


Rapport nr 2016-008

Climate impact of metal-casting

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Swerea SWECAST AB			Status Öppen
Projekt nr 20888	Projekt namn Climate impact of metal-casting		
Författare Martin Wänerholm		Rapport nr 2016-008_	Datum 2016-12-28

Summary

Swerea SWECAST was commissioned by the Swedish Foundry Association to update the background report for the carbon footprint indicator which was first put forward in 2011.

The aim of the work was to analyze the emission of CO2 for thirteen foundry producing countries when producing one tonne of cast product.

The Swedish Environmental Research Institute, IVL, has on Swerea SWECAST mission produced a report with general data on carbon dioxide emissions from electricity consumption from thirteen countries.

Based on the background data presented by IVL and assumptions, calculations have been made for a number of different metals. The results are an indication that there are climatic differences depending on the country the cast components is manufactured in. In essence, it is the countries' electricity mix that controls the outcome, where Sweden is very well, because electricity from hydro and nuclear power produce low emissions of greenhouse gases in the operating phase.

A risk with this kind of work is that the result is taken as income for not working with energy efficiency in the Swedish foundries. So should not the results be interpreted. If foundries in other countries or individual foundries are working to streamline its process and the Swedish foundries don’t there is the risk that the Swedish foundries after all end up behind.

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1 Origins of this report

Swerea SWECAST has been commissioned by the Swedish Foundry Association (SFA) to update the background report for the climate indicator first produced in 2011. The report will be used to produce an updated climate indicator.

2 Introduction

The manufacture of cast parts is an energy-intensive process and it is mainly in smelting plants that most of the energy is used.

There are a number of contributory causes to the climate impact of metal-casting processes, two of these being the production of the electricity purchased for smelting and the transportation from the production site to the customer.

3 Purpose and objective

The purpose of the work on this report has been to analyse the electricity situation of 13 countries that have major foundry production and to describe the amount of CO_2e emissions resulting from the national energy mix.

CO_2e stands for carbon dioxide equivalents. A number of different gases in addition to carbon dioxide can impact on the environment. Because these gases can vary slightly in their environmental impact, a calculation is performed as to how much carbon dioxide this might be equivalent to, the outcome being specified as carbon dioxide equivalents.

4 Production of background data

At the request of Swerea SWECAST, IVL Swedish Environmental Research Institute has produced indicative general data on the carbon dioxide emitted as a result of electricity generation in 13 countries. The countries covered by the study are: China, Denmark, Finland, France, Germany, India, Italy, Norway, Poland, Spain, Sweden, Turkey and the United Kingdom.

IVL's report is enclosed as Appendix 1.

4.1 Data on the energy mix of the various countries

Data on the proportion of fossil carbon in the energy mix of the various countries has been obtained from the World Bank's website and used in the form in which it appears there. The collected data is valid for 2014.

4.2 Data on electricity

As regards electricity use, IVL has for the most part used two different sources for the collection of its data: the EcoInvent lifecycle database of the Swiss Centre for Life Cycle Inventories, and Thinkstep's lifecycle database GaBi Professional Database.

- **EcoInvent**
  The data relates to global warming potential: GWP emissions from the entire lifecycle for medium voltage in the electricity network for the country in question. The calculations are based on data from 2012.

- **GaBi Professional Database**
  The data relates to GWP emissions from the entire lifecycle for medium voltage in the electricity network for the country in question. The calculations are based on data from 2012.

The data sources display a number of differences. Choice of source is discussed further under the heading “Choice of data sources for the calculations”.

5 Choice of data sources for the calculations

IVL has produced two data sources for electricity generation and two data sources for transportation. These sources display a number of differences.

5.1 Choice of data for calculating emissions from electricity generation

From IVL’s report it is evident that both GaBi and EcoInvent are highly reliable sources and generally produce good data. EcoInvent is generally higher than GaBi Professional, but, on the basis of IVL’s report, it is not possible to determine the exact reasons for this. EcoInvent’s results are not infrequently considered to be relatively high compared to other data sources, but this does not mean that they involve a greater degree of error. EcoInvent has a wider international spread and is probably therefore interpreted as being more reliable.

EcoInvent was used for the previous version of this report.

In view of the considerations just mentioned, EcoInvent was chosen as the source for the continuing calculations.

A comparison between the data from EcoInvent and GaBi for the smelting of iron only has been undertaken in Figure 2. From this it can be seen that there is a degree of difference between these databases, but that the relationship between different countries is not thereby affected.

There is no data for electricity production emissions for Turkey in the databases studied. In its report, IVL argued that, in the previous study, Turkey’s emissions were very similar to those of the UK and that it is entirely possible that this remains the case today as well. Based on the data the World Bank published relating to the fossil carbon proportion in the energy mix of the different countries, it may be seen that the fossil carbon proportion for Turkey is similar to that of China, Figure 1 [1]. For this reason, values for carbon dioxide emissions due to electricity use for China have also been applied to Turkey.

