

On a voyage of recovery: reviewing the UK's RRfW infrastructure.

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I set out to write a 2-pager on RRfW infrastructure to join the dots between the CVORR and iBUILD projects and ended up writing a 14k-word epic that I had to battle the editor to accept... now I'm going to try to sum it up in 20 minutes.

Who wants the circular economy?

- **NIP:** an ambition to move towards a '*circular economy*' where material resources are valued and kept in circulation.
- **HS2:** HS2's vision is to be a catalyst for growth and we believe that adoption of *circular economy* principles can play a key role in delivering this.
- **ICE (NNA):** The Government should develop... a strategy to develop a *circular economy* to close the loop of product lifecycles.
- **Apple UK:** Our goal is a *closed-loop* supply chain
- **IKEA:** we have decided to *eliminate waste* from all our operations and to be energy independent by 2020

I'm not going to define a circular economy here as previous speakers have done an excellent job. Our RRfW infrastructure is what will (or won't) enable a CE, so is there the critical mass of stakeholders that want it?

Yes, it seems. Govt., major projects, reviewers of the state of the nation and major corporates all want it. Often it is tied up with related concepts such as zero waste, closed-loop or resource productivity, but the consensus that it is a thing towards which we should strive seems strong.

The question

- Is the UK's RRfW infrastructure ready to move us towards the circular economy?
- No, and neither is it likely to be without radical interventions.



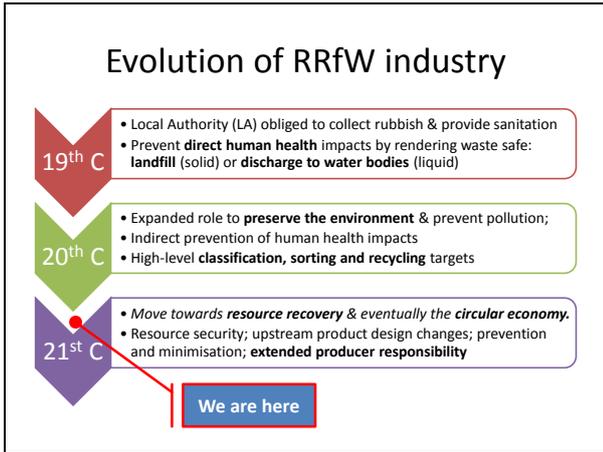
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So the question is (from my perspective, as a civil engineer interested in infrastructure); is our infrastructure and that which we have planned ready to deliver the CE.

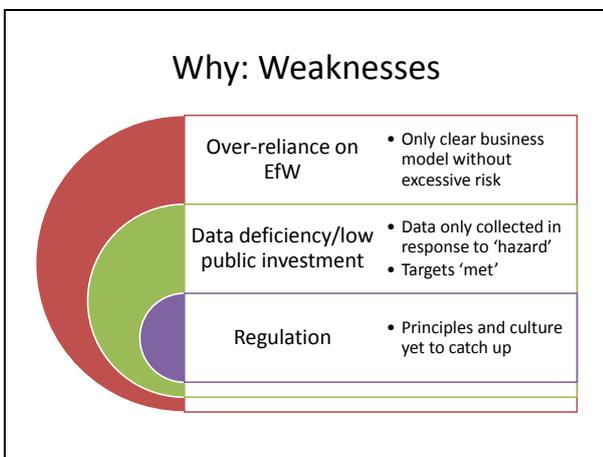
For those of you who have important emails or twitter updates to deal with, we'll move straight to the conclusion... my extensive research and pontificating has revealed... no it isn't, and nor is it likely to be in the near- to medium-future.

But we ought to analyse why, and what might be done about it. This is a top level analysis – much more detail is in the paper.

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But before I start to criticise, we should look at why we are where we are. We are dealing with a legacy infrastructure and associated regulation trying to adapt to a new paradigm. As such, we are in a transition phase and should be looking to help guide the transition.



[This target diagram is intended to be read from the centre out.]

