



Dissemination of the heating technology research results for emission minimization and process optimization towards today's fossil-free heating agenda

RFCS-2021

Grant agreement No 101057930

Report on marked needs, an overview

Deliverable 5.2

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Dissemination level: Public

Version 1.0

Published 2023-10-25

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1 Introduction

This deliverable aims to define the market needs regarding reheating furnaces also taking into account hot charging practices, import of hot rolled products and slabs and mini-mills.

An overview will be presented of steels rolled today, the limits of hot charging, import possibilities and the limits of mini-mills.

2 Market of hot rolled products

The crude steel production in Europe in 2023 reached 128.2 Mton (136.3 Mton in 2022, Figure 1). The demand of steel in EU was 132.2 Mton in 2023.

REGIONS IN DESCENDING ORDER OF
CRUDE STEEL PRODUCTION TABLE • 2022
SOURCE: EUROFER

	% shares	
	2022	2022
Asia	1392,1	73,9
▶ of which China	1017	54,0
▶ of which India	125,1	6,6
▶ of which Japan	89,2	4,7
Europe	266,7	14,1
▶ of which EU27	136,3	7,2
▶ of which Ukraine & CIS	85,2	4,5
North America	112,4	6,0
of which United States	80,7	4,3
South America	43,8	2,3
Middle East	44,5	2,4
Africa	18,9	1,0
Australia/New Zealand	6,7	0,4
WORLD	1885,0	100

MAP OF STEEL PRODUCTION BY REGION

MAP • 2022
SOURCE: EUROFER

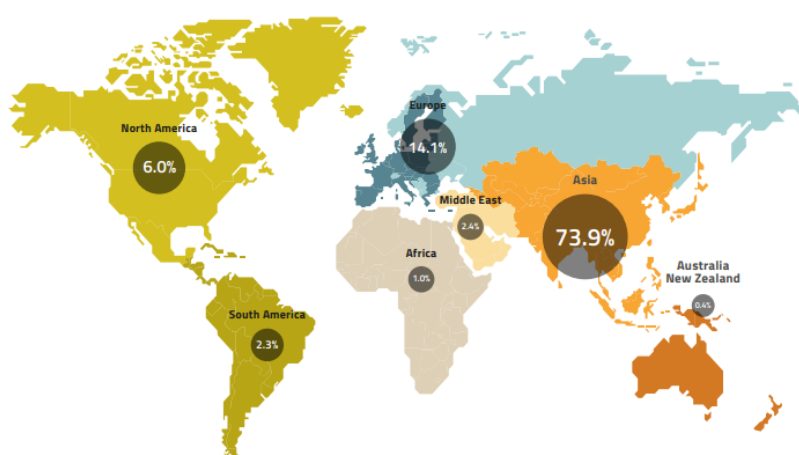


Figure 1 : Steel production by region (EUROFER)

By product quality, it can be observed in Figure 2 that the total number of hot rolled wide strips in 2022 was 63 Mton, of which 35 Mton was cold rolled.

EU strip mill products are mainly sold directly to end-users, 53.8%. 36.7% is sold to steel service centers and 9.5% to merchants.

The biggest market in EU is the “Automotive sector”, 40 to 50%. This also illustrates the strength of the EU steel industry. In many applications a product is developed together with the customer, resulting in long term constructs of 5 to 6 years, related to specific model types of cars. The other markets are “Audio, video and domestic appliances”, “Construction”, “Mechanical engineering”, “Sanitary facilities” and “Packaging material”.