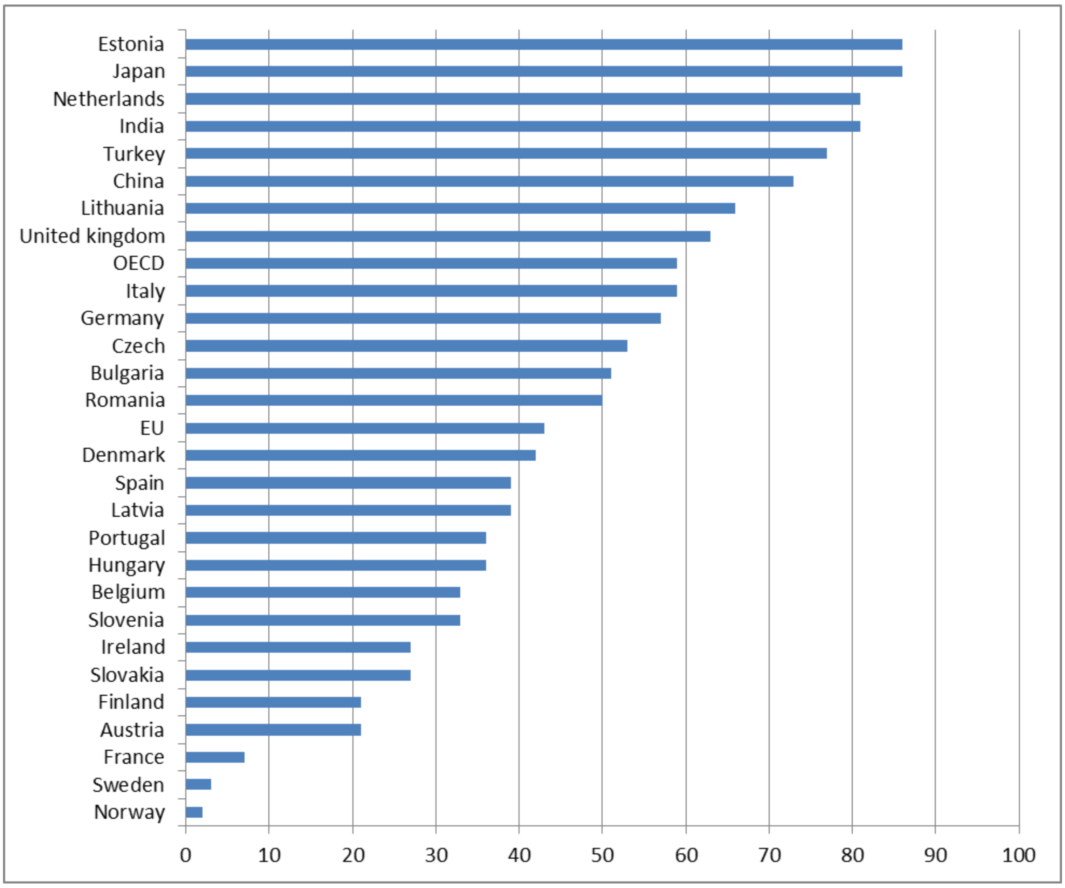


Figure 1 Fossil carbon proportion in the energy mix given in percent.

For China, the is no value in the database from Gabi, but since Ecoinvent have been selected, this has not resulted in any problems.

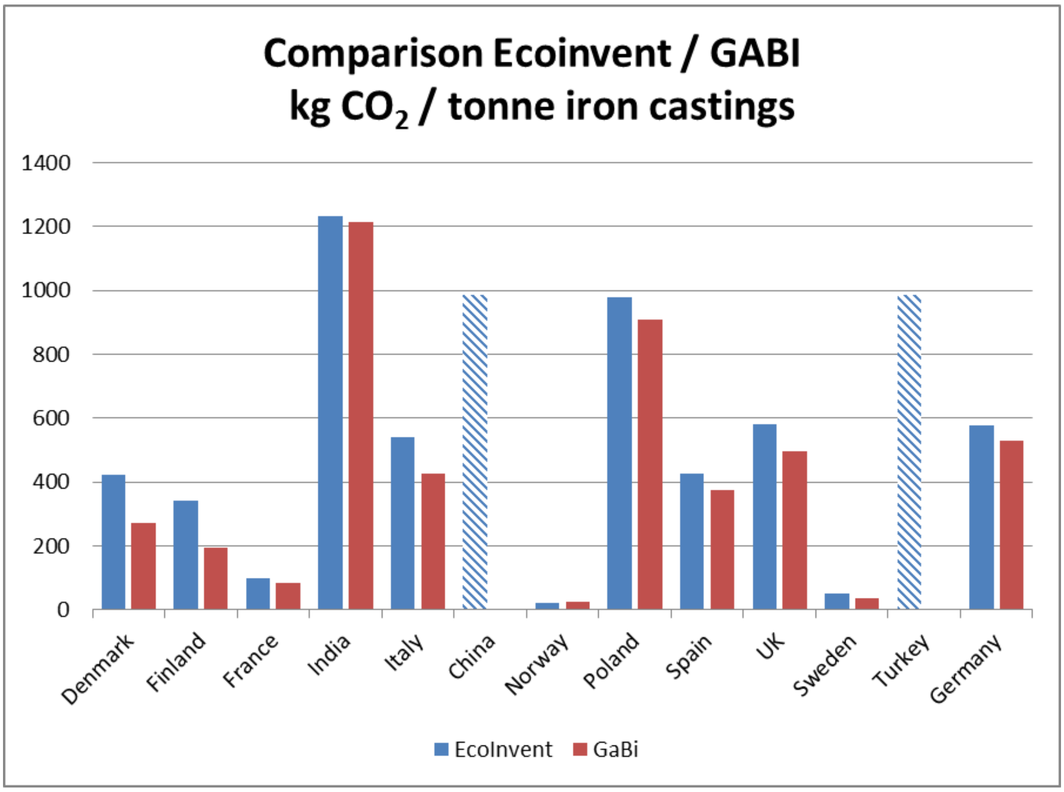


Figure 2. Comparison between Ecoinvent and Gabi regarding emissions generated from the use of electricity for smelting iron metal that produces a tonne of finished product. Turkey and China have no value for Gabi.

6 Assumptions on which the calculations are based

The total energy requirement to manufacture one tonne of cast products of a specific metal depends on a number of different production-related factors. A metal-specific indicator will therefore be extremely unreliable, and presumably the most suitable approach in future versions would be to specify some form of statistical dispersion based on this.

To describe in detail the actual climate impact of cast products production, one would have to use a specific foundry/cast product from a country and compare it with a corresponding foundry/part from another country. It has not been possible to undertake this within the parameters of this report. This is mainly due to the lack of public data produced in the same way in the different countries, but is also down to the fact that it was not within the remit of the project that such detailed findings be produced from comparable foundries in the various countries.

In order to be able to provide an indicative picture of the differences in climate impact due to cast products manufactured in different countries, we have therefore made a few simplifications and assumptions.

