Resource Recovery from Wastewaters

Report on outcomes from the joint CSIRO/AWRCE Workshop held in Melbourne on 7 March 2014

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CSIRO

RESOURCE RECOVERY FROM WASTEWATERS

REPORT ON WORKSHOP HELD IN MELBOURNE ON 7th MARCH 2014

1. Background

The CSIRO and AWRCoE organised a workshop on Resource Recovery in Melbourne on 7 March 2014 to provide the opportunity for a broader discussion with a cross-section of stakeholders across the research, water utility, the broad private industry groups and regulation/policy sectors with experience in resource recovery to help develop an outcome-focused plan to benefit Australia. The aims of the Workshop were to:

- Develop a process to identify the status of current resource recovery from wastewater initiatives and practical experiences within Australia, and how this may compare with other countries;
- Develop the initial scope for necessary inputs to a model business case for resource recovery from wastewater (ideally applicable to all stakeholders), including the identification of 2 representative actual case studies for detailed economic analysis
- Provide outputs that feed into a workshop to be run at OzWater'14.

Further, the AWRCoE intends to use the outputs from this Workshop and those from the OzWater'14 Workshop to develop a 'state-of-the-art' document summarising resource recovery technologies used internationally and their application in Australia, summarising the understanding of stakeholders' needs and knowledge gaps, financial implications and challenges through the development of hypothetical case studies and exploring potential international linkages and co-investment in collaborative opportunities.

2. Format of the Workshop

Appendix A summarises the Agenda for the day and **Appendix B** summarises the Workshop participants.

It will be noted that the proceedings started with an overview of recent activities (in the field of resource recovery) with presentations from John Poon (CH2M HILL), Tim Muster (CSIRO) and Leslie Smith (WSAA). These were followed by an overview of economic assessments of resource recovery with presentations from Murray Hall (CSIRO) and Kelly Brooks (Melbourne Water). Copies of these presentations have been circulated to all participants, as has the CSIRO 2013 Report, entitled "Resource Recovery from Wastewater: A Research Agenda".

Two Workshop Sessions were then held, facilitated by Ian Law. The first had the aim of establishing the current status of Resource Recovery from wastewater in Australia and the second

discussing methods of economic analysis and the development of a business case for Resource Recovery.

3. Format of this Report

The Report commences with a summary of 'take-home' points from each of the pre-workshop presentations, followed by summaries of the outcomes of the two Workshop Sessions. It then concludes with a section on a suggested path forward, based on the day's discussions.

3.1 Pre-Workshop Presentations

1. Overview of Recent Activities

John Poon (CH2M HILL):

John reported on the Clean Technology Innovation Program workshop that was held in October 2012 to brainstorm R&D projects that may be candidates for the $200M program. The outcome was that commercialisation of co-digestion/energy recovery was considered the most appropriate candidate to be put forward for funding. Mention was made of Yarra Valley Water's initiative with co-digestion, a project that had gone to business case and was awaiting funding.

Opportunities with anaerobic digestion of high strength wastes were raised – both for energy recovery and the production of return liquors high in nutrients that could be recovered.

Tim Muster (CSIRO):

This presentation has been circulated to all attendees.

Key messages from this presentation were:

- There is a combined benefit by producing a resource AND treating wastewater
- Water has the highest value and will continue to drive investment
- Need to reduce energy consumption
- Advances in low carbon nitrogen removal allowing more carbon to be fed to anaerobic digesters
- Recovery of ammonia does not appear economically viable at present
- Increasing anaerobic digestion leads to more soluble phosphorus in return liquors; opportunity for struvite recovery and decreased biosolids production
- Treatment technologies are available for full range of resource recovery; treatment plant configurations may be different in the future
- A survey of large scale utilities as to their priorities yielded the following results (where Number 1 is the highest priority). Co-digestion and anaerobic digestion improvements were the clear priorities.