EU TOTAL FINISHED STEEL PRODUCTION BY PRODUCT

TABLE, CHART • 2013 – 2022

SOURCE: EUROFER

NOTE: Downstream processing converts some HRWS into CRF, and some CRF into Hot Dipped and some Hot Dipped into Organic Coated. Downstream processing uses both domestic and imported steel. Production totals may thus not add up precisely.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total Hot Rolled	142,250	144,052	142,874	143,653	147,772	148,478	139,221	123,649	140,661	125,364
▶ of which flat products	87,822	89,328	87,746	88,538	91,747	91,481	85,082	74,720	84,480	74,880
▶ Quarto Plate	10,245	10,860	10,350	10,383	10,994	11,024	10,109	9,137	10,142	10,011
▶ Hot Rolled Wide Strip	76,223	77,074	76,053	76,734	79,256	78,977	73,578	64,339	72,948	63,641
▶ Other flat products	1,354	1,395	1,344	1,422	1,498	1,480	1,395	1,244	1,389	1,228
▶ of which long products	54,428	54,723	55,128	55,115	56,025	56,997	54,139	48,929	56,182	50,485
▶ Wire Rod	19,123	19,192	19,776	19,510	20,479	21,067	20,175	18,386	21,721	18,912
▶ Rebars	12,871	12,708	12,454	12,852	12,195	12,320	12,457	11,321	12,157	11,518
▶ Merchant Bars	11,371	11,869	11,664	11,535	12,146	12,285	10,833	9,515	11,535	10,423
▶ Heavy Sections	8,073	8,024	8,210	8,573	8,568	8,605	8,013	7,172	8,087	7,172
▶ Other long products	2,990	2,931	3,025	2,646	2,636	2,719	2,662	2,535	2,682	2,459
Products obtained from upstream production – from Hot Rolled Wide Strip										
▶ Cold Rolled Flat	41,213	42,357	42,616	43,551	44,641	43,643	41,320	36,058	41,282	35,620
▶ Hot Dipped	23,956	25,703	26,223	26,599	27,292	26,836	25,851	22,454	24,584	21,615
▶ Organic Coated	4,163	4,269	4,271	4,530	4,636	4,619	4,826	4,722	5,252	4,419

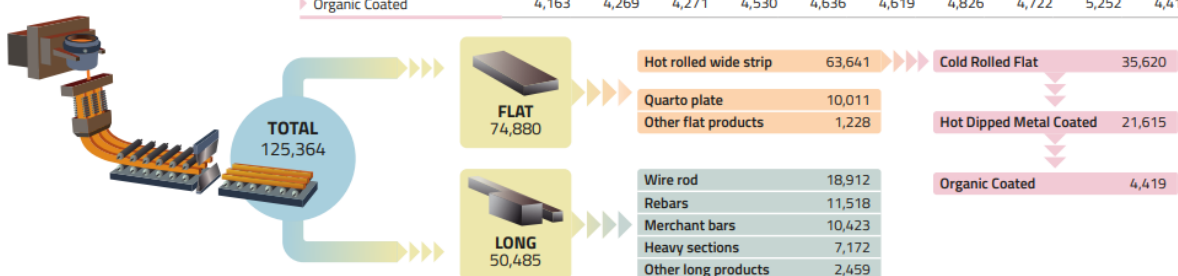


Figure 2 : EU total finished steel production by product

The grades being rolled in each plant can strongly vary. An analysis of the grades being roll in different mills resulted in an average value of product families being produced in a European hot strip mill (Figure 3). The contribution are deep drawing grades followed by HSLA and structural steels.

Product family	%	Mton/year
Drawing/Isotropic	26	16,38
IF Drawing	17	10,71
HSLA	15	9,45
Structural steels	11	6,93
Packaging	9	5,67
IF High Strenght	4	2,52
BH	4	2,52
Dual Phase	2,3	1,449
API tubes	2	1,26
Plates	2	1,26
Ferrite Bainite	1,8	1,134
TRIP	1,8	1,134
High Carbon	1,4	0,882
Enameling	1,2	0,756
Electrical steels	1	0,63
Multiphased steel	0,5	0,315
Total	100	63

Figure 3 : Typical product families being rolled in a HSM

Taking into account an average consumption of 1.4 GJ/ton, the market need regarding reheating furnaces is 88,000,000 GJ.

3 Hot charging

The best method to reduce the market need regarding reheating furnaces is hot charging. Hot charging practices strongly vary between the different European hot strip mills depending on the layout of the mill and the product mix. In some mills, such as ArcelorMittal Florange, hot charging is even not possible as all slabs are imported from other facilities. Today, in average 9% of the slabs are hot charged at a temperature of about 150°C.

Today some mills already apply hot charging for 60% of their product mix even at temperatures up to 750°C.

Hot charging of all slabs is however not realistic (e.g. orders, slab production, slab import, mill productivity, slab yard management).

In 2022 about 5.3 Mton of slabs were imported to Europe. The European steel market was significantly dependent on the import of slabs from Ukraine and Russia. As a result of the war, the supply structure changed significantly: Russia reduced the shipment of slabs, Ukrainian exports collapsed due to the loss of production capacity. Russian exports of slabs to the EU in 2022 amounted to 3.36 million tons. Several European consumers have partially switched to slabs from China (336 kton), India (207 kton), as well as from Brazil (463 kton). In the future, the share of Brazilian slabs in European markets could increase as ArcelorMittal acquired the Brazilian slab producer CSP. Major increases are however not expected.

