

13th IWA Specialized Conference on Small Water and Wastewater Systems, 5th IWA Specialized Conference on Resources-Oriented Sanitation, Athens, 14-16th September, 2016

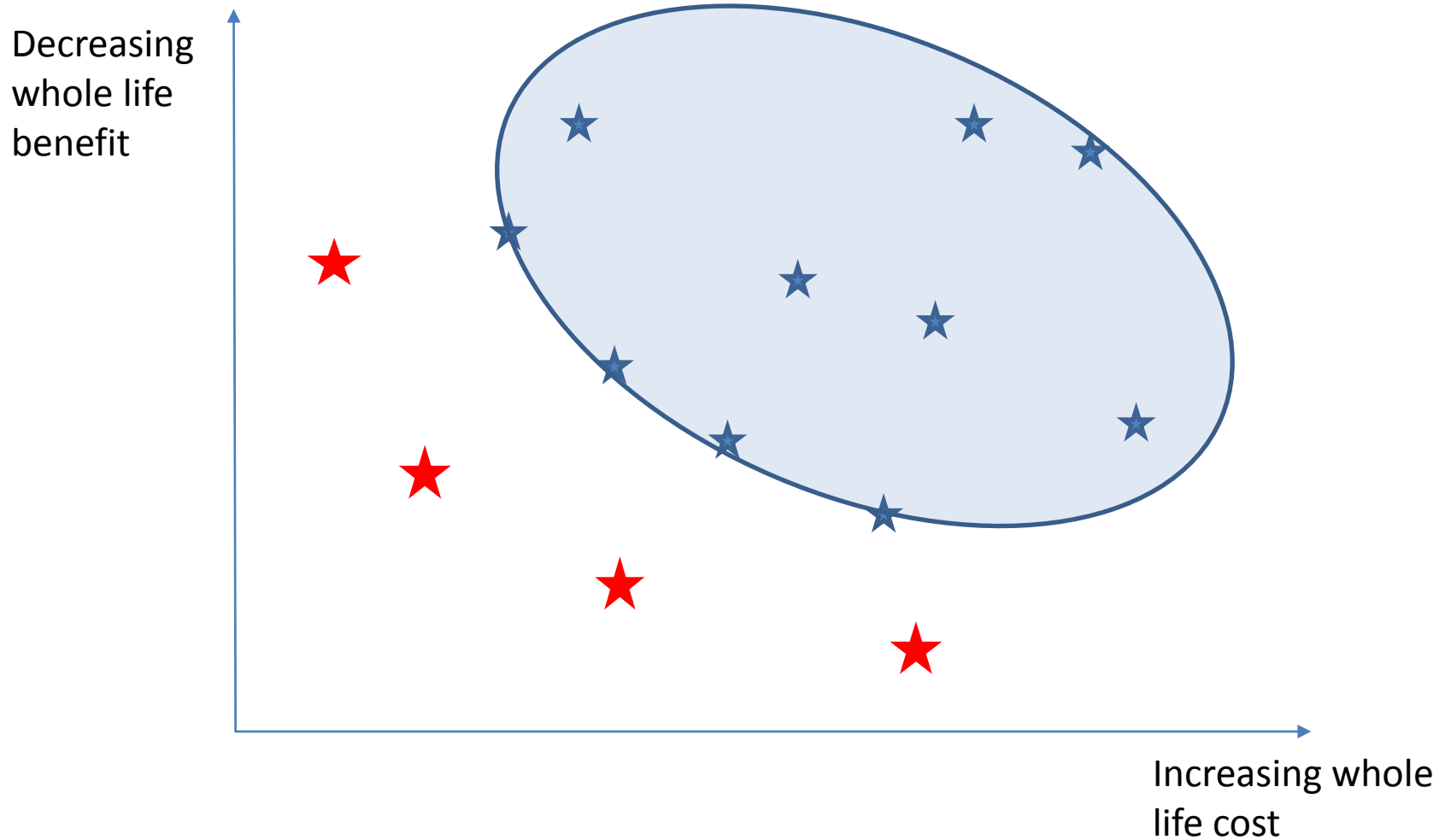
Multi-purpose rainwater harvesting

*Professor David Butler
Director, Centre for Water Systems
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Summary

- RW costs and benefits
- Low energy systems
- Zero energy systems
- Dual purpose systems
- Potable supply systems
- Conclusions

