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THE POTENTIAL FOR RENEWABLE ENERGY IN INDUSTRY BY 2050

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OVERVIEW

Over the last decade, renewable energy moved out from its niche to reach the attention of the public opinion and the policy makers. Most of the discussion have been mainly concentrated on two applications of renewable energy sources (RES): power generation (RES-E) and biofuels (RES-T).

The least discussed application of renewables is heating and cooling (RES-H). In this context, most of the attention is focused on residential space heating applications, in particular biomass and solar thermal. This paper focuses on the relatively under covered topic of renewable energy sources use for process heat in the industrial sector.

The main sources considered for process heat in industry are biomass, solar thermal and heat pumps. Another important potential application for renewables in industry is the substitution of fossil-based petrochemical feedstock with biomass-based ones. The potential for solar cooling (absorption and adsorption) has also been evaluated.

METHODS

Each renewable energy source has its peculiarities. For this reason, the methodology used to estimate the potential at 2050 of different RES-H is specific to each one.

For biomass, whose deployment in industry is already a reality in many regions, the market penetration has been estimated using the Logistic Substitution Model [1] and has been checked versus the estimated availability of sustainable biomass feedstock for industry, constraining it accordingly.

The potential for solar thermal and heat pumps is strongly dependent on the temperature level required by the process (as reported in the Lindal diagram [2]). An analysis on the amount of process heat required by each industrial sector and its split in five temperature levels have been conducted, as the base on which assessing the potential for these two technologies.

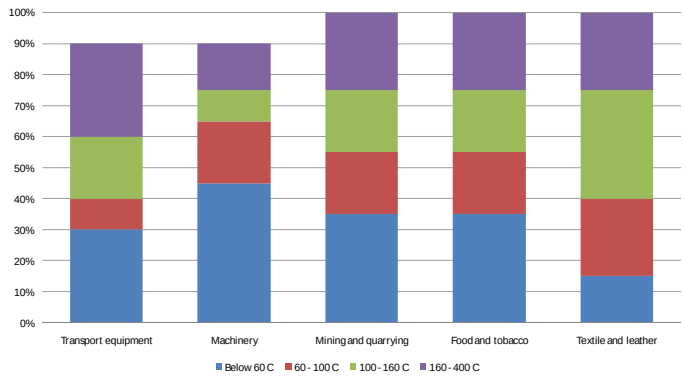

Fig. 1. Selected industrial sectors' process heat split by temperature level

The other main factor for moving from the technical potential to the realisable potential [3] is the cost of the useful energy produced. This is mainly based on the investment cost (and its

evolution on the base of the cumulative capacity installed) and, for solar, on the average solar radiation of the region, for heat pumps, on the average cost of electricity and the climate conditions of the region.
Supply cost curves have also been developed for biomass, solar and heat pumps' process heat, for each industrial sector.

RESULTS

Biomass has by far the largest potential for process heat in industry, mainly for its ability to tackle the most energy intensive sectors and to produce any temperature level required (charcoal can be used both for iron and cement production, as Brazil demonstrates).
In regions with abundant solar radiation, five main sectors have been identified for their large quota of low temperature heat that can be provided by solar thermal systems.
At the same time, where solar radiation is not enough to provide year-round, affordable process heat from solar thermal, heat pumps can cover the same processes, given that electricity is affordable and reliable.
Looking into different sectors, biomass is the main source in the paper and the wood sector; it becomes important also in the chemical and cement sectors.
Solar thermal plays a major role in several sectors, although not the most energy intensive ones, namely: textile, machinery, food, transportation equipment manufacturing and mining.
Heat pumps compete with solar on the same temperature levels and sectors, having an advantage where electricity is cheap and solar radiation is scarce.

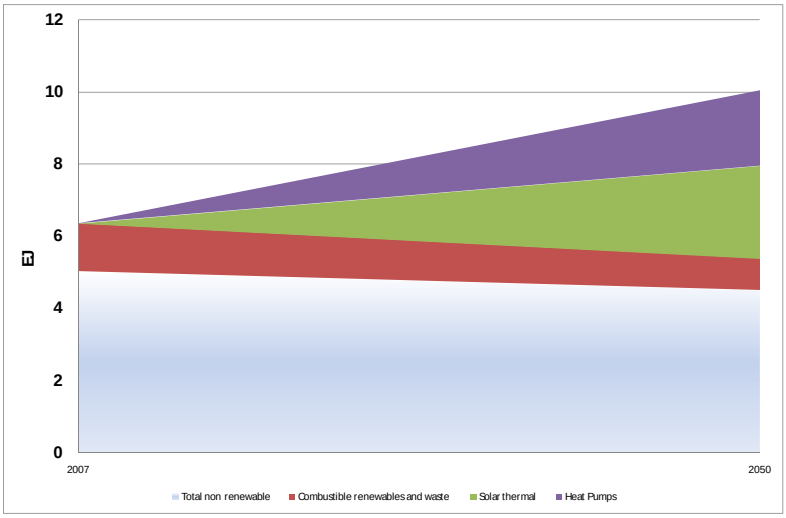

Fig. 2. Renewables in the food sector

Depending on the scenario assumptions on energy demand and carbon price, the estimated realisable potential for renewables in the industrial final energy consumption in 2050 is in the range of 27.5 - 30%, with biomass accounting for 72-85% of it and the rest split in similar proportions between solar thermal and heat pumps.

CONCLUSIONS

Although the main discussion in the industrial sector is concentrated on energy efficiency improvements, renewables can play a major role for both climate change mitigation and competitiveness improvement. Best practices exist all over the world, with Brazil leading the way in the use of biomass for industrial application and countries like India and Greece developing relevant experiences in the use of solar thermal in selected sectors (i.e. dairy).

Our analysis establishes not only the technical feasibility of an increased use of renewable energy sources in industry, but also provides a set of conditions under which different countries can consider developing a national strategy for the deployment of renewables in their industrial sector as a competitive advantage worthwhile to be tackled.

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