As a result, our regulatory system hasn't caught up (more on the next slide). This is not a criticism, it's an inevitable fact of an evolving system.

This, directly or indirectly, leads to two deficiencies: a lack of data (because those creating waste are only charged with collecting it relation to targets regarding hazardous materials or specific [EU] laws, regulations and directives) and a lack of public investment (because in many cases, these targets have been 'met' so no further investment need is perceived).

This manifests, in our current paradigm, as an over-reliance on EfW.

Let's analyse each of these levels in a little more detail...

UK Policy & Regulation

Govt. Dept.	DEFRA	(WGSB)	(NDPBs)	DAERA / (NMGD)
Regulator	UK/England	Wales	Scotland	N. Ireland
Solid waste	Environment Agency	Natural Resources Wales	Scottish Environmental Protection Agency	Northern Ireland Environment Agency
Wastewater	OFWAT	Natural Resources Wales	Water Industry Commission for Scotland	The Utility Regulator

- Mainly EU targets via market-based operating environment that 'drives the right incentives'
- Primary goals: protection of public health, preventing contamination of water supplies & the environment, diversion of solid waste (particularly the biodegradable fraction) from landfill.

Here's the policy and regulatory landscape for the UK – many reps are here so I'll tread carefully... [NB this has been edited in response to factual omissions pointed out at the meeting – many thanks to all]. Note wide variety of structures and reporting lines, with a mixture of independent bodies and those that report to a minister. In theory, the govt depts provide policy and the regulators enforce it.

(WGSB = Welsh Govt Sponsored Body; NDPB = non-departmental public body; NMGD = non-ministerial government department)

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- No direct organisational responsibility for 'circular economy', 'resource recovery' or material flows
- Data only collected in response to specific legislation on potentially hazardous materials and/or recycling targets
- Sectors producing largest arisings have no obligation to report them

None of these people have ever been directly charged with delivering the CE agenda, despite what the great and the good might like them to do. The data they collect and procedures they enforce are not designed to promote a CE which requires robust mass flows with values and qualities attached. It is designed to meet specific EU reporting targets, in a corporate culture that prioritises public and environmental health. This is reflected in the piecemeal quality of the data; the first element of the middle ring in our target diagram...

Discrepancy in public data headings

	ER	R	LF	I	T1	T2	M	LD	U	C1	AD	MB	CA	RR	RU	EX	EG
UK C	xx	x	xo	xx							.o						.o
UK T																	
Eng C	xx	x	xo	xx	x	x	x	x									
Eng T		xx	.x	.x	.x												
Wal C																	
Wal T	.x	.x								.x	.x				.x	.x	
Sco C		xx		xx	xx		xx										
Sco T		.x	.x			.x											
Ni C																	
Ni T	.x	.x									.x				.x	.x	

- C = capacity, T = treatment. Checkboxes: Reported number of facilities, Mtpa; x = yes, . = no, o = other units used.
- ER = energy recovery, R = recovery, L = landfill, T1 = transfer, T2 = treatment, M = metals, I = incineration, LD = land disposal, U = use of waste, C1 = composting, MB = mechanical-biological, CA = civic amenity recycling centre, RR = reprocessor/recycling, RU = reprocessor/reuse, EX = export for recycling, EG = energy generation other than incineration or AD e.g. landfill gas.

There's not a shortage of data – it's just that none of it is compatible. This chart took an hour to compile and you can't even see most of it.

There are at least 17 different headings between the UK and devolved nations (and I've arbitrarily combined a few very similar ones to save space). A bit of explanation: "xx" means both number of facilities and Mtpa are reported; ".x" means number of facilities are not reported but Mtpa is; "xo" means number of facilities is reported but capacity/treatment is reported in different units (e.g. Mm³).

None of them are reported universally (Eng T and Sco C are best at 7 each – but a different set in each case with only 4 in common)

No category is common to all (landfill gets most hits but not consistent units; best consistent category is incineration with 4/10 jurisdictions).

There are more empty boxes than full ones.

It gets worse... because of the way data is reported, double counting is inevitable, as explicitly recognised by analysts and the regulators themselves.

