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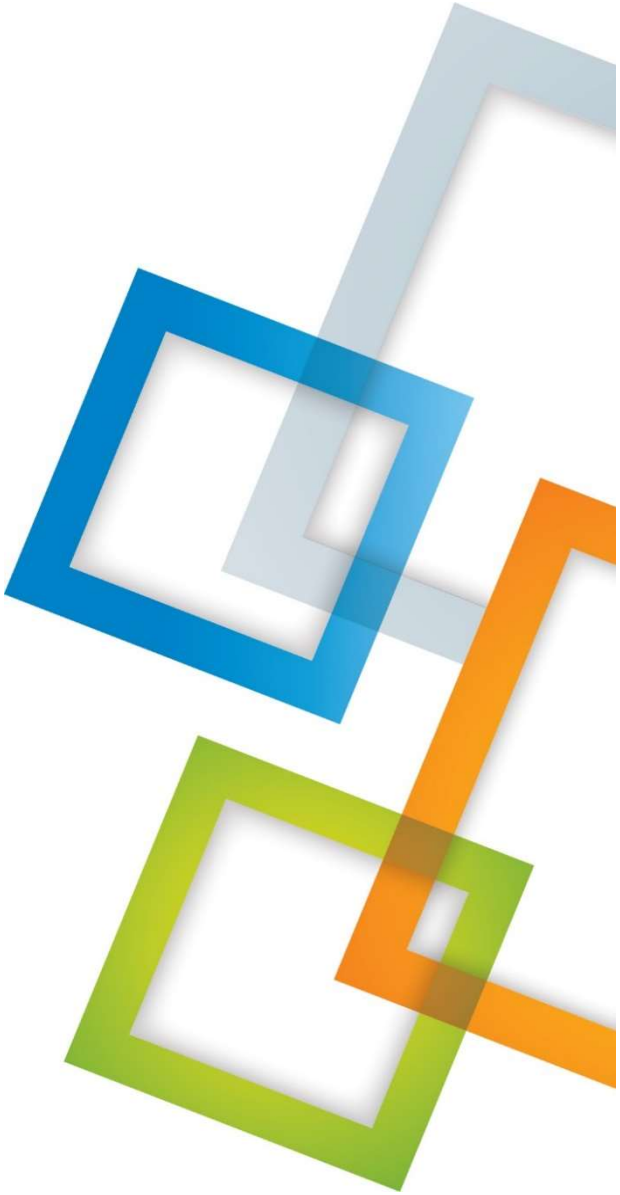
Energy Efficiency of the Paper Industry in the EU

Study for Finnish Forest Industries ry



9.8.2019

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Data Sources and Modeling Principles

- Fisher International Inc. collects information on every pulp and paper mill in the world, provided to its customers via the Fisher*Solve* Next™ platform.
- The capacity in the report describes the Q3/2019 planned annual capacity of each machine line and finished product during normal operation.
- The energy consumption numbers in this report are based on Fisher's benchmarking model, which models mass-energy balance and manufacturing costs of each mill producing over 50 tons per day.
- The energy balance is calculated separately for pulp production (slush pulp) and for paper and market pulp production (paper machine or pulp Dryer).
  - Kraft mill pulp production energy balance is described in a separate slide in the appendix.

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Excecutive Summary
Part 1

- Finnish pulp and paper mills on average are big, efficient and modern in comparison to the EU average.
- Profile of production in Finland and Sweden differ considerably from other EU countries.
  - Majority of the EU's kraft pulp is produced in Finland and Sweden.
  - Virgin fiber is used extensively as raw material in Finland and Sweden, whereas recycled fiber is the main raw material for paper products in the rest of the EU.

