Innovations in Residential Rainwater Harvesting in the UK

A Preliminary Sustainability Assessment of Innovative Rainwater Harvesting for Residential Properties in the UK

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Overview

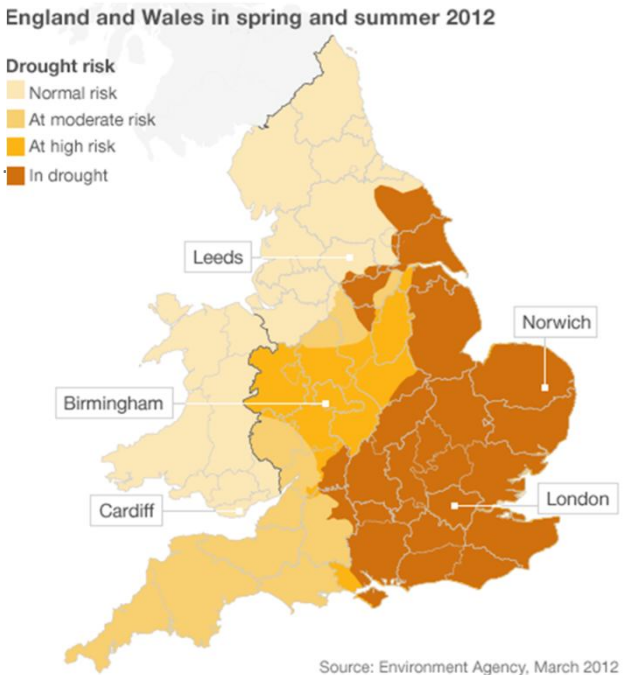
- **Background**
  - UK water sector
  - Existing UK RWH market
  - Benefits of household RWH
- **Study Methodology**
  - Identify existing RWH technology
  - Horizon scan for innovations
  - Appraise traditional and innovative RWH approaches
- **Results**
- Patents, roof-storage and low energy / low cost innovations
- **Initial Conclusions**
- Are innovations more sustainable?
- Future research

