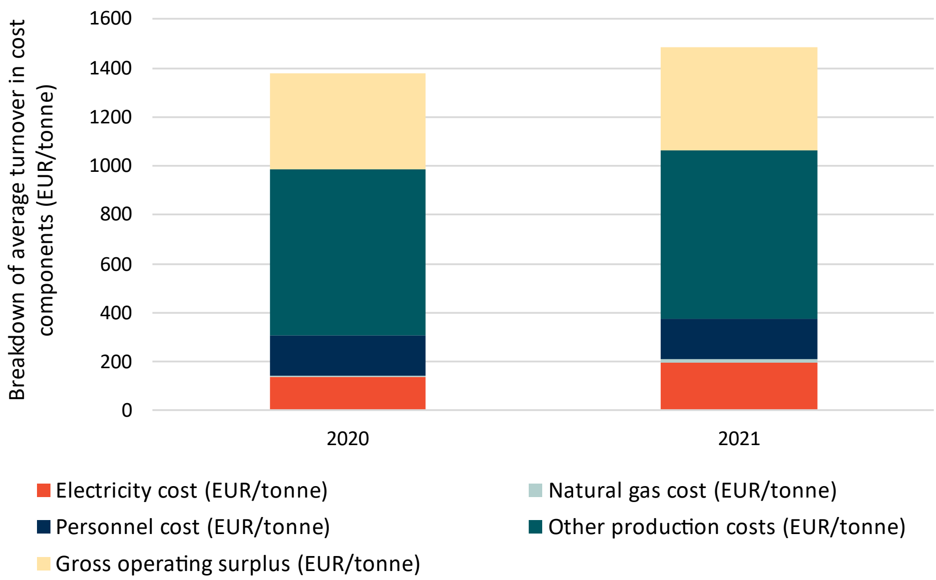

Figure 45: Energy costs, other production costs and Gross Operating Surplus of the zinc industry (€/tonne, NWE region), simple averages.

Source: Own elaboration with data from zinc companies.

Impact of energy costs on competitiveness of the sector

The energy costs represent a significant share of the production costs of the zinc producing companies in the NWE region. The share of energy costs as a percentage of the total production costs was 21% in 2020, and 29% in 2021, with almost all of the energy costs comes from electricity costs.

[33] LME (2022). LME Zinc. Available at: https://www.lme.com/en/metals/non-ferrous/lme-zinc#Price+graphs

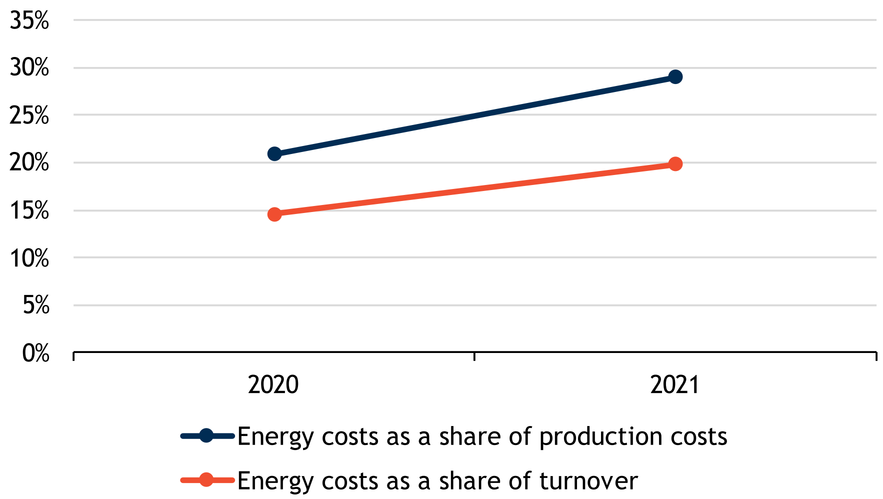

Figure 46 Energy costs as a share of production costs vs energy costs as a share of turnover for the zinc industry (€/tonne, NWE region), simple averages.

Source: Own elaboration with data from zinc companies.

Trading prices of zinc are mainly based on the London Metal Exchange (LME) for primary zinc, i.e. the LME price serves as a reference price and determines the market price for products to a large extent. Other determinants of the market price for zinc products could be based on the types of alloy and the physical and chemical compositions of the product. Therefore, as all zinc is sold roughly at the same price internationally, the differences in competitiveness is in the cost structure of zinc production plants.

According to the last study that was conducted in 2020, the International Zinc Association expressed that the production costs of zinc production companies in the EU were around the average of international values, although the companies fell slightly in the higher half of the distribution of the scale. Since then, electricity and natural gas costs in the EU have soared to unprecedented levels following the Russian invasion of Ukraine. Especially electricity has increased to levels significantly higher than seen elsewhere in the world, which make up a significant share of the zinc production costs as shown in Table 30 and Figure 34.

B.3.6 Consequences of COVID-19 crisis and the Russian invasion of Ukraine for the zinc sector

In general, the surveyed zinc companies were able to continue their operations during COVID-19, despite experiencing some staffing problems. However, zinc consumers did stop their operations then, resulting in depressed demand and large stockpiling of zinc. The zinc producing companies experienced a negligible decrease in output (-0.07%) between 2019 and 2020, but increased by 3% again between 2019 and 2020. Overall, the production output of the zinc producing companies in the NWE region has experienced a 4% increase between the years 2016 to 2021. The COVID-19 crisis also led to an increase in energy costs for the surveyed zinc companies. As the zinc prices are globally traded based on the LME prices, this means that any increase in energy costs will be absorbed by the companies and not be passed on to consumers.

Some surveyed plants have also reported that the Russian invasion of Ukraine has exacerbated the already high energy prices. This has also led to an uncertainty in the planning of the production volume in the long term as it will hinge on the developments in the energy prices as well as the demand for zinc products in the market.

At the point of writing this report, there are two primary smelters with an annual production capacity that are currently closed, i.e. placed on care and maintenance - Nyrstar Budel in the Netherlands with an annual production capacity of 270kt[34] has been closed since 1 September 2022 and Glencore's Porto Vesme

[34] Nyrstar (2022). Nyrstar Budel's zinksmeltactiviteiten worden op care and maintenance gezet. *Press release*. Available at: https://www.nyrstar.com/resource-center/press-releases/nyrstar-budels-zinksmeltactiviteiten-worden-op-care-and-maintenance-gezet

plant in Italy with an annual production capacity of 150kt since Q4 2021[35]. From 1 November 2022, Glencore was also be closing its Nordenham plant with an annual production capacity of 165kt in Germany.[36]

The Nyrstar Auby Smelter in France has recently resumed output since it made its decision to close productions in the first week of January 2022 due to the significant increase in current and projected energy prices. During this phase, permanent employees are also retained and their duties, some 297 personnel in total, are redirected to focus on maintenance, training and investment projects while the plant is not producing zinc.[37] Till date, they have an accumulated loss of input of 50kT. Further, the International Zinc Association shared that some daily peak shaving of about 15% of the remaining running capacity are also occurring in other plants, when electricity spot prices increases (for e.g. due to a peak in demand in the mornings and evenings), with output losses amounting to an estimated range of 60-240kT.

Zinc plants can lower the output to 25-35% of the nominal capacity without causing reversal of the electrolysis (which would create hydrogen gas release and risk of explosions), any further reduction of output would require the emptying of electrolyte from the whole circuit - a process that would take several weeks. Restarting this process after a complete shutdown would also take several weeks and in addition, negatively affects the yield of electrolysis for several months. Therefore, a complete shutdown is only considered if the duration of the shutdown is expected to last for at least 4-6 months.

B.3.7 Evolution of energy prices

Electricity price

The average electricity prices[38] in €/MWh paid by zinc producers of the NWE region have increased by about 86% between 2016 and the first quarter of 2022. There is a sharp increase in the average electricity prices between 2020 and 2021 as it increased by 46.9%, and the average prices increased further by 35.7% between 2021 and the Q1 2022. Between 2016 and 2020, there was an initial peak in 2018 where electricity prices reached 38.1 €/MWh before decreasing slightly in 2019 and 2020 to 33.8 €/MWh (Table 8, Figure 10). In 2020, the range increased significantly in comparison to 2016-2019. Comparatively, the range of the average electricity prices in the first quarter of 2022 was larger than in 2020, ranging from an average of 42.1 €/MWh to 96.2 €/MWh. This wide range of electricity prices paid for by zinc plants are likely to be influenced by the degree to which individual plants have existing fixed contracts that are still running or have the ability to hedge electricity prices at a lower price than the electricity spot market.

Average electricity prices can only be presented at a regional level for NWE, where data was provided by five zinc production plants, i.e. meeting the minimum requirement of three. Since all of the sampled plants are located within the NWE region, no EU averages are shown in the figures below.

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[35] Desai (2021). Glencore's Portovesme zinc operation to enter care and maintenance. *Reuters*. Available at: https://www.nasdaq.com/articles/glencores-portovesme-zinc-operation-to-enter-care-and-maintenance
[36] Reuters (2022). Glencore to place Nordenham zinc smelter on care and maintenance from Nov 1. Available at: https://www.reuters.com/markets/europe/glencore-place-nordenham-zinc-smelter-care-maintenance-nov-1-2022-10-05/
[37] Nyrstar (2021). Nyrstar's operations at Auby, France to be placed on care and maintenance. *Press release*. Available at: https://www.nyrstar.com/resource-center/press-releases/nyrstars-operations-at-auby-france-to-be-placed-on-care-and-maintenance
[38] The average price of electricity indicated in the figure includes the following price components: network costs from the Transmission System Operator (TSO) and Distribution System Operator (DSO) if applicable, levies, taxes, interruptability discounts and CO2 retributions but excluding VAT.

