

Edie Live, NEC, 17-05-16

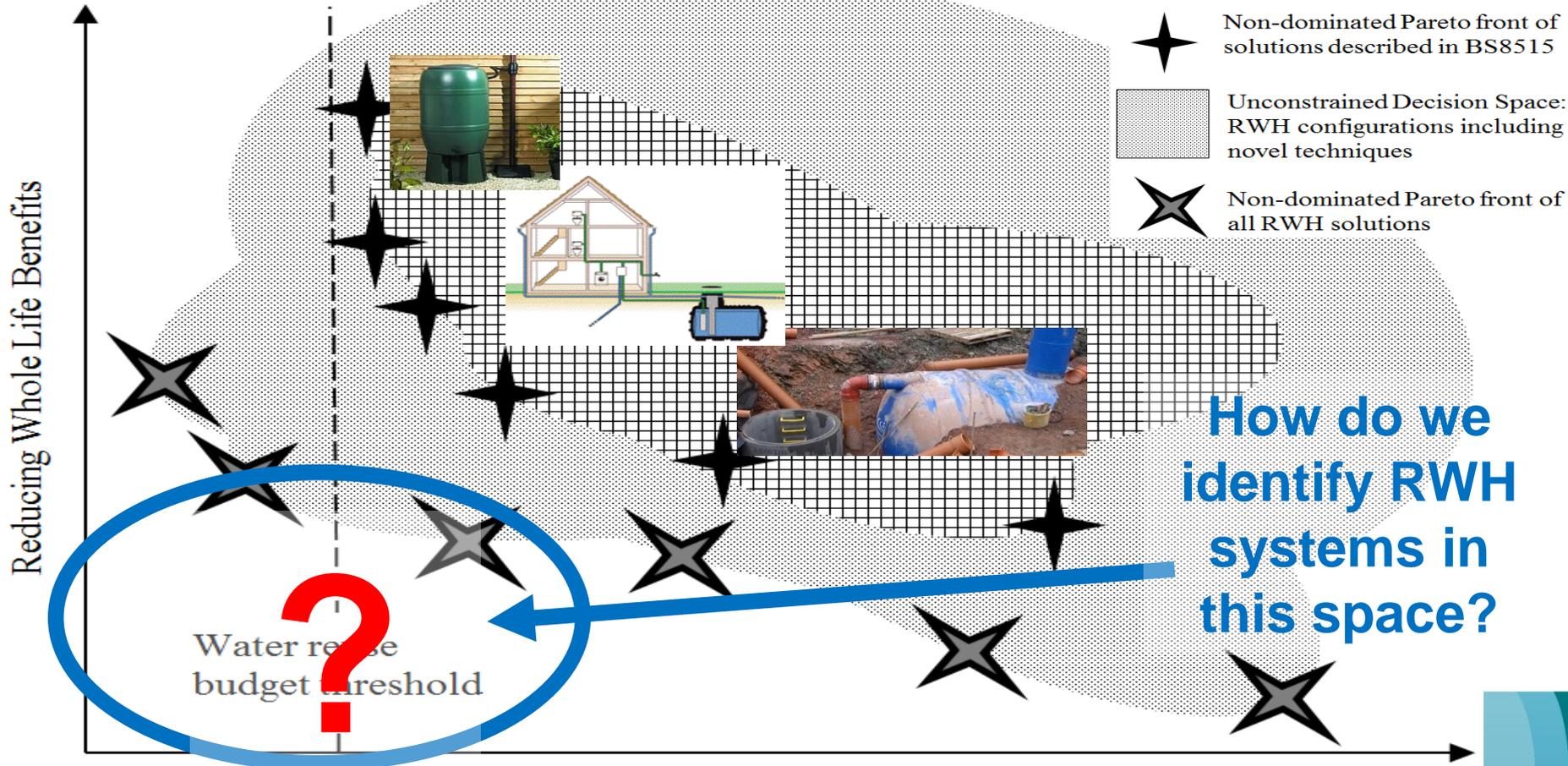
Can we achieve safe, sustainable & resilient rainwater harvesting?