From an engineering point of view, it is impossible to calculate mass flows through the production, consumption and disposal system with this data. Without reliable data on mass flows (and their consequent value or potential to provide stable income streams) it's not possible to predict if there will be a gap between capacity and requirements, which impedes both investment and strategic decision making.

Double counting

- "Mixed waste might be accepted by a transfer station, sorted and then be transported to a recycling facility or for final recovery or disposal. For this reason, waste managed is not analogous to waste arisings and no direct comparison can be made" (Vinogradova 2013)
- "Different methodology is used to estimate generation and final treatment figures. Furthermore, final treatment excludes some treatment processes identified as predominantly intermediate, which nevertheless may effectively be the final treatment for some waste. As a result, there is no direct reconciliation between generation and final treatment of total waste." (DEFRA 2016)

Is there a capacity gap?

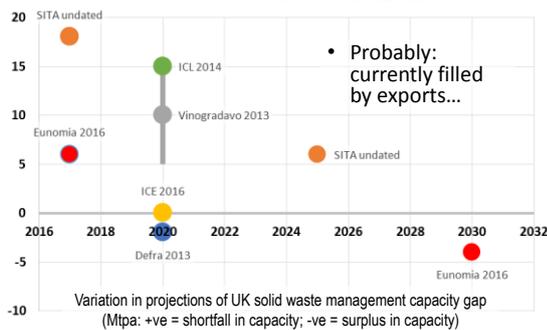
- *Most commentators cite lack of data on waste flows as complicating assessments (and hence investments)*
- Aggregate national assessments: No
- Disaggregated assessments: Yes
 - Local arisings do not match local capacity
 - Impacts of waste haulage
 - Appropriate scales (e.g. WEEE = regional, AD = local): arisings and energy balances

Nonetheless, some analysts have gamely tried to predict future requirements. They all also comment on the difficulty in doing so because of the data.

In general, national-scale assessments suggest there is not a capacity gap; arisings are matched with treatment facilities (more on whether these are the *right* treatment facilities later...)

Analyses that disaggregate between different waste streams and/or analyse at a regional or local level generally suggest otherwise; local arisings do not match local capacities (in scale) and/or capabilities (in nature). The impacts of transporting waste are disputed, and some wastes are best dealt with at the appropriate scale. Only regions generate enough WEEE to merit building resource recovery infrastructure, while biomass AD is generated locally in quantities well-matched with treatment technology.

Is there a capacity gap?

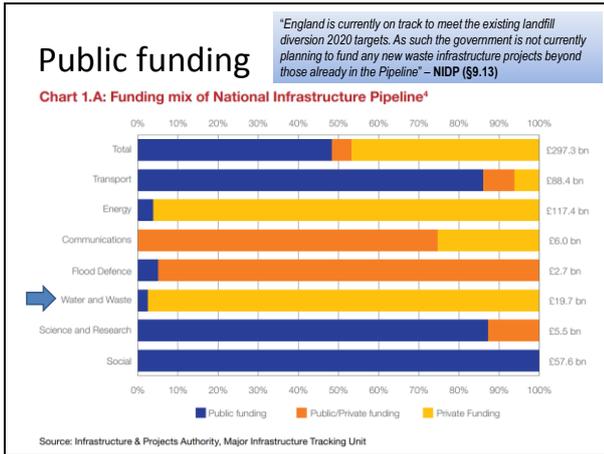


Estimates of how this capacity gap will evolve also vary widely. On balance, most commentators predict a gap – and hence the potential for investment – but the size varies. What gap there might be is currently filled by exports, either as refuse-derived fuel for use in the EU (and this is likely to be destabilised by Brexit), or as secondary materials for reprocessing in e.g. China...

