BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Life-cycle assessment of US biomass supply and the role of biomass electricity for meeting UK emission objectives

Dr. Paul Meier, Boundless Impact
Andreas van Giezen, Boundless Impact

March 10th, 2021

# Boundless Research into Wood-Pellet Biofuel

- Substantiate the requirements needed to deem practices “sustainable”;
- Quantify the carbon intensity, and other environmental impacts, for wood pellet electricity relative to alternative generation technologies; and
- Evaluate the market impacts when wood pellet electricity is deployed at power plants, thereby reducing the grid’s reliance on fossil fuels.

BOUNDLESS
IMPACT RESEARCH & ANALYTICS

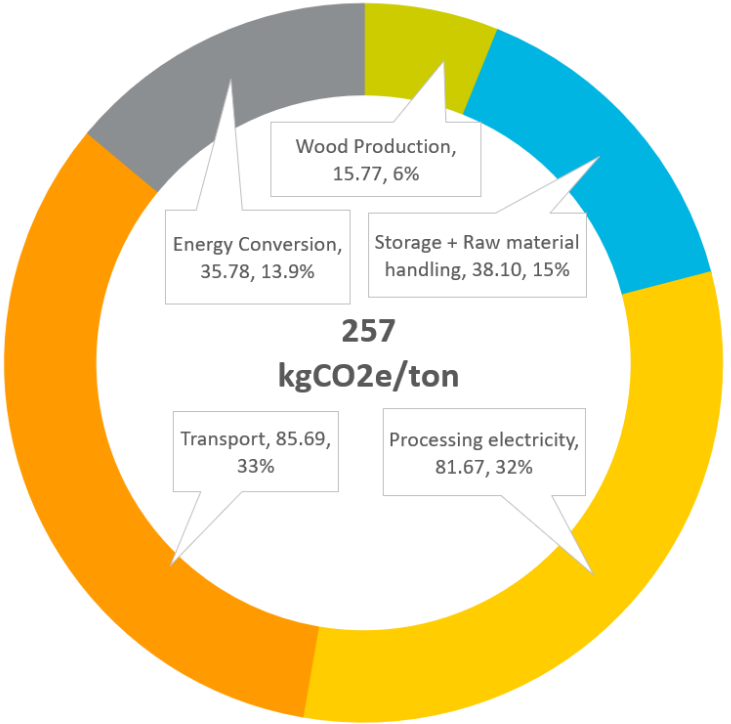
# Sustainable Working Forest

- RED II; Wood-pellets shipped to the EU can only be derived from forestland marked for reforestation. Special attention to land use changes.
- Where is the wood coming from? Low-grade trees, trimmings, ‘waste’ from timber industry, etc.
- Third party certification; accountability mechanism for clarifying biomass wood sourcing.
  - SFI, FSC, ATFS
- Long-term assessment of forest management practices is critical:
  - Many forests have been working forests since 1920s
  - Forest area **and** volume of standing timber over time
- In a sustainably managed system, the carbon that is released as CO2 during biofuel combustion is continuously balanced by CO2 uptake from forest growth and is deemed “carbon neutral.”

BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Case Study: Electricity produced in the UK using wood pellets from the Southeastern U.S.

- Harvesting & transport from the forest to the pellet production plant
- Raw material handling & emissions during storage
- Pellet production
- Transport from the pellet production plant to the port shipment to the UK
- Energy Conversion*