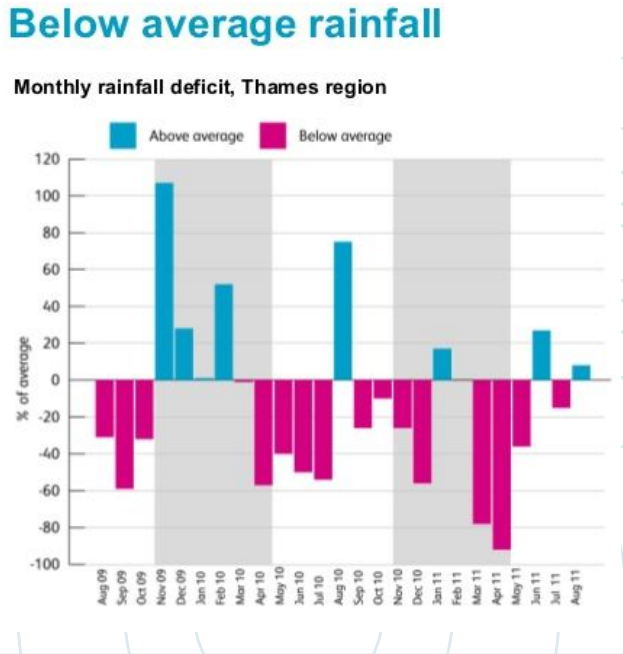
Background

- **UK Water Sector**

  Water and the UK

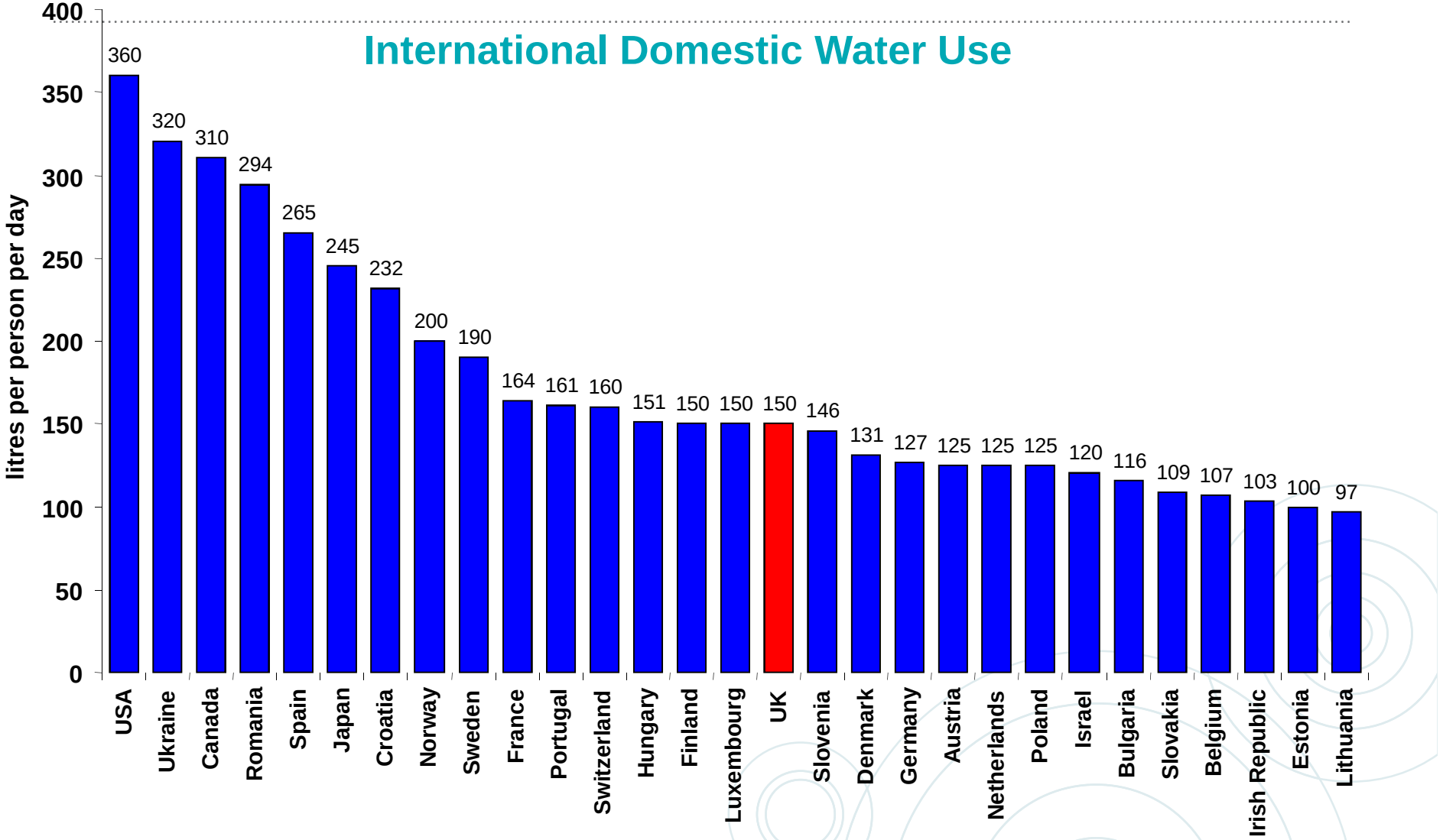
  - Privatised water and sewerage network with a single water supplier / region & high coverage.
  - Annual rainfall in London, 600-800mm/year
  - Household water usage = 150 litres/person/day
  - Lack of resilience to drought and flooding?





"The South-East has less water per head of population than Sudan or Syria because it is much more densely populated" (Environment Agency Cited in Waterwise , 2009)

Background


International Domestic Water Use
litres per person per day
400
350
300
250
200
150
100
50
0
360
320
310
294
265
245
232
200
190
164
161
160
151
150
150
150
146
131
127
125
125
125
120
116
109
107
103
100
97
USA
Ukraine
Canada
Romania
Spain
Japan
Croatia
Norway
Sweden
France
Portugal
Switzerland
Hungary
Finland
Luxembourg
UK
Slovenia
Denmark
Germany
Austria
Netherlands
Poland
Israel
Bulgaria
Slovakia
Belgium
Irish Republic
Estonia
Lithuania