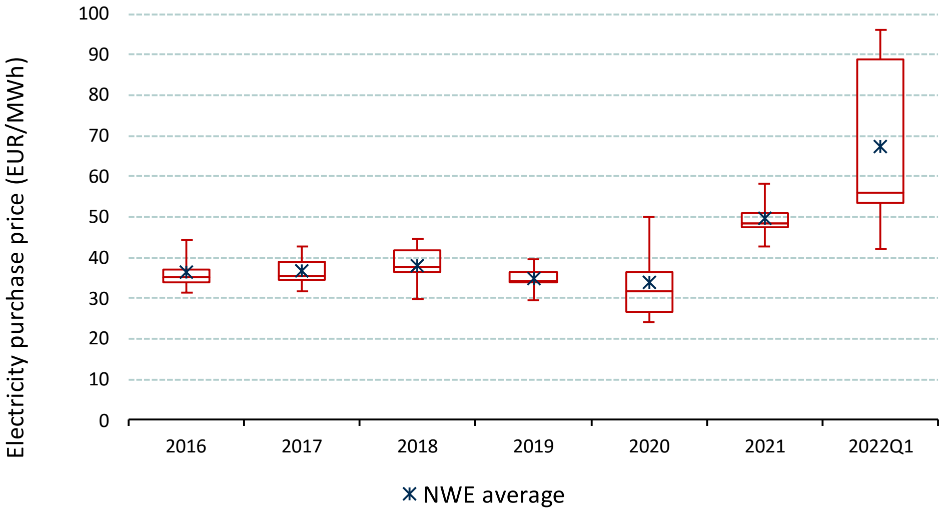

Figure 47: Electricity prices (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 41: Descriptive statistics for electricity prices paid by sampled zinc producers (€/MWh) - simple averages.

Electricity costs (EUR/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
NWE average	36.26	36.65	38.05	34.71	33.77	49.60	67.30

Source: Own elaboration with data from zinc companies.

Components of electricity price

Figure 48 shows the evolution of CO_2 retributions received by zinc producers in the NWE region of the EU between years 2016 to 2019 – simple averages. These retributions are received by plants via the electricity bill or other schemes for embedded CO_2 costs in the price of purchased electricity. These values started to increase between 2018 to 2020, before decreasing again from 2020 to Q1 2022.

Figure 48: CO_2 Retributions received by NWE region of the EU (million euros) - Simple averages.

Source: Own elaboration with data from zinc companies

Figure 49 shows the evolution of the remuneration amounts received by industrial plants, between 2012 to Q1 2022, in exchange for providing network operators the possibility to cut power supply with a predetermined notice – a way to ensure the stability of the electrical network. Generally, there was a downward trend of the remuneration amounts received between 2016 to 2019, with a slight peak between 2017 and 2018. The average remained relatively stable between 2019 and 2021.

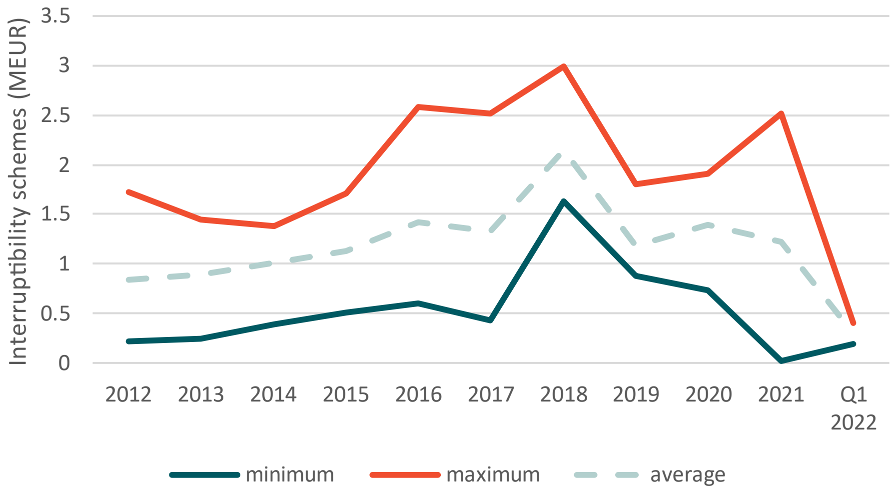

Figure 49: Interruptibility schemes (million euros) - Simple averages.

Source: Own elaboration with data from zinc companies

Further, while 100% of the plants do purchase electricity from the wholesale markets between 2008 and the first quarter 2022, not all the plants do this consistently, i.e. some plants do not purchase electricity from the wholesale market in some years.

Electricity contracts

Box 6: Definition of fixed and variable contracts

The sampled zinc plants were asked about the duration of their energy contracts. For this study, electricity (and natural gas contracts) were classified as follows:

- Fixed contract: when a set rate per energy unit (e.g. Euro/kWh) is charged for the fixed term of the contract. Energy bill is charged based on energy usage.
- Variable contract: when the rate per unit is linked to market activity, and could therefore be subjected to changes throughout the contract period.
- A combination of fixed and variable contract combines fixed rates (usually to hedge against typically volatile periods), and variable rates (which can be structured around peak, non-peak or around the clock prices).

All the five zinc plants in this sample provided information regarding their electricity contracts. 100% of these plants have a variable contract, with the exception of one plant which has two types of contracts - a fixed contract, and a variable contract. The variability of electricity prices as shown earlier in Figure 10 is aligned with the fact that all of these plants have, in general, relied on variable contracts over the years. The ranges experienced by the sampled plants also reflect the mix of electricity prices paid by the plants of which the lower prices are coming from older contracts and higher prices from new variable contracts and spot market purchases.

There was one plant with a fixed contract which has experienced the lowest increase in electricity (€/MWh) across the sampled plants. However, this could be attributed to other reasons as well (such as different measures and prices across MSs) and cannot be said with certainty for being the only reason.

Table 42: Overview of electricity contracts of zinc plant sample

Entire duration of contract	Remaining duration	% of plant(s)
Variable contract		
More than 3 years	2 - 3 years	40%
2 - 3 years	2 - 3 years	40%

2 - 3 years	1 year	20%
Fixed contract		
More than 3 years	More than 3 years	20%

Out of the 5 zinc plants in this sample, 40% have PPA contracts and produce their own electricity between now and 2050. Currently, 60% of the plants also have demand flexibility electricity, while 40% of the plants have planned for this from now until 2050.

Natural gas price

Figure 50 and Table 43 show that the average price of natural gas paid by zinc producers increased by almost 5 fold (4.8 times) between 2020 and Q1 2022. The increase was sharper between 2020-2021 (2.6 times) than between 2021 and Q1 2022 (1.8 times). The range between the highest and lowest prices paid for natural gas by zinc producers also increased during 2019 to Q1 2022. The majority of zinc producers paid above the average price of 83.31 €/MWh for natural gas in Q1 2022. Average regional prices for natural gas other than the NWE region cannot be reported due to lower sample sizes at regional levels.

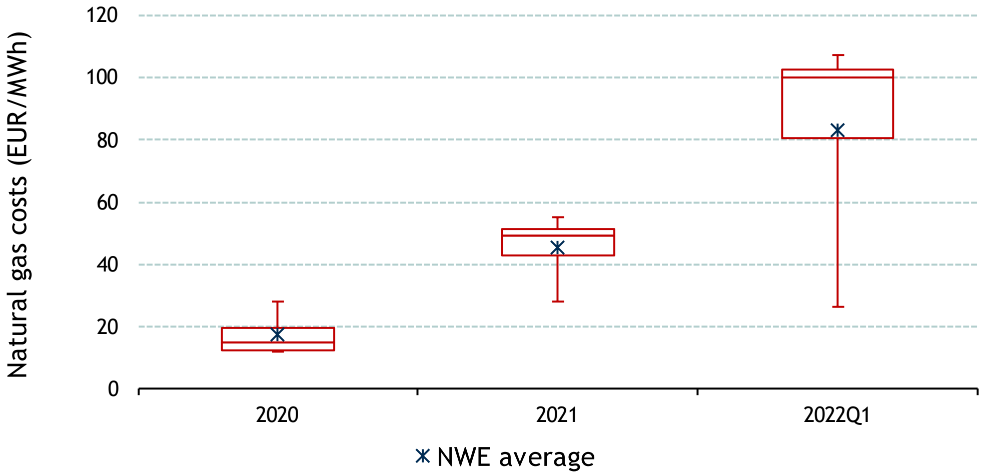

Figure 50: Natural gas prices (€/MWh) - Box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 43: Natural gas prices paid by sampled zinc producers (€/MWh) - simple averages.

Natural gas price (€/MWh)	2020	2021	Q1 2022
NWE average	17.30	45.37	83.31

Source: Own elaboration with data from zinc companies.

B.3.8 Evolution of energy costs

Electricity costs

On average, electricity costs paid by zinc producers of the NWE region range between 144.37€ - 277.63 €/per tonne of production output between 2016 and Q1 2022. (see Figure 37 and Table 33). The range between the highest and lowest cost of electricity by zinc producers per year remains relatively stable, although it varied widely in 2020 and Q1 2022, with a difference of 105.69 and 193.61 €/tonne of production output respectively. This trend also corresponds with the increase in electricity prices in 2020 and Q1 2022.

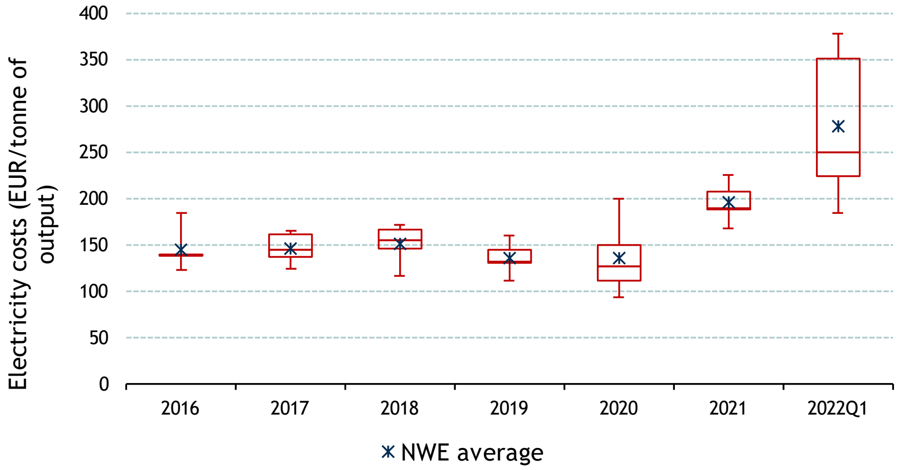

Figure 51: Electricity costs - box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 44: Electricity costs (€/tonne) - simple averages.