Dr Sarah Ward

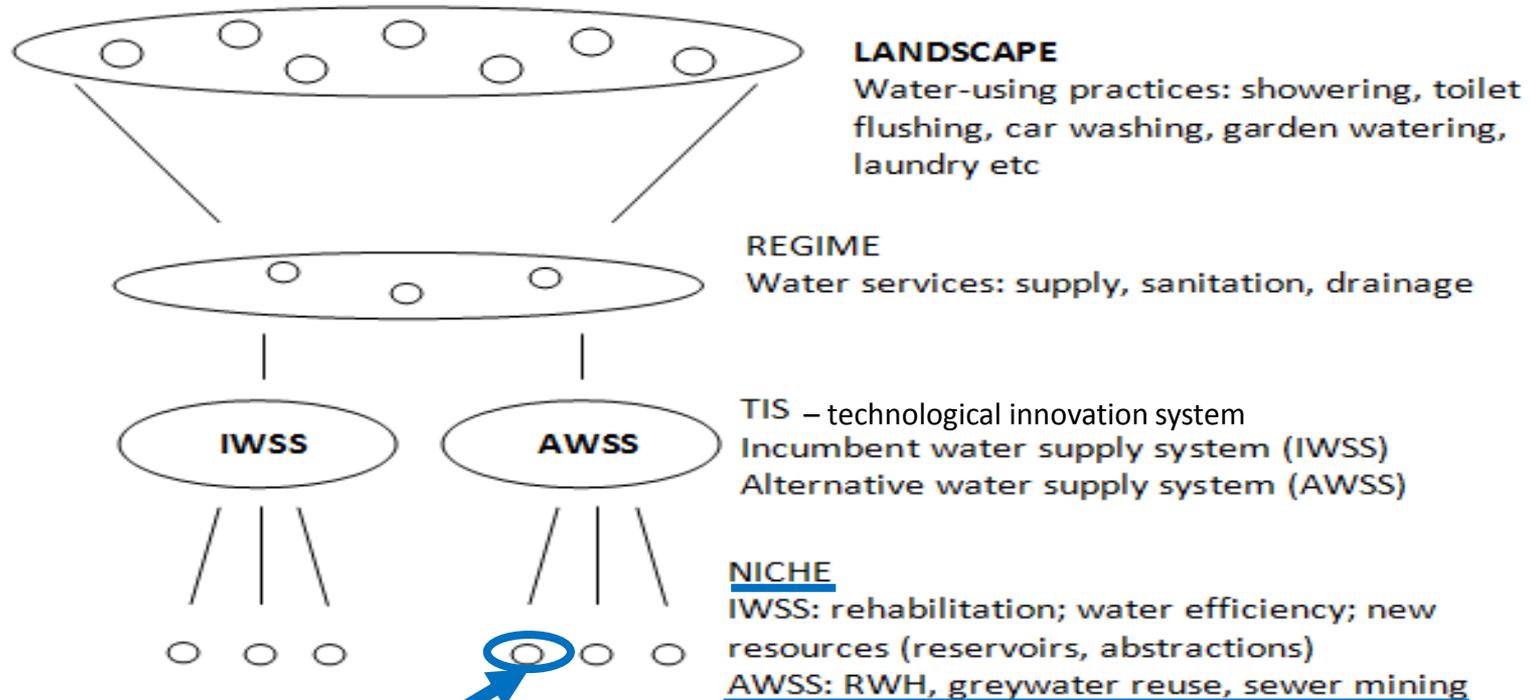
Senior Research Fellow

Centre for Water Systems

What is RWH & what systems exist?



Where is RWH in the water sector landscape?



You are here

What do we mean by safe, sustainable & resilient ('Safe & SuRe')?

Safe ≈ Reliable - "the degree to which the system minimises level of service failure frequency over its design life when subject to standard loading":

Rel = min (failure: probability) "Embedding experiences and new knowledge in best practice"

"Any outcomes and effects of the impacts (i.e. non-compliance with a level of service) on each pillar of sustainability"

"Better protected or prepared"

Sustainable (Su) - "the degree to which the system maintains levels of service in the long-term whilst maximising social, economic and environmental goals":

Sus = max (capital: social, economic, environmental)

Resilient (Re) - "the degree to which the system minimises level of service failure magnitude and duration over its design life"

"Any event with the potential to reduce the degree to which the system delivers a defined level of service"

Threat

Learn

Mitigate

"Reducing the threat"

Consequences

System

"Individual systems of provision, such as water infrastructure and water resources"

Cope

Adapt

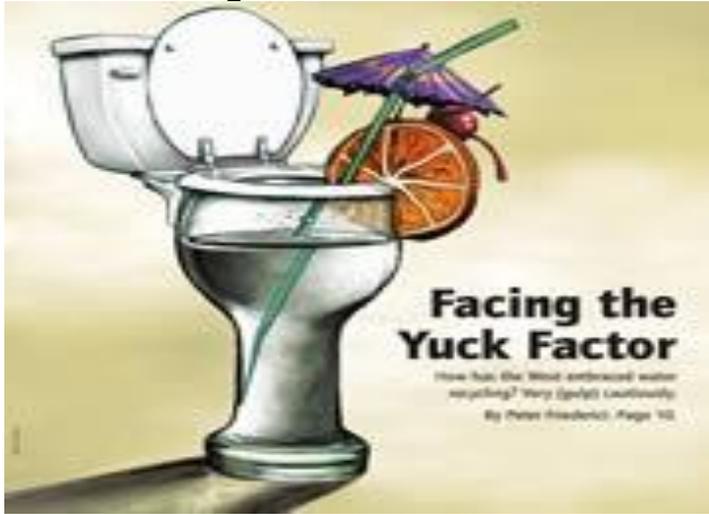
"Efforts to increase system reliability and resilience"

Impact

"The degree of non-compliance with the defined level of service"

Interventions
e.g. RWH

Why does RWH need to be 'Safe & SuRe'?