RWH costs & benefits



RWH costs & benefits

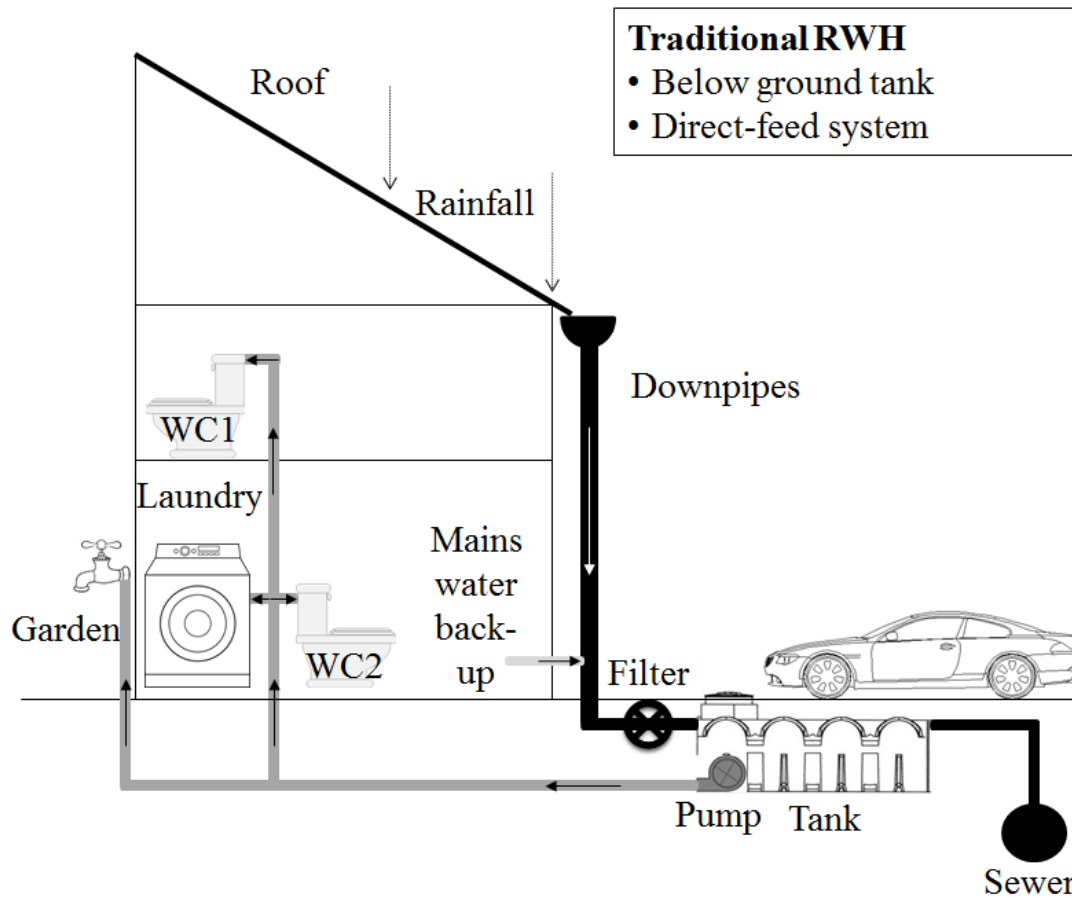
Costs

- Storage tank
- Pumping:
energy/GHGs
- Treatment
- Installation
(retrofitability)

Benefits

- Water resource: corporate
- Water saving: individual
(potable/non-potable)
- Stormwater: flood control
- Stormwater: pollution control
- Resilience/emergency