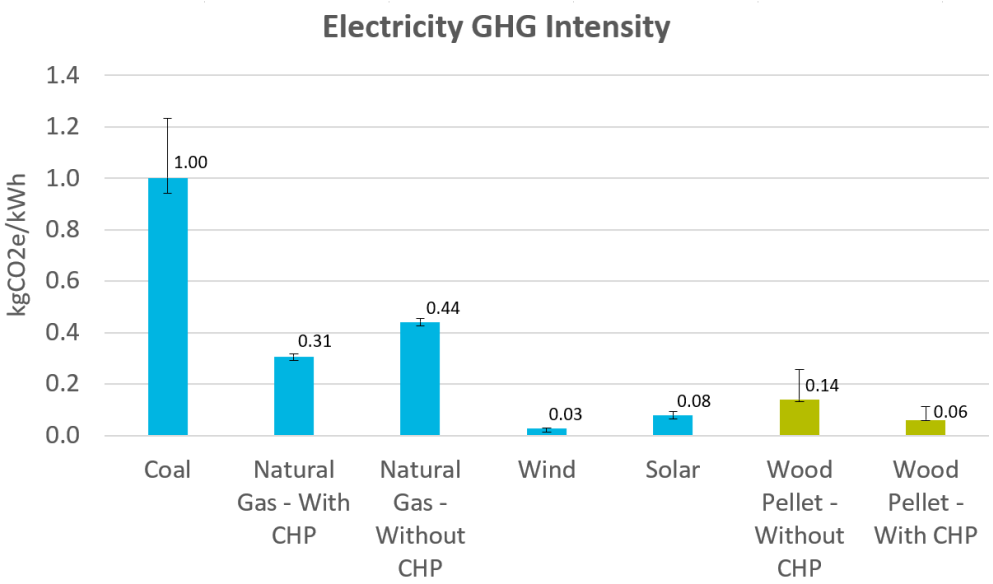



**Carbon in wood treated as "carbon neutral".*

# Carbon intensity for wood-pellet biomass case study relative to electricity generation alternatives.

- Electricity generated using wind turbines, solar photovoltaic, and wood pellet-based biomass emits far less GHG emissions per kilowatt-hour than coal.

- A 1:1 replacement of coal electricity would yield an
  - 86% emission reduction using wood pellets, a
  - 92% reduction using solar PV
  - 97% reduction using wind turbines.

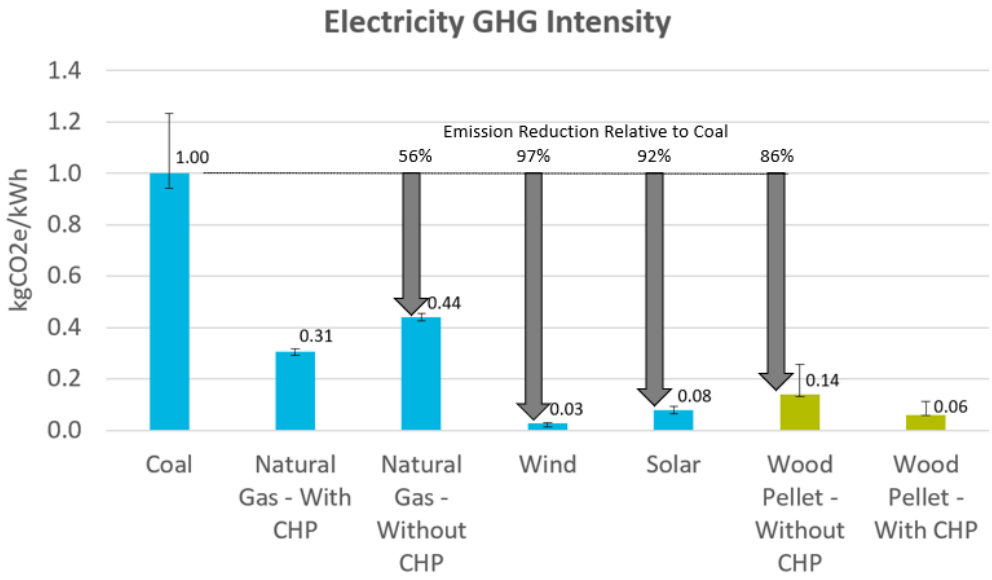



BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Carbon intensity for wood-pellet biomass case study relative to electricity generation alternatives.

