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A new tool for determining potential biomass use for bioenergy in New South Wales

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Abstract: Australia is in the bottom quartile of OECD countries in using bioenergy as a proportion of total energy supply. A lack of reliable information about underutilised biomass feedstocks was identified as a significant roadblock to the development of bioenergy projects across Australia. Existing biomass resources derived from various sources were mapped in New South Wales, Australia as part of the Australian Biomass for Bioenergy Assessment Project. A parallel project is trialling the establishment of Australian native species as short-rotation biomass crops. Focussing for now on the available data for New South Wales (https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy) we have implemented a software product and web browser tool to facilitate the exploitation of this data. This is a tool for a spectrum of users who want to rapidly obtain aggregate information and explore scenarios for the use of biomass, notably but not limited to energy supply.

Two categories of sources of biomass are conceptualised: agricultural, forestry and other residues, and the plantation of energy crops in marginal or degraded land areas. Users can define geographic or point areas as sources of feedstocks, transport and pelletisation hubs, power plants such as a biomass power stations or hybrid solar-biomass plants, and linkages between these nodes (Figure 1). From the defined geographic extents of interest, the tool queries the spatial layers from an ArcGIS server to obtain the potential available biomass for each crop type and biomass productivity from woody biomass crops. Users can optionally adjust values and attributes such as moisture content and energy density. Additional custom feedstock types can be defined. Scenarios can be saved as files to the desktop. The types of outputs reported for a scenario include the carbon footprint and cost of transport, or which size of power plant is feasible given the available biomass of a scenario and the characteristics of the solar irradiation for a hybrid solar-biomass plant. It is also easy to produce the amount of avoided equivalent carbon footprint from a fossil fuel such as coal.

The tool is built mostly with Python. Two packages contain respectively the domain logic and user interface components. The domain package features a data model that consistently handles biomass feedstocks throughout the system, to avoid possible confusions such as wet and dry masses in calculations. The web front-end is built using Jupyter notebooks and the packages ipywidgets and jupyter-flex to work via a web browser. The web application is currently available as a testing site with an access restricted to testers and key stakeholders.

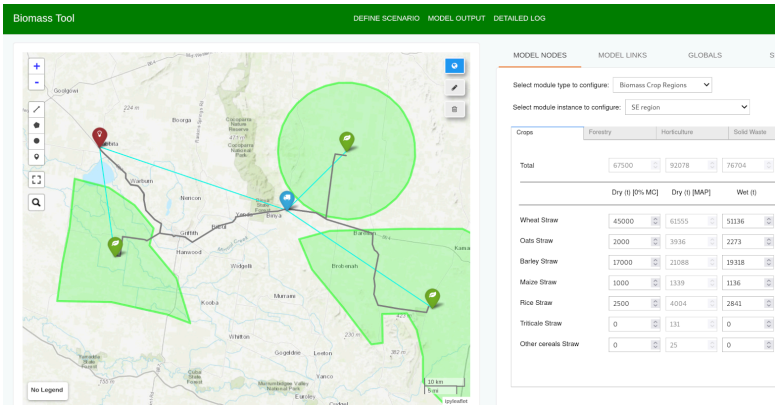

Figure 1. Scenario for a hybrid solar-biomass energy production

The broader vision for this activity is an evolvable software infrastructure for holistic, large-scale assessment of projects using biomass including their engineering, economic and environmental aspects. We are considering opportunities to use this software as an integration platform for other emerging activities exploring ways to transition to a system with a net zero carbon footprint.

Keywords: *Biomass, bioenergy, web application, Python*