C Recovery & Sludge Improvement	1	2	3	4	5	Total
Improved primary treatment i.e. advanced coagulation for dissolved C removal and anaerobic digestion of primary wastewater	4	5	4	3	3	19
High performance anaerobic digestion of sludge (enzymes, fungi and ultrasound)	1	3	5	6	1	16
Incorporation of alternative energy sources – i.e. municipal waste	2	1	1	1	2	7
Biosolids Improvement i.e. Biochar and other options such as biochemical processes	5	2	3	5	4	19
N & P Recovery						
P Recovery in conjunction with the Anammox or other denitrification pathway	3	4	2	4	7	20
Direct manufacture of struvite from concentrated waste streams	6	6	6	2	5	25
Small scale systems						
Bioelectrochemical systems for C, N and P recovery	7	7	7	7	6	34

Number 1 is highest priority

Leslie Smith (WSAA and City West Water):

Leslie, who represented WSAA's 'Community of Practice on Waste to Energy', reported on two 'Waste to Energy' workshops that were held in Adelaide and Melbourne in 2013 under the auspices of WSAA, the Water Environment Research Foundation (WERF) and Smart Water Fund. Minutes of these workshops were circulated to all attendees. These workshops included presentations from international speakers and focussed mainly on co-digestion, noting that Western Water, Yarra Valley Water, SA Water and Sydney Water were all developing co-digestion projects.

Outcomes from these workshops included the need to:

- Facilitate knowledge transfer
- Develop business cases
- Develop a national inventory of relevant WWTPs and quantify opportunities for resource recovery
- Develop a Australian Code of Practice for co-digestion
- Co-ordinate the development of pilot plants

2. Overview of Economic Assessments of Resource Recovery

Murray Hall (CSIRO):

This presentation has been circulated to all attendees.

The presentation started with two research questions:

- Which drivers are the most important for resource recovery, and
- What would the WWTP look like if the aim was resource recovery?

The drivers identified were the value of nutrients (spike in phosphorus prices and variation ammonia prices a function of natural gas price) and the cost of abatement (chemicals and sludge disposal) along with integrating with energy and water recovery, while the treatment plant configuration was dependent upon the resource recovery model adopted.

A Case Study was presented, using data from the Oxley WWTP in Brisbane, in which 'sludge busting' – in this case the CAMBI thermal hydrolysis process – is added to a BNR plant to reduce sludge, increase methane recovery and render the N and P in the biosolids more available.

An example of a Resource Recovery Model was presented in which changes in mass flows as well as resource and pollution prices are considered to establish a value proposition for adopting the treatment configuration investigated.

Kelly Brooks (Melbourne Water):

This presentation has been circulated to all attendees.

Melbourne Water has carried out an extensive evaluation of resource recovery from side streams at its Eastern and Western Treatment Plants – both of which have anaerobic digestion in place. It had worked with Ostara to evaluate the feasibility of Struvite recovery from the side streams but had concluded that side-stream nutrient recovery is not competitive with the benefit of direct use of the nutrients within biosolids – due mainly to cost of chemicals (e.g $MgCl_2$) and energy.

Current breakeven price for recovery of Struvite was shown to be $400-500/T – almost double that offered by an interested party. It was mentioned that the price of phosphorus is expected to remain steady for the next 10 years – a statement subsequently questioned by an attendee from Incitec who stated that the price is still moving upwards.

Biogas generation, co-digestion and soil amendment are currently attractive to Melbourne Water.

The presentation concluded with a slide on how to establish which resource recovery opportunity is best; identifying the steps that need to be followed through to arrive at a meaningful outcome:

- Economic
  - Economic models, e.g. price projections
  - Technologies, products, markets, energy, uncertainty
  - Market – is there one for the product?
  - Logistic models
- Life cycle assessment and TBL assessment
- Community and industry perceptions

4. The Workshops

Each of the two Workshops had overarching aims, as follows:

- *Workshop No* 1: Establish the current status of Resource Recovery from wastewater in Australia
- *Workshop No 2*: Economic analysis and model Business case for Resource Recovery

Workshop attendees were divided between four tables on the basis of skills, backgrounds, affiliations and geographic location. Each Workshop ran for a period of 1 hour, after which a representative from each table gave a report on their table's discussions.

A set of discussion prompts, designed to assist in achieving the required 'workshop aims' were tabled at the start of each workshop.

Appendix C lists the outputs from each table in each Workshop.

5. Summary

A summary of the key outputs from the two workshops as well as the general discussion that followed the workshops is presented below.