The restrictive parameter we have employed is that we only considered the amount of electrical energy that has to be applied to a furnace in order to smelt the amount of metal required to produce one tonne of cast products, including a typical loss due to e.g. resmelting. Generally this means that the climate impact that is obtained represents a part of the total impact the production of one tonne of cast products generates. Table 1 specifies the amount of electricity used to smelt one tonne of metal and an average yield. It might be of help here to explain where these figures came from.

Some were obtained from the so-called BREF (Best Available Techniques reference document) for the foundry industry dating from 2005 [2]. This document contains actual values for different foundries, expressed as a range. Based on this range, a value was chosen that does not need to be the same as the median value. Exactly which value is to be used is difficult to determine, as there is a lot of variation between different foundries, and some have progressed further in their work on energy-efficiencies. It may also be the case that some of the BREF document was produced before 2005. But because of the lack of any more recent values, the decision has been made to use the same figures as for the old report so as to be able to make a comparison.

Some values have been taken from Theoretical/Best Practice Energy Use In Metalcasting Operations, U.S. Department of Energy dating from 2004 [3]. These figures are entirely theoretical and cannot therefore be compared directly with those stated in BREF. In order to still be able to use them, they have been multiplied by 1.65 to obtain an approximate figure for the amount of energy applied to a furnace to smelt one tonne of metal. Equally, the figure of 1.65 is not a precise one. It can vary for different types of foundry and is perhaps somewhat on the high side for foundries involved in pressure die-casting. However, given

that here too there are no precise new figures, the same values as in the previous report have been used, which makes it easier to compare the reports.

If a country’s foundries are engaged in streamlining their foundry processes to make them more energy-efficient, this will be reflected in the actual consumption and the cost to the customer. By the same token, however, it is never reflected in the data presented in the climate indicator.

Table 1. Direct use of electricity for melting (theoretical value) of a tonne of metal, and assumed exchange

Metal	Average yield %	Electricity consumption for melting 1 tonne of metal, kWh
Iron	80	700*1
Steel (Induction)	60	740*2
Steel (arc)	60	550*1
Brass	50	293*3
Bronze	55	227*3
Aluminum	70	530*1
Magnesium	55	518*3
Zinc	30	120*3

*1 Integrated Pollution Prevention and Control. Reference Document on Best Available Techniques in the Smitheries and Foundies Industry, May 2005

*2 BBC Inductive schmeltzen

*3 Theoretical/Best Practice Energy Use In Metalcasting Operation. U.S. Department of Energy. The theoretical values have been multiplied by a factor of 1.65 to obtain a estimate of the amount of energy supplied to the oven to melt one tonne of metal.

7 Differences compared to the previous study

In its report, IVL has highlighted a number of differences compared to the previous study when it comes to emissions from electricity production.

Generally the values are higher than in the previous study. This is presumably down to there being a better data basis and the use of more complete models by EcoInvent and GaBi Professional.

Sweden has achieved a significantly lower result from EcoInvent, but the previous result (91 g CO_2e/kWh) was much higher than various models tend to indicate (for some time Sweden has had a stable generating mix with 90% hydroelectric power and nuclear power), so the result in this report (59 g CO_2e/kWh) is more normal. The result in the previous report was presumably down to an error in EcoInvent’s model/calculation which they then corrected.

8 Usability of the data

Information about data usability can be obtained from IVL’s report.

8.1 Electricity

Data on CO_2e emissions from electricity generation presented in this report provides a good indication of the approximate size of CO_2e emissions linked to electricity generation and electricity consumption in the relevant country.

The data on CO_2e emissions from electricity generation presented in this report should not be used as an exact description of CO_2e emissions from electricity generation or electricity consumption, as many influential parameters have not been included in the calculation (e.g. disclosure of the origin of the electricity, the residual mix and production mixes that vary from year to year).

The production mix is the composition of the various types of power plant existing in a country, weighted on the basis of how much electricity is generated nationally from each type. The residual mix is the production mix that remains after all electricity whose origin has been disclosed is removed. In Sweden this equates, in simplified terms, to the electricity sold on NordPol whose origin is not disclosed. This electricity has e.g. a significantly greater proportion of fossil carbon power, and therefore also greater climate impact, than Sweden’s own production mix. The results presented in the report are based on production mix data, as this is what is generally available.

The electricity presented in this report is what is termed average electricity, which totals emissions per kWh for the various types of power plant (e.g. wind or fossil carbon power) used in the production of electricity within, in this case, a single country. Another way of looking at electricity is in the form of marginal electricity. This describes what type of power plant is used when there is increased demand, use of which then also reduces as demand falls. Both ways of looking at electricity have their limitations and problems, but a common approach is to use marginal electricity for finding out what happens if you increase or reduce electricity consumption, and to use average electricity when totalling emissions from ongoing production.

If two or more countries have a shared, fully functional electricity market, it may sometimes be more relevant to look at the overall average of all the electricity production of these countries. This project has not however examined whether any of the countries in question belong to such fully functional electricity markets. After all, such a situation would be rare anywhere in the world.

9 Results

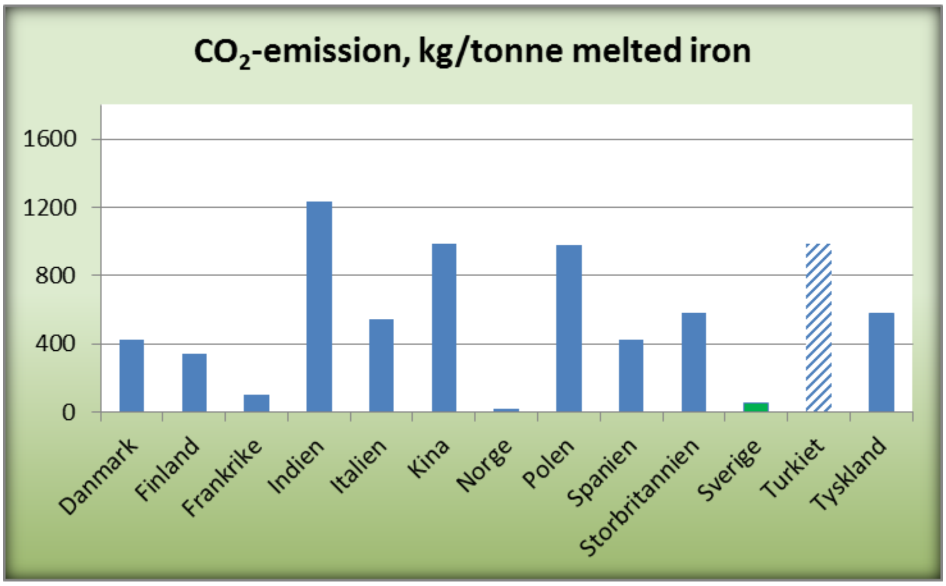
Based on the background data presented by IVL (Appendix 1) and the assumptions made as described in chapter 6, calculations have been performed for the relevant cast metals. For steel, emissions from smelting in both induction furnaces and electric arc furnaces have been calculated.

