What are hybrid solar-biomass plants?
There is a growing number of renewable electricity generation solutions currently being deployed in Australia, including concentrated solar thermal (CST). Hybridisation of CST technology with combustion technologies has the potential to be cost-effective, providing baseload energy while contributing to greenhouse gas mitigation. The climate benefits are improved when sustainably sourced biomass is used for combustion instead of fossil fuels such as diesel. We refer to these systems as hybrid solar-biomass plants (HSB).

Use of biomass in HSB reduces or eliminates the need for storage systems. Combustion of biomass is a mature technology deployed in many power plants operating globally. In addition to electricity, heat is also generated in HSB systems, which can be used for a number of different applications. The potential for greater usage of both biomass and CST for energy generation in Australia has been highlighted recently. The Clean Energy Finance Corporation estimates investment opportunities in bioenergy between $3.5 billion and $5 billion - in energy from urban waste, agricultural waste and forest residues.

For CST, without policy changes, it has been estimated that by 2040 up to 4 GW capacity will be installed. With minimal policy intervention, it is estimated that by 2040 an additional 1 GW capacity will be installed in regional Australia, in locations at the fringe of the power network which could go off-grid in the future.

What are the key advantages of HSB plants over standalone CST?
- 24 hours a day operation (dispatchable power) with constant base-load and higher output during the day aligning with higher energy demand also during the day.
- Flexibility of building smaller plant sizes (5 MWe-50 MWe vs. >50 MWe for stand-alone), resulting in reductions in construction time, investment risk, and initial investment.
- Effective operating hours and energy generation are about 2.8 times higher than in conventional CST of similar size.
- Higher steam cycle efficiency (more energy for the same input); resulting in reduced investment needs per unit of power.

© State of New South Wales through the Department of Industry, 2019. You may copy, distribute and otherwise freely deal with this publication for any purpose, provided that you attribute the NSW Department of Primary Industries as the owner.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (February 2019). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the user’s independent adviser. CM9 Record Number: INT20/39708.
BIOMASS FOR BIOENERGY
Hybrid Solar-Biomass Plants Factsheet

- Steam turbine can operate continuously, avoiding the daily shut down/start up, achieving greater overall efficiencies.
- Through lower investment costs, areas with less than optimal solar irradiation may be considered – in NSW such areas are typically closer to transmission lines and energy demand.
- Allows for local increase of renewable energy, reducing the need to import energy in regional areas, with associated cost reductions in transmission lines.

Are there operational examples of HSB?
The concept of hybridising solar energy with other energy sources is not new. However, HSB plants are a relatively new concept. An example of an operational plant is the Termosolar Borges plant in Spain (Figure 1).

The Borges plant is a 22.5 MW biomass-solar hybrid power plant generating 98,000 MWh/year, providing electricity for 27,000 homes, saving approximately 24,500 tons of CO₂ annually. The main biomass sources for the three boilers are forest biomass, biomass crops and agricultural residues. The total intake is 66,000 tons per year at an average of 45% moisture content. The biomass is shredded and dried before being burned in the boiler, which operates at 37% efficiency. The total investment was €153 million, with about 40 permanent workers operating the plant.

What makes hybrid solar-biomass systems potentially suitable for renewable energy generation in NSW?
Previous work has suggested significant potential for certain regions of Australia to benefit from HSB systems. For NSW specifically, many regions have abundant biomass available and reliable high solar irradiation. The availability of biomass is well documented—for example, in the AREMI tool (Australian Renewable Mapping Infrastructure), the spatial availability of residues from various sources is shown across NSW. Use of residues provides a number of potential co-benefits – reduction of wastage, increasing value-adding and also supporting the generation of locally derived energy. One area of NSW which has been the target of a previous study was Griffith, which has a high direct normal irradiance (DNI) and abundant biomass. The case study was based on an HSB plant with a total capacity of 30MWe (15MWe biomass and 15MWe CST). The economic analysis revealed that the HSB plant would result in at least a 43% cost reduction compared to a CST alone option.

The flexibility in plant size and feedstock types means that there may be many opportunities across NSW for the establishment of HSB plants, which ideally can be integrated with existing industry that requires heat or cooling in their operations. Importantly, such systems may provide an option for regions in NSW to become self-sufficient in energy generation, without relying on fossil fuels.

© State of New South Wales through the Department of Industry, 2019. You may copy, distribute and otherwise freely deal with this publication for any purpose, provided that you attribute the NSW Department of Primary Industries as the owner. Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (February 2019). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the user’s independent adviser. CM9 Record Number: INT20/39708.
What research is NSW DPI doing on hybrid solar-biomass systems?

NSW DPI Forest Science is partnering with the University of Technology Sydney (UTS) to identify especially suitable regions for the establishment of HSB plants. This study will build on previous work⁷, which highlighted the potential for the technology in NSW, by using more refined biomass datasets available at a regional level. The work will combine in-depth analysis of biomass availability, DNI profile and a range of parameters required to support techno-economic assessments. As part of this study, we will also engage with communities to discuss the opportunities and barriers for HSB plants in their region. This research is part of NSW DPI’s Climate Change Research Strategy (https://www.dpi.nsw.gov.au/climate-and-emergencies/climate-change-research-strategy).

Potential impacts of the research

● Informing policy-makers of the potential of a renewable energy option that has so far been largely ignored.
● Provide prospective investors with confidence from the detailed techno-economic assessments.
● Support the development of pilot plants in selected regions.

For further information, please contact

DPI Forest Science
Senior Research Scientist Fabiano Ximenes
T: 0458 760 812
Fabiano.Ximenes@dpi.nsw.gov.au
UTS Institute for Sustainable Futures
Research Director Nick Florin
T: 02 95144797
Nick.Florin@uts.edu.au

References