RWH for UK houses



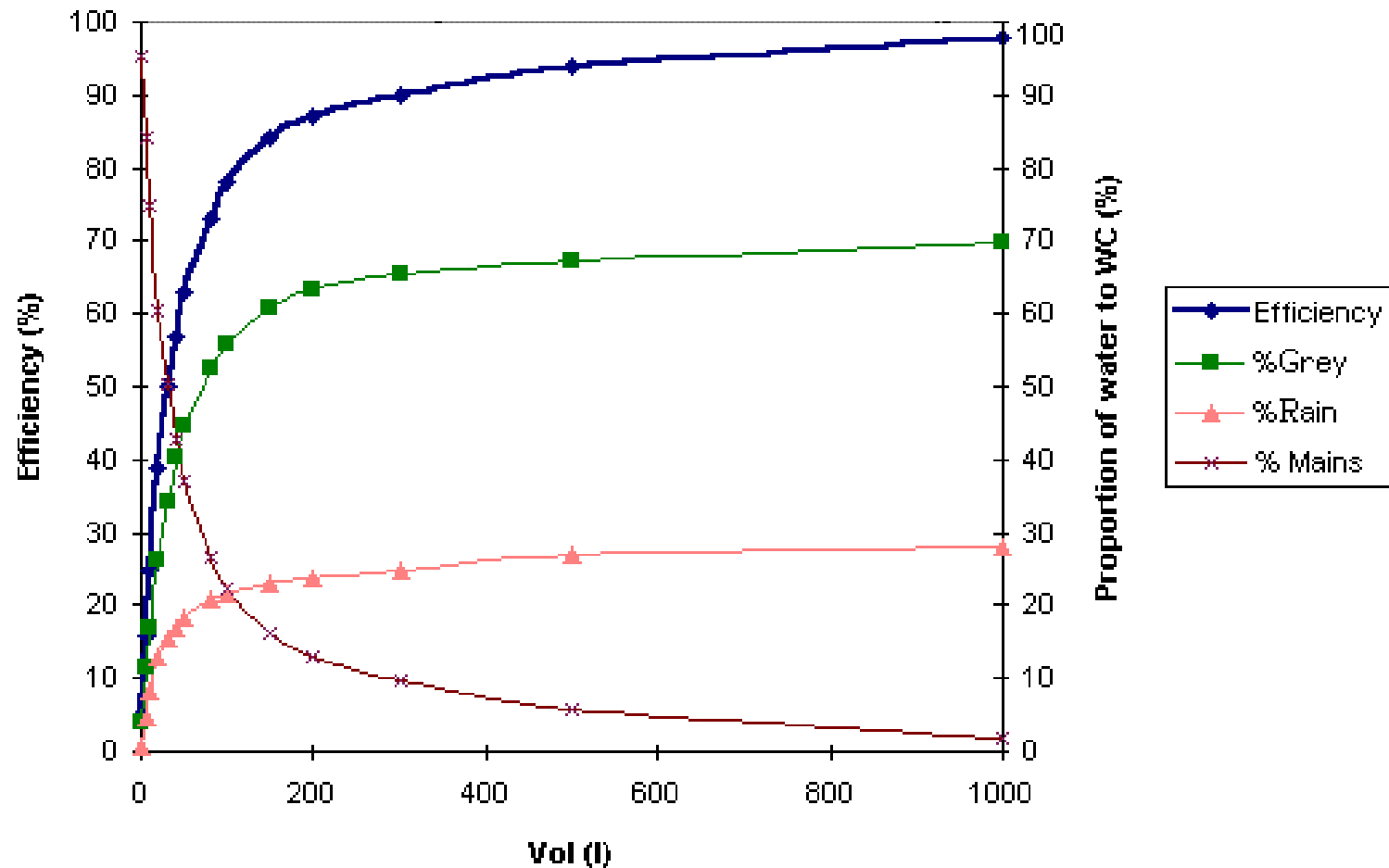
Costs

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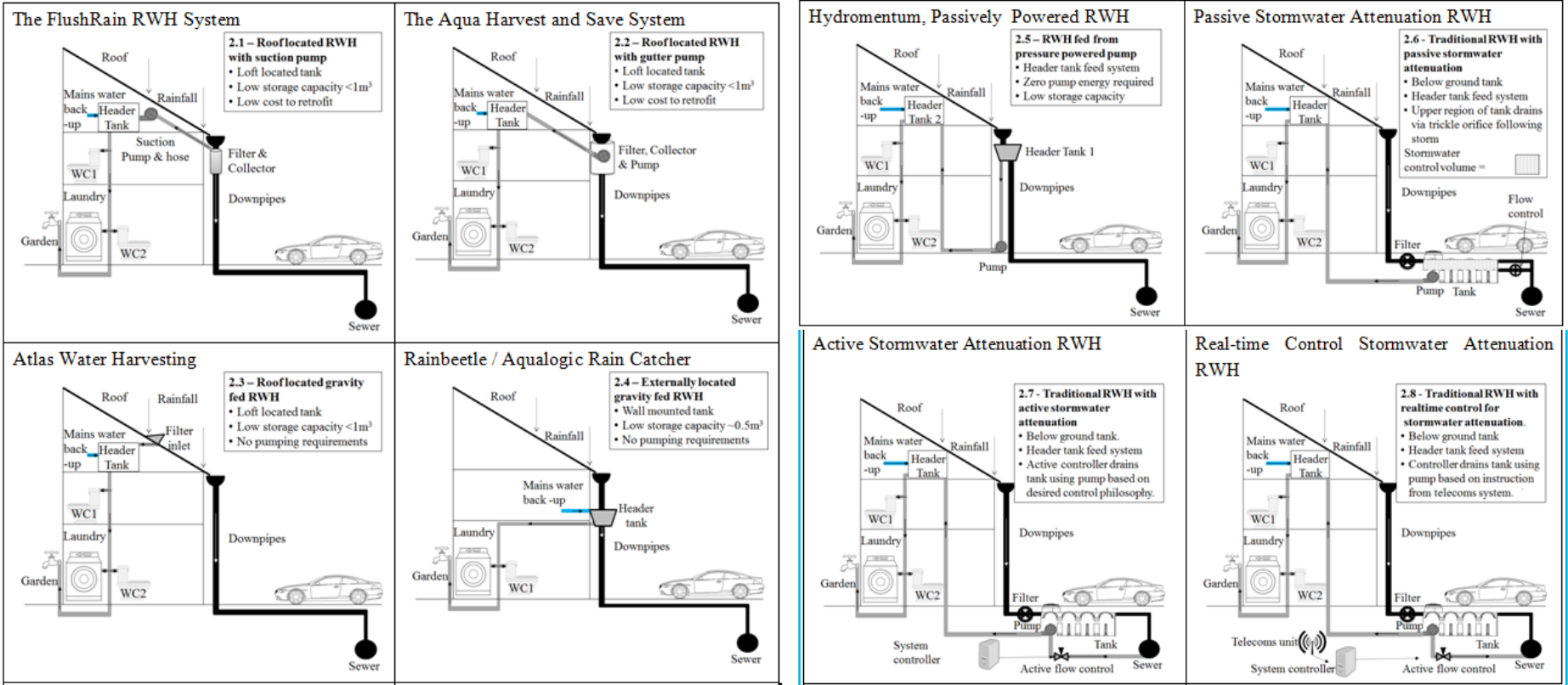
Benefits

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- Stormwater: flood control
- Stormwater: pollution control
- Resilience/emergency

RWH water saving efficiency



An explosion of new system configurations



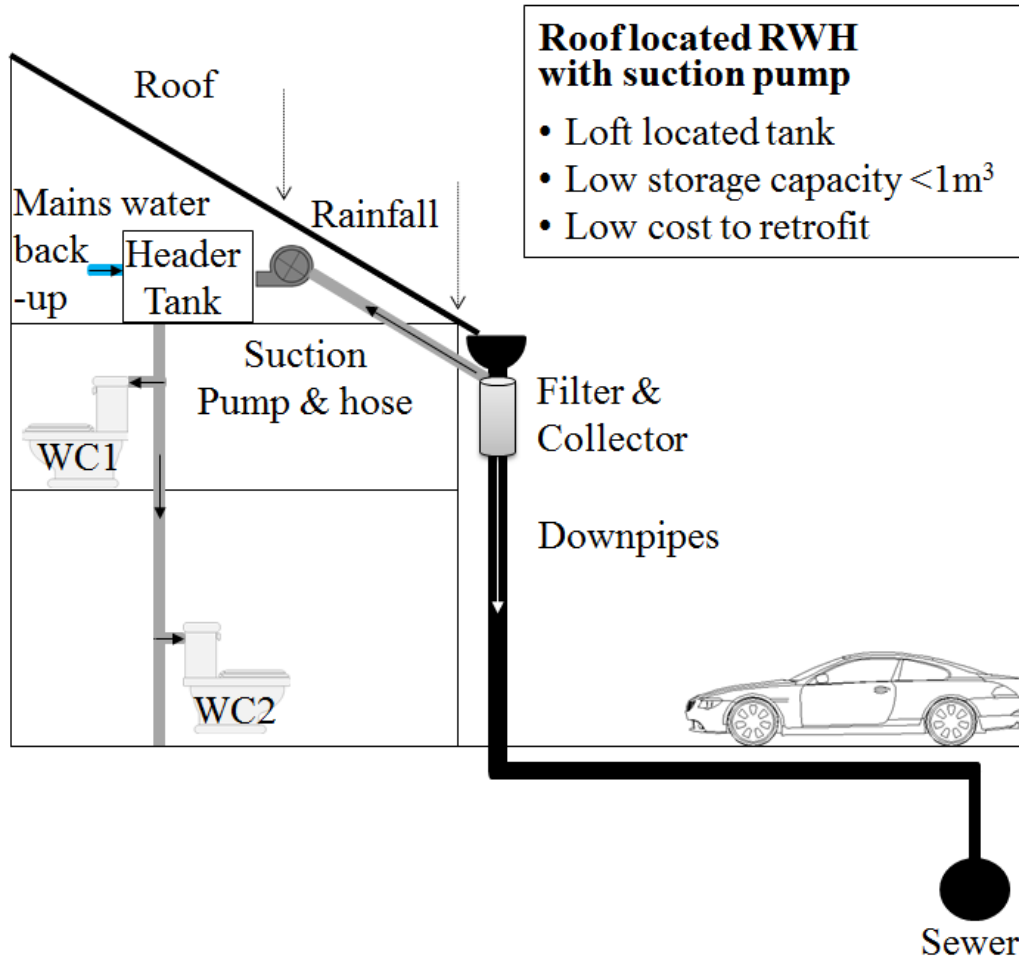
Storage tanks & configurations



Storage tanks & configurations



Low energy RWH



Costs



- Storage tank
- Pumping: energy/GHG
- Treatment
- Installation (retrofitability)