- Resource recovery appears to be more mature and mainstream in Europe and North America than in Australia, although we are keeping abreast of what is happening (CSIRO's WERF Report) and what emerging technologies can bring (UQ's Veolia-QUU, Degremont-SA Water Anammox trials)
- Focus in Australia has been on water recovery (recycling), energy recovery (conventional anaerobic digestion and co-digestion) and applying biosolids to land as compost or 'straight' (with associated nutrient release benefits)
- Side-stream recovery of nutrients (e.g. Struvite) does not appear to be financially attractive at present, although, as the price of phosphorus increases with time and as new technologies come to the fore, this may change
- Increasing landfill prices will be a driver for beneficial use of biosolids on land as well as for technologies that reduce mass of solids produced
- Is energy recovery from landfill gas a competitive option?
- Application to agricultural operations brings with it many factors that must be carefully considered in conjunction with relevant stakeholders:
    - The product (i.e. biosolids) must meet the farmers' requirements – liquid or solid or both. In the case of the product being used to produce compost, the product must meet the quality requirements of the compost industry
    - Steps must be in place for the quality of the product to be maintained; focus must shift from 'disposal' to a 'resource'
    - Market analysis is required covering quality, price, nutrient release performance, presence of micro- and macro-nutrients
    - Regulators need to be supportive; environmental as well as agricultural bodies such as Meat and Livestock Australia (MLA) must be engaged and supportive
    - Brand product as an 'agricultural product' – steer away from all links to human waste product
    - Price must be commensurate with outcomes; consider situation with chicken manure
    - Demonstrated returns must be competitive with traditional fertilisers.
- We need to also focus on the model of Technology ->Economics (market) ->Customers that Table 2 raised in Workshop No 2; we need to turn a 'waste' product into a 'marketable' product to enhance the overall value chain. A different 'branding' is required
- Focussing on enhancing the overall value chain through efficiency, quality assurance, integration and clear business case propositions is where Australia can make a global impact

- A framework for achieving this does need to be developed and we need to better understand what must be presented so as to interest all stakeholders
- Development of this framework should be preceded by a SWOT analysis of the industry in Australia. This should be then used to develop a national agenda that focuses on knowledge sharing and application as well as identifying where research should be focussed
- Given that many of the water utilities around Australia have developed business cases for many of their services, can we use these as a starting point? Could the AWRCoE be the 'filter' for any sensitivities?
- We need to engage with all stakeholders if Resource Recovery is to become a truly National initiative – regulators, energy providers, agricultural bodies, politicians AND the community.

And finally, should we not start using the term *'Resource Production'* in lieu of *'Resource Recovery'*, as that is essentially what we are aiming for?

5.1 Outputs to be considered in the OzWater'14 Workshop

Discussion around what should be considered at the OzWater'14 workshop gave rise to the following suggestions:

- Identify where the most benefit lies, what barriers are in place and what has to be done in order to overcome these and produce a successful business proposition
- Focus on the value chain – from the technology through economics, the market and the community
- How to engage with a wider group of stakeholders than we have currently done; not just the regulators but end-users and the community
- Gain a better understanding of how to interact and liaise with the agricultural sector; promote a dialogue with relevant stakeholders, such as fertiliser producers, farmers and export providers.

6. The Next Step

As mentioned in Section 1 above, the AWRCoE intends to draw on the outputs from this Workshop, together with those from the OzWater'14 Workshop at the end of April 2014, to develop a 'state-of-the-art' report that summarises resource recovery technologies used internationally and their application in Australia, summarises the current understanding of stakeholders' needs and knowledge gaps, financial implications and challenges through the development of business case studies for both a regional and metro resource recovery application.

In addition, it will explore potential international linkages and co-investment in collaborative opportunities. By way of background to this work, the March 2014 newsletter of the *European Sustainable Phosphorus Platform (ESPP)* presents a summary of the work being carried out in Europe (www.phosphorusplatform.eu), as follows:

- P-recovery and recycling BlueTech® Research Analysis report
- Switzerland: Phosphate recovery likely to be made obligatory
- Struvite: Aarhus Aby P-recycling plant opens
- Sewage sludge ash: Plant availability of thermally recovered P
- Anammox plus struvite recovery
- Phosphorus in groundwater
- OECD agri-environmental indicators nutrient losses
- Closing the phosphorus cycle in agriculture
- Nutrients in digestates ARBOR
- AD Europe 2014: anaerobic digestion and nutrient recycling
- Industrial reuse routes for recycled N and P
- Phosphate chemistry and applications
- US & Canada: phosphorus networks
- P as anti-tumour signalling agent
- Horizon 2020 funding opportunities
- Call for texts: perspectives for phosphorus futures