- Electricity generated using wind turbines, solar photovoltaic, and wood pellet-based biomass emits far less GHG emissions per kilowatt-hour than coal.

- A 1:1 replacement of coal electricity would yield an
  - 86% emission reduction using wood pellets, a
  - 92% reduction using solar PV
  - 97% reduction using wind turbines.

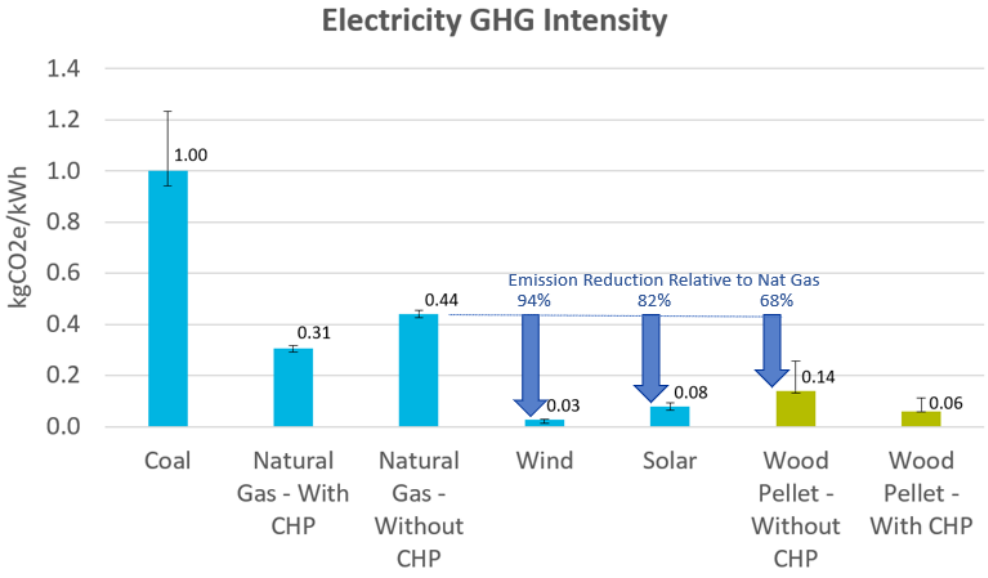



BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Carbon intensity for wood-pellet biomass case study relative to electricity generation alternatives.

- Electricity generated using wind turbines, solar photovoltaic, and wood pellet-based biomass emits significantly less GHG emissions per kilowatt-hour than natural gas

- A 1:1 replacement of natural gas electricity would yield an
  - 68% emission reduction using wood pellets, a
  - 82% reduction using solar PV
  - 94% reduction using wind turbines.




BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Carbon-Cycle Considerations

Basis for carbon-neutral assumption:

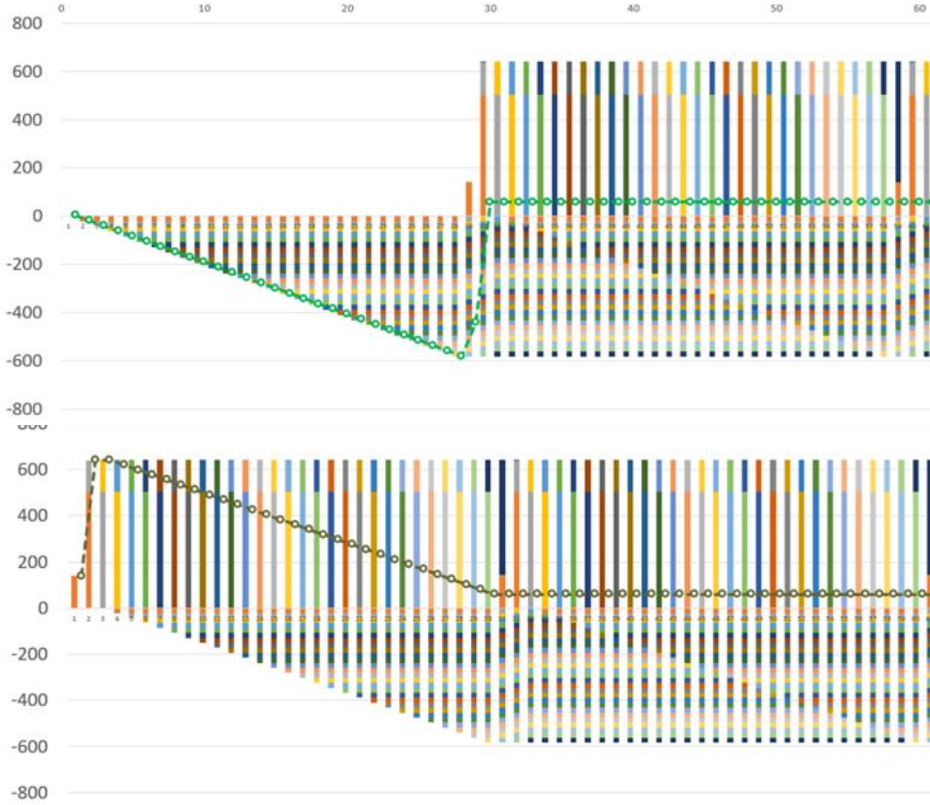
- net increases in forest carbon stocks are occurring for the geographic area of study
- raw materials are sourced from mill residues and forest-harvest by-products,
- biomass production is not derived from the conversion of forest land to other non-forest uses.

A separate but related issue is the timing of carbon offsets during LCA accounting. Whether they be:

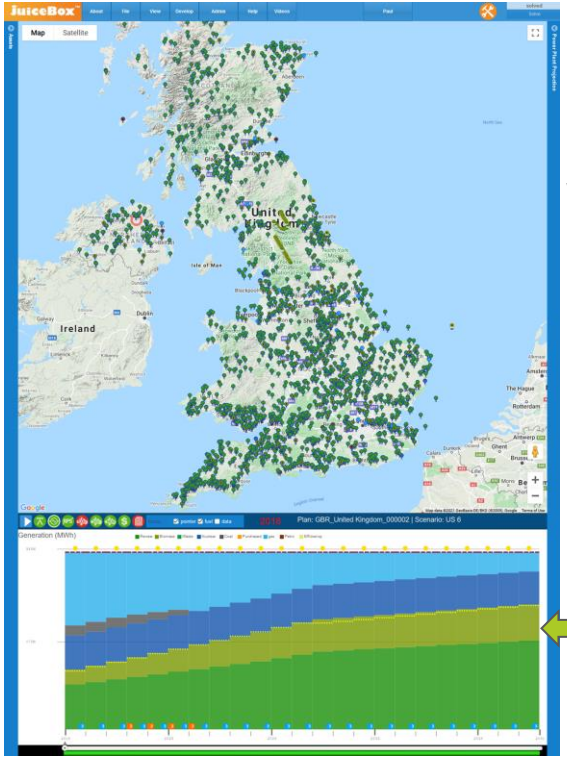
- Credited as a carbon offset during forest growth.
- Not accrued until post combustion (carbon debt).

A low-carbon intensity biofuel does not emit more carbon than coal on a long-term basis, however, not crediting biomass for carbon-uptake during growth increases the time required to account for emission savings.