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Excecutive Summary
Part 2

- In general, the energy efficiency of Finnish mills is either on par or better than EU average.
- The utilization of co-produced electricity and steam is high in Finland, which improves the energy efficiency of the entire site.
- In some packaging and fine paper grade level comparisons, Finland's energy consumption per ton is higher than the EU average; this is due to differencies in furnish and end-product properties.
  - Finland has a larger share of high-value end products.
- Market pulp production in Finland is the most energy efficient in the EU, despite the additional heating needs resulting from colder climate.
- New and modernized biomills produce an energy surplus and a variety of side products. In this report, all energy consumption is calculated by ton of pulp, not taking into account side streams like lignin, tall oil and others.

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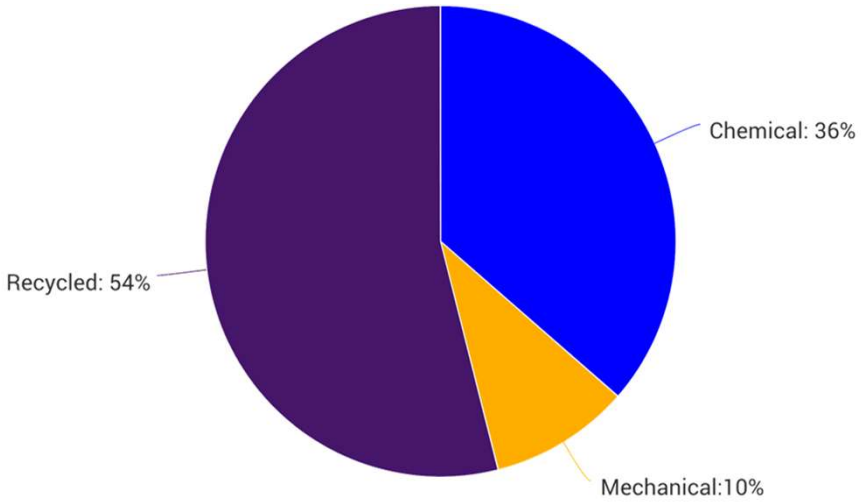
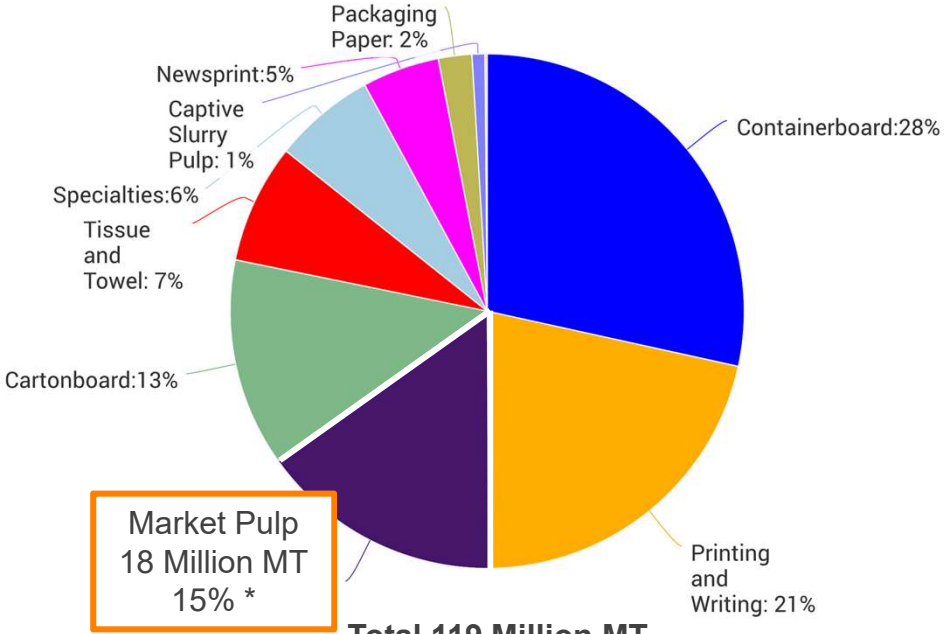
Containerboard Is the Majority Grade in EU

