

# Innovation in Pump Management

SBWWI 1 July 2010

Steve Russell – Senior Consultant

WRc

[Steve.russell@wrcplc.co.uk](mailto:Steve.russell@wrcplc.co.uk)

# Content



- Pumps - background
- WRc project overview
- Main activities and outputs
- Future plans



# Background (1)

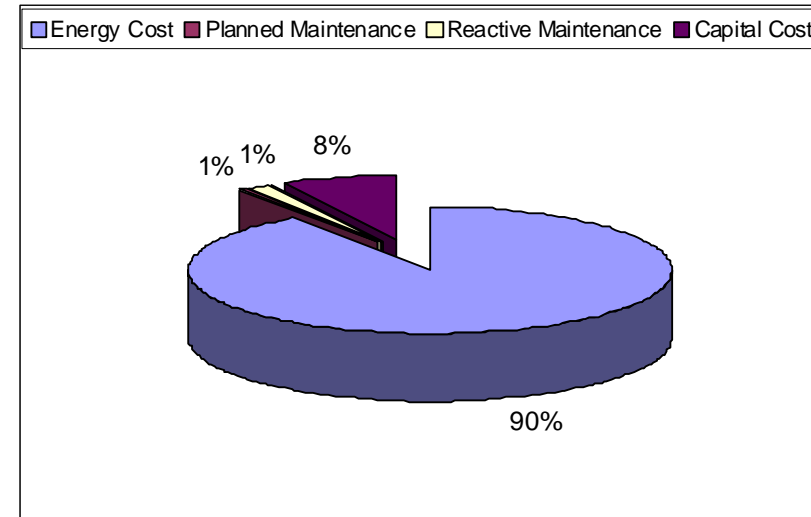


- For England and Wales, wastewater pumping consumes about 850 GWh/year
- Equivalent to 440,000 tonnes CO<sub>2</sub>/year and £70M.
- High percentage of pollution events are due at least in part to pump or pump system failures
- Easily the most important M&E asset group by cost or service

# Background (2)



- Typically 70-95% of the whole life cost of a pump is energy input.
- Optimum refurbishment and replacement timing will have a large impact on energy and whole life costs if it can be achieved.



# Traditional wastewater pump management



- Provide standby capacity to deal with individual pump failures
- Replace on failure
- Primary focus on availability





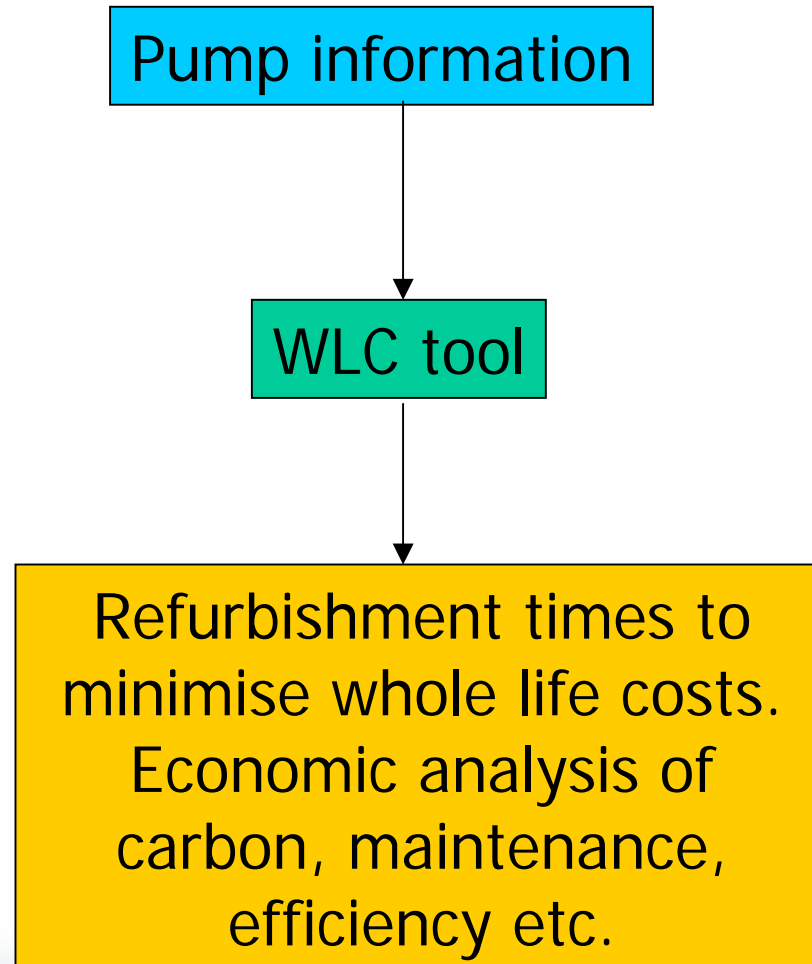
- Water companies: BW, BWHW, NIW, SES, SEW, STW, SW, SWW, Veolia, Wessex, YW.
- Carbon Trust.
- Pump Centre as consultant.
- Support from pump suppliers.
- Efficiency data from AEMS.
  
