Steel Demand Beyond 2030

Forecast Scenarios

Presented to:
OECD
Paris
September 28, 2017
Introduction
Introduction

The long range forecast model was developed to assess the potential impact of key forecast drivers and disruption forces on global steel demand to 2035.

**Forecast Drivers**
- Per capita GDP
- Fixed Asset Investment intensity
- Manufacturing intensity
- Urbanization rate
- Population growth rate

**88 Countries / 6 Groups**
- Mature: high manufacturing intensity
- Mature: low manufacturing intensity
- Emerging: high manufacturing intensity
- Emerging: low manufacturing intensity
- China
- India

**Disruption Forces**
(tested incremental and radical disruption)
- Application of digital technologies by customers, suppliers, other material producers
- Circular economy and changing consumer preferences
  - Reduced end product demand
  - Longer end-product life including re-use and re-manufacturing
  - Accelerated reduction in steel intensity due to material and process substitution

**Scenarios**
- Steel production and raw material
- Tested for impact of increase in EAF production share in China and ROW

**Baseline Projection**

Applied to
Forecast Drivers on Steel Demand

As countries develop, their steel consumption per capita increases to a peak point then per capita consumption starts declining -- finally plateauing

For a given level of economic development -- the higher the importance of manufacturing, investment in fixed assets and urbanization, the higher the consumption of steel

1. Economic Development Level
2. Importance of Manufacturing Sector
3. Fixed Asset Investments
4. Urbanization
5. Steel De-Intensification Factors
Shifting Peak Consumption of Steel per Capita

Technology advancements have driven steel consumption per capita in countries to peak at lower levels of GDP per capita and disruption factors may drive the peaks to even lower levels.

1. Economic Development Level
2. Importance of Manufacturing Sector
3. Fixed Asset Investments
4. Urbanization

5. Steel De-Intensification Factors*

* Factors include material substitutions, quality improvement of materials and changing design.
Historical Analysis
Testing the Model – Predicting the Trend

The econometric model that was developed indicates a very good fit at the global level

The model has an R² of 0.97 at the global level
Testing the Model – Predicting the Peak

The closer to the 45 degree line the better the model explains the peak per capita.

Chart shows data only for those countries that peaked in 2015 or earlier (N = 38)
Over time countries have tended to reach peak steel intensity at lower levels
Disruption Forces
Disruption Factors and Consumption Sectors

The impact of disruption factors were estimated and applied to six major consumption sectors

Disruption Factors
- Reduction in demand for sector’s product
- Increase in useful life
- Change in steel intensity

Consumption Sectors
1. Automotive
2. Capital Equipment and Machinery
3. Residential Construction
4. Commercial Construction
5. Consumer & Durable Goods
6. Infrastructure
Detail - Automotive

Using automotive as an example specific disruption factors were estimated and applied to the baseline estimate of steel demand

- **Sector’s Baseline Steel Demand**
  - +/-

- **Reduction In Demand for Sector’s Product**
  - +/-
  - Sharing, transportation-as-service and consumer preference will decrease per capita passenger vehicle intensity (fewer vehicles per capita)

- **Increase In Useful Life**
  - +/-
  - Longer-lasting / reusable vehicle structural and exterior components as a result of better design and materials will reduce annual demand for new vehicles

- **Change in Steel Intensity**
  - +/-
  - Continued vehicle light weighting for both steel (same surface area – less mass) and impact of substitutes
Total vehicle intensity - pre-disruption forecasts

Vehicles per capita were estimated based on historical ratios and projections of economic development.

Note: Use growth rates from fitted model to project forecasts from actual historical data.
Source: Accenture Research, Oxford Economics, OICA, 2016

Note: Based on 120 countries. $R^2 = 0.84$
Source: Accenture Research, Oxford Economics, OICA, 2016

$y = 0.1259\ln(x) - 0.8606$

Vehicles per capita were estimated based on historical ratios and projections of economic development.
Total vehicle intensity - post-disruption forecasts (incremental scenario)

The impact of the disruption factors shifted the estimated vehicle intensity estimates

Note: Use growth rates from fitted model to project forecasts from actual historical data.
Source: Accenture Research, Oxford Economics, OICA, 2016
Global Steel Demand Forecast
Baseline Global Demand Forecast Under Disruption - Overall

In the baseline forecast, global steel demand grows by **1.4%** per annum to reach around **2.0 billion tons** by 2035