Pulp Production by Pulp Class, 2019



Total 89 Million ADMT

Paper Production by Major Grade, 2019

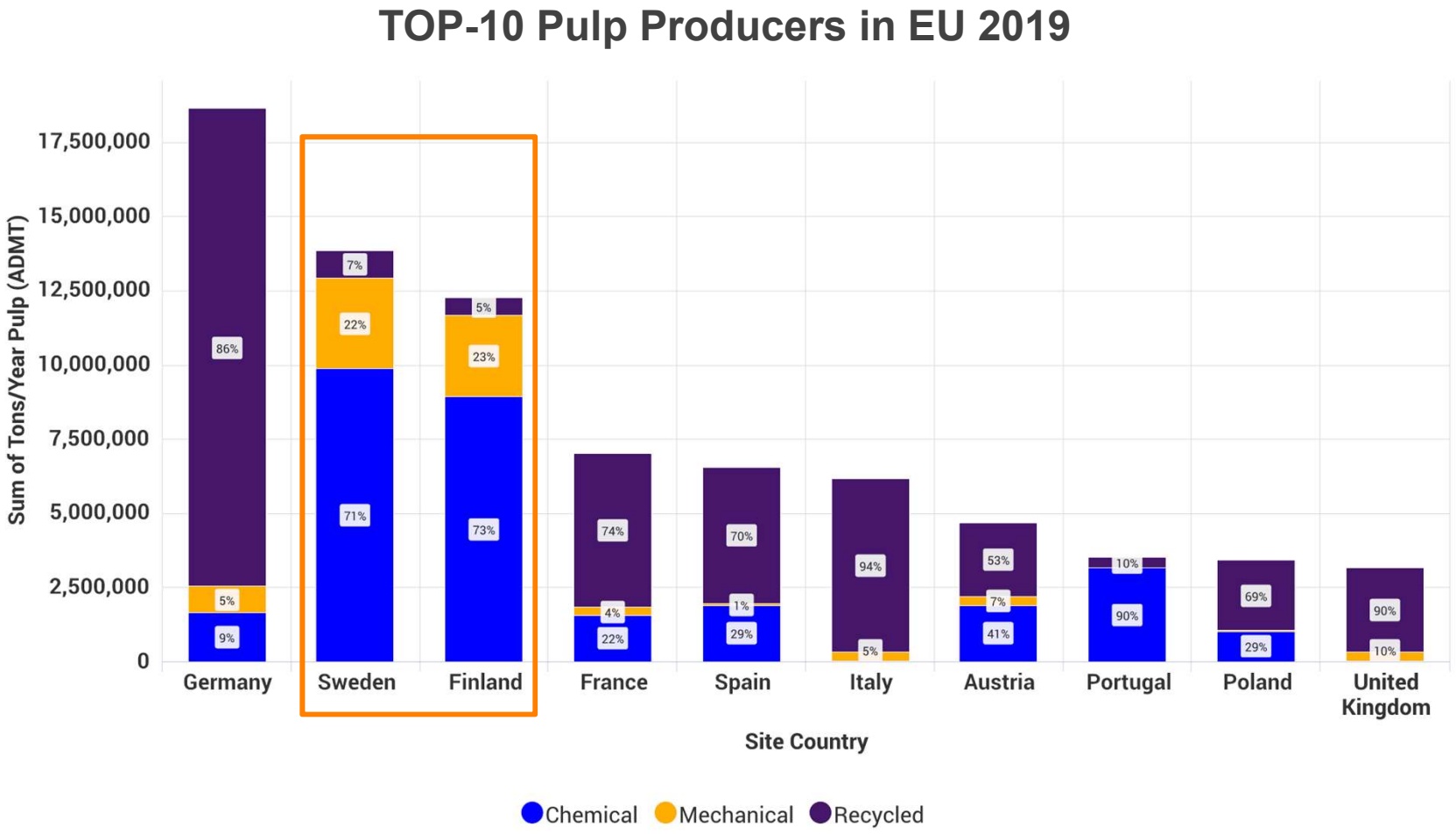


Total 119 Million MT

Source: FisherSolve Next™ © 2019 Fisher International, Inc.