In partnership with
 energy saving trust

 Environment Agency

NHBC FOUNDATION
Funding research in partnership with BRE Trust

Evidence

Energy and carbon implications of rainwater harvesting and greywater recycling

Report: SC090018

Unless there is a huge effort to reduce volumes of surface water entering sewers, and radical changes in the way that we manage run-off, it is very clear that the current problems of flooding, pollution, high power consumption and carbon output will continue to grow, fuelled in the future by climate change.




Dŵr Cymru
Welsh Water

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Surface Water Management Strategy

How can we make RWH Safe (reliable)?

Verify performance against required level of service - **EVALUATE**

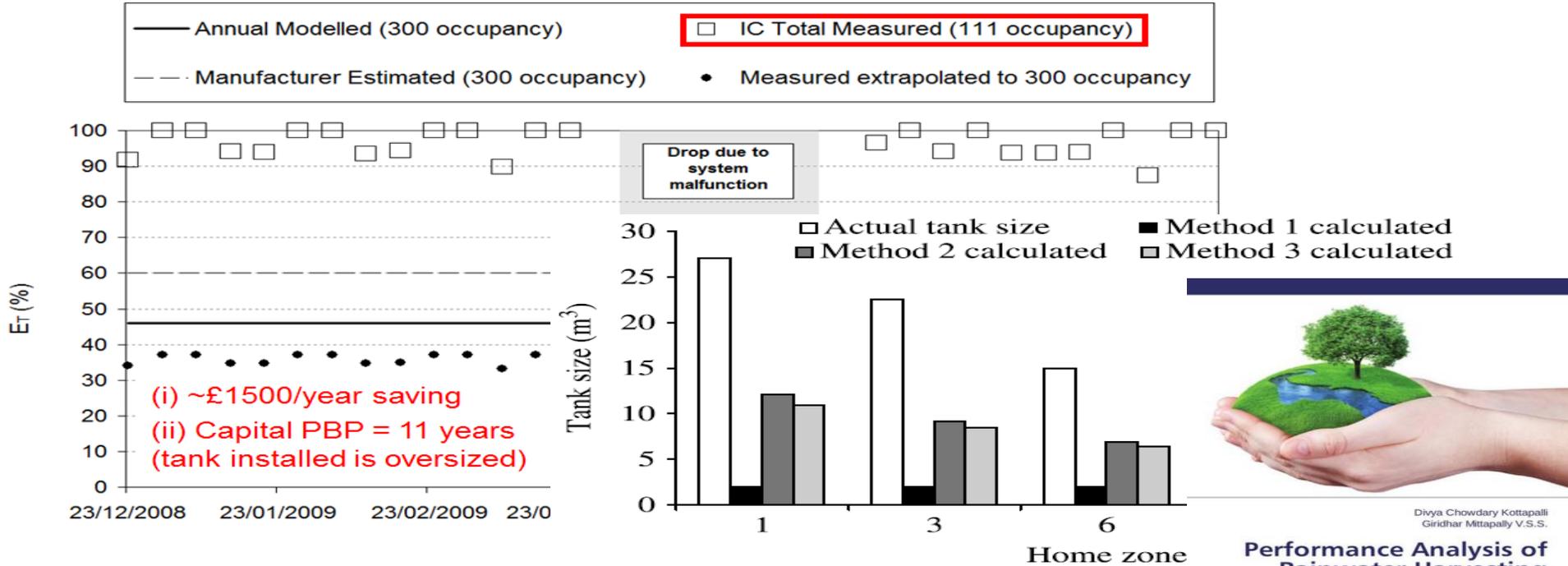
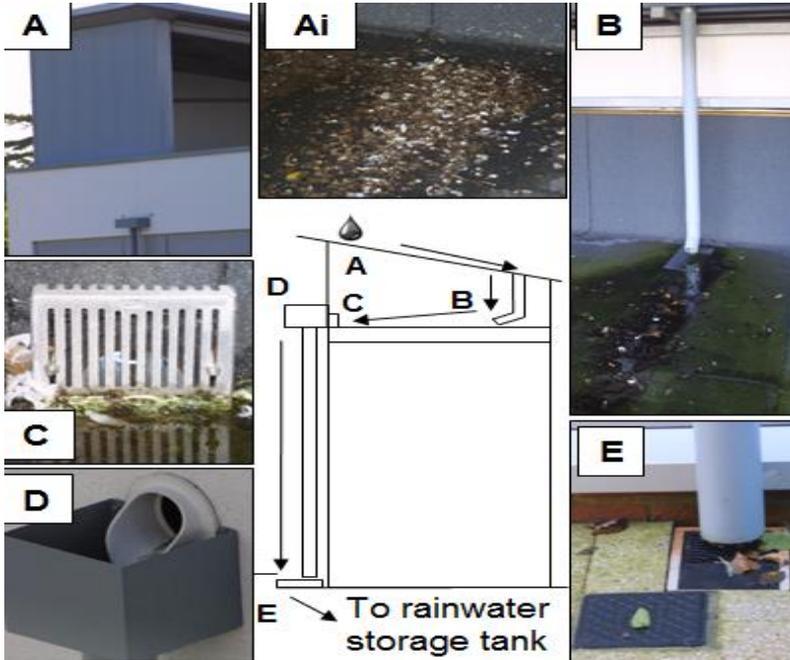


Figure 4 | Differences in HZ tank sizes derived using

How can we make RWH Safe (health)?

