IEA Bioenergy

Technology Pathways for Energy Recovery from Waste in a Circular Economy

Workshop Report

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Background

As the Task's work moves from a focus on combustion-based waste-to-energy to include a wider range of processes and technologies, it is timely to consider the range of pathways that are now becoming relevant in the context of the emerging Circular Economy. Furthermore, as there is a greater need for more diversity in the way we treat and manage waste, we are seeing differing levels of understanding and support in key areas of government and community.

Workshop Aim

Discuss the technology pathways available for energy recovery from waste in a CE and what it would mean for the sector and for the public/government engagement, and use this to shape the work program of the Task for the remainder of the triennium.

Agenda

MORNING SESSION (CLOSED)

Objective: to discuss the scope of the Task deliverables and work towards understanding how the work packages of the task should reflect specific technology pathways for energy recovery from waste in a CE.

1. Scene-setting presentations considering alternative pathways and feedstocks: Beau, Daniel, Michael, Cristina
2. Discussion: scope of our main reports and how we plan to structure our deliverables
3. Discussion: preparation for afternoon session.

AFTERNOON SESSION (INVITED GUESTS)

Objective: to gain local industry and government insights into how EfW technologies can be

implemented to support CE principles and policies.

Invited presentations:

1. Qld Government Biofutures, Michael Burke
2. Qld Government – Developing Queensland's EfW Policy, Esther Richards
3. Australian industry and government perspectives in the context of rapid change, William Clarke, University of Queensland
4. Bringing the people along: Social Licence to Operate and Public Acceptance in WtE, Rod McCrea, CSIRO
5. Case study of a new (combustion alternative) project – Pyrocal and the Logan Council project, James Joyce, Pyrocal.

Workshop Notes

CLOSED SESSION: TASK SCOPE AND DELIVERING THE WORK PROGRAM

Context

The broadening of the Tasks's scope from linear waste-to-energy pathways to be clearly focussed on energy and materials recovery in the context of the circular economy has significant implications for the work program. The Task is no longer about just energy – the scope includes nutrient recovery, as well as materials recovery and new products. This has implications for the technology pathways the Task needs to consider as well as the nature of the deliverables (the latter point is particularly relevant given the new countries participating and the spectrum of familiarities with different aspects of energy and materials recovery from waste.

Discussions of circular economy principles in the context of energy and materials recovery inevitably include combustion technologies, as well as digestion and gasification pathways and more niche technologies such as those based on pyrolysis. This task has some important contributions to make in these non-combustion areas; however, it is important to ensure that we build on outcomes from existing tasks (in particular 33 and 37, which have both released reports recently on areas that will be of interest to the subsequent work in this Task). There may also be a role for Task 36 to add value to some of that work – for example, is there a role for us to diversify or expand some of the AD pathways, especially in the context of more restrictions on applications of digestate to land, which could include conversion of AD digestate to a useful product?

Emerging Pathways and Opportunities

Examples of current bioenergy projects being supported by the DoE highlight the diversity of the emerging technology space. There is a focus on upgrading of landfill gas and other biogas applications, including a technological approach integrating metal organic frameworks (MOFs) with amines for CO_2 capture, and some new pathways for hydrothermal liquefaction. Interestingly the US DoE Bioenergy Technologies Office is losing interest in producing bio-gasoline due to the expected increase in electrification in the transport sector, particularly in light and personal mobility. The focus in terms of fuels is on diesel and aviation fuels.

It is clear that the CE and products space is vast and complex, which highlights the importance of this Task focussing on relevant and important waste streams, and on products people actually want in the context of the CE cycle. This represents a particular challenge for governments and project proponents

as they must decide on the most appropriate pathway for a specific application, and then ensure they can bring the public along accordingly.

Hydrogen is emerging in the Australian (and global) context as a potentially-valuable energy product from waste streams. There is expected to be a significant growth in demand for 'green' hydrogen, and it is anticipated that the waste sector has a role to play. Troublesome feedstocks such as non-recyclable plastics have a potentially-significant contribution to make; however, caution may be needed regarding the definition challenge associated with that (i.e. plastics and other waste materials derived from fossil fuels are usually not deemed to be renewable, or bioenergy feedstocks).

The relevance of biological waste management pathways to the emerging renewable gas and hydrogen sector was reinforced by advances being made in South Africa. This work specifically looked at how fermentative processes could be integrated with more traditional digestion technologies to encourage hydrogen production.

Navigating a Complex Technology-Product Space

In the context of focussing the Tasks's scope to a manageable one consistent with its agreed deliverables, the following guiding principles were used to consider the long list of possible of feedstocks, technologies, and products that are deemed 'useful' in a circular economy. It will be important that the Task provides a framework that can be used to understand the available and emerging technology pathways for a specific waste to be converted to energy and materials consistent with the principles of CE.

Important aspects for consideration:

- Need to develop an achievable scope, and focus on some relevant technologies and their costs that can be applied across sectors and in countries of various levels of 'technological familiarity'—and not just 'one day', but include options for the 'now'.