* Used as raw material for other grades

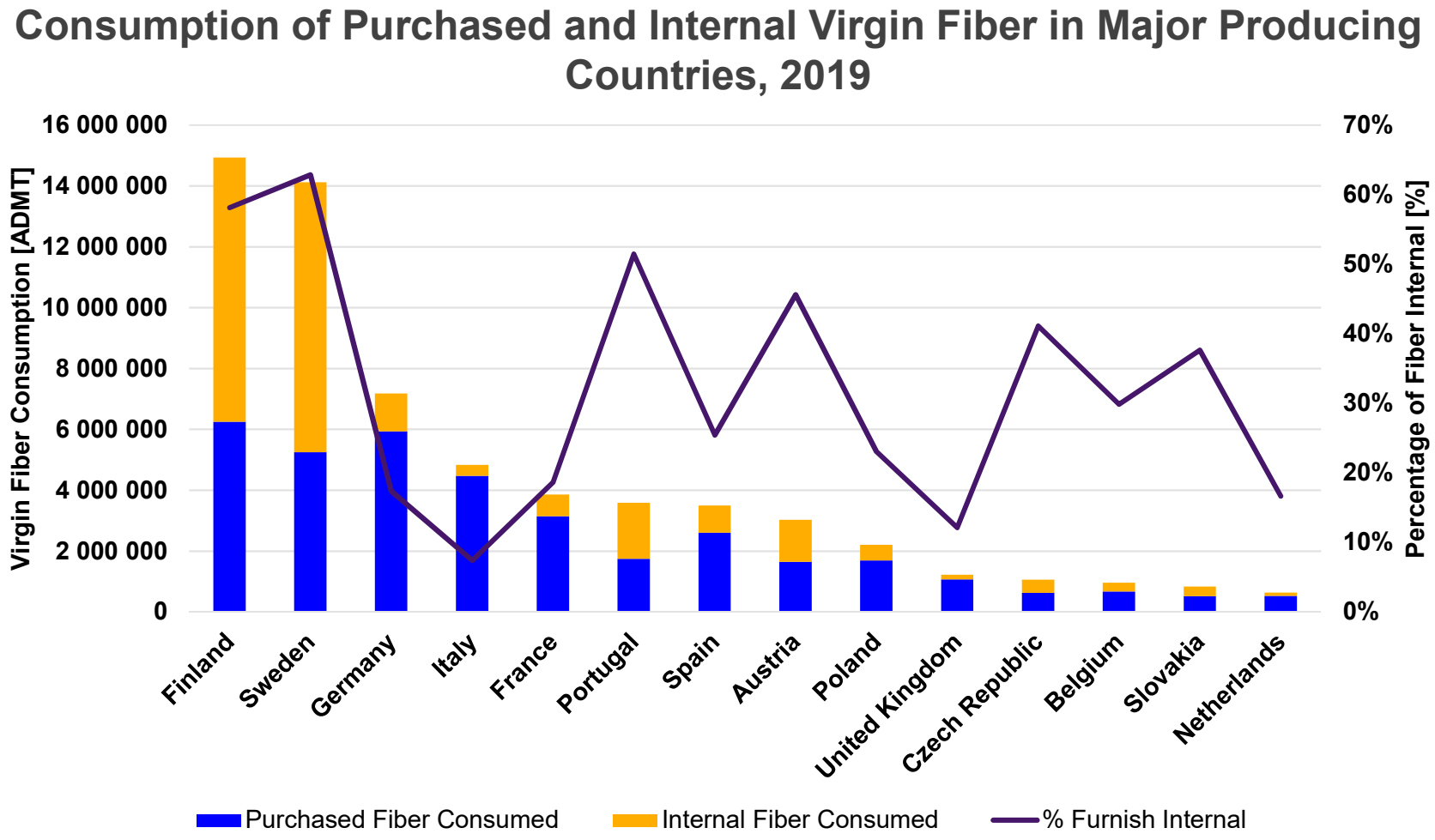
61 % of EU's Virgin Pulp is Produced in Finland and Sweden



Source: FisherSolve Next™ © 2019 Fisher International, Inc.