Benefits

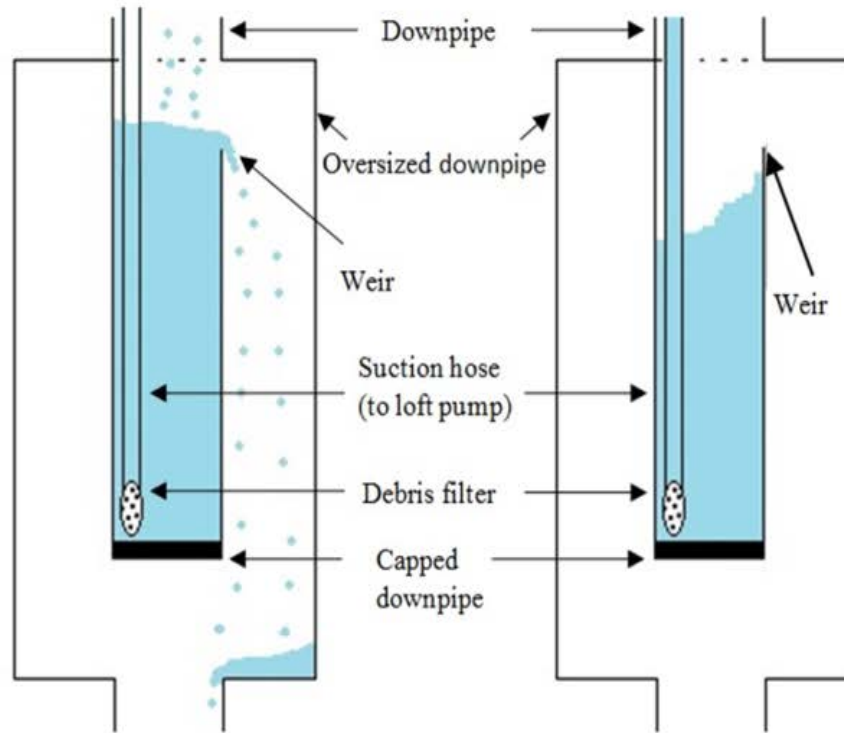


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- Water saving: individual (potable/non-potable)
- Stormwater: flood control
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Low energy RWH



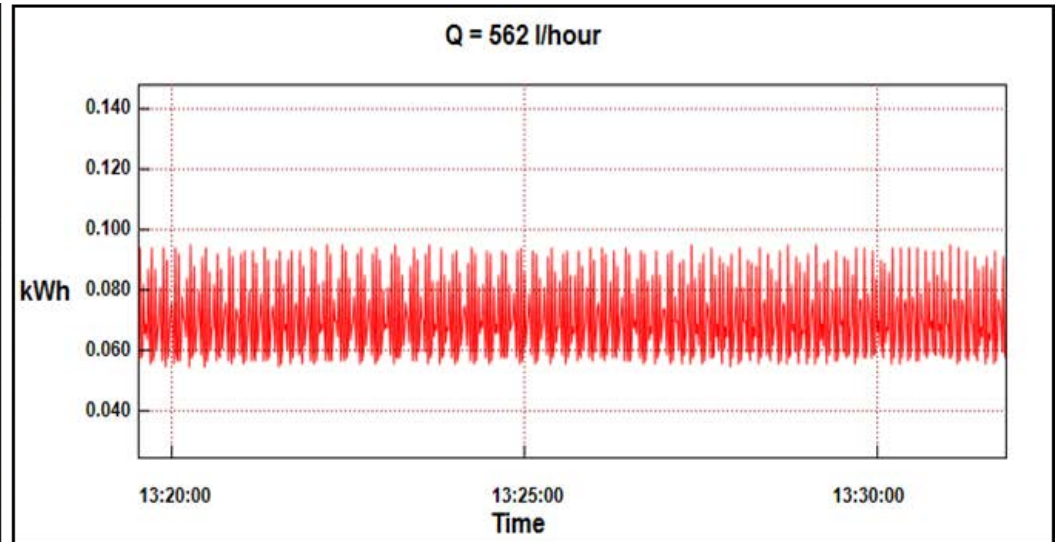
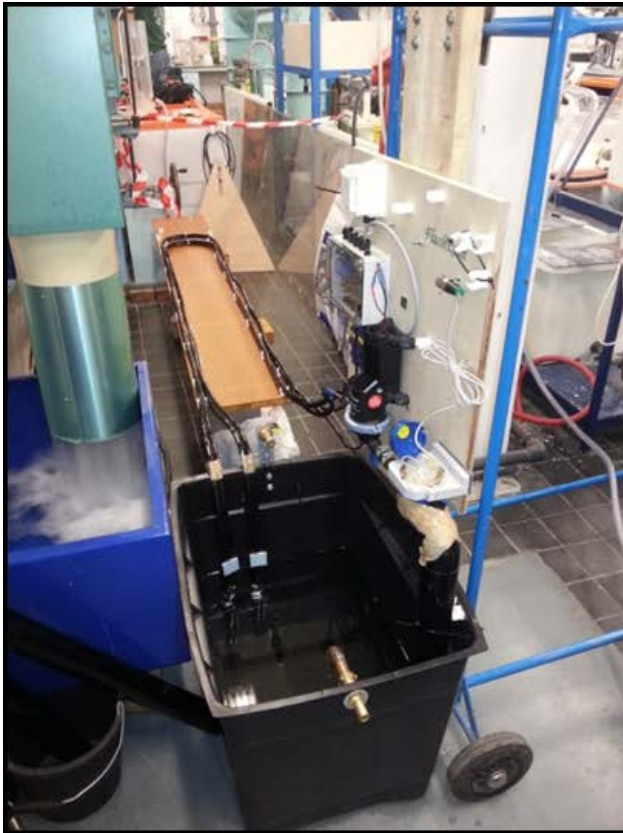
A) Chamber connected to downpipe