Design for it (prevention)



Treat it (cure)



Ward, S., Memon, F.A. and Butler, D. (2010) Harvested rainwater quality - the importance of appropriate design. *Water Science and Technology*, 61 (7), 1707-1714

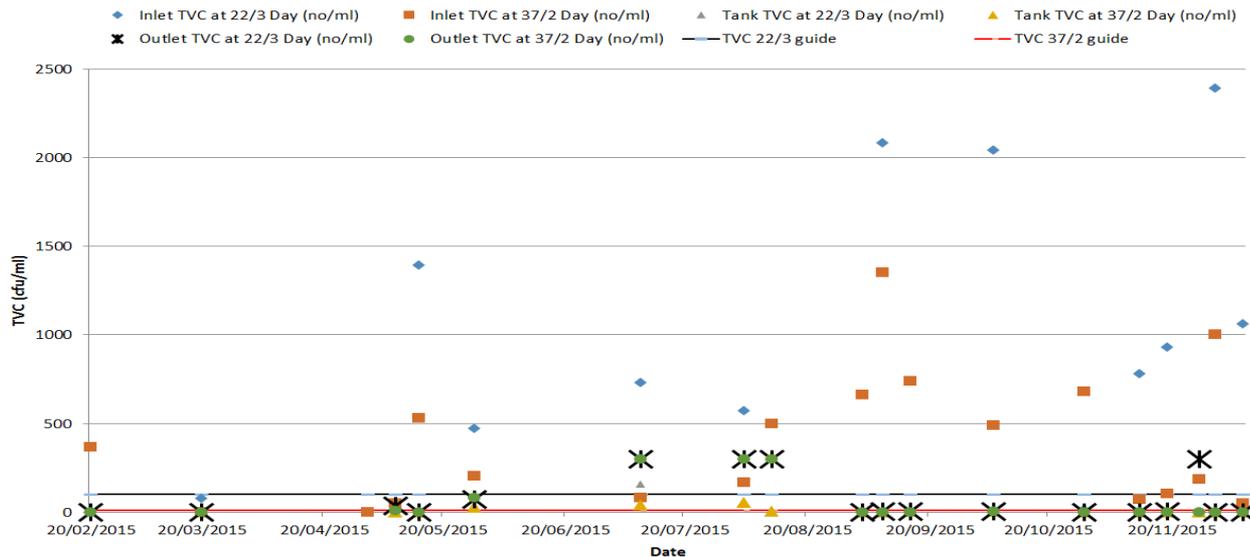
Safe&SuRe
Water management



Exeter



Ward et al (In preparation)
Multi-scale performance of
an off-grid water treatment
device. *TBC*



Full removal of pathogens

(where source water is selected carefully)

	PCV	Inlet (no/ml)			Tank (no/ml)			Outlet (no/ml)		
		Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.
Coliform	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
P. aeruginosa confirmed (presumptive)	N/A	0-1 (0-1000)	N/A (264)	N/A (352)	0 (0-110)	N/A (18)	N/A (41)	0 (0-1000)	N/A (287)	N/A (487)

How can RWH contribute to SuRe?

Threat: climate change (averages)

Mitigate: RWH systems with *lower* operational energy to reduce CO₂ emissions & lessen CC

Mitigate

"Reducing the threat"



Adapt

"Efforts to increase system resilience"

Threat: population growth

Failure mode: demand increase

Impact: supply deficit

Adapt: RWH to *increase* potable water saving efficiency



Threat: urban creep

Failure mode: increased runoff to sewer

Impact: flooding (pluvial or sewer)

(Mitigate: install permeable paving/enforce planning controls)

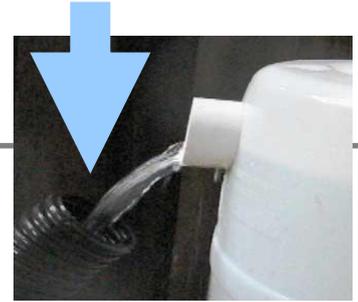
Adapt: install

Threat: climate change (extremes)