However after applying the estimates of the impact of disruptors the projection is that global steel demand will grow by **1.1%** per annum to reach **1.87 billion tons** by 2035

In the Radical scenario, global steel demand grows by **0.4%** per annum to reach **1.75 billion tonnes** by 2035, which is **12.5%** below the baseline forecast of 2.0 billion tonnes

### Summary Table: Apparent steel use (Crude steel equivalent, millions of tons)

<table>
<thead>
<tr>
<th></th>
<th>EME/HM</th>
<th>EME/LM</th>
<th>DEV/HM</th>
<th>DEV/LM</th>
<th>China</th>
<th>India</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
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<td></td>
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</tr>
<tr>
<td>2015</td>
<td>44</td>
<td>315</td>
<td>113</td>
<td>276</td>
<td>672</td>
<td>80</td>
<td>1,500</td>
</tr>
<tr>
<td>2035</td>
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<td></td>
<td></td>
<td></td>
<td>2,000</td>
</tr>
<tr>
<td>CAGR 2015-2035</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Incremental</strong></td>
<td></td>
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</tr>
<tr>
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<td>113</td>
<td>276</td>
<td>672</td>
<td>80</td>
<td>1,500</td>
</tr>
<tr>
<td>2035</td>
<td>77</td>
<td>638</td>
<td>116</td>
<td>269</td>
<td>537</td>
<td>237</td>
<td>1,873</td>
</tr>
<tr>
<td>CAGR 2015-2035</td>
<td>2.9%</td>
<td>3.6%</td>
<td>0.1%</td>
<td>-0.1%</td>
<td>-1.1%</td>
<td>5.6%</td>
<td>1.1%</td>
</tr>
<tr>
<td><strong>Radical</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>113</td>
<td>276</td>
<td>672</td>
<td>80</td>
<td>1,500</td>
</tr>
<tr>
<td>2035</td>
<td>71</td>
<td>593</td>
<td>104</td>
<td>248</td>
<td>504</td>
<td>228</td>
<td>1,749</td>
</tr>
<tr>
<td>CAGR 2015-2035</td>
<td>2.4%</td>
<td>3.2%</td>
<td>-0.4%</td>
<td>-0.5%</td>
<td>-1.4%</td>
<td>5.4%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

EME/HM: Emerging/High Manu
EME/LM: Emerging/Low Manu
DEV/HM: Developed/High Manu
DEV/LM: Developed/Low Manu

Global Steel Use

Baseline
Incremental
Radical

In the Radical scenario, global steel demand grows by **0.4%** per annum to reach **1.75 million tonnes** by 2035, which is **12.5%** below the baseline forecast of 2.0 million tonnes.
Baseline Global Demand Forecast Under Disruption – Per Capita

In the Baseline scenario, global steel per capita increases to 263 kg per person by 2035, but on a very flat curve.

In the Incremental scenario, global steel per capita increase to 246 kg per person by 2035, but is on a downward trajectory.

In the Radical scenario, global steel per capita decreases to 229 kg per person by 2035, which is 33 kg per person lower than the baseline forecast of 263 kg per person.

### Summary Table: Steel use per capita (kilograms per person)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>China</th>
<th>India</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>497</td>
<td>61</td>
<td>235</td>
</tr>
<tr>
<td>2015</td>
<td>173</td>
<td>204</td>
<td>703</td>
</tr>
<tr>
<td>2035</td>
<td>263</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>Incremental</td>
<td>0.5%</td>
<td>0.0%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>2015</td>
<td>173</td>
<td>204</td>
<td>703</td>
</tr>
<tr>
<td>2035</td>
<td>260</td>
<td>226</td>
<td>704</td>
</tr>
<tr>
<td>Radical</td>
<td>235</td>
<td>145</td>
<td>229</td>
</tr>
<tr>
<td>2015</td>
<td>173</td>
<td>204</td>
<td>703</td>
</tr>
<tr>
<td>2035</td>
<td>239</td>
<td>208</td>
<td>636</td>
</tr>
</tbody>
</table>

EME/HM: Emerging/High Manu
EME/LM: Emerging/Low Manu
DEV/HM: Developed/High Manu
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Steel Production & Raw Material Scenarios
Global Steel Production

The model was extended to consider different mixes of types of steel production to project the relative supply-demand balance of scrap – this is the scenario assuming EAF production increases to 40% of total – in this scenario scrap consumption would be below potential scrap supply.