Electricity costs (EUR/tonne)	2016	2017	2018	2019	2020	2021	Q1 2022
NWE average	144.37	146.18	150.35	135.56	135.77	195.14	277.63

Source: Own elaboration with data from zinc companies.

Natural gas costs

Figure 52 and Table 45 show the average costs of natural gas borne by zinc producers of the NWE region, which range from 5.08€ - 33.95 €/tonne of output. The range between the highest and lowest cost of natural gas borne by zinc producers widened in 2021 and in Q1 2022, with a difference of 28.5 €/tonne of output (↑8.4% from 2020) and 67.7 €/tonne of output (↑2.4% from 2021); this trend corresponds with the increase in natural gas prices during the same time period.

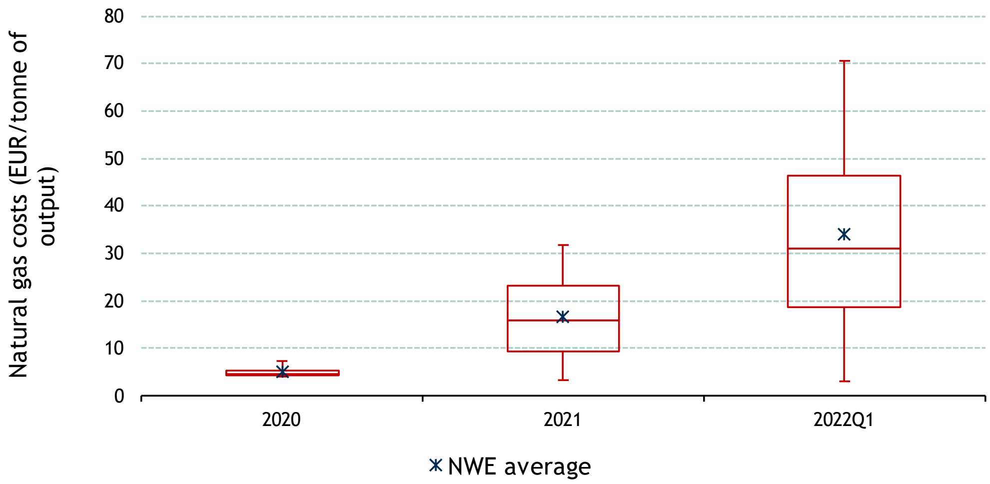

Figure 52: Natural gas - box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 45: Natural gas (€/tonne) - simple averages.

Natural gas costs (EUR/tonnes)	2020	2021	Q1 2022
NWE average	5.08	16.70	33.95

Source: Own elaboration with data from zinc companies.

B.3.9 Energy intensity

Electricity intensity

The electricity intensity (MWh/tonne) of zinc production in the NWE region did not significantly vary between 2016 – Q12022 (Figure 38 and Table 35). Electricity intensity decreased slightly by 1.3%, from

4.01 MWh/tonne in 2016 to 3.96 MWh/tonne in 2019, and increased by 6.3% in Q1 2022. The values for electricity intensity reported by the sampled zinc plants for 2016 and 2021 are rather concentrated, showing that the sampled plants share comparable technical performance in their production process.

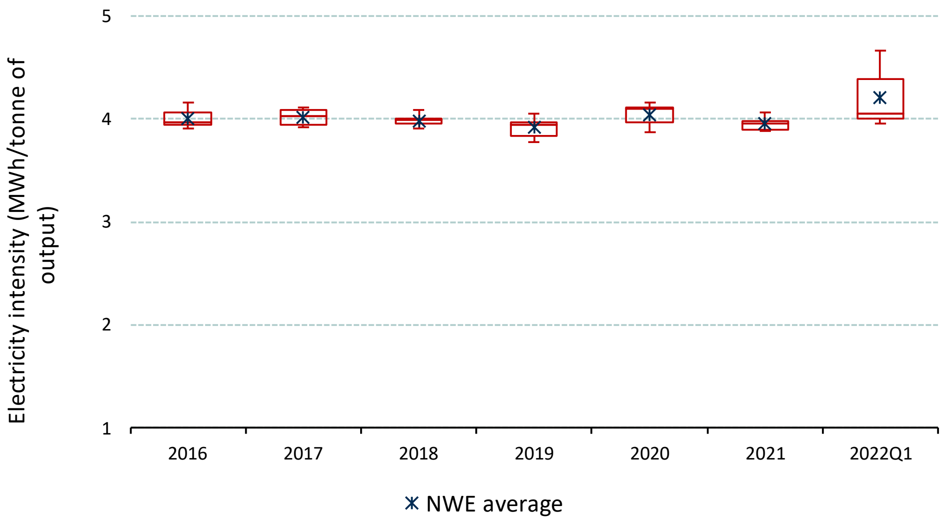

Figure 53: Electricity intensity (MWh/tonne) - box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 46: Electricity intensity (MWh/tonne) - Simple averages.

Electricity intensity (MWh/tonne)	2016	2017	2018	2019	2020	2021	Q1 2022
NWE average	4.01	4.02	3.99	3.92	4.05	3.96	4.21

Source: Own elaboration with data from zinc companies.

Natural gas intensity

The natural gas intensity of zinc production in NWE region was much lower than the electricity intensity, with a difference of more than 11 times. Figure 54 and Table 47 indicate that natural gas intensity at an EU level remained at a steady level between 2020 and Q1 2022.

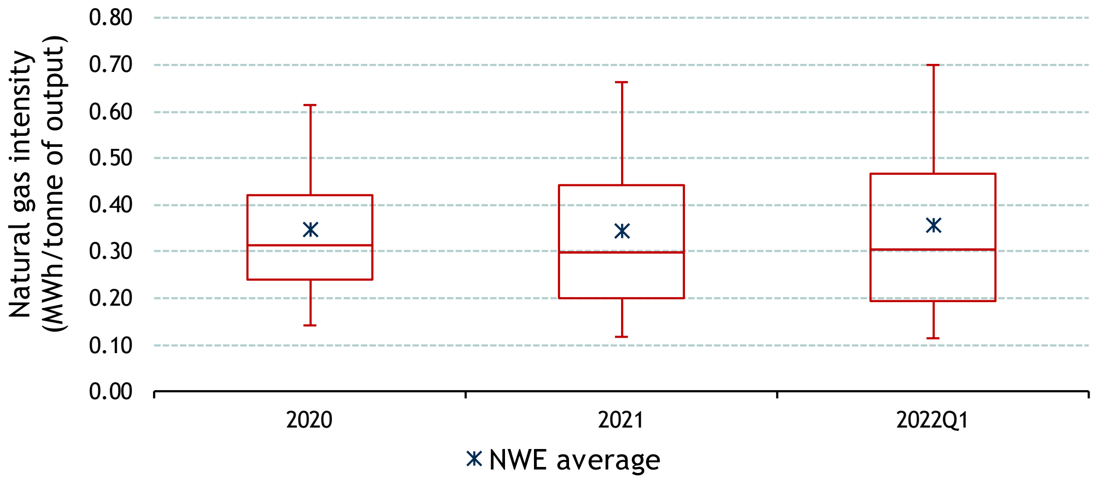

Figure 54: Natural gas intensity (MWh/tonne) - box plots and simple averages.

Source: Own elaboration with data from zinc companies.

Table 47: Natural gas intensity (MWh/tonne) - simple averages.

Natural gas intensity (MWh/tonne)	2020	2021	Q1 2022
NWE average	0.35	0.34	0.36

Source: Own elaboration with data from zinc companies.

B.4 Ceramics

B.4.1 Sample statistics

The sample considered in the following analysis consists of three installations, all of which are located within the Southern Europe region (SE) with EU27, i.e. Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, and Spain. Due to confidentiality reasons, the countries included in the sample cannot be delineated. The inputs received were from plants from different sectors along the value chain, which could vary significantly in terms of production capacities and outputs. Across the European ceramic industry, there are nine ceramic sectors, and is reported as gathering about 2000 companies in the EU ranging from small-medium enterprises to large international groups.[39] The values shown in this section is therefore not representative of the ceramics section. Given the spread throughout the value chain of the companies that responded to the questionnaire, average values for the energy cost per tonne of product or energy intensity are not shown. The energy costs as share of total production costs could also not be shown as not enough plants provided data on total production costs to be able to maintain data confidentiality. Instead, the focus of the sample statistics is to show the relevance and impact of changes in energy prices for the sample companies.

B.4.2 Consequences of COVID-19 crisis and the Russian invasion of Ukraine for the Ceramics sector

The ceramics industry has indicated that the current energy crisis has an extremely dramatic impact on its sector. According to Cerame-unie—the European Ceramic Industry Association, the energy bill of an average ceramics producer has tripled within a year and a half, from around 20-30% of its production costs to about 60%-70%.[40] Some companies have been able to reduce their energy costs by shifting their production to hours with lower energy tariffs and more favourable temperature conditions, while others are planning to invest in new ovens.[41] There are also some companies that have passed on some of the increase in the energy price to their customer. For example, The Iris Ceramica Group—one of the leading Italian companies in the sector—introduced an energy surcharge of 3% on invoices due to the increase in gas prices.[42] However, not all companies have been able to mitigate the increase in energy costs. Cerame-unie indicated that the curtailment of production and even temporary shutdowns have been taken place in several countries.[43] For example, the Portuguese tile company CINCA was forced to shut down for month and a half in 2022 because gas bills went from 300 000 euro to almost 1.5 million euro per month.[44]

European ceramics are internationally appreciated as high-quality products. In 2020, 37% of EU production are exported, and achieved a trade balance of EUR 5.1 billion.[45]

B.4.3 Evolution of energy prices

Electricity prices

Figure 55 and Table 48 presents the average cost of electricity in €/MWh paid by ceramic plants in the SE region between the years 2016 and Q1 2022. The average electricity costs have remained relatively stable throughout this period although it was on a decreasing trend (-13.5%) between 2017 and 2020, before experiencing a sharp increase (+66.5%) in 2021 and Q1 2022.