- Consider these technologies as tools to enable and develop the circular economy, rather than to attempt to prescribe a specific version of a CE (although there is a risk that we only consider something specific to a certain sector or country).

Discussion around 'how we structure our deliverables' included the following possible themes:

- EU circular economy action pan structure, including setting an ambitious target for all countries?

- A best practice review of pathways to assist policy formulation, project development, and decision making?

There was some concern at the broader relevance of these kinds of outcomes:

- How does this relate back to 'localised targets' and plans to achieve those? Given the new diversity in the Task there may be value in the production of a tool for countries (or perhaps even municipalities) to 'localise' technology combinations for best impact.

- A common terminology is important (EFW? Materials and energy recovery? Hybrid systems? Etc)

There was general agreement with a more guiding approach (pointing to the information and data, rather than having to generate and report it). With that in mind, a theme emerged from the discussions regarding what the final report of the Task might look like:

- the notion of a high level 'feedstock, technology, and process' map to outline the potential for the 'energy, material, and nutrient recovery' activities

- overlaying this with (what we eventually decide is a prioritised list of) pathways
- include a series of case studies that demonstrate examples of what's really worked well, what's not, and what is possible. These case studies would support the 'focussing' of the Task onto some priority pathways, and also the notion of pointing people in the direction of good information and insights without having to actually do it all for them
- Could show the clear links in to other aspects of IEA Bioenergy's Tasks.

The next steps here are to distil these discussions into a framework of the final report for the Task for the next teleconference meeting, which can then guide the preparation work for the next face to face meeting in Seattle.

AFTERNOON SESSION: AUSTRALIAN PERSPECTIVES AND CHALLENGES

The intent of the afternoon session was to bring some local industry and government perspectives to the task, to help refine the outcomes of the morning session's discussions and to give Task members some additional insights into some Australian developments.

Queensland's Biofutures Strategy

Queensland's Biofutures Strategy is touted by many in the Australian Bioenergy sector as one of the more supportive plans to encourage the uptake of a range of different bioenergy projects. Michael Burke (Director, Biofutures Queensland) gave an introduction to and overview of the strategy and its potential to impact on the work areas of the task, and a separate presentation from the Department of Environment and Science provided some more detail into the energy recovery from waste policy work being done and the foundation principles on which it is based.

Michael Burke presenting to the Task on Queensland's Biofutures Strategy.

These presentations and the subsequent discussion raised an interesting point around naming conventions, technology classifications, and the potential policy impacts of the blurring of lines between energy from waste and materials recovery. It is possible, for example, that EfW doesn't count as recycling, but can count as resource recovery, which has some interesting implications for how multi-product technologies such as hydrothermal liquefaction are classified: HTL counts as EfW if it's making an energy fuel but as materials recovery if the same product is used differently.

Research Insights: Technology Development and Social Acceptance

Despite the level of interest in waste streams and their management, and more recently in the context o recycling and materials recover, it seems that there is still clarity needed on the size and quality of the waste streams requiring management. There is a view that the current data is not well suited to supporting projects and their planning—especially as we look to better understand seasonal variability and the impacts of policy and technology changes on waste stream composition and how this might impact technology choice and performance.

We know from experience how important public acceptance is to waste management projects—especially those involving energy recovery. This was demonstrated clearly in Australia, where a large combustion-based EfW project in Sydney failed to get government approval—with many observers pointing to a lack of community acceptance as a key factor. Some recent work that has been commissioned by the Victorian state government explored public attitudes to waste to energy and how these drive community acceptance (or otherwise!). These results came from a survey of over 1200 Victorians around their broad perceptions of the industry as well as their views on specific aspects of technologies. There were some key outcomes around views on landfilling, the impact of experience with living near existing landfill operations, and how some of the drivers that support a greater degree of acceptance are influenced by information, governance, and the perception of benefits.

There is considerable opportunity for some followup activities in this space, especially given the diversification of the Tasks's technology base and the increasing need for developments and projects to do a lot of preparatory work regarding community engagement.

Industry Developments: Biosolids Pyrolysis

Biosolids management in Australia is traditionally limited to land application or disposal. This is unlike many European jurisdictions where biosolids are often incinerated as more and more restrictions are placed on agricultural and other land uses. The associated requirements for additional nutrient recovery from biosolids is placing some pressure on these combustion processes, which are needing to integrate additional phosphorous recovery technologies which lead to additional cost increases. With this in mind, there is more interest in non-combustion pathways for biosolids management.

A new project in Queensland will demonstrate the use of a pyrolysis/gasification technology as a management tool for biosolids. This particular technology was originally designed for biochar production from biomass, but which is now being used in an Australian-first demonstration for converting biosolids to a char with integrated drying. While the project does not incorporate any specific pathways for additional nutrient recovery, the process does remove hazardous and pathogenic compounds from the biosolids as well as microplastics, which leaves the biochar product suitable for use as a soil ameliorant, amongst other things. Success in this project should raise the profile of non-combustion technologies for waste management, and highlight their role in nutrient and energy recovery from waste.