Background

- **UK Policy for RWH**

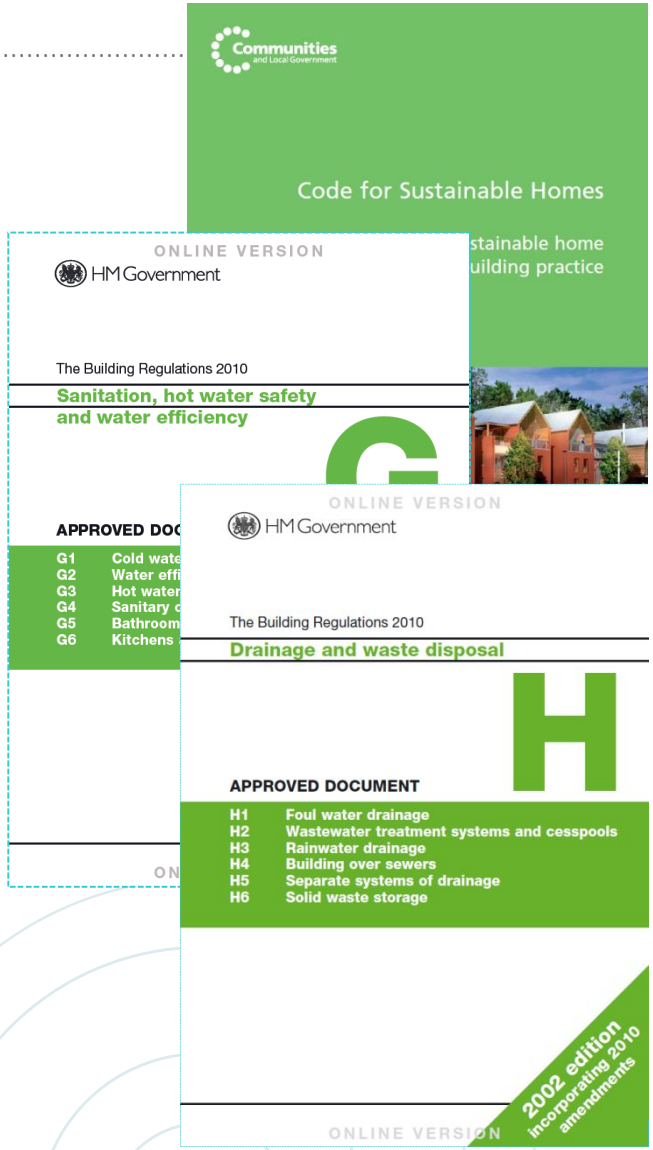
Code for Sustainable Homes (water systems & fittings)

Building Regulations part G (water efficiency)

Building Regulations part H (drainage)

British Standards codes of practice

- BS8515:2009 Rainwater Harvesting Systems
- BS8525-1:2010 Greywater Systems
- BS8595 (tbc) Selection of Water Reuse Systems



Background

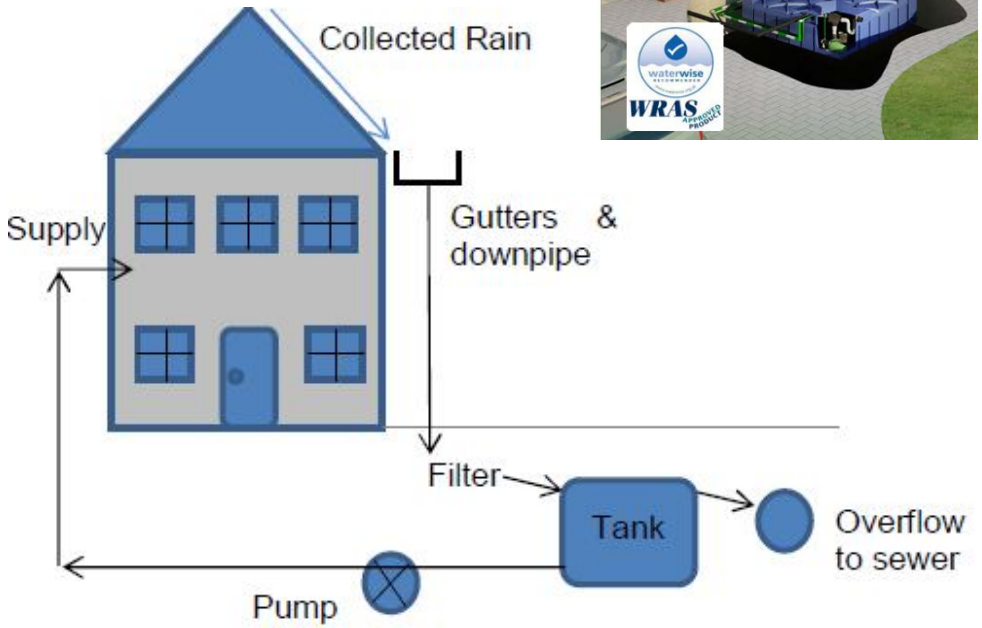
- **Existing UK Residential RWH market**

  Traditional RWH

  - 5,000 per annum
  - Traditional capture-store-pump-use systems
  - <50% of household water demand (WC and laundry)
  - Tank size: 1m^3 to 6m^3
  - Regulator suggests RWH supplies are:

  "generally more carbon intensive than mains/potable water"

  (Environment Agency, 2011)