[39] Cerame Unie (2021). Sectors. Available at: https://cerameunie.eu/members/sectors/
[40] Cerame Unie (2022). Press release. Available at: https://cerameunie.eu/media/5imjwnj2/22-09-08-press-release-energy-crisis.pdf
[41] Berlenga and Sterling (2022). Early starts, new ovens as ceramics industry feels energy pinch. *Reuters*. Available at: https://www.reuters.com/markets/europe/early-starts-new-ovens-ceramics-industry-feels-energy-pinch-2022-09-02/
[42] Jewkes at al. (2021). Gas price surge pushes Europe's ceramics industry to breaking point. *Reuters*. Available at: https://www.reuters.com/world/europe/gas-price-surge-pushes-europes-ceramics-industry-breaking-point-2021-10-27/
[43] Cerame Unie (2022). Press release. Available at: https://cerameunie.eu/media/5imjwnj2/22-09-08-press-release-energy-crisis.pdf
[44] Soares (2022). Portuguese ceramic industry takes a dent as energy crisis looms. *Euronews*, Available at: https://www.euronews.com/2022/09/13/portuguese-ceramic-industry-takes-a-dent-as-energy-crisis-looms
[45] Cerame Unie (2022). Cerame-Unie activity report. Available at: https://cerameunie.eu/topics/cerame-unie-sectors/cerame-unie/2020-2021-cerame-unie-activity-report/, pg 31

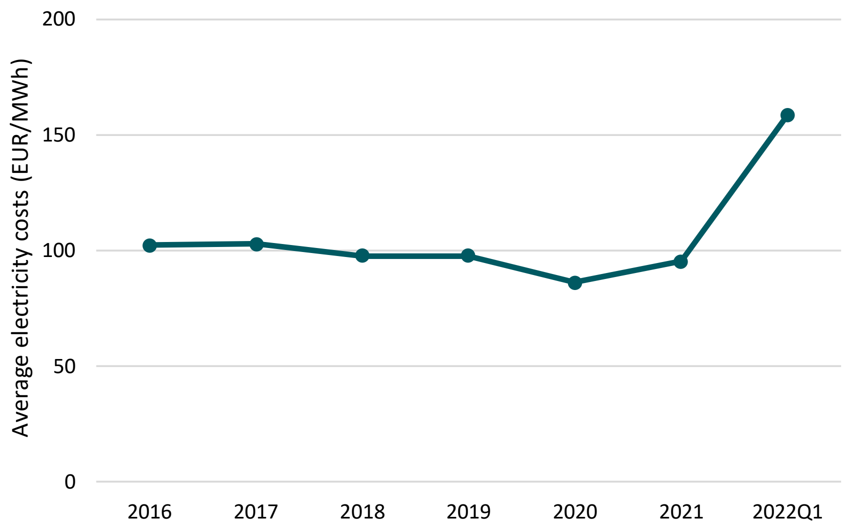

Figure 55: Electricity costs (€/MWh) of sampled ceramic plants - simple averages.

Source: Own elaboration with data from ceramics plants.

Table 48: Descriptive statistics for electricity costs of sampled ceramics plants (€/MWh) - simple averages.

Electricity costs (€/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
SE average	102.26	102.93	97.63	97.68	86.11	95.21	158.51

Source: Own elaboration with data from ceramic plants.

Electricity contracts

Box 7: Definition of fixed and variable contracts

The sampled ceramics plants were asked about the duration of their energy contracts. For this study, electricity (and natural gas contracts) were classified as follows:

- Fixed contract: when a set rate per energy unit (e.g. Euro/kWh) is charged for the fixed term of the contract. Energy bill is charged based on energy usage.
- Variable contract: when the rate per unit is linked to market activity, and could therefore be subjected to changes throughout the contract period.
- A combination of fixed and variable contract combines fixed rates (usually to hedge against typically volatile periods), and variable rates (which can be structured around peak, non-peak or around the clock prices).

Two out of three sampled ceramics plants provided details on their electricity contracts, as well as any other types of energy production and services that they engage in. One plant indicated that they have a fixed contract with a remaining duration of less than a year, and another plant has a variable contract valid for an indefinite amount of time.

Table 49: Overview of electricity contracts of the ceramics sample.

Entire duration of contract	Remaining duration	% of plant(s)
Fixed contract		
1 year	≤ 1 year	33.3%
Variable contract		
Indefinite	Indefinite	33.3%

Source: Own elaboration with data from ceramics plants.

The same two plants who responded are currently producing their own renewables, although only one has indicated that they have plans to continue with producing their own renewables in the longer term (by 2030). In addition, only one of these plants also have plans for PPAs for renewable energy and to invest in demand flexibility services by 2025 and by 2030.

Gas prices

Figure 56 and Table 50 presents the average price of natural gas paid by ceramic plants between 2016 and Q1 2022. Between this period, there was a peak experienced in 2019, before it decreased again in 2020. Natural gas prices have been on the rise, where it has increased by about 2.3 times between 2021 and Q1 2022 (2.3 times). Gas makes up the majority of the energy costs for sampled ceramic plants.

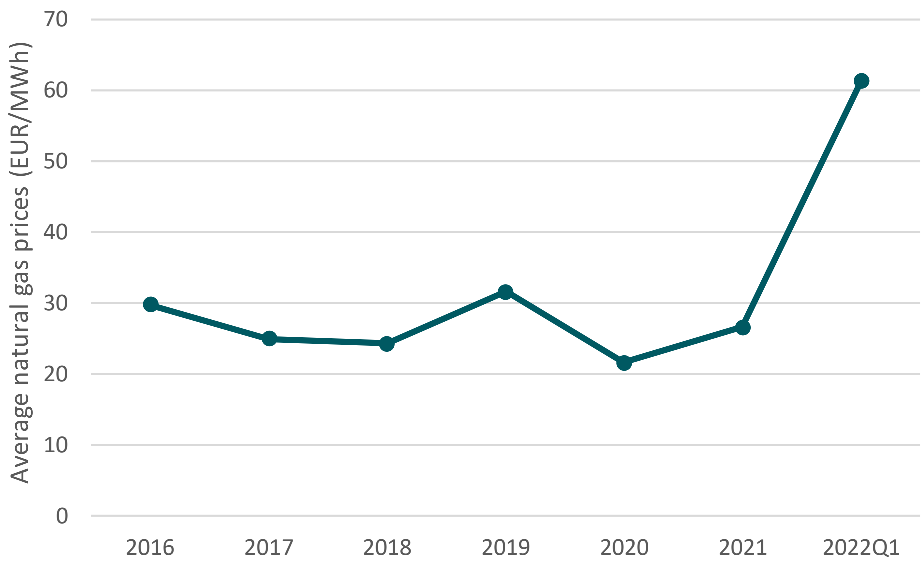

Figure 56: Natural gas prices of sampled ceramic plants (€/MWh) - simple averages.

Source: Own elaboration with data from ceramics plants.

Table 50: Descriptive statistics for natural gas prices paid by sampled ceramics plants (€/MWh) - simple averages.

Natural gas costs (EUR/MWh)	2016	2017	2018	2019	2020	2021	2022Q1
SE average	29.69	24.91	24.18	31.54	21.58	26.55	61.33

Source: Own elaboration with data from ceramic plants.

Gas contracts

Two out of three sampled ceramics plants provided details on their gas contracts. Both plants indicated that they have a fixed contract with a remaining duration of less than a year. Notably, the plant that did not specify the entire duration of its contract showed relative low gas costs even in 2021 and 2022 Q1, implying that it had a contract of several years. However, with the fixed contracts of the sampled plants set to expire in less than a year as of June / July 2022, these plants would be exposed to the gas market prices higher than the current gas costs they have.

Table 51: Overview of gas contracts of the ceramics sample.

Entire duration of contract	Remaining duration	% of plant(s)
Fixed contract		
Not specified	≤ 1 year	33.3%
1 year	≤ 1 year	33.3%

Source: Own elaboration with data from ceramics plants.

B.5 Container glass

B.5.1 Sample statistics

The sample considered in this analysis consists of four installations, all of which are located within the Southern Europe (SE) region of EU27, i.e. Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, and Spain. Due to confidentiality reasons, the countries included in the sample cannot be delineated. As there are 162 plants across Europe,[46] findings based the four installations should not be considered representative of the whole container glass sector. Furthermore, participating companies only provided data for 2021 and Q1 of 2022 due to their limited time and resource availability as a result of the energy crisis. Nonetheless, the findings can provide valuable insights into the relevance and impact of changes in energy prices and costs has had for the sample companies.

B.5.2 Competitiveness of the sector

Table 52 presents an overview of the indicators used to analyse the competitiveness of the container glass sector. The indicators are first calculated per plant for which the information is available and subsequently averaged. The indicators 'energy costs as a share of production costs', and 'energy costs as a share of turnover' presented in the table can therefore be significantly different from the shares if they would be calculated using the average values per tonne presented in the table.

Table 52: Overview of energy costs as a share of production costs, and energy costs as a share of turnover (€/tonne, SE region) - simple averages.

Indicator	2021	2022Q1
Electricity cost (EUR/tonne)	152.96	222.10
Natural gas cost (EUR/tonne)	92.50	254.48
Personnel cost (EUR/tonne)	621.04	616.47
Other production costs (EUR/tonne)	446.81	575.30
Gross operating surplus (EUR/tonne)	527.22	379.52
Turnover (EUR/tonne)	1840.52	2047.87
Electricity costs as a share of production costs	10.0%	10.5%
Natural gas costs as a share of production costs	12.9%	17.2%
Energy costs as a share of production costs	22.9%	27.8%
Energy costs as a share of turnover	13.8%	23.0%

Source: Own elaboration based on data from container glass companies.

Based on the average values presented in Table 52 and shown in Figure 57, the sampled glass container companies have experienced an increase in the turnover per tonne of product between 2021 and Q1 2022, about 11.3%. However, the production costs, including the electricity, natural gas and personnel costs, have seen a higher increase of 27%. This can largely be attributed to the average costs for natural gas almost tripling between 2021 and Q1 2022. This caused the share of energy costs in the production costs of surveyed container glass companies in the SE region to increase from 23% in 2021 to 28% in Q1 2022. As a result, the gross operating surplus also decreased by about 28% between the same period. This shows that the sampled plants were unable to pass on all costs increases and saw their profitability deteriorate as a result.