ADMT = Air Dry Metric Ton

Mills Finland and Sweden Are Highly Integrated to Virgin Fiber

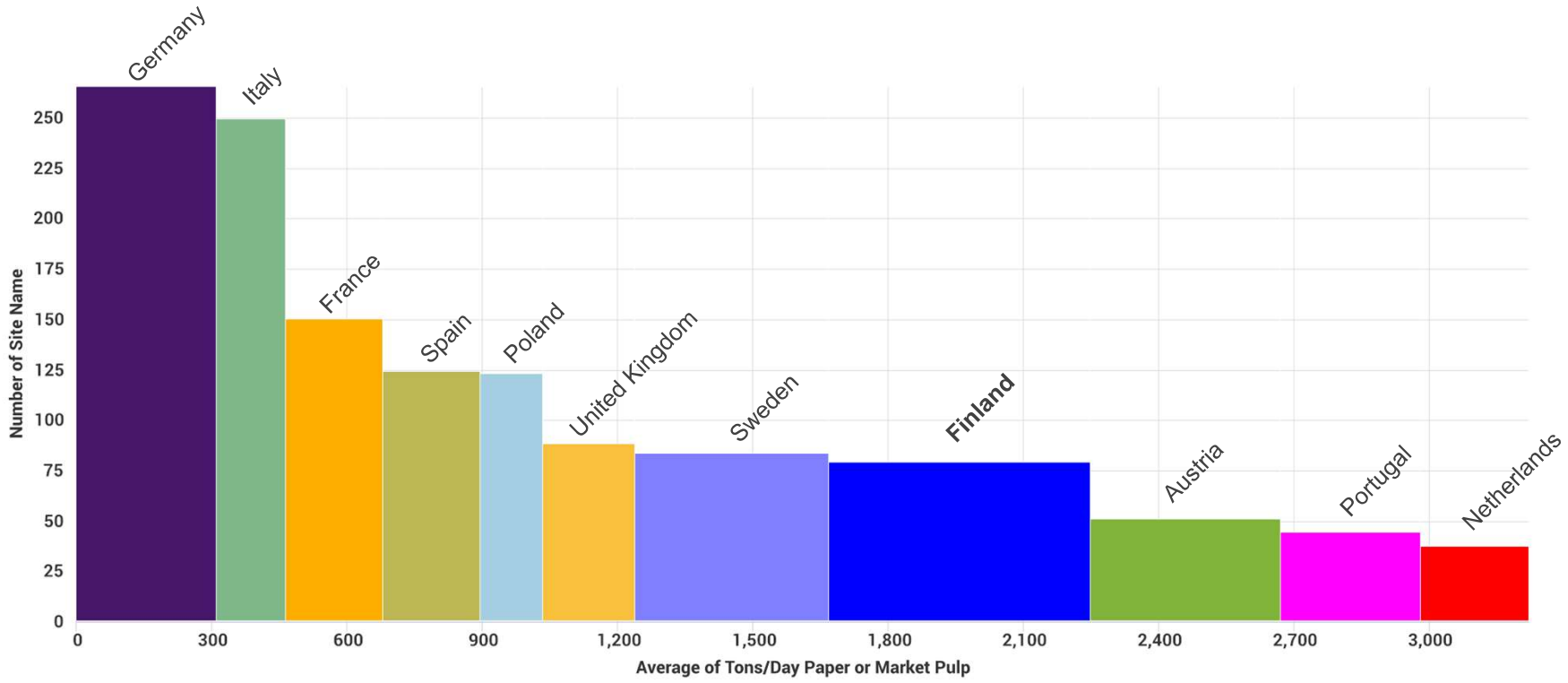


Source: FisherSolve Next™ © 2019 Fisher International, Inc.