- September 2008 - March 2010
- Jan-Mar 2010 – CT funding to fill data gaps and test/improve tool

# WRc project objectives



- Build evidence-based pump deterioration models to determine optimum interventions
- Produce a whole life cost tool with the models
- Recommend pump efficiency testing policy
- Investigate place of condition monitoring in pump maintenance
- Project included clean and dirty water pumps
- Complement Pump Centre LLC procurement tool
- Twin focus on availability and minimum WLC

# Whole life cost tool



# Pump groupings for modelling



- Pumps grouped into:
  - Clean water
  - Borehole
  - Wastewater
- Power bands (following OFWAT):
  - <20 kW
  - 20-100 kW
  - >100 kW



# Costs included in the whole life cost tool

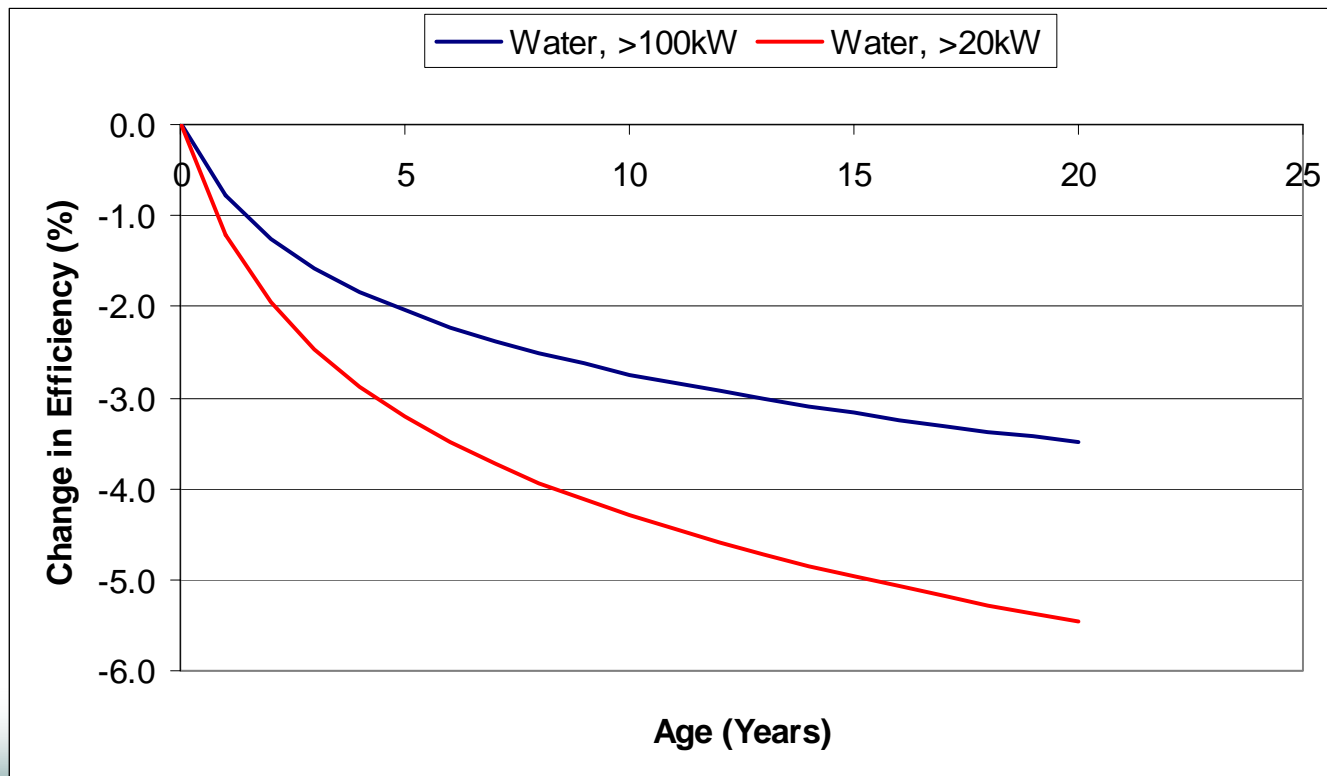


- Energy – calculated from flow, head and efficiency or from motor rating with modelled falling off of pump efficiency
- Unplanned maintenance – calculated from models, increasing with age and hours run
- Environmental costs – carbon cost plus embodied carbon
- Replacement/refurbishment – models based on kW rating and type
- Planned maintenance – add if required
- Downtime cost – add if required

# Energy models



- Models produced from pump test data
- Models based on average duty for the pump type
- Deterioration adjusted prorata if hours run are input



