Comparing the environmental performance of Kuura® fibre with the alternative cellulosic fibres

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Metsä Spring, the innovation company of Metsä Group, has completed a Life Cycle Assessment (LCA) of its Kuura textile fibre.[1] The outcome of the assessment conducted by Etteplan is very promising. The textile fibre production process is currently being researched and developed at a greenfield demo plant in Äänekoski, Finland. The demo plant's nominal capacity is approx. 1 tonne per day. As a part of an ongoing conceptual design exercise (pre-study) for a possible first commercial mill producing the Kuura textile fibre, the environmental impact was examined through a standard life cycle assessment methodology ("Life cycle assessment study of Kuura® textile fibre" as reported by Etteplan in the report v3.0).

In regard to environmental performance, when comparing to commercial man-made cellulosic fibres (viscose and lyocell),[2] and to cotton fibres,[3] large-scale production of Kuura fibre using the Metsä Group concept, would result in clearly lower level of global warming potential (GWP), supporting its potential viability as a sustainable new alternative for the global textile fibre market (Figure 1). The Kuura textile fibre is produced from softwood Kraft pulp, not from dissolving pulp, which is commonly used as raw material in the production of man-made cellulosic fibres such as lyocell and viscose fibres. The wood for the pulp production is, in turn, procured from forests located close to the pulp and textile fibre mill. A significant share of the forests in question are owned by owner-members of the parent company of Metsä Group. The bioproduct mill (i.e., the unit producing the pulp) is a greenfield investment started up in 2017. It does not use any fossil energy and it is one of the most efficient pulp-producing mills globally, which in practice means that the bioproduct mill generates significant amounts of excess renewable energy (steam, electricity, etc.). This excess, in turn, is used at the source of energy, when producing Kuura fibre. Integrating the textile fibre production to such a modern host mill results in a product with a clear climate change mitigation potential compared to the use of existing commercial textile fibres.

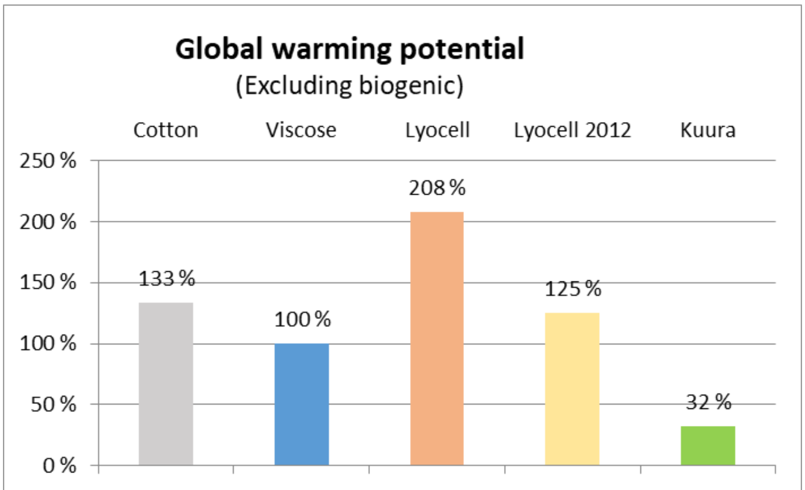

Figure 1. Normalised the cradle-to-factory gate global warming potential (fossil, kg CO_2 eq.) for one tonne of cellulosic staple fibres. (Cotton: fibre production, Ecoinvent 3.10;[3] Viscose, Austria: European beech, integrated production, biomass & recovered energy from MSWI; Lyocell, Austria: eucalyptus and beech, separate pulp production, energy 70 % gas & 30 % biomass; Lyocell 2012, Austria: eucalyptus and beech, separate pulp production, 100 % recovered energy from MSWI).[2]

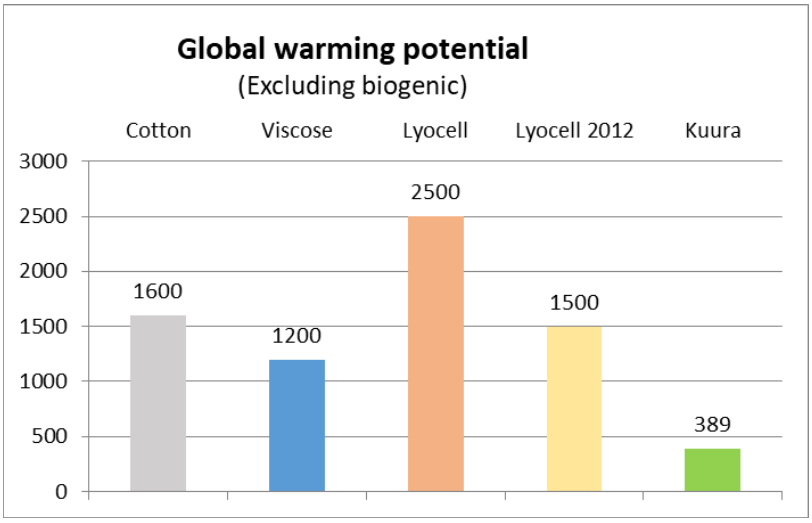

Figure 2. The cradle-to-factory gate global warming potential (fossil, kg CO_2 eq.) for one tonne of cellulosic staple fibres. (Cotton: fibre production, Ecoinvent 3.10;[3] viscose, Austria: European beech, integrated pulp production, biomass & recovered energy from MSWI; Lyocell, Austria: eucalyptus and beech, separate pulp production, 70 % gas and 30 % biomass; lyocell 2012, Austria: eucalyptus and beech, separate pulp production, 100 % recovered energy from MSWI).[2]

The LCA was made by Etteplan according to ISO 14040:2006 and ISO 14044:2006 standards for LCA studies and ISO 14067:2018 for carbon footprint studies applying a cradle-to-gate system boundary. The LCA study was critically reviewed by RISE Research Institutes of Sweden / Innventia UK Ltd. No major cut-offs existed in the study. Inventory data of Kuura manufacturing was based on newest available mass and energy balances for a possible 100,000 t/a commercial mill integrated to Metsä Group's bioproduct mill in Äänekoski, Finland. The data used to assess the references was collected from a well-known peer-reviewed scientific source (Shen, L. and Patel, M.K., Life cycle assessment of man-made cellulosic fibres, Lenzinger Berichte 88 (2010) 1-59). The functional unit is defined as one tonne of staple fibres. Staple fibres are not end products, but necessary semi-finished products that are ready to be processed into many textile end products. A typical use of textile fibres is the production of yarns. The yarns are then used to make fabrics, etc.[7]

References:

1) "Life cycle assessment study of Kuura® textile fibre" v3.0, dated 30th October 2024.
2) Shen, L. and Patel, M.K., Life cycle assessment of man-made cellulosic fibres, Lenzinger Berichte 88 (2010) 1-59.
3) Cotton fibre. Ecoinvent 3.10 LCIA method IPCC 2021. Fibre production, cotton, ginning | cutoff, system process, rest of world | global warming potential (GWP100).
4) ISO 14040:2006. Environmental management – Life cycle assessment – Principles and framework, International Standardisation Organisation.
5) ISO 14044:2006. Environmental management – Life cycle assessment – Requirements and guidelines, International Standardisation Organisation.
6) ISO 14067:2018. Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification, International Standardisation Organisation.
   Shen and Patel utilise one tonne of staple fibres as the functional unit and conclude that "a comparison for final textile products would be a challenging task because of the large number and types of textile products and because a suitable way for accounting for the different fibre properties in the use phase (e.g., differences in comfort level as a consequence of differences in water absorption) would need to be found".