Generally, greater uncertainty must be ascribed to the emissions for Turkey, as described previously.

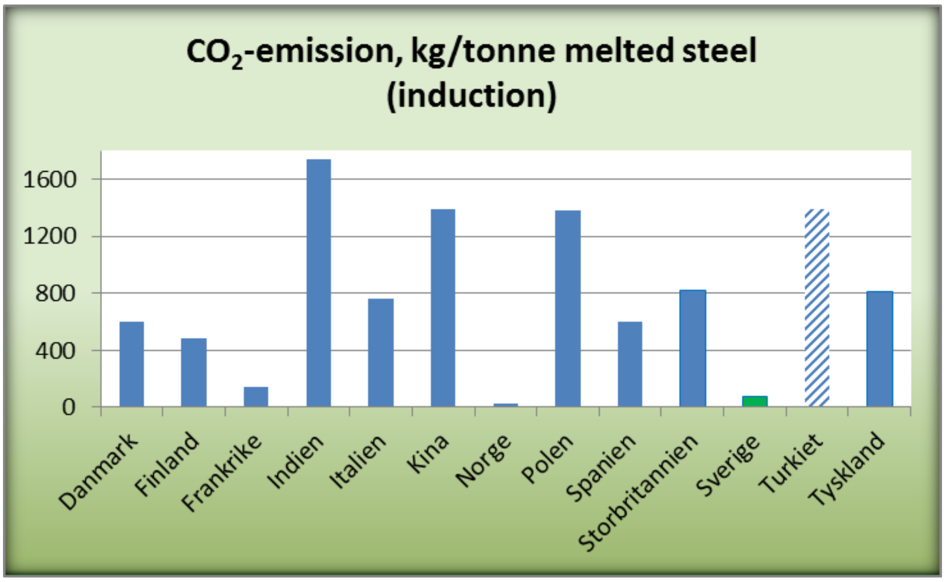
The figures used in producing the diagrams are shown in Table 2. The results for the various metals are reported in Figur 3 to Figur 10.

Table 2. Results of completed calculations for each metal in 2016.

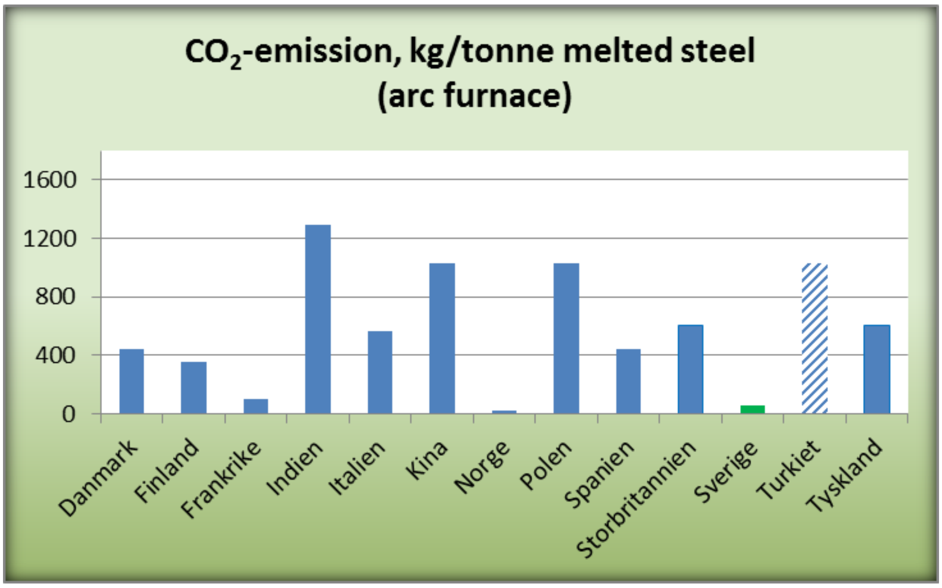
	Metal							
Land	**Iron**	**Steel (Induction)**	**Steel (Arc)**	**Aluminum**	**Magnesium**	**Brass**	**Bronze**	**Zinc**
Denmark	424	597	444	366	456	284	200	194
Finland	340	480	357	295	366	228	161	156
France	99	139	104	86	106	66	47	45
India	1233	1738	1292	1067	1327	826	582	564
Italy	543	765	568	469	584	363	256	248
China	986	1390	1033	853	1061	660	465	451
Norway	20	28	21	17	22	13	9	9
Poland	979	1380	1026	847	1054	656	462	448
Spain	425	599	446	368	458	285	201	194
UK	580	818	608	502	624	389	274	265
Sweden	52	73	54	45	56	35	24	24
Turkey	986	1390	1033	853	1061	660	465	451
Germany	578	814	605	500	622	387	272	264