ADMT = Air Dry Metric Ton

Finland and Sweden have High Average Capacity by Site

Paper Mill Daily Capacity and Number of Sites of Top Producing Countries in the EU, 2019



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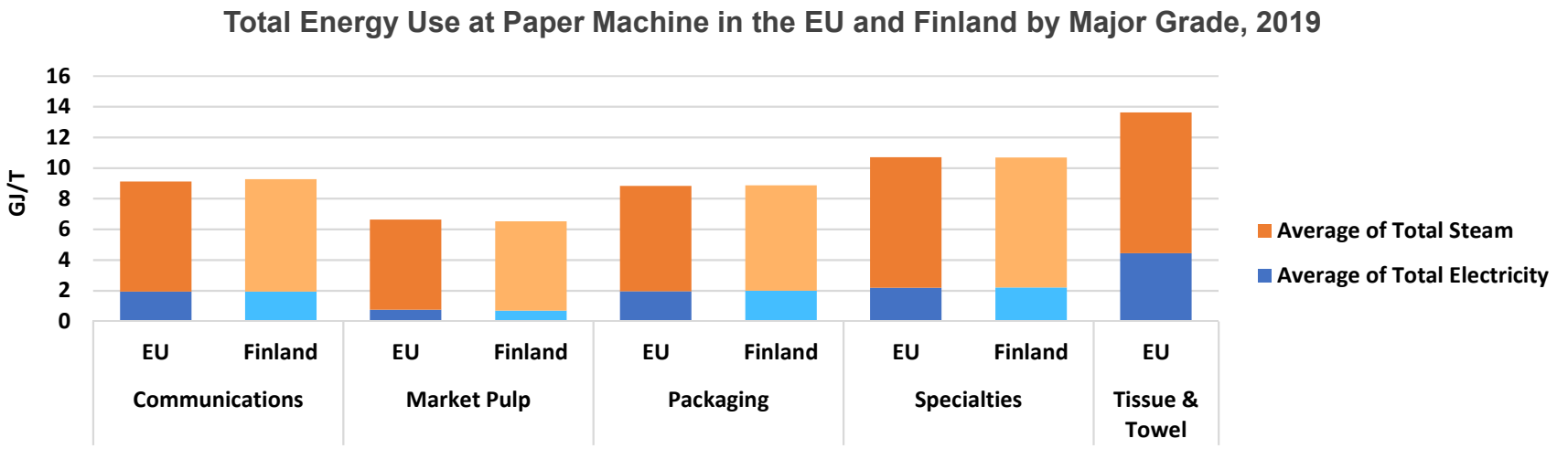
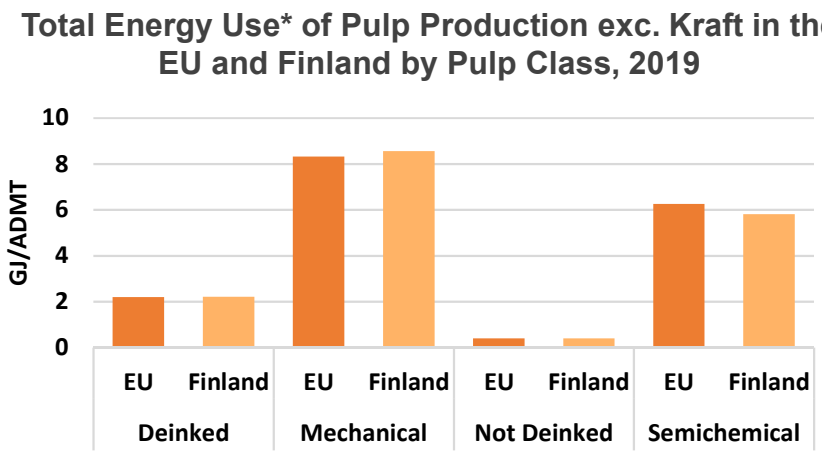
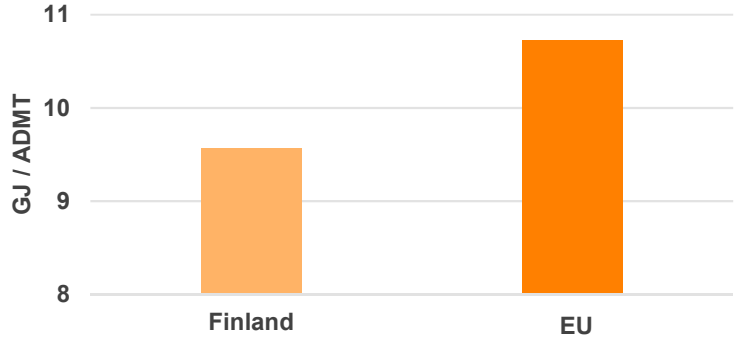
In Total Energy Use of Paper Industry, Finland is Close to EU Average with the Exception of Kraft Pulp