Background

- **Perceived Benefits of RWH**

  For the PROPERTY OWNER

  ECONOMIC

  Reduced water and sewerage bills

  £50-£300 / annum saved

  ENVIRONMENTAL / SOCIAL

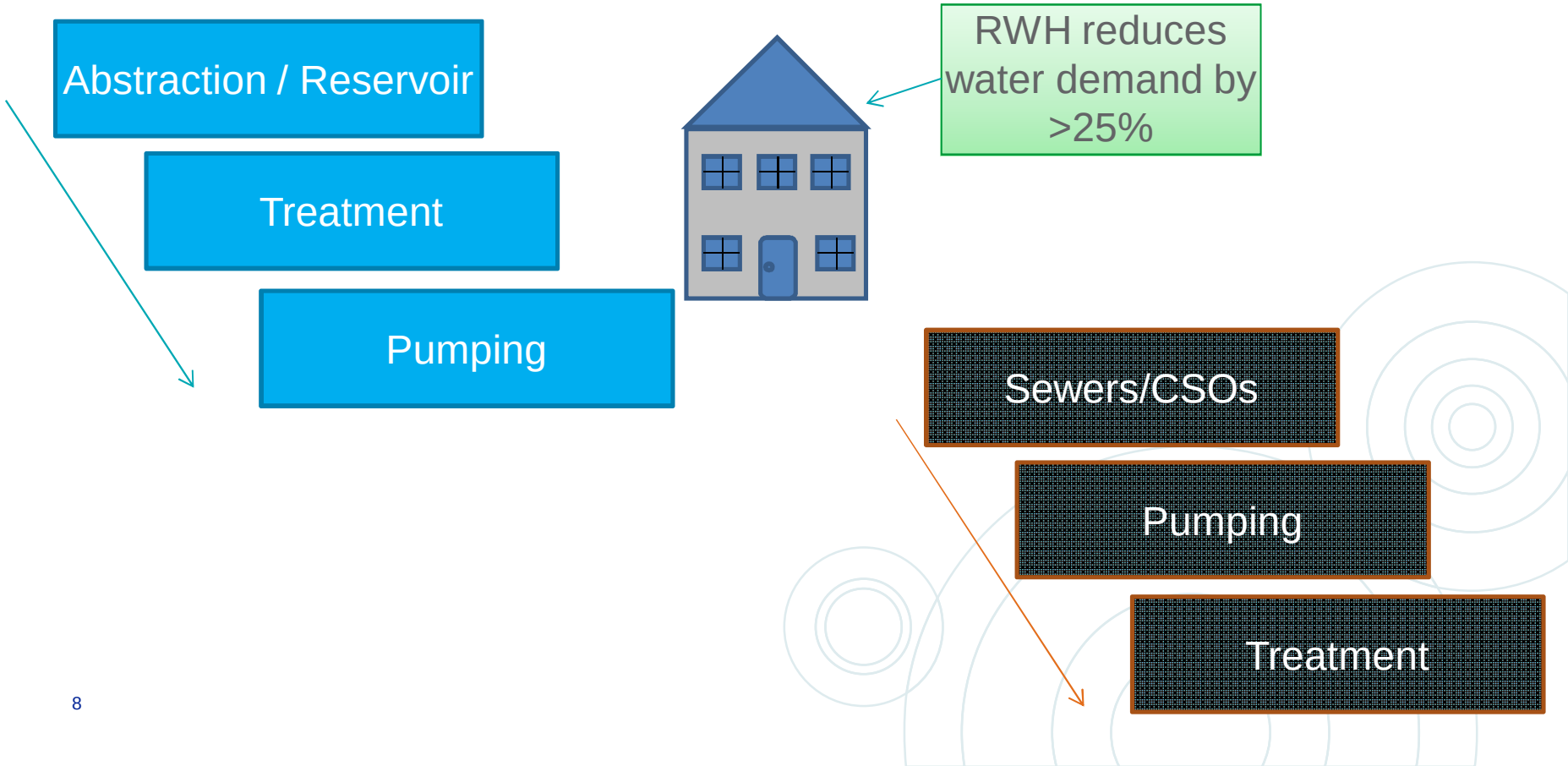
  Water available during hosepipe bans

  SOCIAL

  Social feel-good factor (social)