B) Illustration of chamber discharging to downpipe

C) Illustration of chamber being pumped empty

Low energy RWH – lab testing

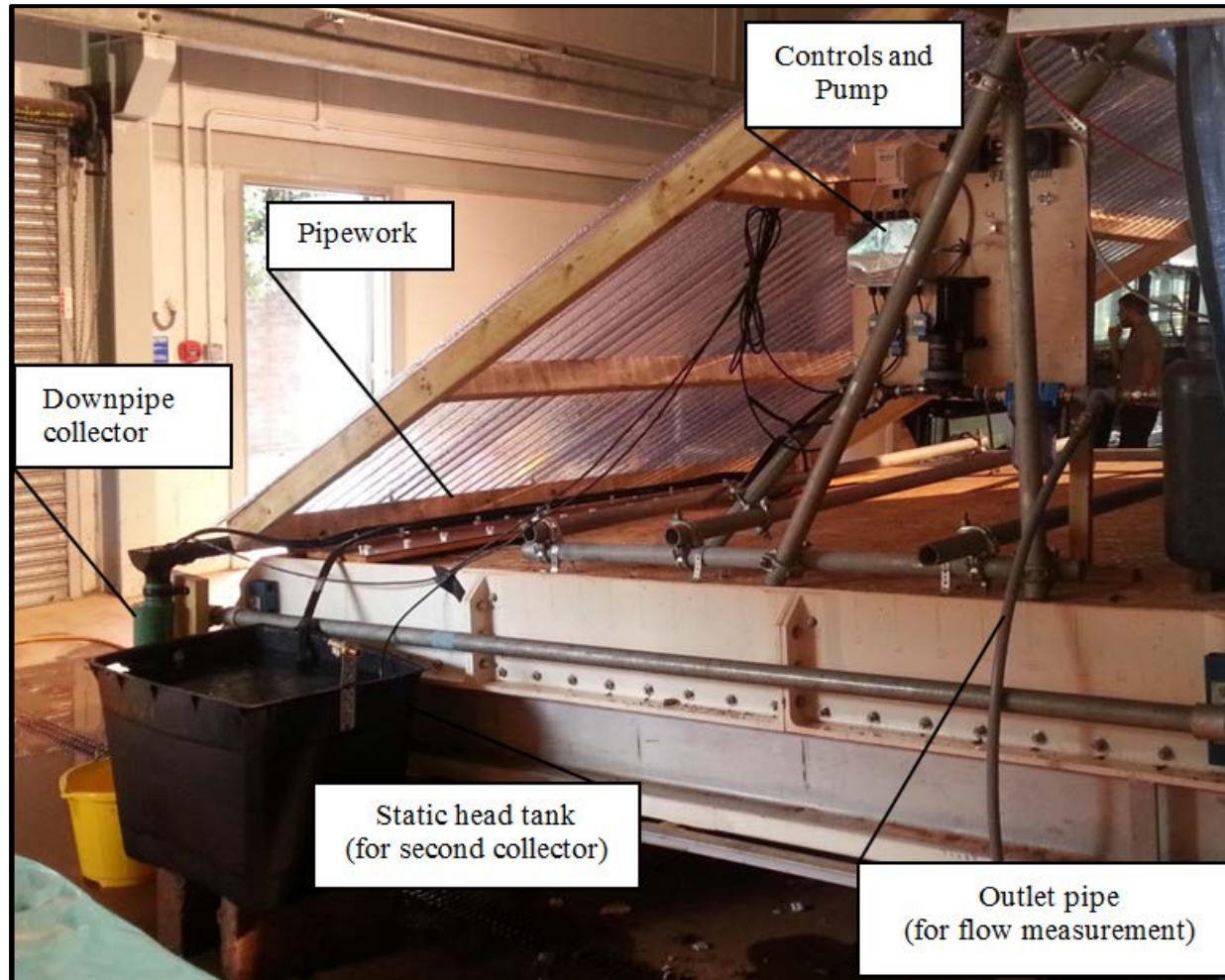


Laboratory energy use:
0.12-0.18 kWh/m³

Water supply power consumption

System	Consumption (kWh/m ³)	Ref
This study	0.12 – 0.18	
Commercial RWH	0.54	1
Market Leader RWH	0.68	1
Municipal supply	0.60	1
Median of 10 RWH studies	1.40	2
Global desalination	3.60	2

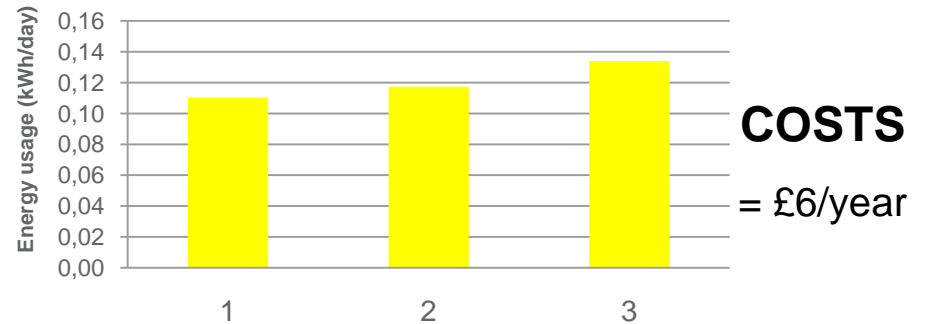
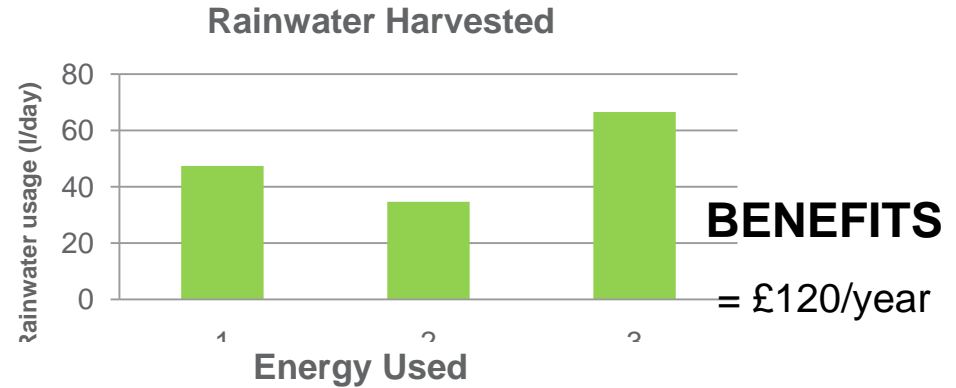
Low energy RWH – lab testing