Assumption - In 2035 China at 20% EAF and rest of world at 50% EAF

Note: * factual data from WSA
Sources: Modeling results
Steel Production in China

However the availability of scrap would not be evenly distributed with China having greater availability of scrap than projected consumption even with an assumption of 20% EAF share by 2035.
Steel Production in Rest of World

The rest of the world would have a scrap deficit with presumably China exporting scrap.
Scenario Results: Global Indicators

Another interesting output of the scenario is that in the middle part of the next decade the world will hit peak iron ore consumption.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>CAGR, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent steel use</td>
<td>1.50</td>
<td>1.73</td>
<td>1.81</td>
<td>1.85</td>
<td>1.87</td>
<td>1.1%</td>
</tr>
<tr>
<td>Crude steel production</td>
<td>1.62</td>
<td>1.86</td>
<td>1.95</td>
<td>2.00</td>
<td>2.02</td>
<td>1.1%</td>
</tr>
<tr>
<td>BOF</td>
<td>1.21</td>
<td>1.31</td>
<td>1.30</td>
<td>1.27</td>
<td>1.22</td>
<td>0.0%</td>
</tr>
<tr>
<td>EAF</td>
<td>0.41</td>
<td>0.56</td>
<td>0.65</td>
<td>0.73</td>
<td>0.81</td>
<td>3.5%</td>
</tr>
<tr>
<td>Demand for iron ore</td>
<td>2.01</td>
<td>2.21</td>
<td><strong>2.24</strong></td>
<td><strong>2.23</strong></td>
<td>2.16</td>
<td>0.4%</td>
</tr>
<tr>
<td>Balance of scrap</td>
<td>0.12</td>
<td>0.05</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>-6.2%</td>
</tr>
<tr>
<td>Demand for scrap</td>
<td>0.55</td>
<td>0.70</td>
<td>0.78</td>
<td>0.84</td>
<td>0.90</td>
<td>2.5%</td>
</tr>
<tr>
<td>Supply of scrap</td>
<td>0.68</td>
<td>0.76</td>
<td>0.81</td>
<td>0.87</td>
<td>0.94</td>
<td>1.6%</td>
</tr>
<tr>
<td>Home scrap</td>
<td>0.12</td>
<td>0.14</td>
<td>0.14</td>
<td>0.15</td>
<td>0.15</td>
<td>1.1%</td>
</tr>
<tr>
<td>Prompt scrap</td>
<td>0.22</td>
<td>0.23</td>
<td>0.24</td>
<td>0.25</td>
<td>0.27</td>
<td>1.0%</td>
</tr>
<tr>
<td>Obsolete scrap</td>
<td>0.33</td>
<td>0.39</td>
<td>0.43</td>
<td>0.47</td>
<td>0.52</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

2035 (IV) - Net exports of finished steel in China is 100 Mt; BOF/EAF in China is 80/20; BOF/EAF in RoW - 50/50.

Sources: Modeling results.
Conclusion
Summary Findings

- An incremental disruption scenario reduced the growth rate for steel demand from about **1.4% per annum to 1.1%**
  - **1.87 billion tonnes in 2035** a reduction of 130 million tonnes compared to the baseline projection of 2.0 billion
  - Global steel demand is not expected to peak in this period, but could peak by mid-century
  - Automotive and capital equipment markets are expected to experienced the largest % reductions

- Country group forecasts
  - Demand in **mature economies** will show **zero to slightly negative growth** rates over the period
  - Demand growth in **emerging economies will be in the range 2.5% to 4%** - less robust than experienced by developing countries in the past
  - Demand in **India** is forecast to **grow** at around **5.6% per annum** to reach around 240 million tonnes
  - Demand in **China** is expected to **decline at 1.1% per annum**

- Under a scenario of **EAF share** in China reaching 20% in 2035 (compared to 6 % today) and in the rest of the world to 50% (vs. 42% today)
  - There will likely be sufficient scrap available at the global level, with significant transfers from China for several years
  - Global demand for iron ore rises from 2 billion tons to **a peak of around 2.24 billion tons in 2025**, then starts to decline
Conclusion

- Any assumption that global steel consumption will significantly increase in the future appears to be flawed given potentially disruptive factors, including:
  - Circular economy driven by economics and environmental concerns
  - Digital technologies enabling reduced intensity of products
  - Materials science driving light weighting and substitution for steel

- Slower growth will impact the relative supply demand balance of raw materials which in turn will influence choices of technologies