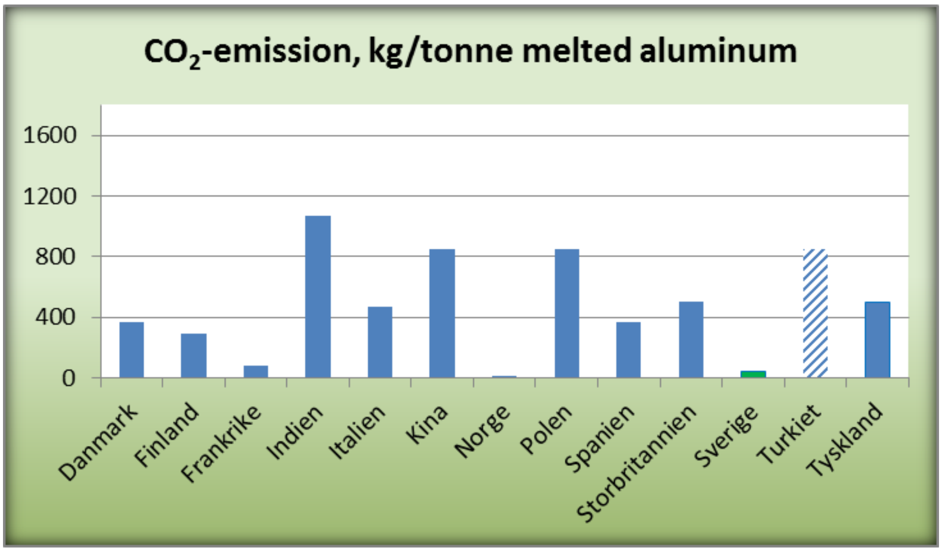
Figur 3. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



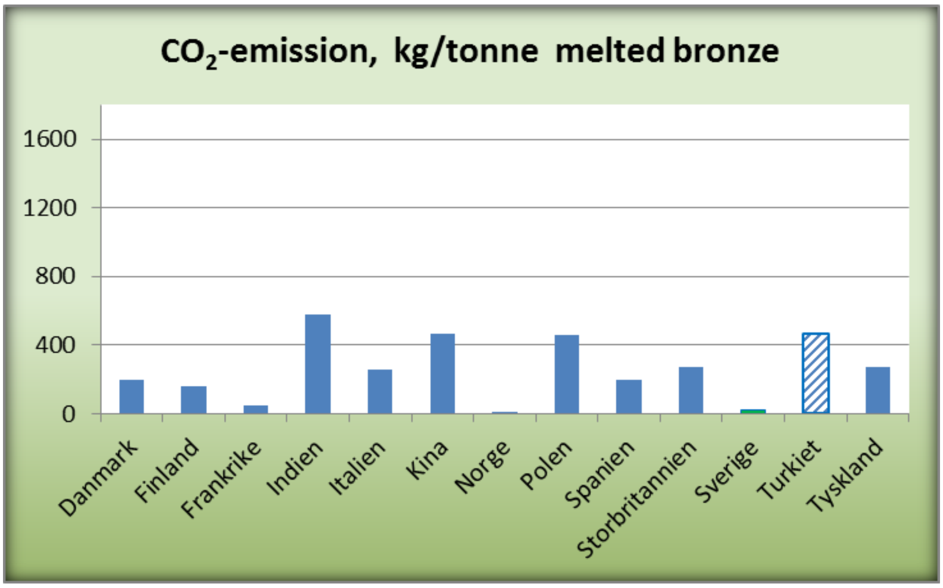
Figur 4. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



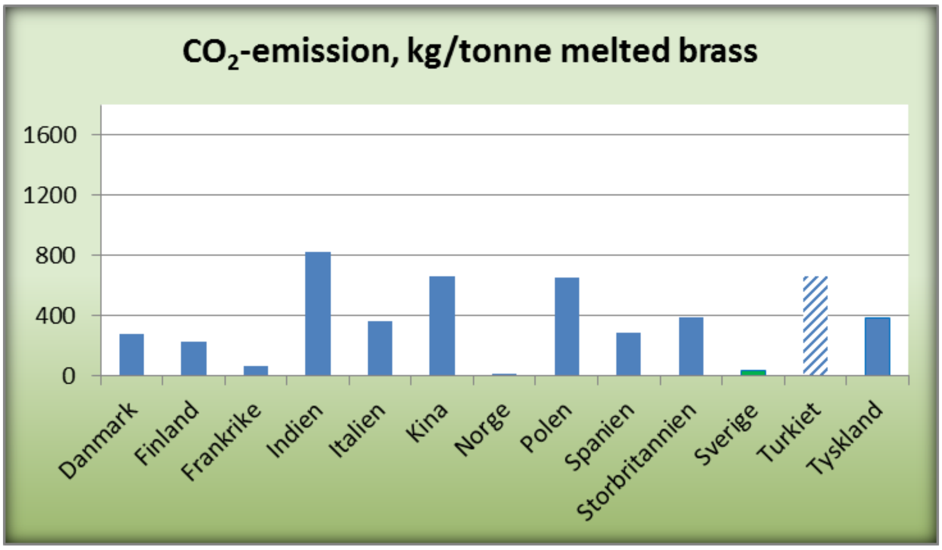
Figur 5. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



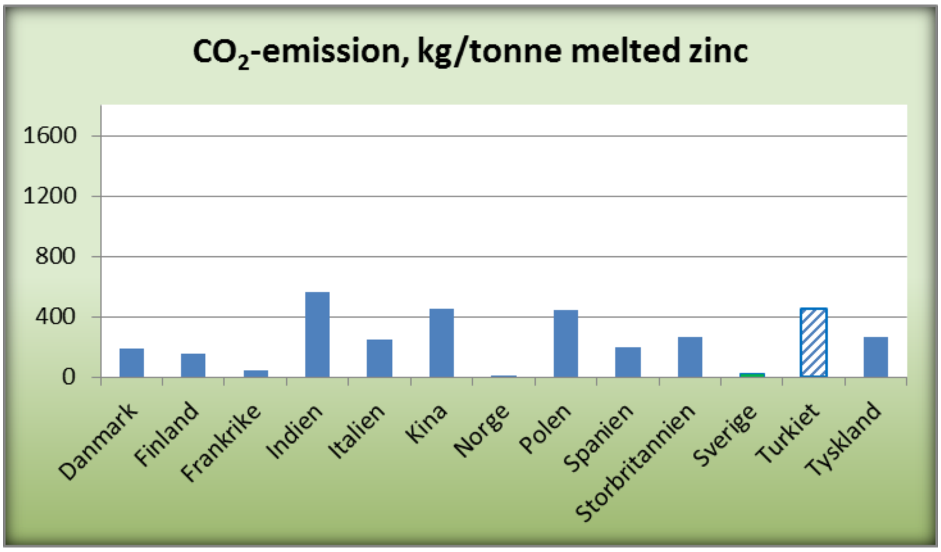
Figur 6. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