Many of these topics have relevance to Australia and were raised at the Workshop and as a guide to potential international linkages, the partners in the ESPP are:

- Thames Water (www.thameswater.co.uk)
- Outotec (www.outotec.com)
- Phosphoric Acid and Phosphates Producers Association PAPA (www.cefic.org)
- Dutch Nutrient Platform (www.nutrientplatform.org)
- ICL Fertlilizers Europe (www.iclfertilizers.com)
- United Utilities (www.unitedutilities.com)
- Ecophos (www.ecophos.com)
- Ostara (www.ostara.com)
- Severn Trent Water (www.stwater.co.uk)
- Fertilizers Europe (www.efma.org)
- NuReSys (www.nuresys.org)
- Fachhochschule Nordwestschweiz (www.fhnw.ch)

APPENDIX A: WORKSHOP AGENDA

Timing	Agenda item	Presenter
9.15am	**Tea & coffee on arrival**	
9.30am	Welcome and introduction Purpose and format of the day	Karen Rouse (CSIRO) Mark O'Donohue (AWRCE)
9.45am	**Overview of Recent Activities** • Outcomes from the October 2012 waterAUSTRALIA and WSAA workshop on resource recovery • CSIRO review - Resource Recovery from Wastewater: a Research Agenda, and subsequent gap analysis • Outcomes from the September 2013 WSAA / WERF Waste to Energy Symposium	John Spoon (CH2M Hill) Tim Muster (CSIRO) Lesley Smith (WSAA)
10.15am	**Overview of Economic Assessments of Resource Recovery** • CSIRO review at Luggage Point and Oxley WWTP • Melbourne Water	Murray Hall (CSIRO) Kellie Brooks (MW)
10.45am	**Morning tea (15 min)**	
11.00am	**Workshop Session 1**	Facilitator (Ian Law)
11.00am	**Establish the current status of Resource Recovery from wastewater in Australia** Develop a process to identify: • Who is doing what in recovery of Nutrients, Energy and Biosolids • Feedback on the perceived economic benefits and practicality of these applications • The knowledge and technology gaps and how can they be addressed	All participants
12.00pm	Report back and plenary discussion	Facilitator (Ian Law) and all
12.30pm	**Lunch (45 mins)**	
1.15pm	**Workshop Session 2**	Facilitator (Ian Law)
1.15pm	**Economic analysis and model Business Case for Resource Recovery** Identification of: • A suggested process and information required for economic analysis • Representative case studies, e.g. urban / peri urban; large / small plant	All participants
2.15pm	Report back and plenary discussion that includes topics for inclusion in the OzWater'14 workshop.	Facilitator (Ian Law) and all
2.45pm	Summary/synthesis discussion and next steps	Karen Rouse/Mark O'Donohue
3.20pm	Closing remarks	Karen Rouse/Mark O'Donohue
3.30pm	**Close**	

APPENDIX B: LIST OF WORKSHOP ATTENDEES

Fist Name	Second Name	Affiliation	Table 1	Table 2	Table 3	Table 4
Joel	Byrnes	AECOM	1			
Chris	Olszak	Aither		2		
Erik	van Driel	Aquatec Maxcon	1			
Don	Alcock	AWRCE			3	
Don	Begbie	AWRCE				4
Mara	Wolkenhauer	AWRCE		2		
Mark	O'Donohue	AWRCE	1			
James	Currie	Black & Veatch			3	
Andrew	Hodgkinson	CH2M Hill			3	
John	Poon	CH2M Hill				
Jamie	Ewert	CRC for Water Sensitive Cities	1			
Karen	Rouse	CSIRO	1			
Murray	Hall	CSIRO		2		
Stewart	Burn	CSIRO			3	
Tim	Muster	CSIRO				4
Stuart	Gowans	Degremont		2		
Brett	Millington	East Gippsland Water				4
Sam	LeRay	EPA Victoria			3	
Steve	Shinners	Gippsland Water	1			
Charlie	Walker	Incitec Pivot	1			
Ian	Law	Independent				
John	Radcliffe	Independent			3	
Tony	Priestley	Independent	1			
Julian	Fyfe	ISF at UTS			3	
Jessica	Yeung	Melbourne Water	1			
Kelly	Brooks	Melbourne Water		2		
John	Marsden	MJA			3	
John	Ciccotelli	MWH				4
Kym	Whiteoak	RM Consulting Group				4
John	Messenger	SKM		2		
Vicky	Whiffin	Sydney Water			3	
Jurg	Keller	UQ /CRC WSC				4
Stephen	Gray	VU				4
Mikel	Duke	VU and NCEDA		2		
Anna	May	Western Water				4
Dean	Phillips	Western Water		2		
Lesley	Smith	WSAA (City West Water)		2		
Francis	Pamminger	Yarra Valley Water			3	