[46] FEVE (n.d.). Glass packaging industry. Available at: https://feve.org/glass-industry/

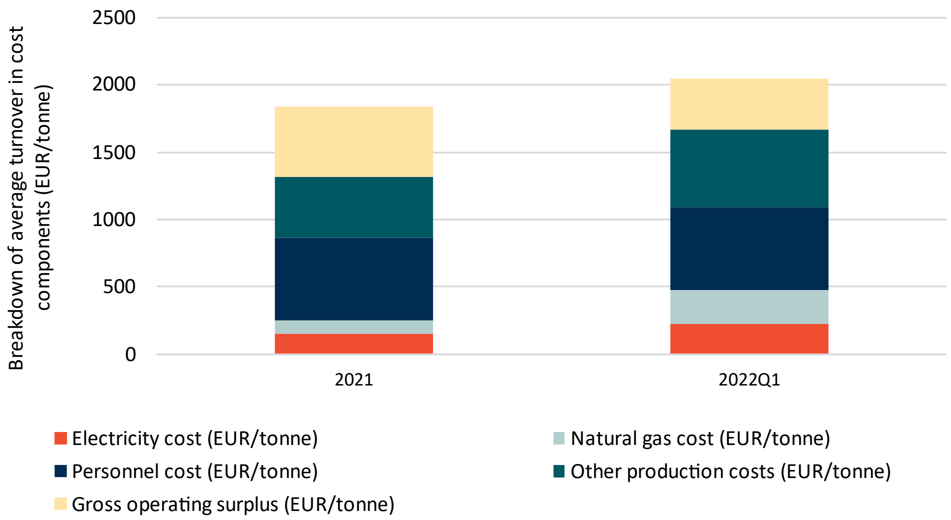

Figure 57: Energy costs, other production costs and gross operating surplus of the container glass industry (€/tonne, SE region), simple averages.

Source: Own elaboration with data from container glass companies.

B.5.3 *Consequences of COVID-19 crisis and the Russian invasion of Ukraine for the Container Glass sector*

Despite the market challenges posed by COVID-19 and rising energy prices, the container glass industry experienced a record growth in its production in 2021, driven by high market demand.[47] Based on a data released by FEVE—the European Container Glass Federation, the container glass industry is continuing its recovery from a 2020 decline, and has recorded a highest-ever production growth of 5% for food and beverage glass packaging in 2021, as compared to 2020 figures.[48] However, the industry worries that the increase in demand may not be sufficient to compensate for the rise in production costs.

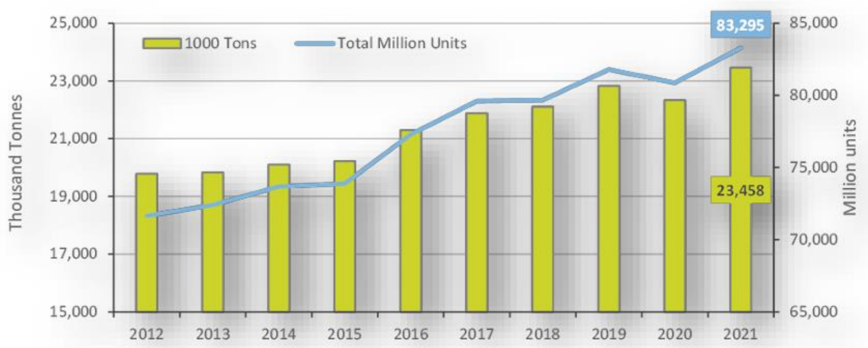

Figure 58: Production data of the container glass industry in Europe from 2012 - 2021.

Source: FEVE[49]

Glass container manufacturers have expressed their worries regarding the continuously increasing energy cost, as their gas prices in September 2022 came to be 14-15 times higher than pre-crisis levels.[50] According to FEVE—the European Container Glass Federation, the energy costs in the sector is 24% of the production costs. This corresponds to the findings with the surveyed plants located in Southern Europe, where the share of the energy costs in production costs increased even further in Q1 of 2022. In an attempt to prevent the disruptive option of shutting down their furnaces, glass container manufacturers have chosen to raise the price of their products. For example, the German Brewers' Association indicated in

[47] FEVE (2022). EU Container glass industry records highest ever growth in production. *Press release*. Available at: https://feve.org/year2021production/

[48] Ibid.

[49] FEVE (2022). EU Container glass industry records highest ever growth in production. *Press release*. Available at: https://feve.org/wp-content/uploads/2022/07/Press-Release-Production-Year-2021-Final.pdf

[50] FEVE (Host). (2022, September 22). How the energy crisis threatens the future of the glass bottle – In conversation with Adeline Farrelly. In *Areni Global*. https://areni.global/how-the-energy-crisis-threatens-the-future-of-the-glass-bottle-in-conversation-with-adeline-farrelly/

May 2022 that some breweries have to pay 80% more for new glass bottles than a year ago.[51] Half of the surveyed plants in this study also indicated that there was an increase in the market price of container glass during the period of the COVID-19 crisis and the Russian invasion of Ukraine. The main factors are attributed to the general increase in production costs resulting from the rising costs of energy, raw materials, packaging, transportation as well as inflation (Consumer Price Index).

Nonetheless, none of the 162 factories in Europe has been closed down so far.[52] Glass containers are produced in furnaces that work permanently for 10-15 years as glass needs to remain in liquid form at around 1400°C during the production stages. Shutting down the glass furnaces, which primarily run on natural gas, even for a single day in this long-term process, would lead to the complete destruction of glass and irreversible damage to the furnace installation.[53] The sector is planning to boost electrification of their production process, with the ambition to bring 80% of the glass production furnaces to be fully electric, as well as increasing the production of recycled glass.[54]

B.5.4 Evolution of energy prices

As discussed in Section B.5.2, the surveyed companies saw a significant increase in their energy costs. Analysis shows that this is primarily driven by increases in energy prices, which are further discussed in this section.

Electricity prices

The average electricity prices[55] in €/MWh paid by the surveyed container glass companies of the SE region have increased by 50.5% between 2021 and the first quarter of 2022, from 138.4 to 208.2 €/MWh. The electricity prices paid are relatively similar across the surveyed container glass companies in the SE region, meaning all surveyed companies experienced a significant increase in electricity prices in Q1 of 2022.

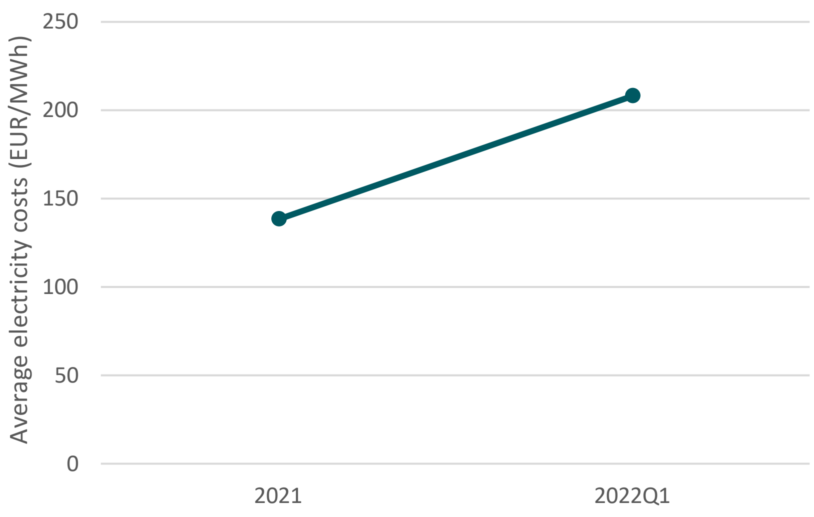

Figure 59: Electricity prices (€/MWh) - simple averages.

Source: Own elaboration with data from container glass companies.

[51] Schwertheim (2022). Glass bottle prices soar 80% for German beer brewers amid production and transport crises. Available at: https://www.packaginginsights.com/news/glass-bottle-prices-soar-80-for-german-beer-brewers-amid-production-and-transport-crises.html
[52] FEVE (Host). (2022, September 22). How the energy crisis threatens the future of the glass bottle – In conversation with Adeline Farrelly. In *Areni Global*. https://areni.global/how-the-energy-crisis-threatens-the-future-of-the-glass-bottle-in-conversation-with-adeline-farrelly/
[53] FEVE (2022). FEVE paper addressing the risk of energy shortages in the container glass industry. Available at: https://feve.org/wp-content/uploads/2022/03/FEVE-Position-on-non-interruptability-of-energy-supply-10032022.pdf
[54] FEVE (Host). (2022, September 22). How the energy crisis threatens the future of the glass bottle – In conversation with Adeline Farrelly. In *Areni Global*. https://areni.global/how-the-energy-crisis-threatens-the-future-of-the-glass-bottle-in-conversation-with-adeline-farrelly/
[55] The average price of electricity indicated in the figure includes the following price components: network costs from the Transmission System Operator (TSO) and Distribution System Operator (DSO) if applicable, levies, taxes, interruptibility discounts and CO_2 retributions but excluding VAT.

Table 53: Descriptive statistics for electricity prices paid by sampled container glass companies (€/MWh) - simple averages.

Electricity costs (EUR/MWh)	2021	2022Q1
SE average	138.41	208.24

Source: Own elaboration with data from container glass companies.

Electricity contracts

Box 8: Definition of fixed and variable contracts

The sampled container glass plants were asked about the duration of their energy contracts. For this study, electricity (and natural gas contracts) were classified as follows:

- Fixed contract: when a set rate per energy unit (e.g. Euro/kWh) is charged for the fixed term of the contract. Energy bill is charged based on energy usage.
- Variable contract: when the rate per unit is linked to market activity, and could therefore be subjected to changes throughout the contract period.
- A combination of fixed and variable contract combines fixed rates (usually to hedge against typically volatile periods), and variable rates (which can be structured around peak, non-peak or around the clock prices).

Three out of the four plants in this sample provided information regarding their electricity contracts. Half of the plants have a combination of fixed and variable contract, while 25% of the plants have a variable contract. The increase in electricity prices as shown earlier is aligned with the situation that most of the sampled plants have variable (or partly variable) contracts in the past year.

Table 54: Overview of electricity contracts of container glass sample.

Entire duration of contract	Remaining duration	% of plant(s)
Variable contract		
Indefinite	Indefinite	25%
Combination of fixed + variable contract		
1 year	≤ 1 year	25%
More than 3 years	More than 3 years	25%

Source: Own elaboration with data from container glass companies.