Some slab grades can also not be imported as the temperature of the slab between casting and rolling cannot go below 150°C, so they must be warm charged. The rules of the plants are different but in general it concerns grades with a $C \geq 0.4\%$ or $C \geq 0.3\% + Mn > 1.0\%$ or $Si > 1\%$. So, this accounts for some C-Mn grades, AHSS or high Mn grades, or high Si/ high Al grades. In average about 3% of the product mix.

So, considering all constraints (e.g. orders, slab production, slab import, mill productivity, slab yard management) it could be viable to hot charge about 60% of the slabs at 500°C. The average energy consumption could be reduced to 1 GJ/ton, and by this lower the market need for energy regarding reheating furnaces to 63,000,000 GJ, or a reduction by almost 30%.

4 Import

Another factor that could reduce the market need regarding reheating furnaces is of course the import of hot rolled flat products.

The import of flat hot rolled strips in 2022 in the EU was about 9 Mton (Figure 4). The main import countries are Turkey, India, South Korea and Taiwan. The export from the EU of flat hot rolled products in 2022 was about 2 Mton (Figure 5), resulting in a difference of 7 Mton. Compared to a production of flat hot rolled strips in EU of 63 Mton, means about 11% is imported. If import would increase with a factor 2, it would lead to a reduction of market need regarding reheating furnaces of 10%. So, 79,000,000 to 56,000,000 GJ if hot charged. Major increases are however not expected taking into account the client relationship and if necessary, Europe could also protect his market.