APPENDIX C: SUMMARY OF DISCUSSION POINTS RAISED BY EACH TABLE

A. Workshop No 1

Workshop Aim: Establish the current status of Resource Recovery from wastewater in Australia

One of the four tables (Table 4) did not consider the Discussion Prompts but rather just addressed the Workshop Aim through an holistic discussion. Its outputs are summarised at the end of this wrap-up of Workshop No 1.

Table 3 only considered Discussion Prompts 1 and 4 in this Workshop.

1. ***Discussion Prompt No 1:*** *Why the push for resource recovery?*

Table 1

Problem	Benefit
• Increase in wastewater flows resulting in increased cost to treat – energy and transport of biosolids • Population growth a threat to current 'food bowls' • Current approaches not sustainable; e.g. landfill • Regulatory constraints ; barrier to resource recovery	• Reduce transport costs • Reduce energy costs • Reduce land area required for biosolids

Table 2

- Cost pressures – rising water prices
- 2003 drought 'pushed' water recovery and need for new revenue streams
- 'Peak' phosphorus and oil plus political instability in some areas – drivers for increased attention to nutrient and energy recovery
- Push towards self-sufficiency with renewable in a carbon-constrained economy
- Regulatory drivers and particular local issues – e.g. Moreton Bay in Queensland

Table 3 (considered Discussion Prompt Nos 1 and 4 together)

- Increasing power costs – driver for energy recovery across all aspects of the WWTP
- Emerging needs to close the 'resource gaps'
- Currently meeting environmental regulations but investment portfolio must cover range of options to meet market opportunities
- In driving or aiming for future solutions, need strong and comprehensive business cases that cover both environmental and economic aspects, increasing transport and energy costs offsets, resilience of the schemes, policy impacts etc
- Technology options are now available for adoption and $ savings can be made
- Energy recovery a major driver at present due to increasing electricity costs

- Some easy co-digestion options
- Value of water that can be recovered and sold is far greater than value of recovering nutrients from digester side-streams
- Consider small gains on multiple recovery streams
- Just focus on biosolids but improve on how we are currently doing it
- Don't focus purely on end-of-pipe treatment options – also consider reducing contributions to the WW stream , e.g. from houses
- Need a systems approach – consider entire system including markets, treatment and conveyance options as well as receiving catchments

Discussion Prompt No 2: *What is being achieved in resource recovery in Australia*

Table 1

Bio-gas recovery:

- Examples - Goulburn Valley Water, Western Water (Melton), SA Water (Bolivar, Glenelg), Melbourne Water (WTP, ETP), Gippsland

Co-Digestion – added energy recovery:

- Yarra Valley Water, SA Water, Sydney Water, Water Corporation (Woodman Point)

Table 2

- Irrigation and reclaimed water – understand risks
- Energy and water recovery more common and expanding
- Water recovery – we have the technology, greater political impacts
- Biosolids – land application, other products, market expectations
- Energy from sludge understood.