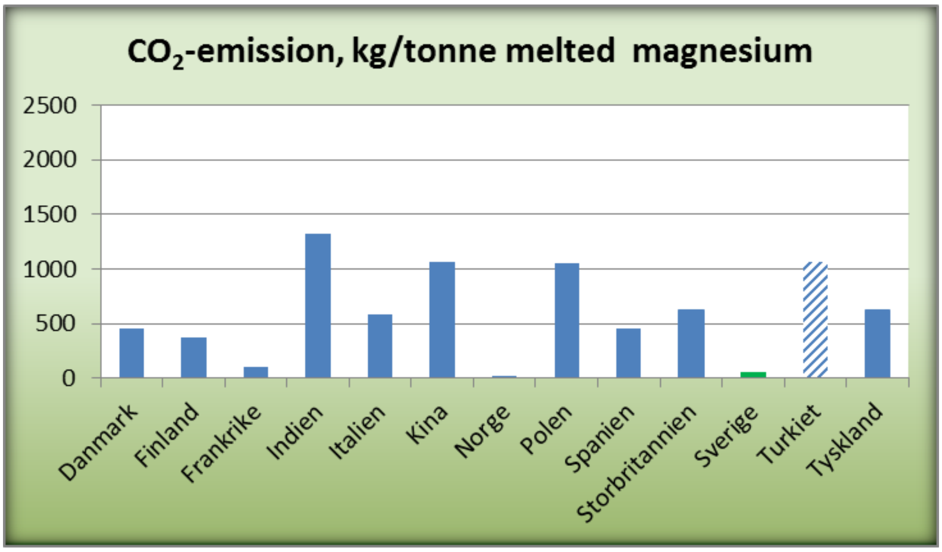
Figur 7. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



Figur 8. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



Figur 9. Carbon dioxide emissions for the melting of metal for one tonne of cast components.



Figur 10. Carbon dioxide emissions for the melting of metal for one tonne of cast components.

10 Discussion

The results are an indication that there are climate-related differences for the manufacturing of cast components in various countries. Generally it is the energy mix of the various countries that determines the results. Sweden is very well-placed in that electricity is generally generated from hydroelectric and nuclear power, these having low emissions of greenhouse gases in the production phase.

Various data sources have been used as a basis, and it may be seen that the choice of data source has an impact on the end result. The figures produced and reported should not therefore be seen as absolute in themselves, but rather an indication of the situation. For Turkey, for instance, there are no reliable data sources and an estimate has therefore been made. This may introduce further error into the calculations.

There are also sources of error in how the theoretical values for the amount of energy used in smelting have been converted into actual values. The actual values obtained from the literature are more than 10 years old, and various types of production streamlining must have happened in various parts of the world.

We are aware that the results may be misinterpreted to mean that Swedish foundry companies are so good they do not need to work on achieving energy-efficiencies. Misinterpretation of this kind may result in problems for the Swedish foundry industry in the future. If foundries that have a greater impact on the climate are engaged in streamlining their processes and Swedish foundries fail to do so, there is a risk that Swedish foundries will get left behind in developing their productivity. As regards the way in which the climate indicator was devised, an individual foundry’s or even a country’s streamlining work will not be reflected, as the main variables here are the generating mix for the production of electricity and transportation.

The data used for electricity production in the various countries is based on data from 2012. One point worth bearing in mind is that there is rapid growth in

renewable electricity production throughout the world, e.g. in China, and already in a few years time this may alter the relationship between various countries.

This report does not take into consideration the lifecycle perspective of a cast material. Nothing is said as to whether e.g. a cast product can result in reduced carbon dioxide emissions in its use phase or if the life span of a cast component will vary depending on where in the world it is cast.

11 Further work

It would be relevant to undertake more in-depth studies into e.g. individual foundries that manufacture similar products, so as to provide more recent data on actual energy use.

It would also be a good idea to study what the best foundries in the world can achieve in terms of energy-efficiencies as against those foundries that have not streamlined their processes, in order to thereby reduce emissions of greenhouse gases wherever cast products are made.

Another important line of study would be to adopt a lifecycle perspective for the climate impact of cast components, where consideration is given as to how the component impacts on emissions during the use phase. Such an approach points the way to the circular economies of the future, where it will be entirely natural to retain a lifecycle perspective on the climate impact of a cast product.

12 References

[1] Data from The World Bank 2014. http://www.tsp-data-portal.org/Breakdown-of-Electricity-Generation-by-Energy-Source#tspQvChart.

[2] European Commission, Integrated Pollution Prevention and Control. Reference Document on Best Available Techniques in the Smitheries and Foundies Industry (2005).

[3] J.F. Schifo, J.T. Radia, Theoretical/Best Practice Energy Use In Metalcasting Operations (2004).

Nr U 5736
December 2016

Uppdatering 2016 Klimatsmart gjutgods

På uppdrag av Swerea SWECAST & Svenska Gjuteriföreningen

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Rapporten har granskats och godkänts i enlighet med IVL:s ledningssystem

Innehållsförteckning

1 Inledning

På begäran från Swerea SWECAST och Svenska Gjuteriföreningen har IVL Svenska Miljöinstitutet tagit fram indikativa, generella data på koldioxidutsläpp från elkonsumtion och godstransport från tolv länder som har en gjutgodsindustri, tio europeiska länder plus Kina och Turkiet. Syftet är att bidra med underlag till förenklade klimatpåverkansanalyser för gjutgods, som ska användas både internt och för marknadsföring.