Out of the four sampled plants, one plant is currently producing their own energy from renewable sources, while two other plants have indicated that they have plans to arrange for RES-PPA contracts and produce their own renewables by 2025, 2030 and 2050.

Gas prices

The average price of natural gas paid by the surveyed container glass companies increased by more than twofold between 2021 and Q1 2022. As shown in Figure 60, some plants were at the lower range of the natural gas price paid in 2021, while this range became narrower in Q1 of 2022. This means that for some plants, the natural gas price in Q1 of 2022 was four times the price they paid in 2021.

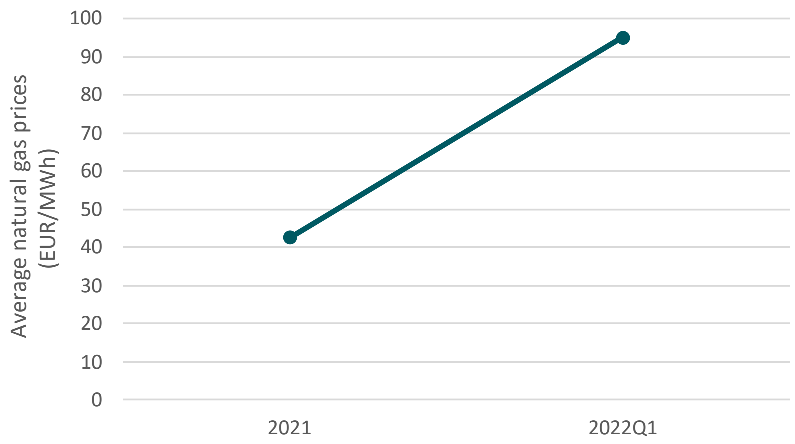

Figure 60: Natural gas prices (€/MWh) - simple averages.

Source: Own elaboration with data from container glass companies.

Table 55: Natural gas prices paid by sampled container glass companies (€/MWh) - simple averages.

Natural gas costs (EUR/MWh)	2021	2022Q1
SE average	42.45	95.06

Source: Own elaboration with data from container glass companies.

Gas contracts

Three out of the four plants in this sample provided information regarding their gas contracts. 50% of the plants have a combination of a fixed and variable contract which is still valid for less than a year, while 25% of the plants have a variable contract that is valid for an indefinite period of time. It is noted that the plants with a combination of fixed and variable contract experienced a less steep increase in the cost of natural gas per MWh between 2021 and Q1 2022 (about 1.8 times increase) as compared to the plants with a variable contract (about 4 times increase).

Table 56: Overview of gas contracts of container glass sample.

Entire duration of contract	Remaining duration	% of plant(s)
Variable contract		
Indefinite	Indefinite	25%
Combination of fixed + variable contract		
1 year	≤ 1 year	50%

Source: Own elaboration with data from container glass companies.

B.6 Fertilisers

B.6.1 Sample statistics

The sample considered in the following analysis consists of three installations within EU27. Due to confidentiality reasons, neither the region nor the countries included in the sample can be delineated. Due to the limited sample size, the values shown in this section is therefore not representative of the fertilisers sector. Instead, the focus of the sample statistics is to show the relevance and impact of changes in energy prices for the sample companies.

B.6.2 Consequences of COVID-19 crisis and the Russian invasion of Ukraine for the Fertilisers sector

Natural gas is used as a main raw material to produce ammonia – the basic component for all mineral nitrogen fertilisers. Therefore, an increase in the natural gas prices affects both energy and material costs of fertiliser plants, making up about 60-80% of their total production cost[56].

[56] Fertilizers Europe (2019). Energy cost. Available at: https://www.fertilizerseurope.com/industry-competitiveness/energy-cost/

Based on the responses of the sampled plants as well as market reports, the current energy crisis has forced many plants to reduce, suspend or to permanently cease production[57], which has a negative impact on their personnel as well. Fertilizers Europe—the association representing the majority of European fertiliser producers—indicated that as of August 2022, around 70% of European production capacity has been curtailed.[58] Production stops of fertilisers have taken place across the whole of Europe as shown in Figure 61. For example, Azomures—the largest natural gas consumer in Romania—has suspended its ammonia production since June 2022 and announced in September 2022 that they would reallocate or send 200 of its 1000 employees into technical unemployment.[59] Similarly, Achema—Lithuania's largest fertiliser producer—has stopped its fertiliser production as of September 2022 with 5% of its 1250 employees expected to be laid off and some other employees to be up on downtime with 40% of their average salary.[60] The significant curtailment in European fertiliser production shows that producers have very limited means to mitigate the soaring gas prices in the current energy crisis; one respondent also mentioned that it was not possible to pass on the entire energy price increase to the consumers.

In addition, fertiliser plants have also reported an increase in the price of ammonia. Some plants have since reduced their purchase of ammonia or resorted to importing them from others in order to meet the demand of their customers. For example, BASF—one of the world's largest chemical producer—significantly reduce its own ammonia production and purchase ammonia from others for their fertiliser production.[61] Yara—one of the world's largest fertiliser producer—stated that, following the curtailment of their European production due to the higher gas prices, they are importing ammonia to meet European demand.[62]

[57] Hodges (2022). Food costs and interest rates rise as energy and fertilizer supplies are hit by the invasion. Available at: https://www.icis.com/chemicals-and-the-economy/2022/09/food-costs-and-interest-rates-rise-as-energy-and-fertilizer-supplies-are-hit-by-the-invasion/

[58] Fertilizers Europe (2022). Europe's fertilizer industry victim of EU's energy chaos. Available at: https://www.fertilizerseurope.com/wp-content/uploads/2022/08/Fertilizers-Europe-Press-release_Europe-fert-industry-victim-of-EU-energy-chaos-1.pdf

[59] Chirileasa (2022). Romanian fertilizers maker Azomures reduces its activity again. *Romania-insider.com*. Available at: https://www.romania-insider.com/azomures-reduces-activity-again-sept-2022

[60] Achema (2022). „Achemos“ sunkūs sprendimai yra privalomi. Available at: https://www.achema.lt/news/267/491/Achemos-sunkus-sprendimai-yra-privalomi

[61] Burger (2022). BASF readies more ammonia production cuts in gas supply crunch. Available at: https://www.reuters.com/business/energy/basf-considers-more-ammonia-production-cuts-gas-supply-crunch-sources-2022-07-27/

[62] Rasmussen and Solsvik (2022). Yara cuts cast doubt on Europe's fertilizer production. *Reuters*. Available at: https://www.reuters.com/business/environment/yara-cuts-cast-doubt-europes-fertiliser-production-2022-08-25/

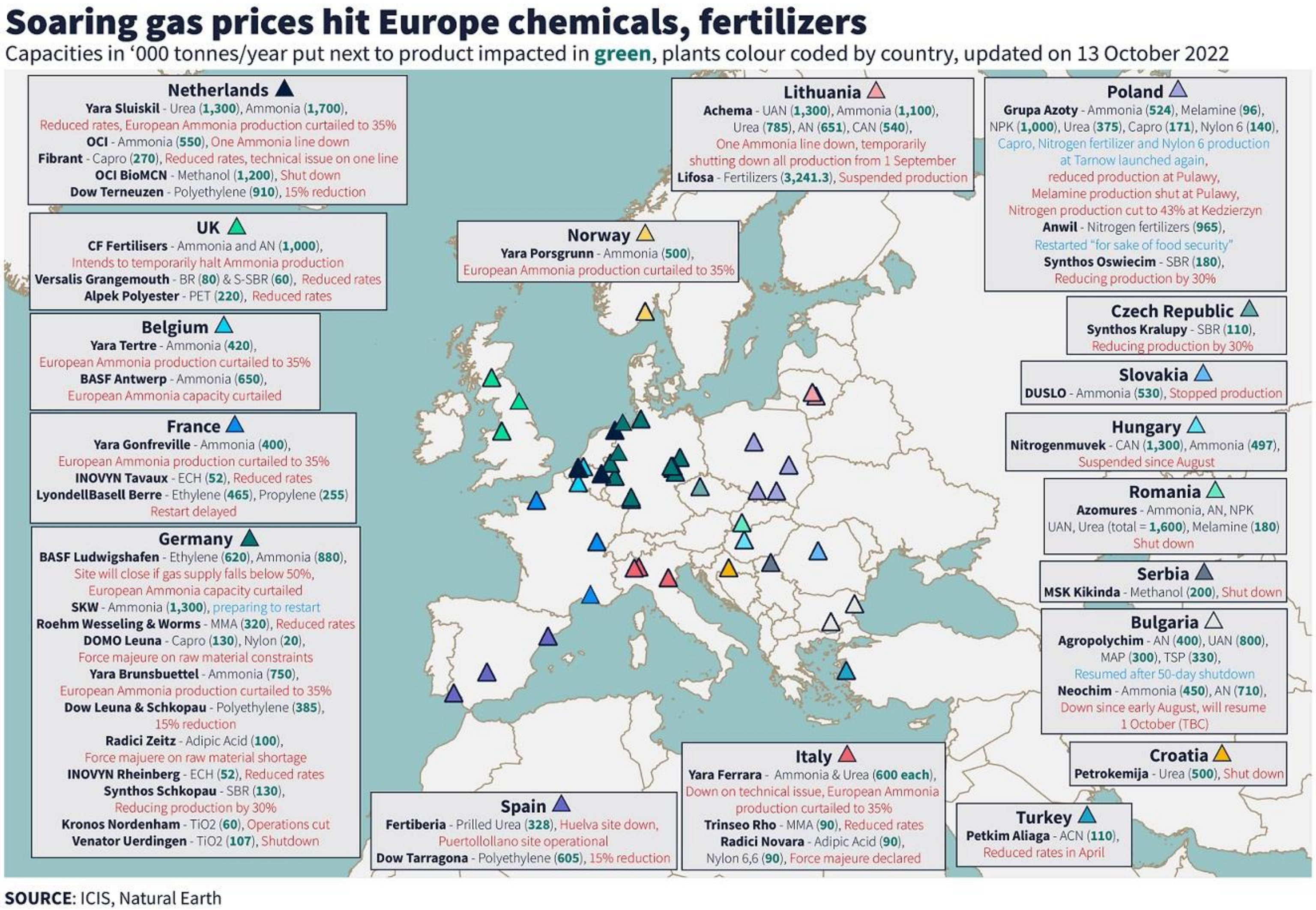

Figure 61: Overview of production curtailment of fertiliser plants across Europe (as of October 2022).