Discussion Prompt No 3: *How do our experiences and applications compare with other countries of the world?*

Table 1

- 10-15 years behind, compared to Europe and the US; BUT we have different drivers – land availability
- Australia is ahead on treatment of brewery waste streams
- Recycling of water driven by drought and political considerations
- A barrier is that we cannot import Anammox sludge

Table 2

- Lead in water recovery practices
- Behind in nutrient recovery compared with Europe (Holland in particular) and the US; different drivers such as land area, pressure on landfills and drive towards increased energy recovery.
- Work jointly with regulators to target setting – not the case in Australia

Discussion Prompt No 4: *What are the impediments to wider scale adoption of resource recovery in Australia?*

Table 1

- Biosolids to land: heavy metals & other contaminants present difficulties – but not a show stopper
- Traditional sources of nutrients (and energy?) still cheapest
- Move to no-tillage agriculture has implications on quality and nature of biosolids applied to land

Table 2

- Good at water but not at the psychology of the market
- Diversity of drivers and problems across our regions, different issue with different focus points
- Imperfect price signals from outputs – need good business cases, the make-ups of which are accepted by all
- Utilities need to stand up and build arguments covering social, economic and environment issues

Table 3 – included in Discussion Prompt No 1

Discussion Prompt No 5: *Are any forms of resource recovery currently a practical and economical option? If not, where must there be improvement?*

Table 1

- Biogas to energy – borderline?
- Co-digestions shown to be economic in some areas – e.g. Yarra Valley Water
- Getting price right is crucial
- Struvite from side-streams – need to reduce the magnesium costs
- Other issues all add up – transport, market price, market acceptance etc - LOCATION SPECIFIC

Table 2

- Water – but many high quality, non-potable schemes (e.g. dual or third pipe systems) not currently economical
- Energy from methane – but loosing capacity for this with many of our coastal plants
- 70-80% of cities discharge to the sea – lost resource (water and energy)?
- Some areas have massive potential resource but no capital to realise – legacy of poor water pricing over many decades?

***Discussion Prompt No 6**: Do we have the technologies available – in Australia? Elsewhere?*

Table 2

- Water, Energy and Biosolids – YES
- Nitrogen – NO in Australia (at present) but YES overseas (Europe in particular) but in different stages of development
- Phosphorus – YES in Australia but other than biosolids to land is not mainstream
- Upstream source control and product design have resulted in P levels reducing in WW streams
- General comment: We have the technologies, but at what cost?

Other Comments from Table 1

- Market for recovered resources is there
- Farmers work in a highly competitive market – any increase in fertiliser costs will not be acceptable
- Struvite market needs focussed evaluation with input from all stakeholders – including community
- Chicken manure – cheap source of nutrients, facing pressure from urban growth and regulatory expectations

Table 4 – Discussion Summary

- Opportunities in water, biosolids and energy from biogas
- Resource recovery must bring not only Opex savings as well as generate a revenue stream but it must also result in environmental benefits and avoided Capex
- A 4-year payback period should be a target
- Third party composting generally cheaper than landfill disposal – definite trends as landfill costs increase due to are availability constraints

- Medium sized facilities or water utilities are potential targets
- Need collaboration with solid waste contributors and organic waste generators
- Business model must assist in establishing the most appropriate technology/option to be adopted
- Focus on risk rather than opportunity is an impediment to development of resource recovery schemes

B. Workshop No 2

Workshop Aim: Economic analysis and model Business Case for Resource Recovery

Discussion Prompt No 1: *What inputs are required for the development of an economical analysis?*

Table 1

- Address seven steps:
  - Define the problem
  - Define the benefits
  - Identify Government and Non-Government options
  - Analyse **genuine** options – cost benefit analysis
  - Define who wins and who loses
  - Assess stakeholder views
  - Can it actually be done???

Table 2

- What factors influence the case – e.g. geographically – these need to be known
- Selection of a decision support tool
- Mapping out supply and demand to provide guidance on where opportunities exist
- Exclude water recycling as many examples exist
- $ value for quantity and QUALITY of product need to be understood (very relevant to biosolids)
- Understanding of key market players in end use of products
- Understanding what the market demands (sensitive to temporal and special conditions)
- Economic Case could be broader than Business Case – former may be more advantageous to AWRCoE
- Economic Case could consider broader cost-benefits and be used in advocacy role
- Project Steering Group could included reps of multiple sectors

Table 3

- Define risks, demand, costs, possible products, market needs, competition & opportunities
- Regulatory issues, cost of technology, market revenue opportunities
- Also need to consider 'liveability' impacts (on customers & residents) around plants or landfill areas – Sydney Water is trying to monetise these issues, including avoidance costs
- Be clear about who or what the business case is for – clarify the key drivers
- Note that a Business Model is different to a Business Case – e.g. a state policy framework vs a specific local utility or industry solution to recovery of particular resources