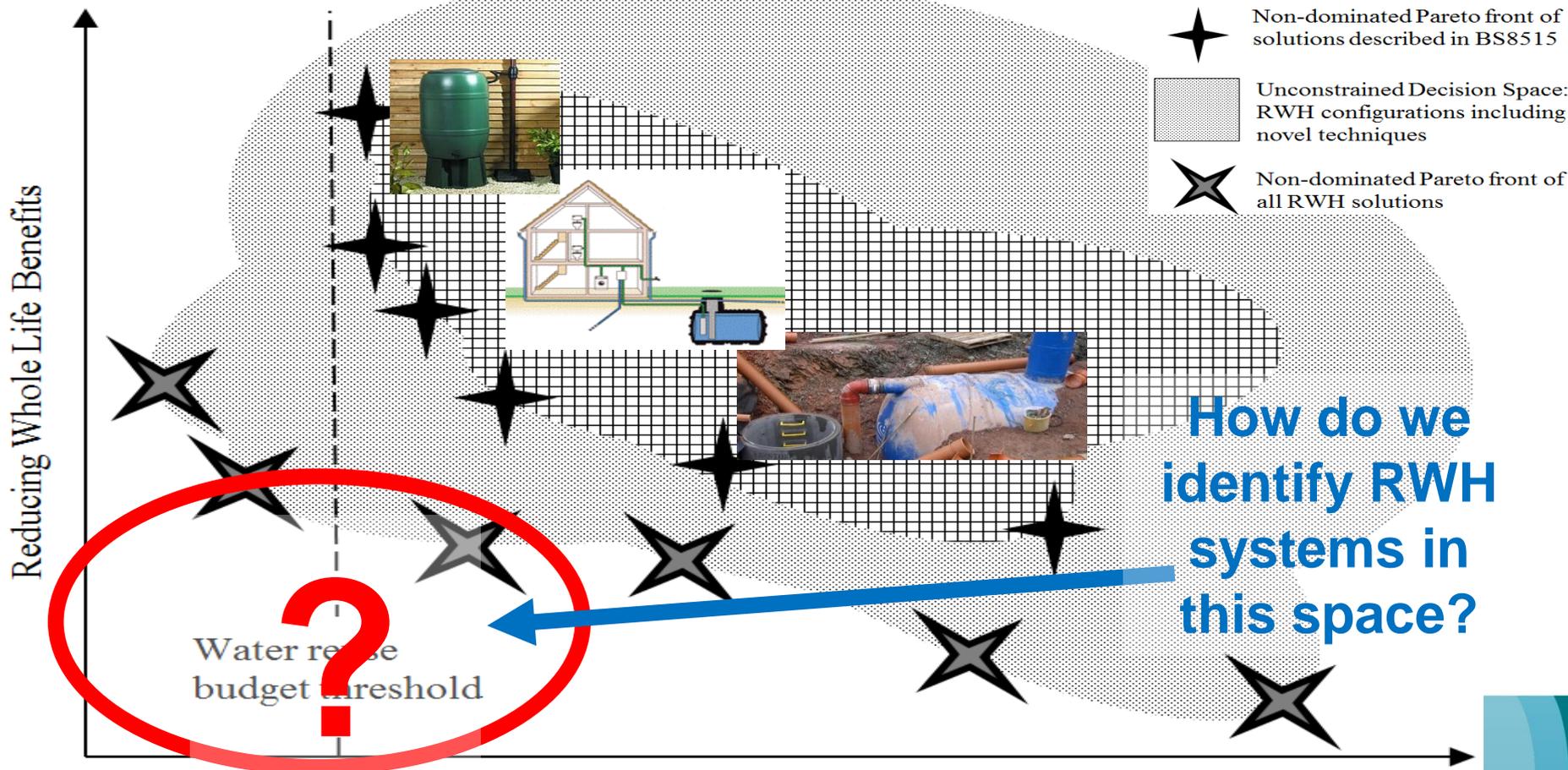
Failure mode: CSO spill

Impact: point-source pollution

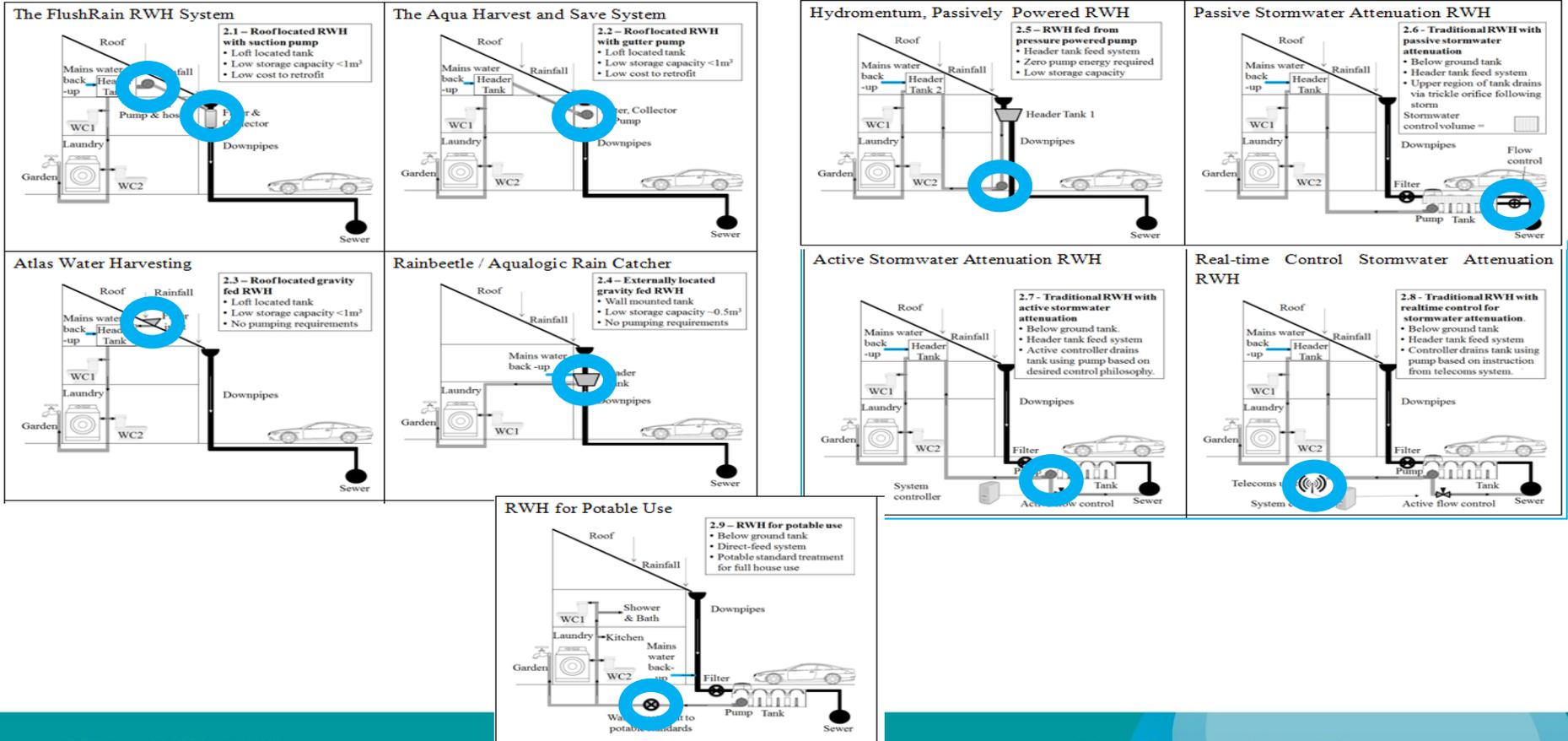
Adapt: RWH to *minimise* sewer discharge (frequency & volume)



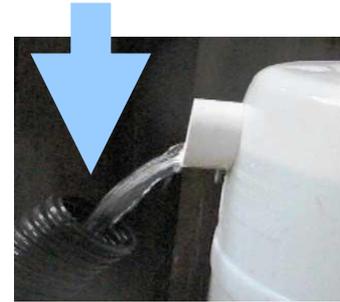
Can we make 'new' Safe&SuRe systems?...



...Yes we can make 'new' Safe&SuRe systems...

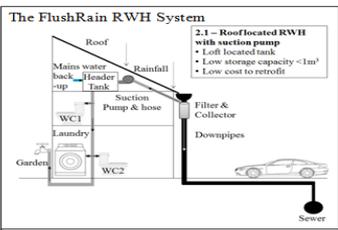


Evaluating 'new' Safe&SuRe systems

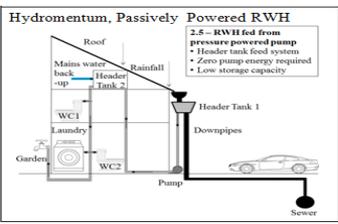


Driver	Target
D ₁ Capital cost of system	T ₁ Minimize capital cost of RWH system
D ₂ Water Efficiency	T ₂ Maximize water saving efficiency of system
D ₃ Reduction in operational energy consumption for rainwater supply	T ₃ Minimize energy used to supply water
D ₄ Reduction in stormwater flow	T ₄ Minimize discharge (rate and volume) of rainwater during storms
D ₅ Reduction in combined sewer overflow	T ₅ Minimize discharge (frequency and volume) of sewer network spills downstream of the site