Background

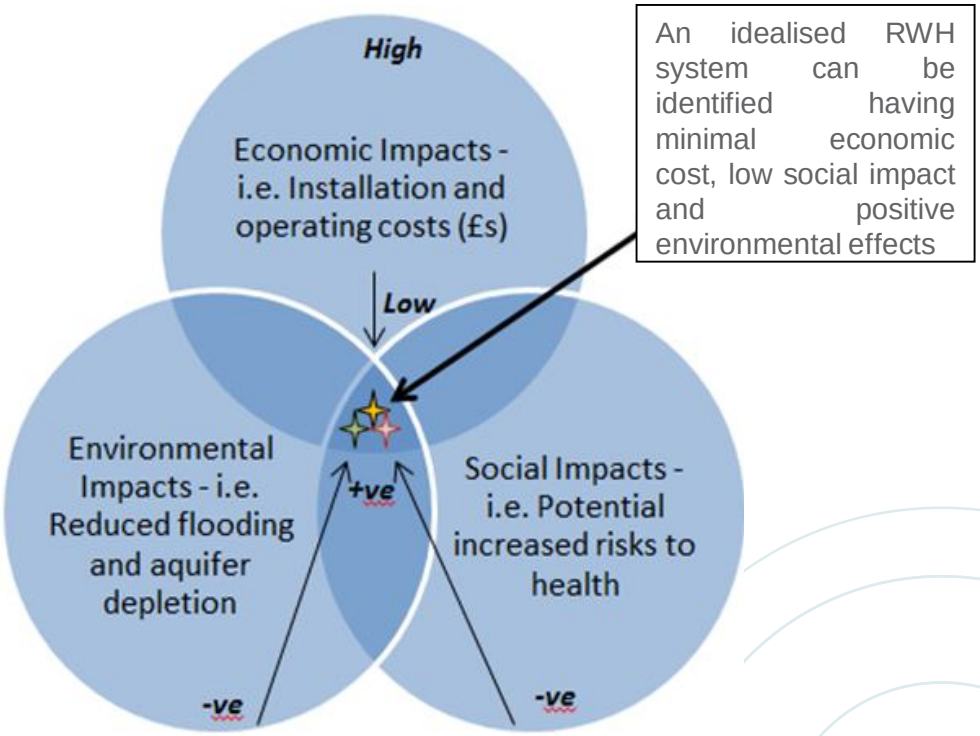
- **“Future” Benefits of RWH**
  For the WATER & SEWERAGE COMPANY
  - **Reduce Carbon, Energy & Need for Capital Investment?**



Background

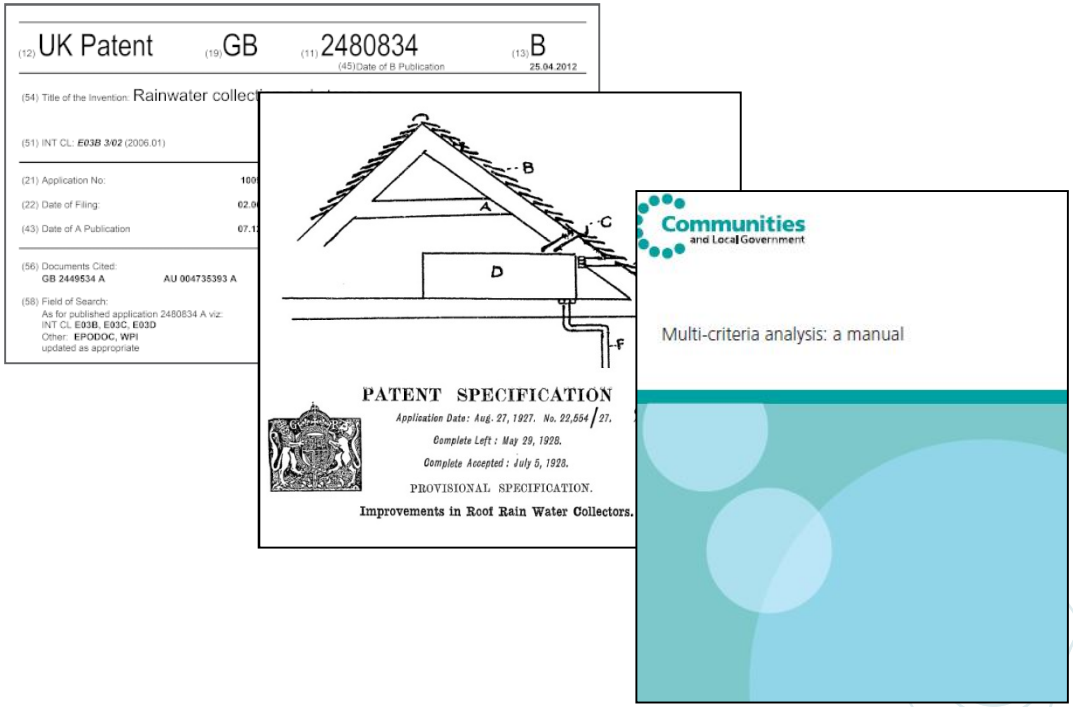
- **Study Aim**

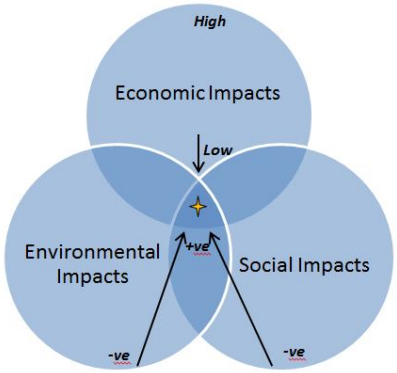
  Identify and undertake an initial appraisal of UK RWH systems against a conceptual model built upon the Three Pillars of Sustainability (Elkington, 2004)



