Balancing Envornmental, Economic, and Social Goals in the Bioeconomy:

Important Trends in the Forest Industry

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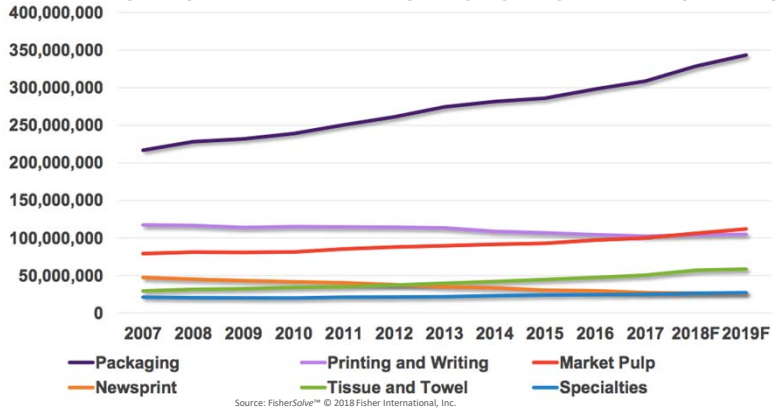
Given the increasing digitalization of the economy, is the global consumption of wood fiber expected to fall?

No, the consumption of wood is expected to continue to rise.

- Solid wood consumption not very affected by digitalization, and still rising with population and income per capita.
- Aggregate Pulp & Paper consumption is still growing (~2.5%/year), but becoming a Packaging (and Tissue) Industry that is still dependent on market pulp.

Global Pulp, Paper, and Tissue Capacity by Major Grade (tonnes)



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Globally, Where is the Money Going?

- **Packaging & Tissue Paper machines in Asia**
  - ✓ China could easily account for 1/3 of all global pulp, paper, and tissue production in just 10 years' time
- **Pulp mills in S. America.**
  - ✓ Lull in new capacity over next 1-2 years due to recent merger activity, but expect an acceleration of new low cost capacity after 2020.
- **Sawmills in the U.S. South and Eastern Russia.**
  - ✓ Almost 5.0 BBF (12 million m3) of new capacity already announced in the U.S. South in 2018-2020, with ~1/3 by Canadians.
  - ✓ Continued strong capacity growth in Russian Far East, mostly financed by Chinese capital.
- **Bio-products in Europe.**

Finland is the leader, with a focus on specialty pulp and advanced bio-products.

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Value of Long vs Short Fiber: Recent Data Point

- Consider an interesting data point generated in late 2017.
  - A subsidiary of Asia Pulp & Paper paid a very high premium for El Dorado's pulp mill and expansion option in Brazil
  - Reflected a particularly positive view on pulp from Asia.
  - Paid $2,810/tonne of pulp capacity
    - ✓ ~70% premium over average Brazilian peers (Fibria, Suzano)
    - ✓ > 500% premium over the NBSK producer Canfor Pulp
  - Interesting perspective on the future demand for pulp, and relative attractiveness of southern hardwood and northern softwood pulp.
- Many Canadian & Scandinavian companies talk about the unique qualities of slow growing northern pulp. But how much of a price premium are they actually getting for it?

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Case Study: Finland

Nine major new and pending projects related to Bio-Products in Finland

Investor	Location	Year	Product/ Investment type
Metsa-Fibre	Aanekoski	2017	- NBSK & NBHK pulp - Micro Fibrillated Cellulose (MFC)]
UPM-Kymmene	Kouvola Pietarsaari	2017 2019	- NBSK/NBHK pulp - NBSK/NBHK pulp
Stora-Enso	Imatra Uimaharju	2019 2019	- MFC - Dissolving pulp
Boreal Bioref	Kemijarvi	2020	- NBSK & dissolving pulp - Micro Crystalline Cellulose
KaiCell Fibers	Paltamo	2021	- Biorefinery with NBSK & intermediate for viscose
FinnPulp	Kuopio	2021	- NBSK pulp
Kaidi	Kemi	2021	- Biodiesel & bio-gasoline
NEB	Kajaani	2017	- Bioethanol
SEB	Kouvola	2019	- Bioethanol

In addition to pulp, this includes bio-materials (eg., MFC, MCC, intermediate for viscose) and biofuels.

Metsa's EUR 1.2B bioproduct mill is the largest investment in the history of Finland's forest products industry

If all the planned product is exported, it would likely boost Finland's bio-products trade by more than 2 billion euros/year.

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Implications for Governments & Communities?

- In North America, Scandinavia & Russia, play an active role in supporting the transformation agenda:
  - ✓ Embrace the bio-refinery concept – multiple bio-products from integrated facilities. Focus on bio-products where proximity to the customer and knowledge is a clear advantage.
  - ✓ Grow the solid wood segment, but find new economic uses for the residuals (from both the forest and mills) – bio-based electricity is not the main answer.
- In South America, Indonesia (and eventually Africa), figure out how to manage the social and environmental impact of extensive plantations and large market pulp mills.

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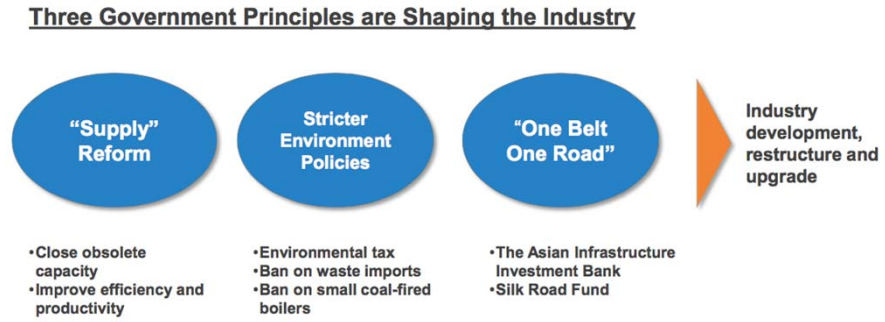
China's government plays a bigger role in shaping its forest industry than do governments in most countries.



Carbon Pricing and Other Options for Governments

UK Government estimates the Social Cost of Carbon to be in the range of $41-$124, with a central estimate of $83.

In April 2018, only about 20% of global GHG emissions were subject to a carbon price, and ~3/4 of these are priced below $10/ton (eg., EU, Chinese pilots). Notable exceptions:

- Sweden ~$140
- Finland ~$77; Norway ~$64
- British Columbia~$27; Alberta ~$23
- California/Quebec/Ontario ~$15

Political constraints suggest most carbon prices will remain below the Social Cost of Carbon. If true, what are the alternative policy options needed to support the bio-economy?

- Incentive tools vs Compliance tools?

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