Detta är en uppdatering av ett projekt som genomfördes år 2011. En del innehåll i detta dokument är samma men allt väsentligt har uppdaterats.

2 GWP-utsläpp från elproduktion, genomsnitts-el 2012 (g CO2e / kWh)

Klimatpåverkande utsläpp per kWh från produktion av elektricitet (g CO2e / kWh)

Data gäller för år 2012	EcoInvent	GaBi Professional
Danmark	484	310
Finland	389	224
Frankrike	113	96
Indien	1409	1388
Italien	620	487
Kina	1127	Data saknas
Norge	23	28
Polen	1119	1040
Spanien	486	427
Storbritannien	663	567
Sverige	59	43
Turkiet	Data saknas	Data saknas
Tyskland	660	604

Datakälla: EcoInvent (v.3)och GaBi Professional Database (v. 2015).

EcoInvent: Swiss Centre for Life Cycle Inventories:s livscykeldatabas EcoInvent. Accessad genom livscykelprogramvaran GaBi 4. Data gäller GWP-emissioner från hela livscykeln för medelspänning i elnätet, för respektive land. Beräkningarna bygger på data från 2012.

GaBi Professional Database. Framtagen av Thinkstep, som produserar livscykelmodeleringsmjukvaran GaBi. Accessad genom GaBi 4. Data gäller GWP-emissioner från hela livscykeln för medelspänning i elnätet, för respektive land. Beräkningarna bygger på data från 2012.

Turkiet saknar data i båda fallen och därför lämnas här lite extra information om detta land. I den förra studien så bifogades data från IEA som visade på utsläpp på 471 g CO2e / kWh, vilket då var i nivå med Storbritannien. Sannolikt ligger Turkiet fortfarande i nivå med dem, även motiverat med att produktionsmixarna hos de båda länderna liknar varandra (de domineras av kol och naturgas med inblandning av andra produktionsslag) enligt IEA (https://www.iea.org/statistics/statisticssearch/).

3 GWP-utsläpp från godstransport (kg CO2e / ton gods)

Klimatpåverkande utsläpp från godstransport från olika länder (kg CO2e / ton gods)

Land	Rutt	NTM	EcoInvent
Danmark	Odense - Stockholm	67	138
Finland	Tampere/Tammerfors - Stockholm	39	53
Frankrike	Paris - Stockholm	155	314
Indien	Hyderabad - Stockholm	387	502
Italien	Milano - Stockholm	172	351
Kina	Wuhan - Stockholm	459	630
Norge	Oslo - Stockholm	44	90
Polen	Poznan - Stockholm	112	190
Spanien	Madrid - Stockholm	259	531
Storbritannien	Birmingham - Stockholm	174	312
Sverige	Borlänge - Sthlm	18	36
Turkiet	Ankara - Stockholm	309	602
Tyskland	Hannover - Sthlm	92	190

Datakälla: NTM 4.0 och EcoInvent 3. Avstånd tagna från viamichelin.com (landtransport Europa), travelmath.com (landtransport i Indien och Kina), uppskattningar med hjälp av googlemaps.com (sjötransport Puttgarden – Rödby och Harwich – Rotterdam)och maritimechain.com (all övrig sjötransport).

För transporterna som går inom Europa gäller data för lastbilstransporter med lastbil med släp av EU-standard, inklusive utsläpp från RoRo-fartyg på sträckorna Puttgarden-Rödby (alla transporter bortsett från de med ursprung i de nordiska länderna), Helsingfors-Stockholm (transporten från Finland) och Harwich-Rotterdam (transporten från Storbritannien). För transporten från Kina gäller data för lastbilstransporter inom Kina och Europa med lastbil med släp av EU-standard och båttransport från Shanghai i Kina till Rotterdam i Nederländerna med oceangående fraktfartyg. För transporten från Indien gäller data för lastbilstransporter inom Indien och Europa med lastbil med släp av EU-standard och båttransport från Mumbai i Indien till Rotterdam i Nederländerna med oceangående fraktfartyg.

NTM 4.0: Nätverket för Transport och Miljö (NTM), accessad genom www.transportmeasures.org/ntmcalc. Data gäller CO2e-emissioner från godstransport med ”Truck with trailer 28-34 t” (landtransport och roro-färjor) och ”Container ship” (interkontinental sjötransport) och täcker hela livscykeln, men systembeskrivningar saknas.

EcoInvent 3: Swiss Centre for Life Cycle Inventories's livscykeldatabas EcoInvent. Accessad genom livscykelprogramvaran GaBi 4. Data gäller CO2e-emissioner från godstransport med " RER: transport, freight, lorry 16-32 metric ton, EURO6 ecoinvent" (landtransport), " RER: transport, freight, inland waterways, barge" (inomeuropeisk sjötransport) och " GLO: transport, freight, sea, transoceanic ship" (interkontinental sjötransport) och täcker hela livscykeln, men systembeskrivningar saknas.

4 Tolkning och användbarhet av data

4.1 CO2-utsläpp från elproduktion

Data på CO2-utsläpp från elproduktion presenterade i denna rapport ger en god indikation om ungefärlig storlek av CO2-utsläpp förknippade med elproduktion och elkonsumtion i respektive land.

Data på CO2e-utsläpp från elproduktion presenterade i denna rapport bör ej användas som en exakt beskrivning av CO2e-utsläpp från elproduktion eller elkonsumtion, då många påverkande parametrar ej är inkluderade i beräkningen (t.ex. ursprungsmärkt el, residual-mix och varierande produktions-mix från år till år).

4.1.1 EcoInvent

Data gäller CO2e-emissioner från hela livscykeln för medelspänning i elnätet, för respektive land. Beräkningarna bygger på data från 2012.

4.1.2 GaBi Professional

Data gäller CO2e-emissioner från hela livscykeln för medelspänning i elnätet, för respektive land. Beräkningarna bygger på data från 2012.