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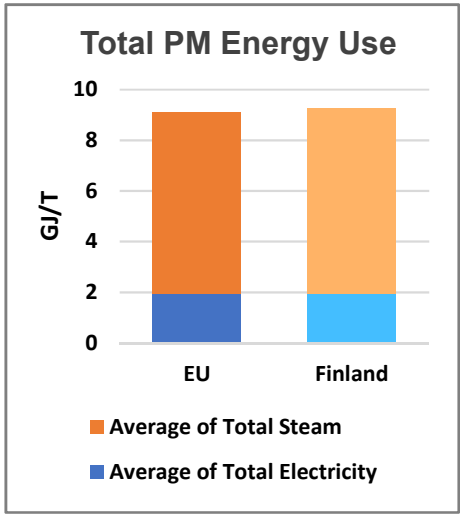
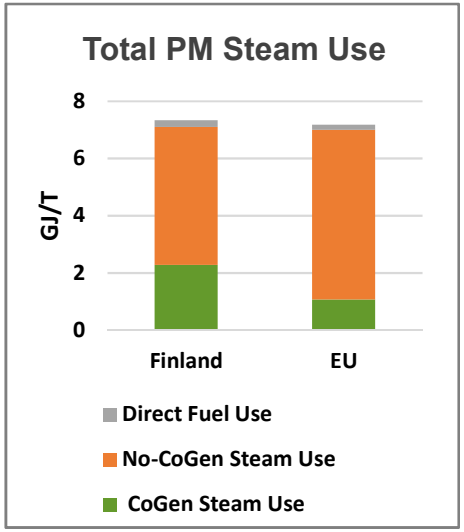
Source: FisherSolve Next™ © 2019 Fisher International, Inc.

ADMT = Air Dry Metric Ton

Communications

- Majority (68%) of Communication Paper Capacity in Finland is virgin integrated vs. EU Average 40%
  - Never dried virgin pulp requires more energy at the paper machine for dewatering than pulp that has already been dried once.
  - On virgin integrated sites, the surplus steam from fiber production is utilized at the paper machine, making the production more energy efficient
- Finland's Steam Consumption is higher than EU average for Uncoated Freesheet and Uncoated Groundwood Grades
  - In these grades Finland is producing lighter grades (lower grammage) than EU average, resulting in high productivity by area but low in tons produced for Finland