# Example part output



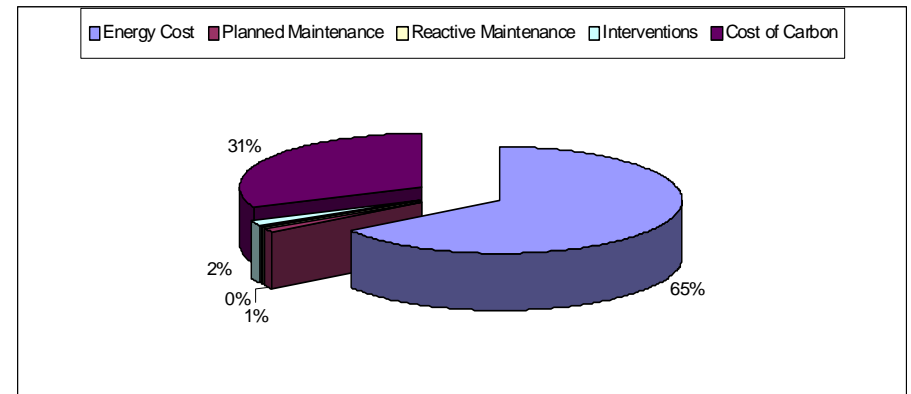
	Year											
	0	1	2	3	4	5	6	7	8	9	10	11
Effective Asset Age	0	2	3	4	5	6	7	0	1	2	3	4
Power Usage (kWh)	0	93,150	93,918	94,523	95,022	95,449	95,822	90,329	92,088	93,150	93,918	94,523
Wire to Water Efficiency (%)	0	64.4%	63.9%	63.5%	63.1%	62.9%	62.6%	66.4%	65.2%	64.4%	63.9%	63.5%
Energy Costs (£)	0	8,383	8,453	8,507	8,552	8,590	8,624	8,130	8,288	8,383	8,453	8,507
Planned Maintenance Costs (£)	0	186	186	186	186	186	186	186	186	186	186	186
Reactive Maintenance Costs (£)	0	29	33	37	41	44	47	13	23	29	33	37
Cost of Carbon (£)	0	2,601	2,623	2,690	2,756	2,819	2,882	2,788	2,819	2,901	2,976	3,046
Replacement / Initial Cost (£)	0	0	0	0	0	0	0	0	0	0	0	0
Refurbishment Cost (£)	0	0	0	0	0	0	0	2,167	0	0	0	0
<b>Total Cost (£)</b>	0	11,199	11,294	11,420	11,534	11,639	11,738	13,284	11,315	11,499	11,647	11,775
<b>Cumulative Total Cost (£)</b>	0	11,199	22,493	33,913	45,447	57,086	68,824	82,108	93,423	104,922	116,569	128,344
<b>Net Present Cost (£)</b>	0	10,702	10,314	9,968	9,623	9,284	8,953	9,651	7,891	7,671	7,433	7,190
<b>Cumulative NPC (£)</b>	0	10,702	21,015	30,983	40,606	49,890	58,843	68,494	76,385	84,056	91,489	98,679

<b>NPC</b>	199,419
<b>Calculated Residual Value (£)</b>	0
<b>User Entered Residual Value (£)</b>	0
<b>NPC Less RV (£)</b>	199,419

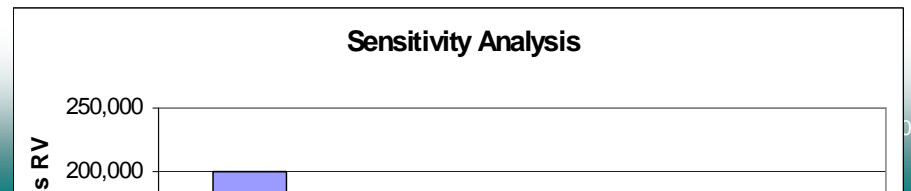
## NPC Results

	Total Cost (£)	Net Present Cost (£)	%
Energy Cost	253,691	129,940	65.16%
Planned Maintenance	5,570	2,854	1.43%
Reactive Maintenance	1,026	521	0.26%
Interventions	6,502	3,289	1.65%
Cost of Carbon	110,706	62,815	31.50%
	377,495	199,419	
<b>Excluding Carbon:</b>	266,789	136,604	

Current Scenario: Example (Water 20kW)



## Sensitivity Analysis



# Examples for wastewater submersible pumps



Power	Hours/yr	Cost penalty, refurb 2 yrs late
20	2000	£480
20	4000	£5300
60	2000	£1300
60	4000	£19,500

Message - Running a worn pump hard is likely to be expensive

# What has been achieved?



- Tool to provide optimised refurbishment times, but based on average deterioration
- Inherently more variability in wastewater than clean – less prescriptive than on clean water
- Use to identify Ww pumps where refurbishment likely/very likely to deliver net benefits
- Evaluates the likely cost of doing nothing
- Scenarios to compare costs of early/late interventions
- Outputs used to develop rules of thumb for efficiency testing and the installation of efficiency monitoring

# Benefits of timely refurbishment



- Net cost and energy savings
- Pump stock will be in better condition – funded by energy cost savings
- Secondary benefits:
  - Avoid unquantified loss of pump capacity
  - Improved pump controllers – improved information

# Future work – CP348B



- Collect new data and improve models
- Build models for different wastewater pump impeller types
- Extend tool to cover sets of pumps
- Cost/benefit tool for VSDs
- Improve sensitivity analysis
  
- CP410 separate project on condition monitoring technology and policy

# Summary



- Evidence-based pump whole life cost tool to determine optimum refurbishment times has been produced and is in use
- Saves cost, carbon and improves pump stock
- Contribution to a more proactive approach to pump management