System components



Low energy RWH – field trials

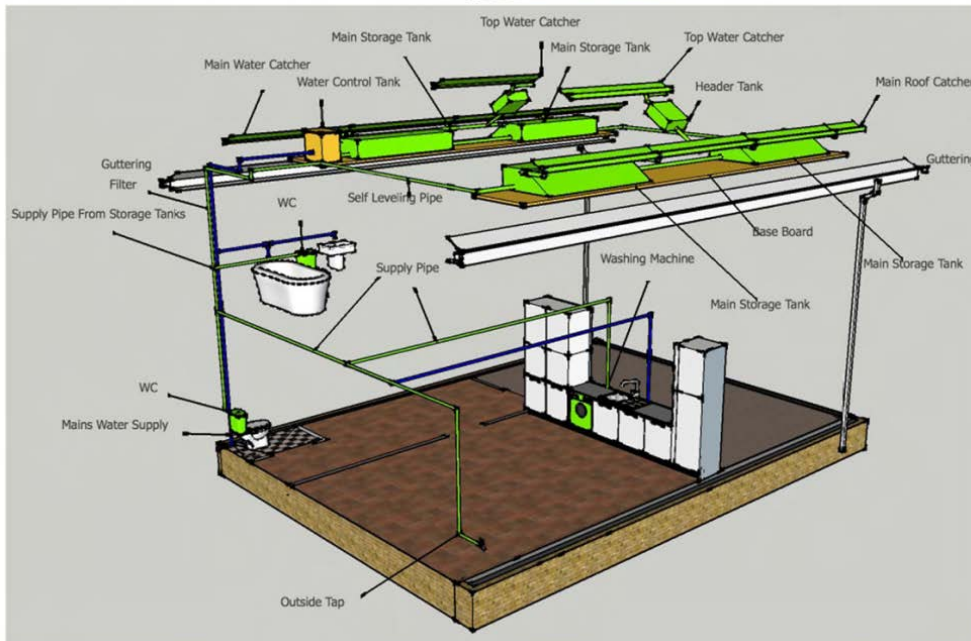
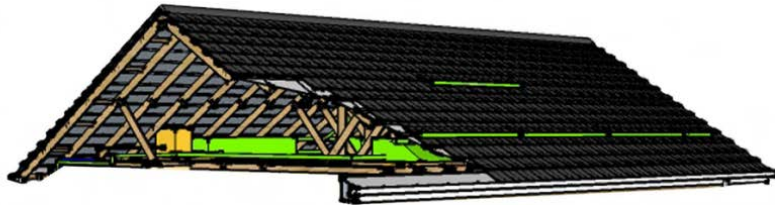


0.5m³ RWH tank supplying
10-20m³/annum

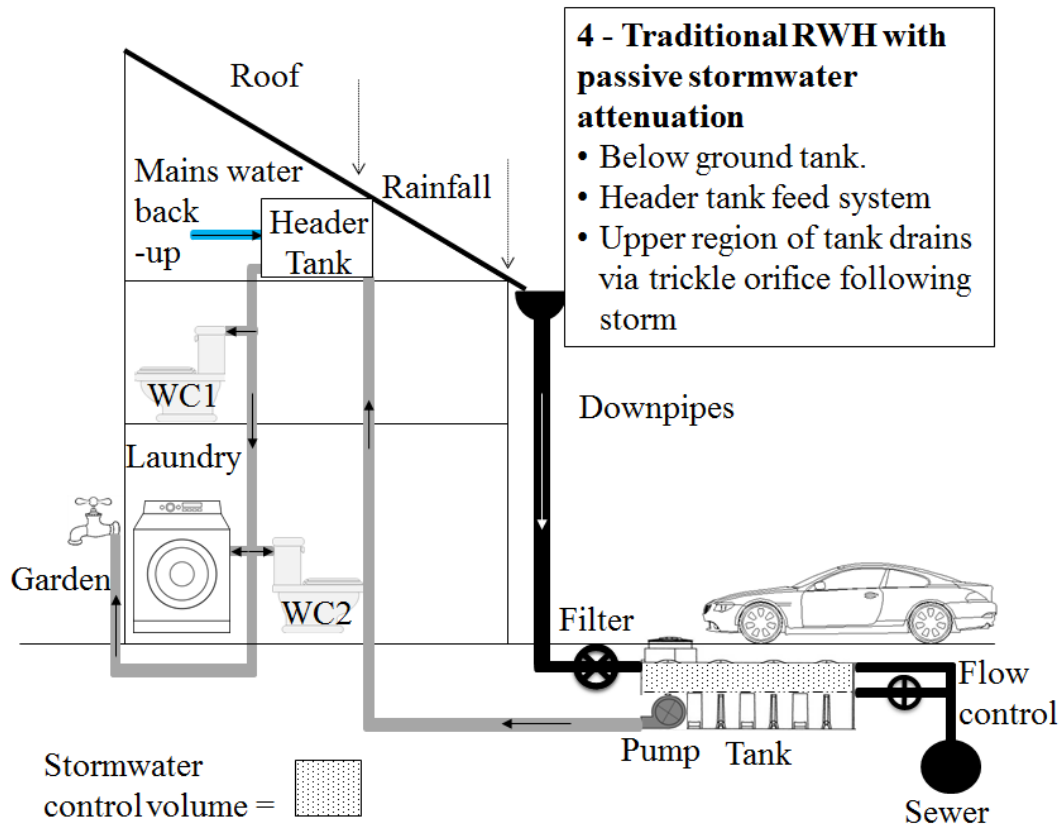
Zero energy RWH – lab testing



Zero energy RWH – product



Dual purpose systems: water supply & stormwater



Costs



- Storage tank
- Pumping: energy/GHG
- Treatment
- Installation (retrofitability)

Benefits

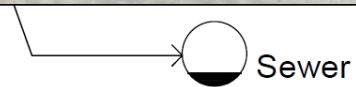


- Water resource: corporate
- Water saving: individual (potable/non-potable)