FLAT PRODUCT IMPORTS INTO THE EU BY PRODUCT CHART • 2013 – 2022

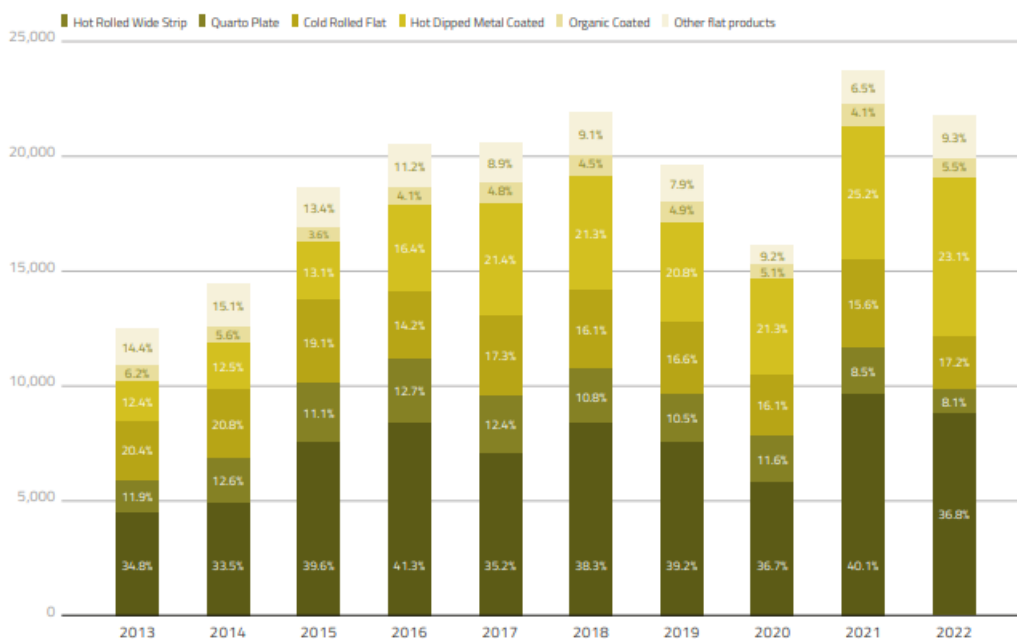


Figure 4 : Import of flat products into the EU

FLAT PRODUCT EXPORTS FROM THE EU BY PRODUCT CHART • 2013 – 2022

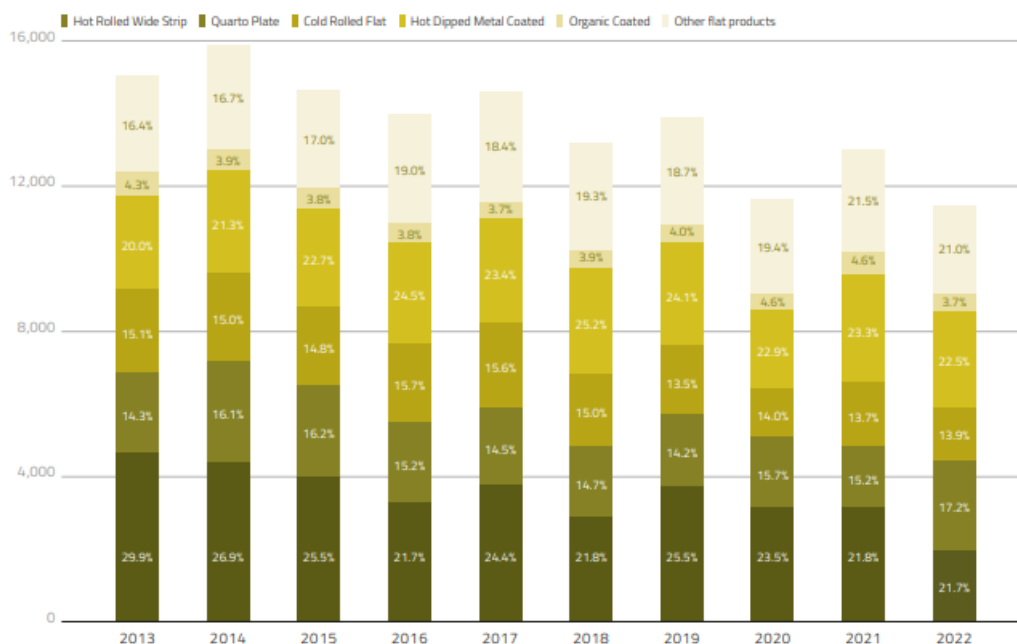


Figure 5 : Export of flat products from the EU

5 Mini-mill

A third option to reduce the requirement of reheating furnaces is the increase of mini-mills in EU. The energy consumption in a mini-mill is about 0.9 GJ/ton. In 2022 about 7 Mton of hot rolled strip has been rolled on mini-mills, about 11%. The main mini-mills are the ESP (Endless Strip Production) plants of Arvedi, the CSP (Compact Strip Production) plant of TKSE, the CSP plant of ArcelorMittal in Sestao and the DSP (Direct Sheet Plant) of Tata Steel NL. An increase of mini-mills in EU is however not expected as some companies already intended to close their operation. In 2023, only 0.2 Mton was produced at the CSP plant of ArcelorMittal Sestao.

The main limiting factors are:

- The investment cost in new plants
- Only production gains for thin products (<2mm)
- The mixed scheduling
- Limited number of grades that can be rolled. On a mini-mill it is possible to produce low carbon, high-strength low alloy (HSLA), electrical steel grades, ferritic bainite steels, and some multi-phase and Si grades.
- The secondary cooling configuration during casting (edge cracks)
- Surface quality (high reductions, high roll wear)
- Limited cooling power and length on the runout table

Mini-mills are especially of interest for local markets with the availability of steel scrap. By EAF a low capex is required. With the transition in Europe to DRI-EAF route perhaps the interest of mini mills will increase.

If the current mills would produce at their maximum capacity, the volume could increase to 13 Mton, so 20% of the market needs. If investment capital and time to market is not a problem in theory 75% of all hot rolled strips could be produced on mini-mills. It is however not expected that their share will increase higher than 25%, so an additional 15%. By this the market need regarding reheating furnaces could reduce to 83,000,000 GJ, or a reduction 5%.

6 Conclusions

The total production of hot rolled strips in Europe is about 63 Mton/year. The import of hot rolled strips from 3rd countries is 9 Mton/year, mainly Turkey and Asia, and the export is to 3rd countries is 2 Mton/year. So, the market of hot rolled strips in Europe is about 70 Mton/year, mainly deep drawing grades followed by HSLA and structural steels (see Figure 3). Major changes are not expected due to customer relationships.

To produce 63 Mton/year the market need regarding reheating furnaces is 88,000,000 GJ/year. This requirement could be reduced by:

- Optimal hot charging practices, 30%
- Increased import, 10%
- Or the optimal use and/or new investments in mini-mills, 5%