Table 4

- Perspective – maximum relevant scope, i.e. source to end use
- Involve other players and industries
- Need to generate and show Capex and Opex costs
- Identify benefits:
    - Revenue streams at multiple points (e.g. gate fees, product sales)
    - Avoided costs (e.g. infrastructure upgrades avoided)
    - Non-market benefits (e.g. value of environmental improvement – improved waterway health, reduced GHG emissions) – all of which may not have revenue streams
- Context:
    - Risk & security
    - Regulatory drivers (environmental, energy feed-in tariffs)
    - Changing policies
    - Optimising scale
    - Assumptions of cost & price
    - Understanding tipping points, market maturity
    - Defining the base case is critical – then the alternative options
    - Identify any synergistic benefits

Discussion Prompt No 2: *Has such an economic study been carried out in Australia on a resource recovery initiative before?*

Table 1

- Plenty of examples, but there is a real need to share information – particularly on what real costs are & the FAILURES – learn by doing.

Table 2

- Business case component needs to utilise existing projects and highlighting learnings – where it has worked and highlighting to stakeholders who might not be aware of opportunities

- Examples from Gold Coast Water (WAS digestion), Melbourne Water, Sydney Water, Western Water, Yarra Valley Water and SA Water)

Table 3

- Many examples of economic studies exist – Sydney Water has carried out ten and Marsden Jacobs have produced templates for the NSW EPA

Table 4

- Yes – most water utilities have carried out such studies but:
  - Not public or consistent in approach
  - No evidence of having engaged with broader markets

Discussion Prompt No 3: *Do we consider a retrofit or a greenfield application, or both noting the technologies that are now available?*

Table 1

- Need examples of both retrofit and greenfield applications
- Note that Resource Recovery has not been core business of utilities but is becoming so as externalities continue to rise.

Table 2 (covers Discussion Prompts 3 and 4)

- Consider both, noting that retrofits are probably more likely given capital constraints
- Focus on high level and highlight where case studies are successful, identifying commonalities
- Identify organisations and/or individuals who can be 'champions'.

Table 3

- Develop a business case for high strength organic waste
  - It is a viable opportunity
  - Readily forms biogas
  - Requires reliable associated WWTP
  - Large resource in Australia
- Can be done with food processing – info is available and needs to be collated
- Unco-ordinated, resource opportunity with large food processors (dairy and meat) in Melbourne, Sydney, Adelaide and Brisbane

Table 4 – suggested that both applications be considered

Discussion Prompt No 4: *Do we consider a regional or urban example, or both?*

Table 1

- Take a regional view of potential for wider involvement of stakeholders, e.g. a development plan for Werribee which involves not just the WTP but implications for future treatment plant design if diversion/capture/recovery of resources is incorporated.

Table 2 – discussion included in Discussion Prompt 3

Tables 3 and 4 – No specific discussion on this Prompt.

Discussion Prompt No 5: *What items should be included in the OzWater'14 workshop?*

Table 1

- Provide wider examples of Business Case Analyses and propose the outline of a broader higher level Business Case Analysis for Resource Recovery
- Discuss the barriers:
  - Regulatory
  - Planning
  - Technical
  - Cross industry participation

Table 2

- High level projects useful for advocacy work
- Also capture where it has not worked
- Water – problem with connecting to the market, understanding customer behaviour. Relate this to the overall resource opportunities
- Technology -> Economics (markets)->Customers

We have this	Here is where energy & nutrients are at	This is where Recycled Water is stuck

- Water, Energy and Nutrients have different issues at the customer interface – context for economic and business cases
- Mapping fertiliser markets and trends as well as sensitive waters will help identify priorities

Table 3

- Focus on where we could get the most benefit
- Workshop to identify where the opportunities are, eg reduced sludge, industrial sites, volumes

- Look for possibilities for a R&D partnership with industry
- What has to be done to maximise the chance of a business opportunity getting up?
- Biggest game changer in terms of resource recovery will be industry and community acceptance of direct potable reuse.

Table 4 – No specific discussion on this Prompt.