Methodology

- **Identify traditional & innovative RWH technologies**
  - Approach existing UK suppliers
  - Patent search
  - Develop simple Multi Criteria Analysis





Economic	Installation Cost
	Annual financial benefit
	Payback ability
	Company able to install system within 4 weeks
	Funding supporting the RWH company
Social	Ease of new build installation
	Ease of retrofit installation
	Risk of health issues minimised
	Risks of structural issues minimised
Environmental	All roof runoff collected by each system
	Large storage achievable following development
	Zero Operational CO2
	Low capital CO2
	Provides flood management benefit
	High Demand met / year

Results

- **Traditional RWH Appraisal**

  Four companies assessed

  - Specifications and costs provided for a small and large RWH system
  - Suppliers estimated on-site installation costs to be >1 times retail price assuming a retrofit scenario.
  - Onsite installation costs were therefore assumed at a cost of £1,300 for traditional systems with storage <2m^3 :
  - Cheapest Traditional RWH System estimated at £2,653 with 1m^3 tank.

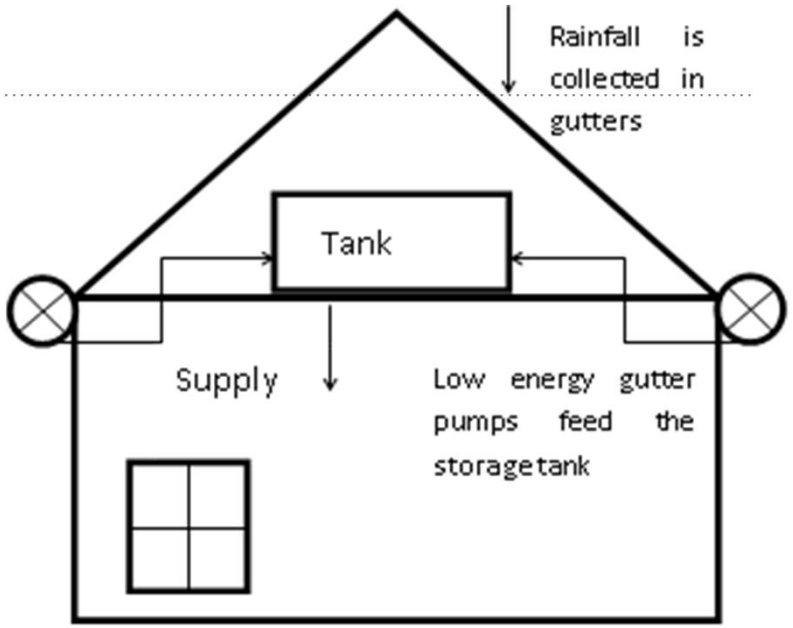
x10 for Yuan = 13,000 RMB

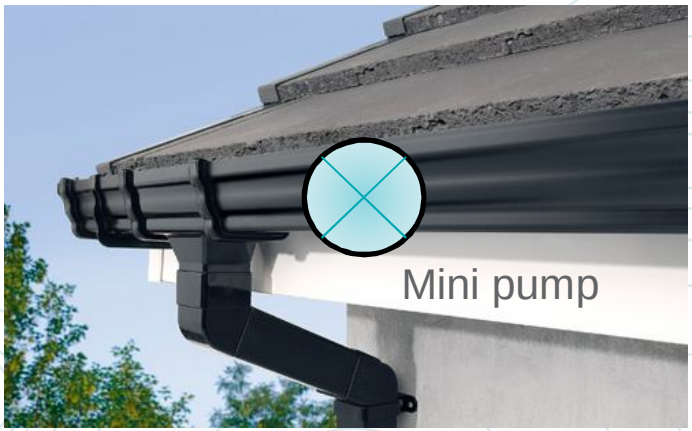
Results

- **Patents & Innovations**

Aqua Harvest and Save, gutter mounted rainwater recovery

- 1m^3 roof-space storage
- V low head pump (<0.5m)
- Very low energy requirements (50W pump)
- Easy to retrofit
- Patented load bearing tank system