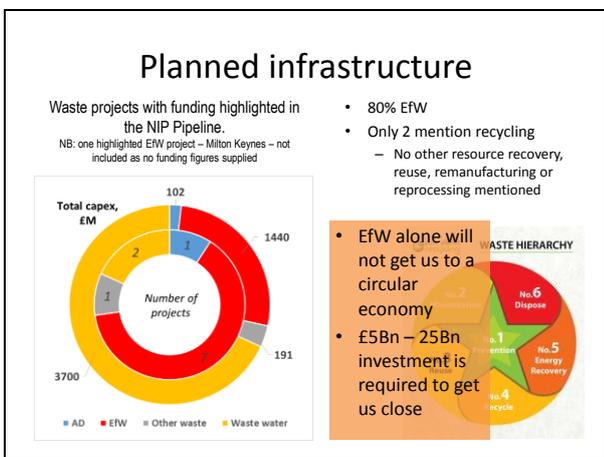
Life moves fast #1...

- Oct 2017: China announces ban low-quality solid waste imports of plastics, textiles and mixed paper.
 - UK ministers see 'an opportunity' (Cole, C. *Independent* 25/10/17)
 - Industry predicts 5-10% drop in LA recycling rates as there will be "no market for them to go to" (Read, A. *Recycling & Waste* 4/10/17)

...and here events overtake research. Since writing the paper, China has severely restricted the quantity of low-quality recyclates it will import. While some ministers reportedly see this as an opportunity (presumably for the UK to become a sink for EU waste, probably reclassified from recyclate to RDF), industry analysts have pointed out that the closure of the Chinese route will immediately impact on local authority recycling target achievement.



The second element on the inner ring of the target diagram is public investment. Comparing WM to the other branches of infrastructure, we can see that it has the lowest proportion of public funding of any sector, and negligible PPP investment – the industry is almost 100% privately funded. Why is this? Well, at its core, is regulation again. As far as Govt is concerned, the targets have been met and so no further investment is needed to stimulate the sector. But these narrow, specific targets will not push us towards the CE that so many organisations, Govt and private, profess to want.



This is reflected in the lack of diversity in waste investment. Of the solid waste projects highlighted in the NIP, 80% are EfW plants etc. This is because it is the only waste processing technology with a clearly-defined business model and thus able to attract private investment.

EfW in its current form is not part of the CE. It destroys value and removes materials from the supply chain, rendering them unusable and only suitable for disposal. It is a last resort – and should not be the dominant technology. Even discounting this, any sector with such little technological diversity is vulnerable to economic shocks. It is an unhealthy situation.

Various commentators have estimated what it would take to get us to a CE infrastructure – what is clear is that to raise this sum, we will need public investment, in order to stimulate new technologies and better business models; this would need to be aligned with a change in regulation and policy that considers resource conservation – through the lens of resource productivity i.e. doing more with less – equally to public health and environmental protection.

The case for public investment in CE Infrastructure

- Materials security
 - E.g. 100% importers of critical materials key to low-carbon technologies: lithium, cobalt, REM...
 - Global demand increasing, no recycling routes
 - Develop exportable skills
 - Brexit will destabilise supply chains

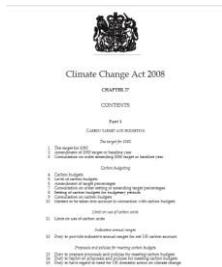


Many people have made the 'cost-benefit' case for investing in the CE – variously highlighting the potential additions to GVA, thousands of jobs created and so on. The robustness of these assessments is not for me to question – I'm an engineer, not an economist – but the fact that none of them have materialised via 'the market' is telling. This normally suggests that some public funding stimulus is required to unlock the door. Here, I present a few political arguments to add to the case.

First, resource security. For example, we are 100% importers of all the critical materials required for low-carbon infrastructure and systems: lithium and cobalt for batteries, and rare earth metals for the magnets used in high-performance motors (electric vehicles) and generators (wind turbines). What imports we do have access to are negotiated via our membership of the EU – itself a 100% importer. There is globally (and very rapidly) increasing demand for these materials and no current recycling technology. On the positive side, we could use public investment to develop a recycling industry for these materials and design expertise that allows products to be designed in such a way that these materials can be easily recovered. Doing so would not only secure our national materials security, but also allow us to export services to the rest of the world. Not doing so is likely to leave us at the mercy of markets for scarce materials.