Source: ICIS, Natural Earth

B.6.3 *Energy cost*

Electricity prices

Figure 55 and Table 48 presents the average cost of electricity in €/MWh paid by sampled fertiliser plants, which experienced an increase of 1.76 times between 2021 and Q1 2022.

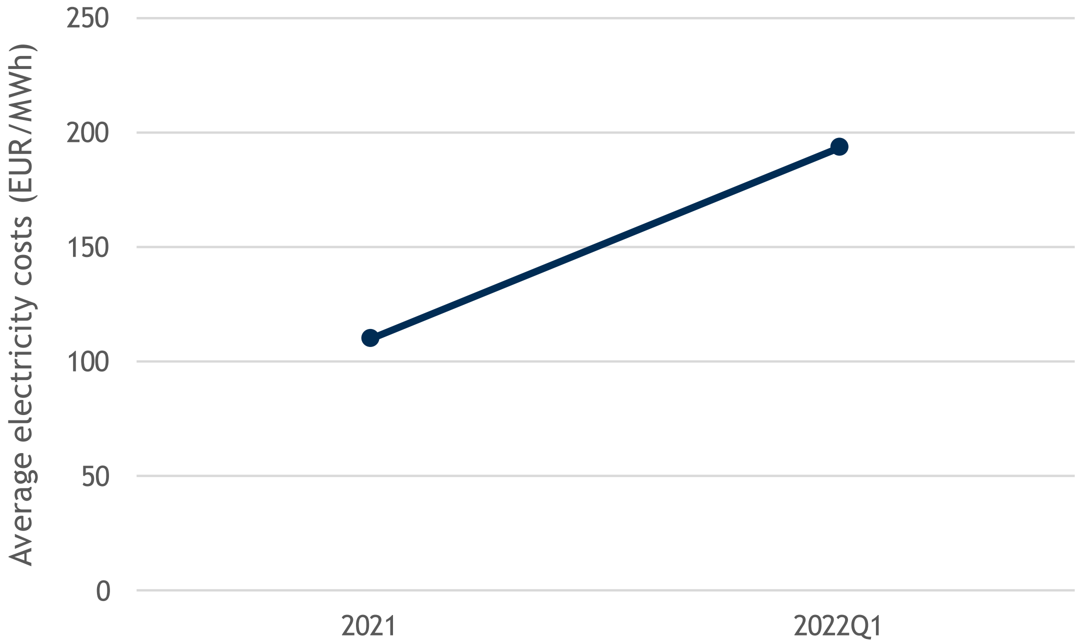

Figure 62: Electricity costs (€/MWh) of sampled fertiliser plants - simple averages.

Source: Own elaboration with data from fertiliser plants.

Table 57: Descriptive statistics for electricity costs of sampled fertiliser plants (€/MWh) - simple averages.

Electricity costs (€/MWh)	2021	2022Q1
EU average	109.91	193.76

Source: Own elaboration with data from fertiliser plants.

Electricity contracts

Box 9: Definition of fixed and variable contracts

The sampled fertiliser plants were asked about the duration of their energy contracts. For this study, electricity (and natural gas contracts) were classified as follows:

- Fixed contract: when a set rate per energy unit (e.g. Euro/kWh) is charged for the fixed term of the contract. Energy bill is charged based on energy usage.
- Variable contract: when the rate per unit is linked to market activity, and could therefore be subjected to changes throughout the contract period.
- A combination of fixed and variable contract combines fixed rates (usually to hedge against typically volatile periods), and variable rates (which can be structured around peak, non-peak or around the clock prices).

Two out of three sampled fertiliser plants provided details on their electricity contracts, as well as any other types of energy production and services that they engage in. One plant indicated that they have a fixed contract of more than three years with a remaining duration of 2 – 3 years; another plant has a variable contract for one year which will expire in less than one year.

Table 58: Overview of electricity contracts of the ceramics sample.

Entire duration of contract	Remaining duration	% of plant(s)
Fixed contract		
> 3 years	2 - 3 years	33.3%
Variable contract		
1 year	< 1 year	33.3%

Source: Own elaboration with data from ceramics plants.

The same two plants who provided a response to the type of electricity contracts they have also indicated the types of energy production and/or services their company have. One of the plant plans to produce their own renewable energy by 2030 and 2050. Another has indicated that they plan to produce their own renewables already by 2025, and in addition have RES-PPAs in place between 2025 to 2050.

Gas

Due to insufficient data received, we are unable to provide any further analysis of the natural gas prices paid by the sampled fertiliser plants. However, it appears that the increase in gas prices as reported by plants do fall within the same price range and have also seen a similar rate of increase that is experienced across the other sectors between 2021 and Q1 2022.

Gas contracts

Only one out of three sampled ceramics plants provided details on their gas contracts. They had a fixed contract with a short duration, which have since expired at the time of writing of this report.

Table 59: Overview of gas contracts of the fertiliser sample.

Entire duration of contract	Remaining duration	% of plant(s)
Fixed contract		
< 1 year	< 1 year	33.3%

Source: Own elaboration with data from fertiliser plants.

B.7 Iron and steel

Iron and steel production can be broadly divided into two main categories:

- Primary steelmaking using blast furnaces and basic oxygen furnaces (BF-BOF) to turn iron ore into steel, which is an energy- and carbon-intensive process.
- Secondary steelmaking using electric arc furnace (EAF) to produce steel mainly from steel scrap, which is characterised by a high specific electricity consumption.

In the EU, steel made via the BF-BOF route account for about 60% of the steel production and EAF steel for about 40%.[63] Since BF-BOF steel and EAF steel have distinct different energy consumption patterns, their energy costs have been analysed separately.

This section is solely developed based on publicly available data from TransitionZero on 26 plants in the EU (14 in Germany and 12 in Italy)[64] and other publicly available information. Data for plants in other countries are not publicly available from the dataset. Data is available for 2015 to 2021 and have recalculated from USD/t to EUR/t based on the average annual ECB exchange rates.[65]

B.7.1 Energy costs of the sector

Table 60 presents an overview of the annual electricity costs, fuel costs and total production costs per steel production route, averaged over the German and Italian plants in the dataset. Fuel costs also include fuels that serve both as an energy carrier and as feedstock such as coal and coke.[66]

Table 60: Overview of energy costs as a share of production costs (€/tonne) - Simple averages of plants in Germany and Italy

Indicator	2015	2016	2017	2018	2019	2020	2021
Electricity cost (EUR/tonne)							
BF-BOF	61	55	65	79	71	56	123
EAF	82	70	85	98	88	66	142
Fuel cost (EUR/tonne)							
BF-BOF	22	16	21	26	17	13	33
EAF	25	21	27	33	23	17	39
Energy cost (EUR/tonne)							
BF-BOF	83	72	86	106	88	69	155
EAF	108	91	112	130	111	83	182
Total production costs							
BF-BOF	473	478	544	574	562	520	790
EAF	468	434	513	553	503	467	720
Electricity costs as a share of production costs							
BF-BOF	13%	12%	12%	14%	13%	11%	16%
EAF	18%	16%	16%	18%	17%	14%	20%
Fuel costs as a share of production costs							
BF-BOF	5%	3%	4%	5%	3%	3%	4%
EAF	5%	5%	5%	6%	5%	4%	5%
Energy costs as a share of production costs							
BF-BOF	18%	15%	16%	18%	16%	13%	20%
EAF	23%	21%	22%	24%	22%	18%	25%

** BF-BOF - Blast Furnace-Basic Oxygen Furnace, EAF - Electric Arc Furnace*

Source: Own elaboration based on data from TransitionZero

[63] Eurofer (2020). What is steel and how is steel made? Available at: https://www.eurofer.eu/about-steel/learn-about-steel/what-is-steel-and-how-is-steel-made/
[64] Transition Zero (2022). Global Steel cost tracker. Available at: https://www.transitionzero.org/global-steel-cost-tracker
[65] European Central Bank (2022). Euro foreign exchange reference rates – US dollar (USD). Available at: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html
[66] A further disaggregation of the fuel costs is not available in the data of Transition Zero.

The following observations can be made regarding the energy costs in BF-BOF and EAF steel based on the public data, averaged over Germany and Italy:

- Energy costs as a share of steel production costs are slightly higher for EAF-based steelmaking (22% on average) compared to BF-BOF-based steelmaking (16% on average).[67] This relates to the higher electricity costs for EAF-based steelmaking as the process is highly electro-intensive. Nonetheless, electricity costs are also higher on average for BF-BOF steelmaking compared to fuel costs for the combination of German and Italian plants, despite BF-BOF being an energy-intensive process with high coal and coke consumption.
- In both types of steelmaking, energy costs are mainly driven by electricity costs, which correspond to 80% of total energy costs. This means that changes in electricity costs would affect the competitiveness in both steelmaking routes, and not only EAF-steelmaking that is known to be electro-intensive.
- In 2020, energy costs as a share of steel production fell to a 7-year minimum, followed by an increase in 2021 to peak levels of 20% for BF-BOF-based steelmaking and 25% for EAF-based steelmaking. The significant increase in energy costs as a share of production costs in 2021 can be explained by the increase of both electricity and fuel costs. Most notably, the fuel costs in 2021 increased by 152% for BF-BOF-based steelmaking and 129% for EAF-based steelmaking compared to 2020. Similarly, the electricity costs increased by 126% and 118% respectively over the same period.