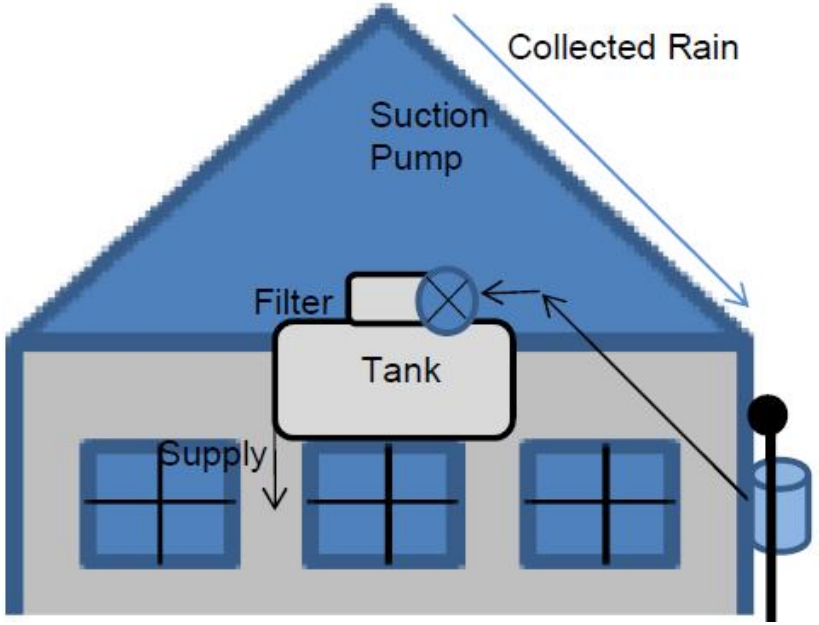


Results

- **Patents & Innovations**

  Flushrain – Downpipe mounted rainwater recovery

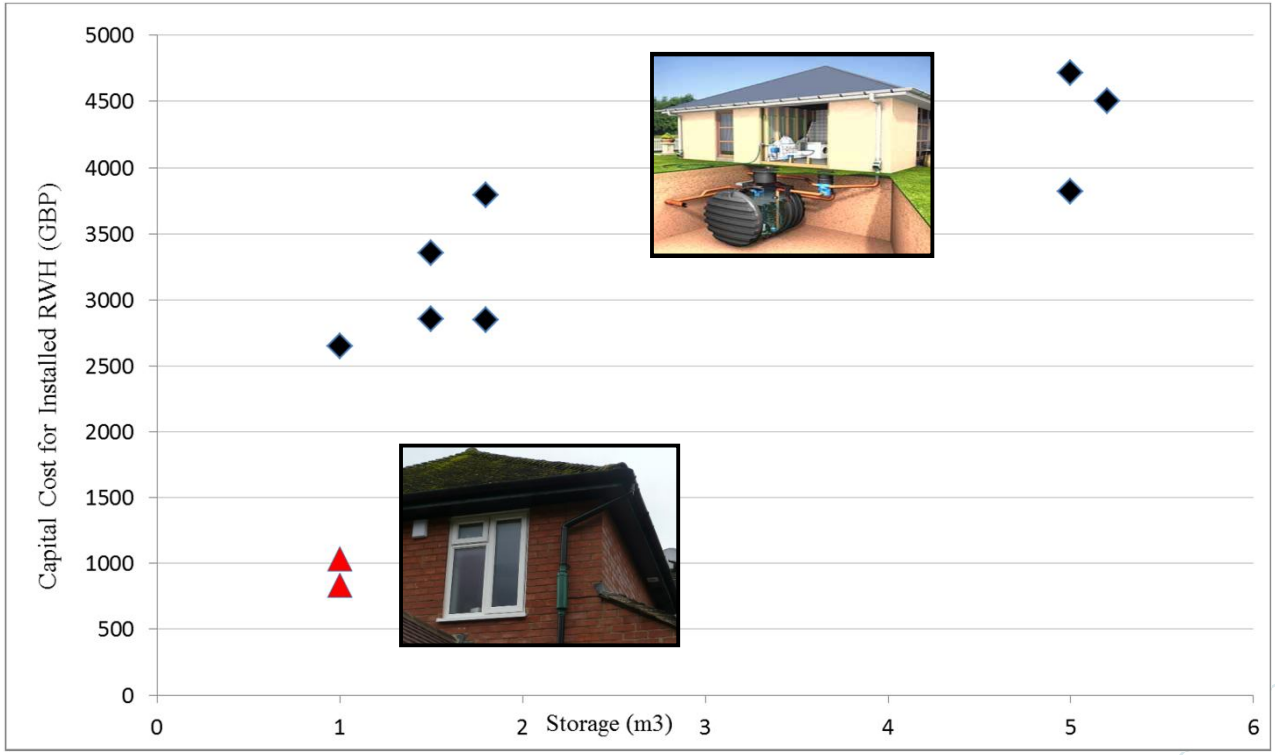
  - 1m^3 roof-space storage
  - Low energy requirements
  - Easy to retrofit