The case for public investment in CE Infrastructure

- UK eCO₂ emissions associated with producing primary materials that end up in waste >200 Mt eCO₂ per year - 1/3 of the total
 - Current recycling avoids ~60 Mt eCO₂ per year
 - Windfarms avoid only ~36 Mt eCO₂ per year



A story that does not seem to be adequately emphasised is the ability of better reuse and recycling to drastically reduce carbon emissions. One-third of UK carbon emissions are associated with producing primary materials; even current recycling avoids more CO₂ emissions than the UK's current wind generation capacity. This could be drastically increased and in a world where a CO₂ tax is likely to loom large, this makes economic as well as environmental sense.

The case for public investment in CE Infrastructure



RRfW also has the capacity to engage with every one of the UN sustainable development goals. As we lose soft power on the global stage owing to Brexit, we must take every opportunity to reassert our role in the world order.

The role of a new CE regulator

- To protect the national interest by enforcing efficient use of materials, preventing waste, and encouraging reuse and recycling. Throughout the supply chain:
 - Rationalise *data* collection and reporting, with a first priority of accounting for the value and volume of material flows
 - Express *targets* in terms of functional value recovered, not volume diverted from landfill
 - Manage fiscal support for the industry to *protect investments* in design, manufacture, use and reuse that prevent dissipation of value into waste
 - Reinforce the principle of *extended producer responsibility*; we are custodians, not consumers, of resources
 - Increase the *material security* of the UK
 - Support the development of *high- and low-skilled jobs*, and the development of exportable technologies and services in RRFW.

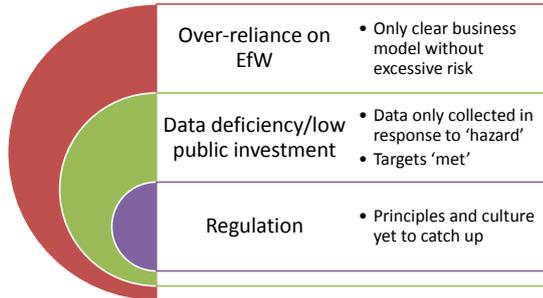
Having established the case for public investment, we then need to set out the role of the new regulator. The narrative is simple; a change from a focus on public health and environmental protection to one of resource stewardship, promoting security and productivity. Some example of key tasks are given in the slide.

Life moves fast #2...

- EU Withdrawal Bill debates – mixed messages
 - Concern that “polluter pays” and “precautionary principle” concepts may not transfer into UK law (e.g. Lucas, Goldsmith, Creagh *Hansard* 11/9/17)
 - Some commentators see “apparent political consensus on e.g. **new independent body to monitor environmental performance**, and new environmental protection act ASAP (Chambers, R. *Green Alliance* 16/11/17)

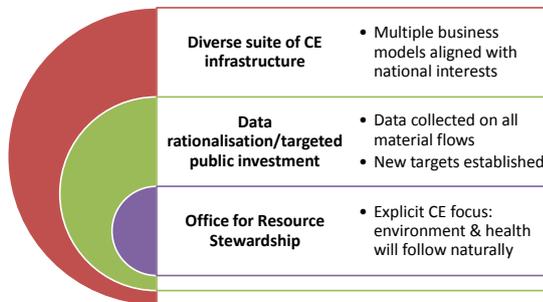
We may need to intervene here... strike while the iron is hot to make sure that any new proposed body is created with the goals outlined on the previous slide as a core part of their mission.

Why: Weaknesses



So if we return to our target diagram, I hope I've clarified the issues in each ring. Perhaps we can now move towards a new version of the diagram...

Summary



Thank you

- Support: NERC, ESRC and EPSRC via grants *iBUILD* (EP/K012398/1) and *CVORR/RRfW* (NE/L014149/1)
- The RRfW and CVORR teams
- All the authors I reference in the paper – and the reviewers – who gave a Civil Engineer some insight.

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