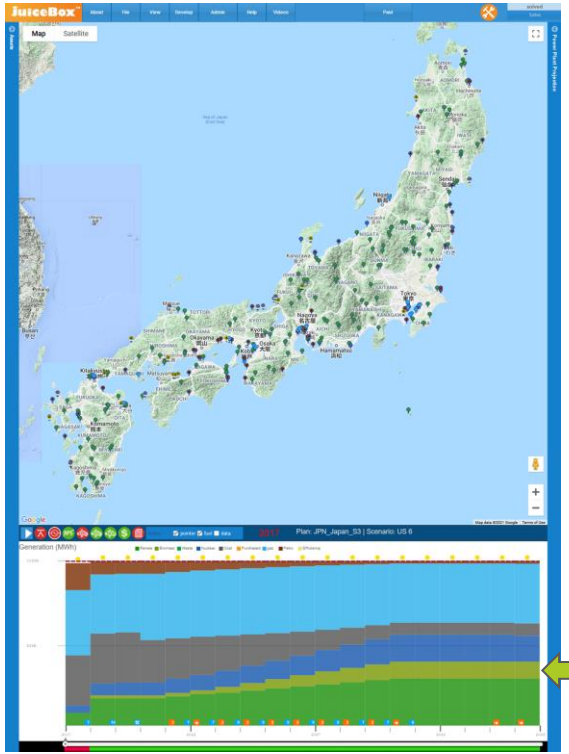
Simple carbon-neutral production of one metric tonne wood-pellet fuel, 30-year repeating cycle.



# Power sector modeling to evaluate $CO_2$ reductions from expanded wood-pellet electricity.




**UK Scenarios**
Increase wood-pellet biofuels along with wind and solar generation resources to accelerate emissions savings to meet a 59% reduction goal by 2030.




**Japan Scenarios**
Convert existing coal-powered facilities to use wood pellets as an inexpensive “emissions hedge” against the risk of nuclear plants not re-opening.

# Case study: Increasing U.K. power sector renewables to 59% by 2030.

UK1 Scenario - Uniformly increase (approximately 80%) wind, solar and biomass electricity contributions from current levels  by 2030.

UK2 Scenario - Increasing wind and solar only shows higher emission levels.

UK3 - Same as UK1 scenario, but with coal plant retirement.

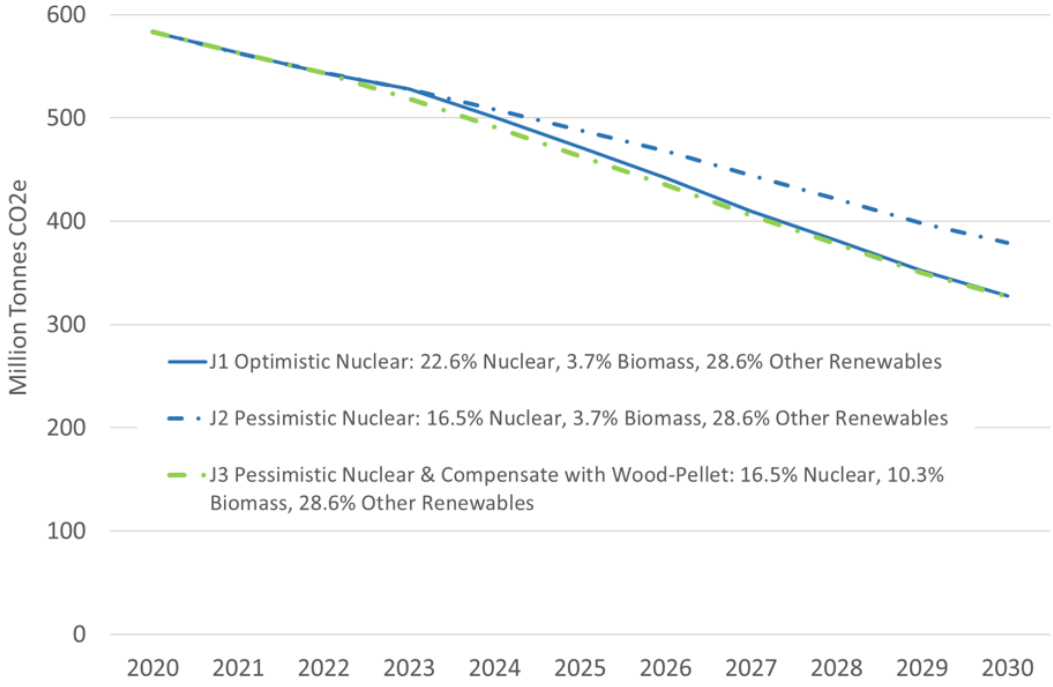

BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Case study: Variations on Japan's strategic energy plan by 2030.