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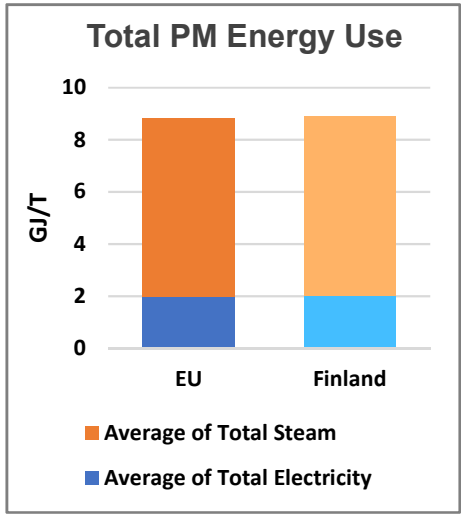
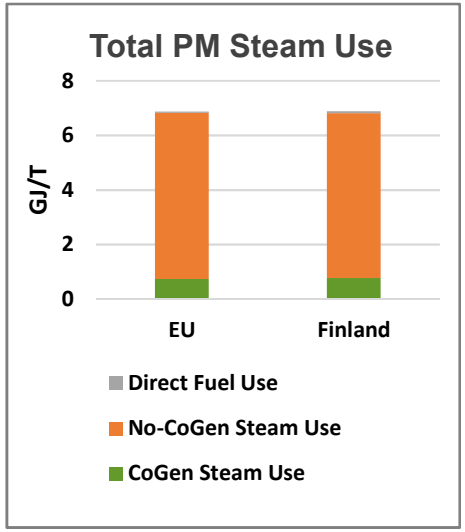
PM = Paper Machine

Packaging

- In Packaging (and Specialties) the differencies of end product properties affect energy consumption
  - Finland produces most of its packaging grades from virgin fiber which requires more refining energy than recycled pulp
- Packaging machines in Finland are in TOP-5 in Europe by technical age and productivity
- Energy Consumption in each packaging grade in Finland is either in par or lower than EU average





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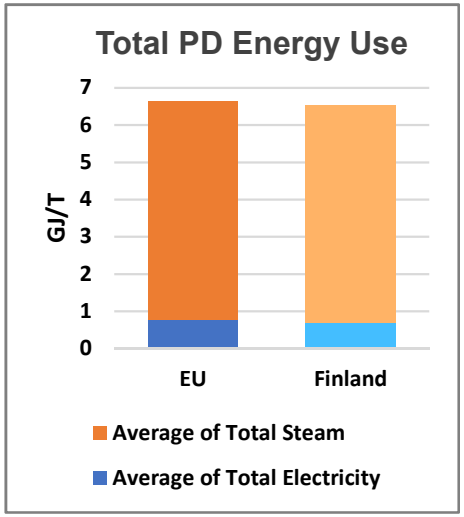
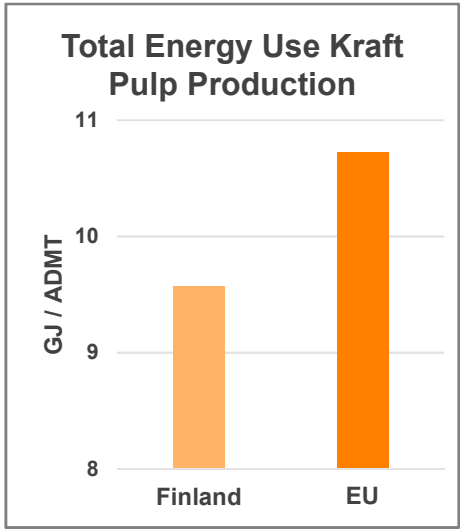
PM = Paper Machine

Pulp and Market Pulp Production

- On pulp dryer energy consumption, Finland is second most energy efficient producer in EU
- On kraft pulp (non-dried slush pulp) production, Finland's energy efficiency is significantly better than EU average despite of cold climate
  - Finland's on average modern kraft mills also use a significantly higher share of renewable energy than older mills, and produce a range of other products than pulp and paper.
- In mechanical pulp Finland is the second, and in semichemical pulp the second most energy efficient producer in EU
  - In Finland, the steam generated in mechanical pulping process is recovered and utilized at the mill





PD = Pulp Dryer
ADMT = Air Dry Metric Ton

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Fisher International is an information services and management consulting firm offering pulp and paper businesses better performance through the strategic use of business intelligence.

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Corporate Headquarters
50 Water Street
Norwalk, CT 06854 USA
T +1 203.854.5390
www.fisheri.com