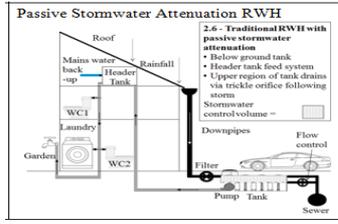
Evaluating 'new' S&S systems



FlushRain



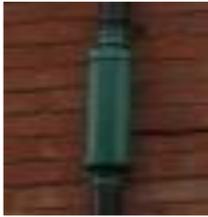
Hydromentum™



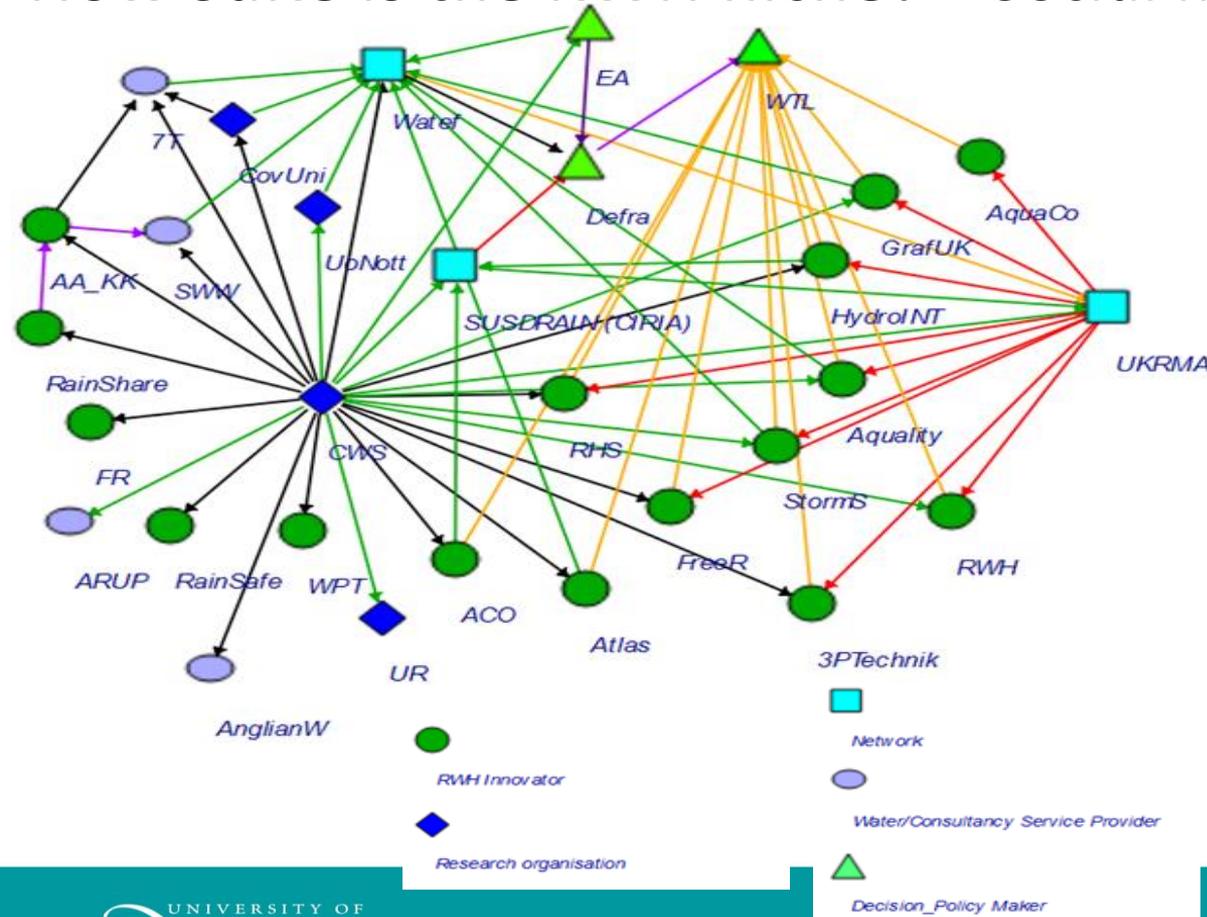
Rain Activ



What happens once we have Safe&SuRe RWH configurations?



How SuRe is the RWH niche? *Social network analysis*



Strengths:

- Strong tech: RWH innovators
- Plenty of innovation to meet drivers *without* financial incentive (see previous slides!)
- Strong networks & forums

Weaknesses:

- Small, dense, disconnected from regime
- Bias of RWH innovators/overlapping networks
- Innovation in isolation – ignored by regime
- Regime poorly represented & no set targets from regime
- End-users/social enterprises poorly represented

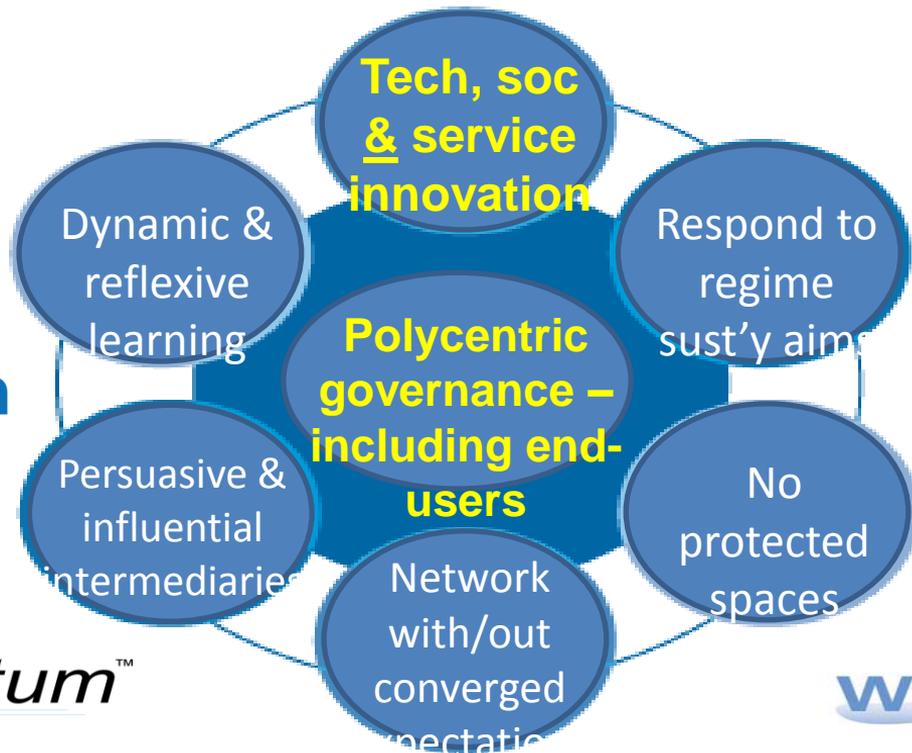
Ward, S., Leonelli, S. & Butler, D. (Under revision) Modelling interactions on RWH – an integrated infrastructure-organisation analysis. *Water journal*