- Stormwater: flood control
- Stormwater: pollution control

- Resilience/emergency

Dual system: passive control

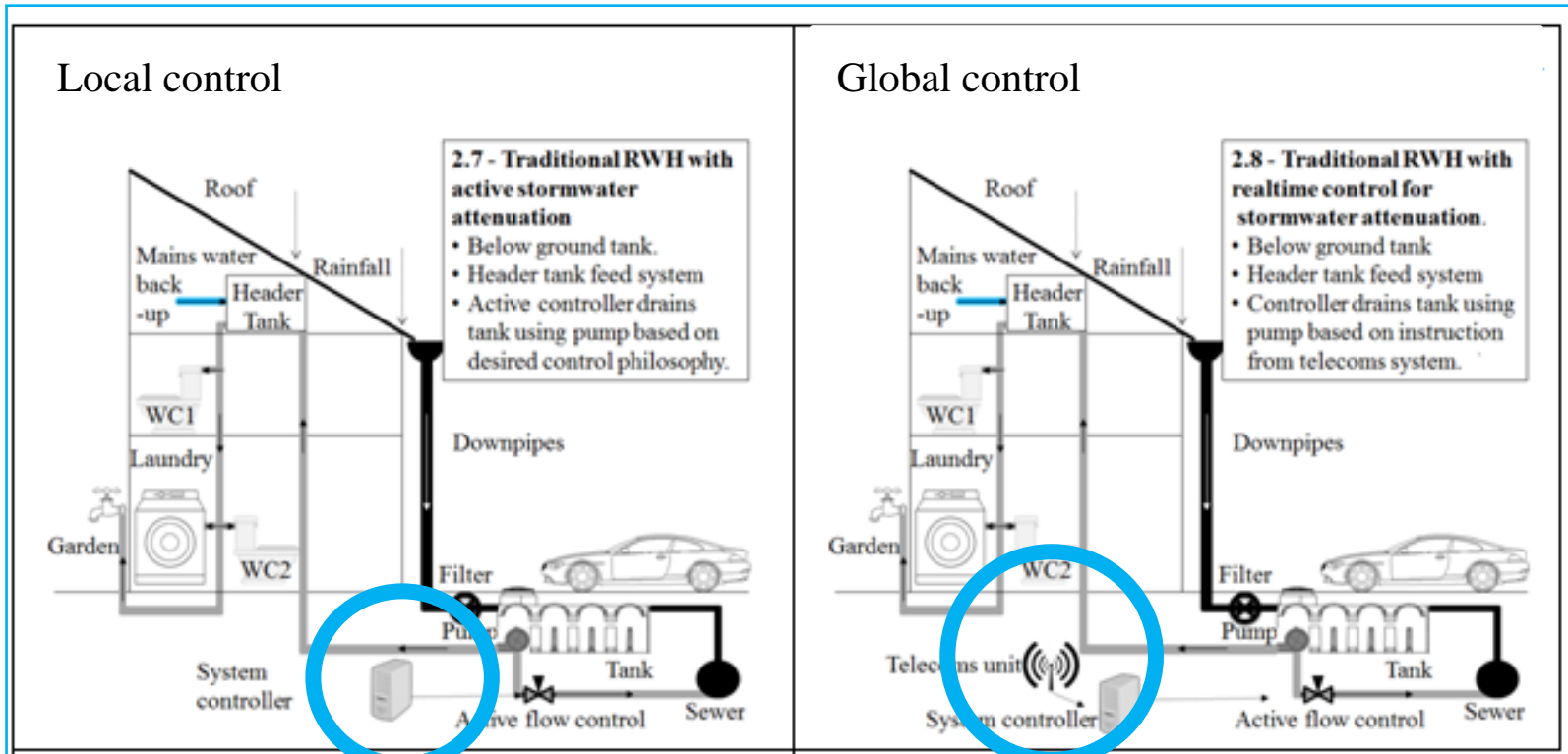


Dual system: passive control

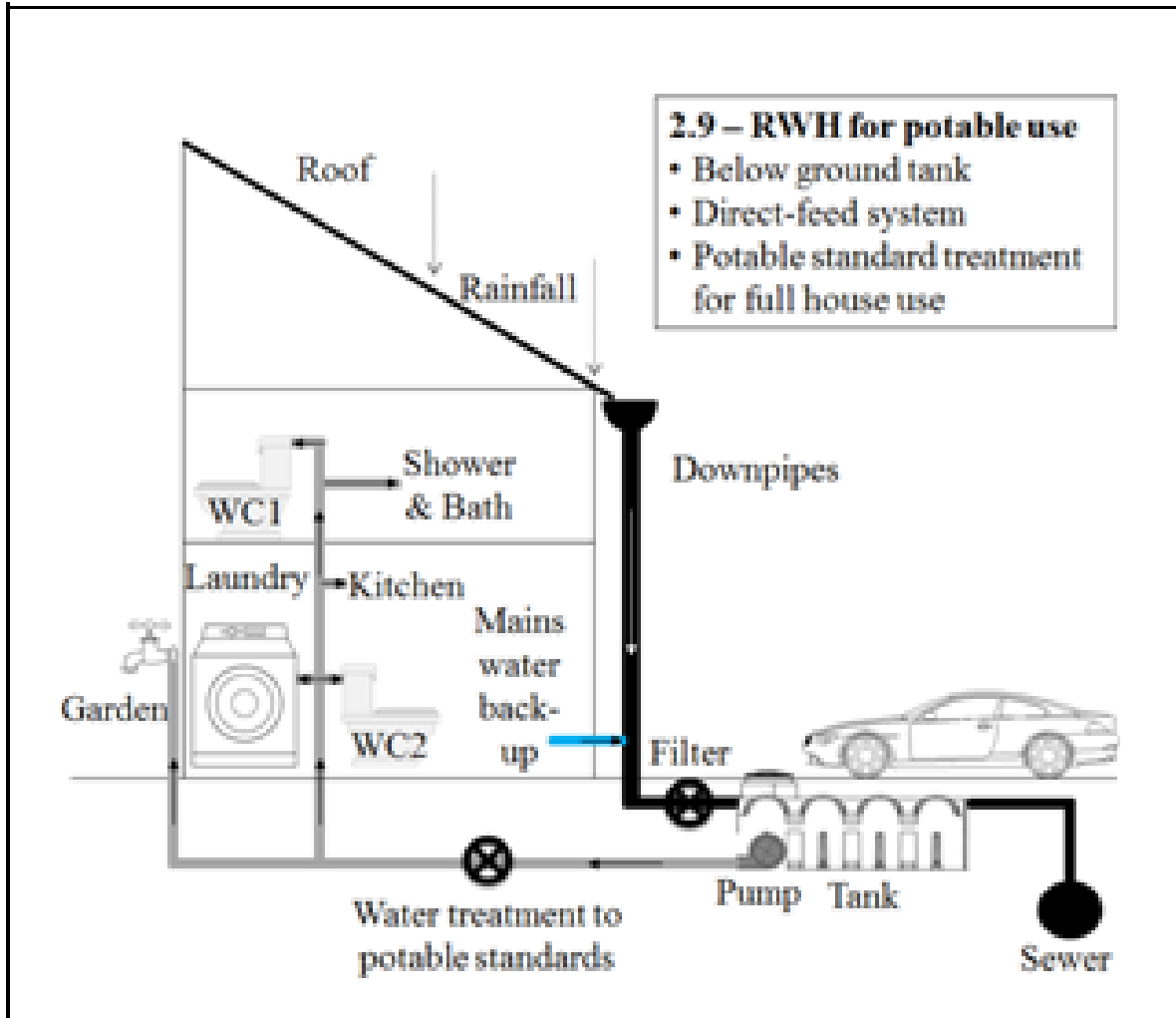


2.5m³ RWH tank supplying 30-60m³/annum.
PLUS >2.5m³ of stormwater attenuation (source control)

