

vorldsteel

#### The use of biomass in the steel industry

Åsa Ekdahl | Head Environment & Climate Change
World Steel Association (worldsteel)
Prospects of biocoal for the metallurgical industry
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#### worldsteel – who we are

worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes. Members represent around 85% of global steel production.

It has headquarters in Brussels, Belgium. A second office in Beijing, China, opened in April 2006. The World Steel Association (worldsteel) is a non-profit organisation.

# The scale of the challenge

In 2022 1.9 billion tonnes of crude steel were produced, an increase of 120% since 2000

In 2020, on average, every tonne of steel produced led to the emission of 1.9 tonnes of  $CO_2$ .

In 2020, the total direct emissions were of the order of 2.6 billion tonnes, representing between 7% and 9% of global anthropogenic CO<sub>2</sub> emissions.



### worldsteel's 3-step approach

### IEA scenarios and our approach

Steel production, total CO2 emissions and CO2 intensity 2020-2050 under the International Energy Agency (IEA) Net-Zero Emissions scenario (NZS)









## Ironmaking began with biomass

- In pre-industrial times biomass (wood and charcoal) was used extensively in ironmaking
- Charcoal provided a source of carbon to reduce iron ore in the blast furnace.
- In the 17<sup>th</sup> century coke replaced charcoal in the blast furnace due to it's compressive strength and high temperature behavior
- Separating ironmaking from the availability of wood, and allowing the use of a much stronger charge material allowed bigger and more efficient blast furnaces to be developed

### 21<sup>st</sup> century biomass

- Steel plants in different regions will adopt different breakthrough technology solutions based on their local circumstances.
- Biomass has always played a role in some regions, most notably Brazil, while in others research is being undertaken
- Biomass can play an important role by replacing a proportion of fossil carbon resources.
  - As a reductant
  - As a source of alloying carbon
  - As a replacement for fossil energy in other processes
- The potential for biomass-derived products to mitigate CO<sub>2</sub> emissions in the BF-BOF route is substantial



#### Uses of biomass in iron and steelmaking

- Charcoal is currently used commercially to substitute a proportion of the coal used in blast furnaces, primarily in Brazil.
- While some blast furnaces do currently operate entirely using biomass, the relative strength of charcoal compared to coke means that these are smaller furnaces.
- Biochar can potentially substitute coal used for pulverised coal injection (PCI) in the blast furnace and coke breeze in sintering.
- Biogas could replace natural gas in heating furnaces and potentially in Direct Reduced Iron (DRI) production



### Biomass can make a significant impact

#### **Proposed Biomass Applications: Integrated BF-BOF Route**



### **Biomass considerations**

- The low-carbon transition of the steel industry will involve new or redesigned production processes and input materials
- Charcoal/Biochar cannot be swapped 100% like-to-like with coal using existing technology
- Biomass properties can be engineered:
  - Superior composition (no gangue)
  - Tailored to provide specific co-product properties
- Use of biomass can feature in different production processes and coupled with CCS offers the possibility for negative emissions



### Biomass challenges

- Robust supply chains exist to move the large amounts of raw materials (such as coal, iron ore, lime, scrap) required in modern steelmaking.
- Similar supply chains will need to be developed to collect biomass at volume, convert and process, and to deliver it reliably to steel manufacturing facilities
- Many sectors are looking to use biomass and competition for the resource is likely to be significant
- Sustainable credentials of biomass used would need to be demonstrated
  - The full supply chain must be considered, and all emissions associated with the production, processing, transport and use of bioenergy



### worldsteel policy paper

Restructured and expanded public website content in the new <u>Climate Action section</u> includes the policy paper and:

- Fact sheets detailing the suite of low-carbon breakthrough technologies currently under development.
- Examples of member initiatives in related areas, including new business practices encouraging lowcarbon market development
- Work being carried out by other international organisations including the IEA and ResponsibleSteel

#### Public policy paper Climate change and the production of iron and steel



#### Biomass in steelmaking



The transition to a low-carbon world requires a transformation in the way we manufacture iron and steel. There is no single solution to CO.-free steelmaking, and a broad portfolio of technological options is required, to be deployed alone, or in combination as local circumstances permit. This series of fact sheets describes and explores the status of a number of key technologies and issues.

#### What is biomass?

Biomass is renewable organic material that comes from plants and animals, containing stored chemical energy from the sun. Plants produce biomass through photosynthesis. Biomass can be burned directly for heat, converted to renewable liquid and gaseous fuels through various processes1, or used in industrial processes such as steelmaking.

#### Biomass sources for energy include:

- Wood and wood processing wastes firewood, wood pellets and wood chips, lumber and furniture mill sawdust and waste, and black liquor from pulp and paper mills
- Agricultural crops and waste materials corn, sovbeans. sugarcane, switchgrass, woody plants algae, and crop and food processing residues
- Biogenic materials in municipal solid waste paper, cotton and wool products, and food, yard and wood wastes
- Animal manure and human sewage Landfill gas
- Biofuels made from biogenic alcoho



#### Why consider biomass in steelmaking?

Under the right circumstances, biomass can be considered a carbon-free resource; therefore, it can be an attractive option to reduce emissions from iron and steel production.

The International Energy Agency (IEA)'s bioenergy programme notes that "within the biospheric carbon cycle, bioenergy can be carbon neutral because the carbon that is released during combustion has previously been sequestered from the atmosphere and will be sequestered again as the plants regrow, i.e. if sustainably produced.

However, the full supply chain must be considered, and all emissions associated with the production, processing, transport and use of bioenergy need to be included. Particularly harvesting, transport and processing generally involve fossil energy use. Nevertheless, analysis shows that the fossil energy used in the supply chain is generally a small fraction of the energy content of the bioenergy product, even for woody biomass transported over long distance, e.g. between North America and Europe."2

Biomass is already used to a significant degree in the power sector. For example, the former Drax coal-fired power plant in North Yorkshire, England, converted four of the power station's six generating units to use sustainable biomass instead of coal. This has transformed Drax, which supplies 5% of the country's electricity, into the UK's largest renewable power generator and the biggest decarbonisation project in Europe.

#### Biomass in iron and steelmaking

#### Worldsteel contact



Åsa Ekdahl Head of Environment and Climate Change ekdahl@worldsteel.org

### ASSOCIATION

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