Safe & SuRe niche governance (i.e. not management)



FlushRain

Hydromentum™



Rainwater Users Forum?

RainShare

wat≡f

waterwise

Safe&SuRe RWH – including users & social enterprise



- ✉ 70,000+ energy focused consumer mailing list
- 👥 1,100+ community renewable groups
- 🐦 3,800+ Twitter followers
- 📘 2,500+ Facebook likes
- 📣 1.5+ million partner reach
- 📋 2000+ registered energy businesses in our directory

BRIGHTON ENERGY
CO-OPERATIVE



If we can do it for energy & travel, why not water?



7 5 1 0 8

MEMBERS SO FAR!!

LATEST GROWER
SERE FROM SWANSEA ▶

[FIND OUT HOW IT WORKS](#)



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Safe&SuRe RWH – including users & social enterprise



HOW ARE WE DOING?

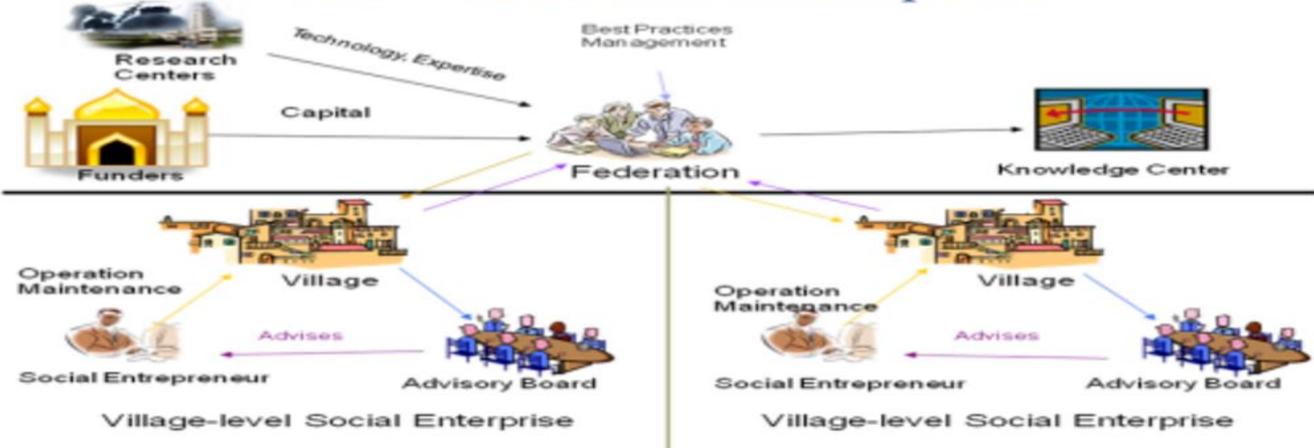
- No SYSTEMS INSTALLED: **1,700**
- No people helped: **12,862**
- No LITROS HARVESTED: **140,000,000**

[→ DONAR](#)

Aakash Ganga, India

Mexico

AG – A Social Enterprise



UK



RainShare

- Connecting people with too much runoff with those who need more!
- Including the end-user - making space for people
- Reconnecting people with water – giving back ownership
- Helping communities grow/wash/flush (swapping non-potable for potable)
- Keeping rainwater out of sewers/slow its entry to sewers (local source control)

rainshare.co.uk

@rainshare



Urban Greening & Commercial-Residential



Exeter and East Devon
Growth Point

Audio interview



<http://waterenergy nexus.co.uk/rainshare/>

Where are we with Safe & SuRe RWH?

- ✓ **Safe**
 - Verify performance to LoS (e.g. demand requirements, water quality standards)
- ✓ **Sustainable**
 - Reduce (negative) consequences (e.g. lower capital cost)
 - Increase (positive) consequences (e.g. higher water saving efficiency; end-user participation)
 - Social/service innovation
- ✓ **Resilient**
 - Reduce threats (e.g. carbon emissions)
 - Contribute to stormflow reduction (helping adapt the drainage system to extreme conditions)

The future: Safe&SuRe RWH?