Dual systems: active control



RWH: direct potable supply



Costs



- Storage tank
- Pumping: energy/GHGAs
- Treatment
- Installation (retrofitability)

Benefits



- Water resource: corporate
- Water saving: individual (potable/non-potable)
- Stormwater: flood control
- Stormwater: pollution control
- Resilience/emergency

RWH: direct potable

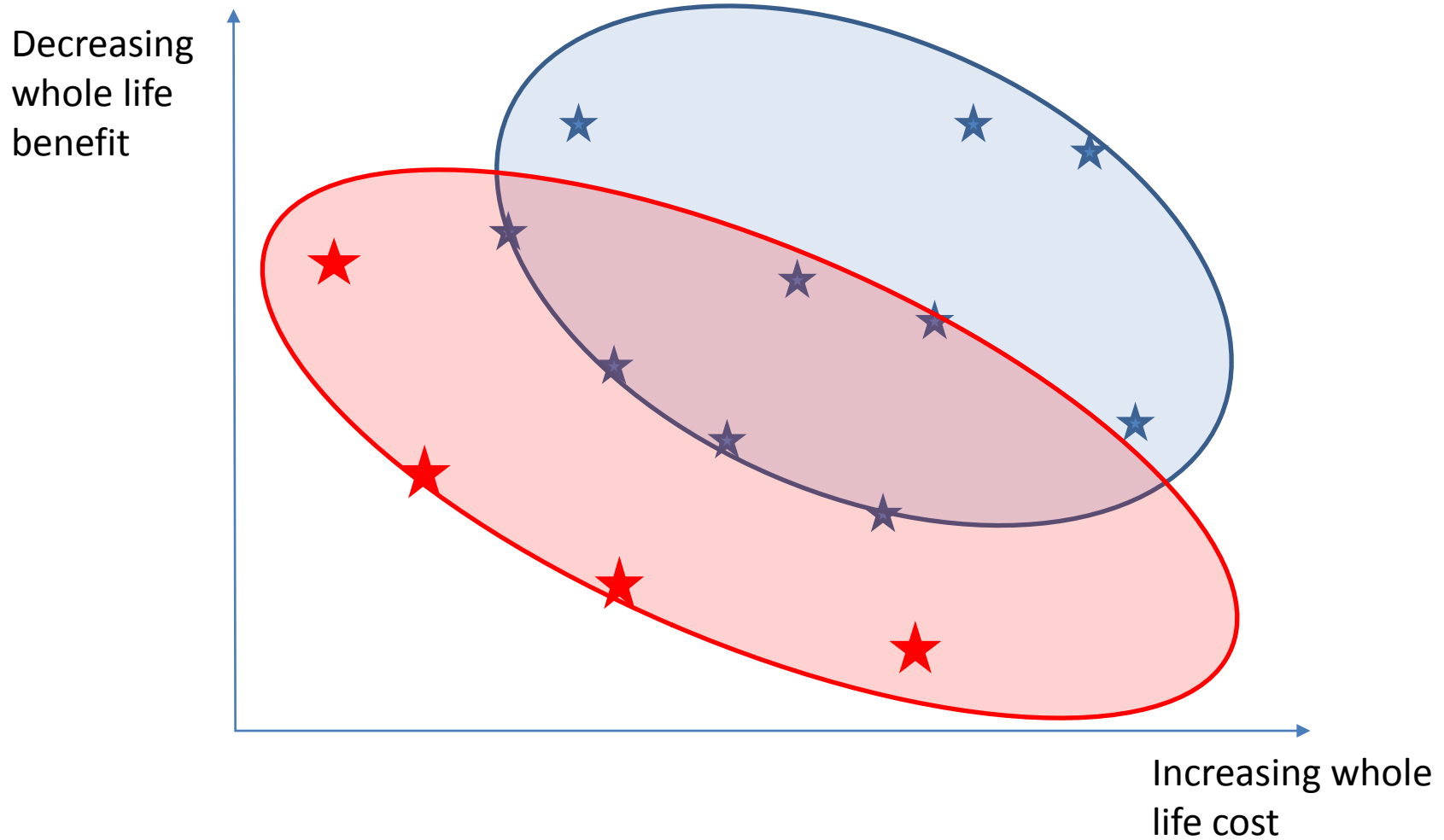


RWH: direct potable

		Inlet (no/ml)			Tank (no/ml)			Outlet (no/ml)		
	PCV	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
Coliforms	0	0-510	185	203	N/A	0	N/A	N/A	0	N/A
E. coli	0	0-210	57	75	N/A	0	N/A	N/A	0	N/A
Enterococci	0	0-900	229	309	N/A	0	N/A	N/A	0	N/A
TVC22	100	1-25600	3581	6256	0-157	16	40	0-300	73	126
TVC37	10	0-1350	381	377	0-56	8	16	0-300	55	114

Based on 26 weekly samples taken during 2015

RWH Costs & benefits



Conclusions

- RWH can come in many configurations
- **Lower cost:** smaller, retrofittable tanks (€1,500/house, ~3x cheaper than existing systems).
- **Lower GHG emissions:** high-level systems (comparable or lower than central delivery)
- **Lower stormwater discharges:** larger tanks, dual configuration (active improves over passive).

Conclusions

- **All** systems deliver water saving benefits **AND** stormwater benefits to varying degrees
- Where **demand is low**, tanks are likely to be emptied less frequently so **yield is higher**
- Where **demand is high**, tanks are likely to be emptied more frequently so **yield is lower**, but this provides greater **stormwater control**.
- **Multi-purpose RWH systems** – tailored solutions for droughts & floods!

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