Design and introduction of a carbon management system to NI Water

Beatrice Smyth, Karen McDowell and Charlie Pollock
Northern Ireland Water

ATWARM meeting, Cranfield University

Tuesday, 1st May 2012
Contents

• Project overview
• Technical update
• Future work
• Project outputs
• Benefit of project
  – To water industry
  – To other projects in ATWARM
Project overview

• Project title  Design and introduction of a carbon management system to NI Water

• Start date  3rd May 2011

• Duration  2 years

• Project team:  Karen McDowell, Charlie Pollock, Paul Davison, Paddy Brow, Beatrice Smyth

• NI Water provides water & sewerage services to the whole of Northern Ireland (1.8 million people)
Project aims

- Project drivers
  - UK: 15% renewable energy by 2020
  - NI: 40% renewable electricity by 2020
  - NI Water is the largest electricity user in Northern Ireland
  - UK Climate Change Bill
  - Kyoto Protocol

- Project deliverables
  - Recommendations for accounting for carbon emissions
  - Cost benefit analysis on embodied carbon
  - Delivery of systems for data collection

- Projects objectives include
  - Provide better understanding of the technicalities of carbon management
  - Highlight the potential to deliver business value through improved management
  - Provide NI Water with a carbon policy and a strategy that enables it to meet its business needs
Technical update

• Current
  – Embodied carbon
    • WWTPs
    • Rising mains
  – Operational carbon

• Planned
  – Carbon targets and assessment
  – Treatment of industrial effluent using short rotation coppice willow
Embodied carbon

- The direct and indirect GHG emissions resulting from the extraction, transportation and processing of raw materials and from the site construction activities required to create or maintain a built asset....\(^1\)

- In NIW, this means GHG emissions from the construction of assets, such as wastewater treatment plants, pumping stations and rising mains....

- Embodied carbon typically accounts for <10\% of total lifetime carbon \(^2\)

---

\(^1\) UKWIR Project CL01/B207, A framework for accounting for embodied carbon in water industry assets, Draft final report, February 2012.

Measuring embodied carbon for project appraisals

• Approach required
  – Robust, straightforward
  – Specific to NI Water (based on recent NIW construction data)

\[
\sum (\text{BOQ item} \times \text{Carbon factor}) = \frac{\text{Total project construction costs}}{\text{kgCO}_2} \text{ £}
\]

e.g. 10 m\(^3\) C20 blinding concrete \(\times\) [(384.27 kgCO\(_2\)/m\(^3\) for provision of C20 concrete) + (5.9 kgCO\(_2\)/m\(^3\) for placing of blinding concrete)] = 3902 kgCO\(_2\)

• Results for WWTP construction projects indicate approx.
  – 1500kgCO\(_2\) per £1000 investment
Embodied carbon of rising mains

DI and PE comparison

• Graphs developed for carbon emissions vs pipe diameter for
  – Polyethylene (PE) and ductile iron (DI) pipes
  – Laid in roads and fields/grass verge
Embodied carbon of rising mains

Carbon emissions of rising main laid in road

Total = Pipe + Bedding/surround + Backfill with gravel + Disposal of excavated material + Road reinstatement + Manholes + Valves

Emissions from:
- Material production & processing
- Transport to site
- Installation
Embodied carbon of PE rising mains

- PE pipe laid in road
  - Main emissions source is road reinstatement

- PE pipe laid in field/grass verge
  - Main emissions source is pipe itself
Embodied carbon of rising mains

• Further work
  – Cost data to be incorporated into pipe analysis
  – Materials recycling to be considered wrt analysis boundaries
    • Cradle to gate vs cradle to grave
      – E.g. recycling of DI pipes at end of life
    • Design life, maintenance, cost
Operational carbon

• Database of carbon factors developed for project appraisals
  – Carbon factors of chemicals and other consumables

• Data collection implemented for WWTP trials to analyse
  – Carbon emissions from electricity, other fuel and chemical usage…
  – …with respect to final effluent quality and discharge consent standards
Planned work

• Development of **targets and strategy** for carbon reduction in NI Water
  – Proposed work plan submitted for review

• GHG life cycle analysis (LCA) of industrial effluent applied to willow compared to treatment of effluent in a conventional WWTP
  – Secondment
    • Agri-Food and Biosciences Institute (AFBI)
    • Collaborating with Answer project (Agricultural need for sustainable willow effluent recycling)
GHG LCA of industrial effluent applied to willow

Industrial effluent

Pumping

Treatment in conventional WWTP

Energy, chemicals, sludge incineration

Transport

Establishment, maintenance, harvesting

Carbon sequestration

Fossil fuel replacement

Combustion

Use as fertiliser for SRC willow

Willow chips for heat
Project outputs

- Research to date has contributed to
  - Methodology for inclusion of carbon externalities in “Assessing the sustainable economic level of leakage” (NI Water guidance)
  - OPEX unit cost table for NPC appraisals, which forms part of the NI Water process selection manual for wastewater treatment processes
  - Carbon Reduction Commitment and Carbon Trust Standard (carbon and energy efficiency schemes in NI Water)
  - UKWIR (UK Water Industry Research) project CL01/B207 “A framework for accounting for embodied carbon in water industry assets”
  - WRc (Water Research Centre) project CP443 “Carbon Abatement Scenario Strategy Modelling (CASSM)”

- Planned papers/reports
  - Embodied carbon (WWTPs and pipelines)
  - GHG analysis of industrial effluent applied to willow
  - Carbon targets and assessment in NI Water
Benefits of project

• Benefit to water industry
  – Contribution to joint water industry reports
  – Putting carbon on the agenda in NI Water
  – Developing assessment methods

• Benefit to other projects in ATWARM
  – Summer school LCA presentation
  – Think about sustainability!
Thank you!

Questions?