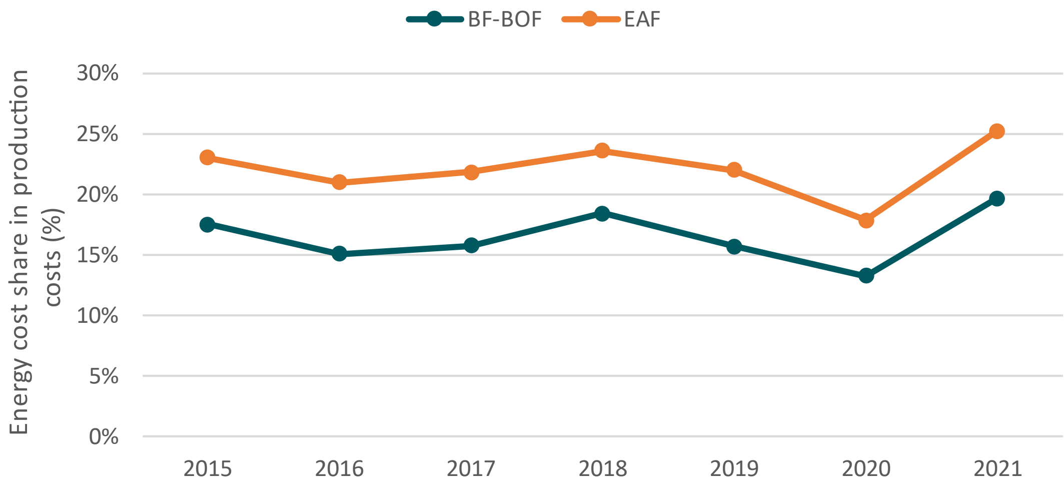

Figure 63: Energy costs as a share of production costs by type of steelmaking

Source: Own elaboration based on data from TransitionZero

B.7.2 Evolution of energy costs

Figure 64 shows that the same dynamics in the energy costs can be observed for both steelmaking routes. The average electricity and fuel costs per tonne of output in EU steel plants had an upward trend until 2018, when electricity costs reached 79 and 98 EUR per tonne of output and fuel costs 26 and 33 EUR per tonne of output from BF-BOF-based and EAF-based steelmaking, respectively. This followed by a drop in electricity costs of around 30% and even higher 50% drop in fuel costs in 2020. In 2021, both electricity

[67] Energy costs as a share of steel production costs based on data for German and Italian plants are in line with an earlier report by the 2020 JRC on production costs in the steel sector. In the 2020 JRC study, the share of energy costs corresponds to 17% for BF-BOF processes (equivalent to 77 EUR per tonne) and 20% of total costs for EAF-based steelmaking (equivalent 95 EUR per tonne). Source: Medarac et al. (2020). Production costs from iron and steel industry in the EU and third countries. *EUR 30316 EN*. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC121276

and fuel costs have almost doubled compared to the 2016-2020 average energy costs. As a result of this increase in energy costs, the TransitionZero report indicated that cost of steelmaking is now the highest in Germany and Italy compared to all major steel producing countries outside the EU such as Japan, the United States, China, India and Russia.

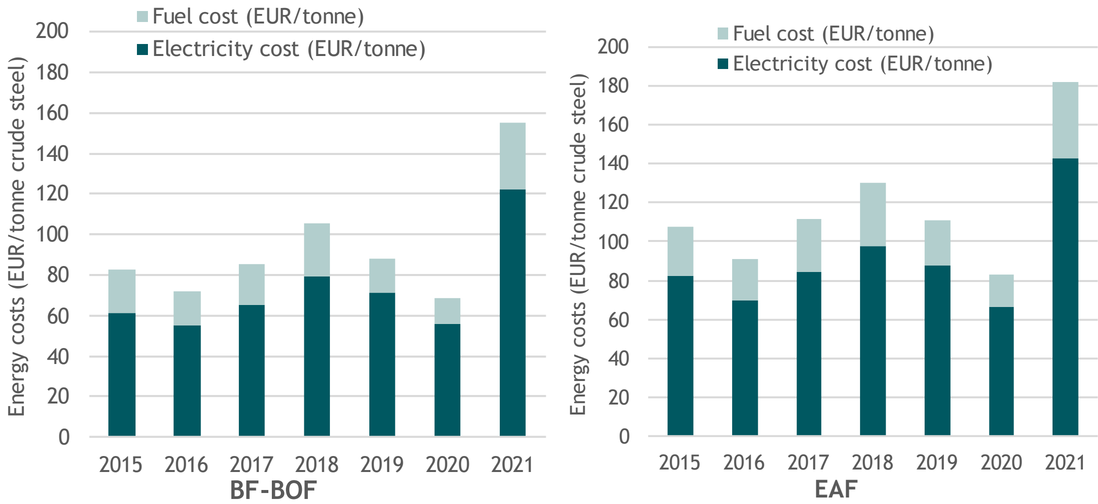

Figure 64: Energy costs, divided per type (€/tonne, Germany and Italy), simple averages

Source: Own elaboration based on data from Transition Zero

B.7.3 Consequences of COVID-19 crisis and Russian invasion in Ukraine for the steel sector

The current energy crisis, which started in autumn 2021 and worsened after Russian invasion, prompts widespread steel output cuts as European steelmakers announce planned outages and reduce steel output.[68] Market analysts indicated that between May 2021-2022, the steel production dropped by 6.8% in the EU, with in France, Croatia, Germany, Finland, Netherlands and Spain the production declining by more than 10%.[69]

According to ArcelorMittal, the largest producer of flat steel in Europe,[70] the main reasons for the decline in steel production are sharp slowdown in demand for steel products from key sectors (including the automotive industry), high energy costs and raw material prices. Market analysts indicated that the rise in energy costs especially degraded competitiveness of European producers and led to increase in imports from outside Europe[71]. They indicated that flat steel prices in Europe have been pushed down in recent months due to low end-user demand and overstocking from earlier panic buying.[72] The Russian invasion and consequent war is also considered as a major global supply shock for the steel value chain, as it led to shortage of essential raw materials, which are mostly from Russia and Ukraine.[73]

[68] Burgess (2022). European energy woes unlikely to significantly boost US steel exports . *Fastmarkets*. Available at: https://www.fastmarkets.com/insights/european-energy-woes-unlikely-to-significantly-boost-us-steel-exports
[69] Glushchenko (2022). EU decreased steel production by 6.8% y/y in May 2022. *Eurometal*. Available at: https://eurometal.net/eu-decreased-steel-production-by-6-8-y-y-in-may-2022/
[70] ArcelorMittal Europe (n.d.). Who we are. Available at: https://europe.arcelormittal.com/aboutarcelormittaleurope/who/europewhoweare
[71] Bolotova (2022). Weak demand, cheaper imports put pressure on European flat steel prices. *Eurometal*. Available at: https://eurometal.net/weak-demand-cheaper-imports-put-pressure-on-european-flat-steel-prices/
[72] Novokreschenova et al. (2022). Six months of war: How has it changed the global steel market?. *Fastmarkets*. Available at: https://www.fastmarkets.com/insights/six-months-of-war-how-has-it-changed-the-global-steel-market
[73] Houlden et at. (2022, April 05). War in Ukraine – The impact on commodity markets. *CRU Webinar*. Available at: https://www.crugroup.com/knowledge-and-insights/webinars/2022/war-in-ukraine-the-impact-on-commodity-markets/

Due to the deteriorating market conditions for European steel producers, as of September 2022, at least 18 steel plants across the EU have announced measures to reduce their production as shown in Figure 65 . The figure shows that factories are shutting down some units or temporarily stopping production all together, as well as reducing working hours of their staff.

EUROPEAN STEELMAKER SITE CLOSURES 2022
Latest updates in red

Company	Plant	Location	Measures taken	Products affected
ArcelorMittal Spain	Sestao	Spain	EAF operations stopped in mid-August, restart postponed.	Flat steel
	Asturias (Gijon)	Spain	BF "A" to be stopped before end-September.	Plate, wire rod
ArcelorMittal France	Dunkirk	France	BF 2 stopped in June; number of rolling operations adjusted; BF 3 and one sinter line to be stopped before end-September; two glavanizing lines closed.	Flat steel
ArcelorMittal Germany	Bremen	Germany	Reduced working schedule since July; plans to shut down one BF before end-September.	Flat steel
	Eisenhüttenstadt	Germany	Stopped one BF in summer, implemented shortened working hours.	Flat steel
	Hamburg	Germany	DRI module to be shut down starting Q4 2022.	Long steel
	Duisburg	Germany	Shortened working hours implemented.	Long steel
ArcelorMittal Poland	Dąbrowa Górnicza	Poland	BF 3 will be stopped before end-September without fixed date for restart; BF 2 to remain operational.	Flat steel, long steel
	Warszawa	Poland	EAF stopped in August 2022 on high costs.	Long steel
Acciaierie d'Italia	Taranto	Italy	Two BFs stopped in August; hot-dipped glavanizing lines stopped.	Flat steel
Arvedi	Cremona	Italy	Output being reduced; hot flow will stop for one week in four; if market fundamentals remain bad, closures will extend to two weeks in four.	Flat steel
Dunaferr	Dunaferr	Hungary	Stopped small BF in August, stopped second BF in mid-September due to lack of coke.	Flat steel
Hebei Iron and Steel Serbia (HBIS Serbia)	Smederevo	Serbia	One BF stopped end-July 2022 with no date for restart.	Flat steel
Liberty Steel	Liberty Ostrava	Czech Republic	Shut down BF 2 on July 26 2022 for a maintenance, no date for restart.	Flat steel
Pittini Group	Osoppo (Ferriere Nord)	Italy	Production stopped in early September until October 2 due to high energy costs.	Long steel
Salzgitter Group	Salzgitter Flachstahl	Germany	BF "C" idled in October 2019; restart planned for June 2022 but postponed to September 2022.	Flat steel
Thyssenkrupp	Thyssenkrupp	Germany	Shortened working hours implemented, no equipment stoppages heard.	Flat steel
US Steel Kosice	US Steel Kosice	Slovakia	Company denies reports that it stopped one BF end-June 2022; confirmed stoppage of one BF on September 4 for 60 days.	Flat steel
Vitkovice Steel	Vitkovice	Czech Republic	Stopped operations in May 2022 on lack of feedstock.	Plate

Source: Fastmarkets

Figure 65: Overview of production stops in European steelmaking sites as of September 2022

Source: Fastmarkets MB[74]

[74] Bolotova (2022). Dunaferr effectively halts steelmaking in Hungary with closure of second BF. *Eurometal*. Available at: https://eurometal.net/dunaferr-effectively-halts-steelmaking-in-hungary-with-closure-of-second-bf/

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MJ-AG-24-002-EN-N

Publications Office
of the European Union

ISBN 978-92-68-14285-1