4.1.3 EcoInvent jämfört med GaBi Professional

Båda organisationerna har hög trovärdighet och producerar generellt bra data, EcoInvent har dock större spridning och sannolikt även något större trovärdighet. EcoInvent ligger generellt högre än GaBi Professional, men det går utifrån denna studie inte att avgöra exakt vad det beror av.

4.1.4 Skillnader jämfört med förra studien

Den förra studien utfördes år 2011, och dataunderlaget kom från 2004 (EcoInvent) och 2006-2008 (IEA).

Generellt är värdena högre än vid förra studien. Sannolikt beror detta på bättre dataunderlag och att mer kompletta modeller har använts (hos EcoInvent och GaBi Professional). I många fall är det säkert även ändringar i produktions-mixen som bidrar.

Sverige har fått markant lägre resultat från EcoInvent, men det förra resultatet (91 g CO2e/kWh) var mycket högre än vad olika modeller brukar komma fram till (Sverige har under lång tid haft en stabil produktions-mix med 90% vattenkraft och kärnkraft) så resultatet i den här rapporten (59 g CO2e/kWh) är mer normalt. Det höga resultatet i den förra rapporten kan ha berott på ett problem i EcoInvents allmänna modell/beräkning, som fick ovanligt stora konsekvenser för just Sveriges resultat, men som de sedan dess har rättat till – men detta är ren spekulation.

4.1.5 Residual-mix och produktions-mix

Produktions-mixen är sammansättningen av de olika kraftverksslag som finns i ett land, viktat utifrån hur mycket som produceras nationellt av varje slag. Residual-mixen är den produktions-mix som kvarstår efter att all ursprungsmärkt el plockas bort, i Sverige motsvaras detta förenklat av den el som säljs på NordPol och inte är ursprungsmärkt – den elen har tex en väsentligt större andel kolkraft, och därmed även högre GWP-värde, än Sveriges produktions-mix. De resultat som presenteras i rapporten bygger på produktions-mix-data eftersom det är vad som generellt finns tillgängligt.

4.1.6 Genomsnitts-el och marginal-el

Elen presenterad i denna rapport är så kallad genomsnitts-el som summerar utsläppen per kWh för de olika kraftverksslag (t.ex. vind- eller kolkraft) som används vid tillverkning av el inom, i detta fall, ett land. Ett annat sätt att se på el är som marginal-el som istället beskriver vilket kraftverksslag som utnyttjas vid ökad efterfrågan, och som då även minskar vid fallande efterfrågan. Båda sätten att se på el har sina begränsningar och problem, men en vanlig uppdelning att använda marginal-el för att svara på frågan vilken effekt det får om man ökar eller minskar elkonsumtionen, och att använda genomsnitts-el när man summerar utsläpp från pågående produktion.

4.1.7 Internationella elmarknader

Om två eller fler länder har en gemensam, väl fungerande, elmarknad så kan det ibland vara mer relevant att istället titta på det totala genomsnittet för alla dessa länders elproduktion. Detta projekt har dock ej undersökt huruvida några av de berörda länderna ingår i sådana, väl fungerande, elmarknader.

4.2 CO2-utsläpp från transporter

För de listade transporterna som går inom Europa gäller data för lastbilstransporter med lastbil med släp av EU-standard, inklusive utsläpp från RoRo-fartyg på sträckorna Puttgarden-Rödby (alla transporter bortsett från de med ursprung i de nordiska länderna), Helsingfors-Stockholm (transporten från Finland) och Harwich-Rotterdam (transporten från Storbritannien). För

transporten från Kina gäller data för lastbilstransporter inom Kina och Europa med lastbil med släp av EU-standard och båttransport från Shanghai i Kina till Rotterdam i Nederländerna med oceangående fraktfartyg.

Skillnaderna i utsläpp mellan NTM och EcoInvent härstammar från skillnader i utsläpp för lastbilstransporter från de två databaserna. Eftersom systembeskrivningar saknas i båda fallen är det inte möjligt att säga vilken som är mest heltäckande, eller om någon av dem är mer eller mindre representativ i vissa specialfall. EcoInvent anses ofta ha relativt hög miljöpåverkan i många av sina dataset, jämfört med andra datakällor, men utifrån den här analysen går det inte att säga att EcoInvent är mindre trovärdig.

Både NTM och EcoInvent har hög trovärdighet, men NTM kan antas vara mer inriktad på svenska förhållanden, medan EcoInvent kan antas vara mer känt utomlands.

Start och slutpunkterna är godtyckligt valda med hänsyn till geografiska och demografiska centra.

Data gäller för allmänt gods som transporteras i lastbil utan kyl- eller frysaggregat, och som inte är så lätt att transportkapaciteten hos fordonet begränsas kraftigt av volym, snarare än vikt.

4.3 Användbarhet allmänt

4.3.1 Kvalitetssäkring

Rapporten har interngranskats på IVL och godkänts för leverans.

Det är vår expertanalys att det inte finns någon anledning att ifrågasätta delgivna resultat, baserat på erfarenhet, rimlighetbedömning av resultaten och dataleverantörernas allmänt höga trovärdighet. Men det ligger förstås utom vår kontroll om det skulle finnas kritiska fel i någon av de bakomliggande modellerna då vi inte har tillgång till dessa.

Det är också värt att nämna att resultaten kan ifrågasättas genom att ifrågasätta representerbarheten hos valda in-parametrar och antaganden (t.ex. att medel-el från 2012 har använts, eller vald rutt för transport från ett visst land), men sådana ifrågasättanden kan alltid göras och det enda som kan sägas om detta är att resultaten gäller för just valda in-parametrar och antaganden – ju sämre dessa passar in vid en jämförelse desto större potentiellt fel i resultatet.

4.3.2 Överensstämmelse med ISO

Framtagning av data, modellering och beräkning, både hos dataleverantörerna (EcoInvent, GaBi Professional och NTM) och IVL överensstämmer med regler och praxis beskrivet i ISO 14040 &14044 (LCA) och ISO 14067 (Carbon footprint).

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