J1 Scenario - Restart nuclear units to achieve 22% of generation mix. Increase renewables to 29% of supply by 2030.

J2 Scenario - Political and technical challenges limit nuclear supply to 16.5% of generation mix.

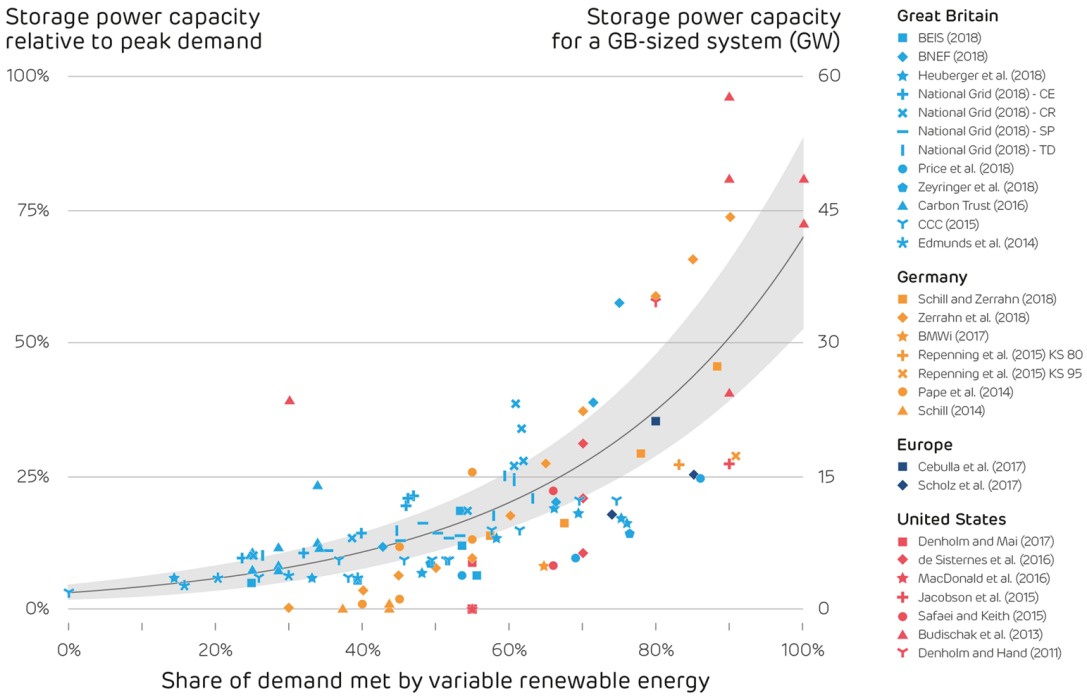
J3 - Convert coal-fired power plants to use wood pellets and increasing the total biofuel contribution to the power sector from 3.7% to 10.3%.




BOUNDLESS
IMPACT RESEARCH & ANALYTICS

# Deep decarbonization - benefits from “all of the above” approach

- Relying exclusively on intermittent resources such as solar and wind for deep decarbonization requires increasingly dramatic reliance on energy storage (see image).
- While natural gas power often has excellent load balancing capabilities, its associated GHG intensity is significant.
- Wood-pellet biomass generation can substitute directly for coal with relatively low capital cost required to convert an existing coal facility.
- Wood-pellet electricity is “dispatchable”, providing a low emission alternative to to balance the variable power supply from other intermittent renewable resources.




Graphic Source: Drax Electric Insights. ttps://electricinsights.co.uk/#/reports/report-2019-q3/detail/how-much-energy-storage-will-we-need?&_k=qfyztq

# Q & A

www.BoundlessImpact.net