Results

- **Capital Cost Assessment**

1m³ roof-space storage systems found to be cheaper



- No external excavation
- Easy retrofit
- Lower manufacturing costs

Results

- **Simple Multi Criteria Analysis - Summary**

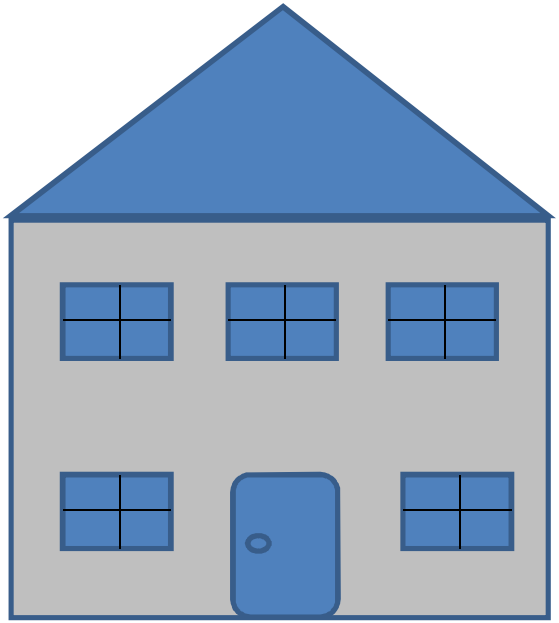
1m^3 roof-space storage systems have higher "Sustainability Scores":

- No external excavation
- Easy retrofit
- Low operational and capital carbon footprint

Factor	Maximum Score (%)	Comment	Benchmark Traditional RWH	Innovative RWH Systems	
			A	B	C
Economic	35	**Five economic factors have been weighted to derive this score:** Installation Cost, Annual financial benefit, Payback-ability, Business-ready, Funding-ready.	22	23	25
Social	20	**Four social factors have been weighted to derive this score:** Ease of installation, Ease of retrofit installation, Health issues minimised, Risks of structural issues minimised.	13	14	15
Environmental	45	**Six environmental factors have been weighted to derive this score:** All roof runoff collected, Large storage achievable following optimised design, Low operational CO2, Low capital CO2, Flood management benefit, High demand met.	19	27	27
TOTAL SCORES	**100**		54	64	67

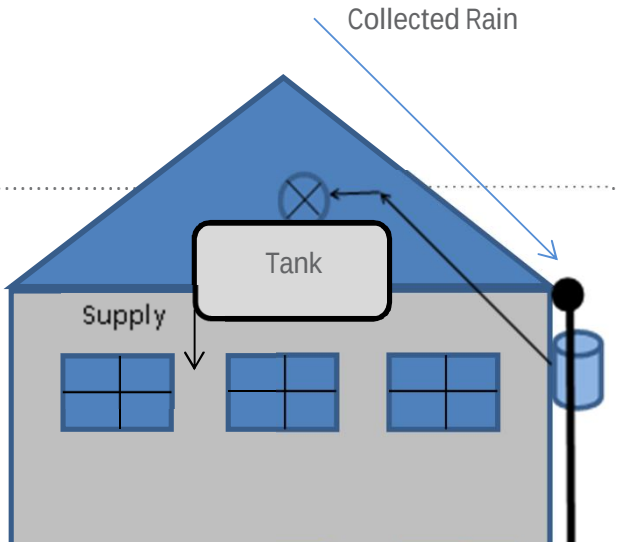
Further Work

Conceptualising Further Research



House 1 – No RWH

- 220m^3 potable water / annum
- Status quo



House 2 – With RWH

- 164m^3 potable water / annum (25% reduction)
- Abstraction reduced, less flooding, cleaner watercourses, reduced energy used for pumping, water infrastructure assets have extended lifetime, lower CO_2, less chemical use
- Reduced water used = reduced income for water provider
- **More sustainable? Cheaper whole life cost?**

Further Work

Research Questions:

1) **Is residential RWH a sustainable technology for the UK?**
2) **Does the evidence suggest that policy changes or subsidies are required?**

Doctorate Project: "RWH in the Wild"

- Install pilot RWH systems in 12 properties
- Monitor water & energy use (>1year) and compare to centralised "costs"
- Identify overall benefits to both customers and environment / water provider.
- Quantify and model broader benefits/negatives of wide scale RWH uptake

Looking Forwards

Initial Findings:

- Estimates project that RWH can be retrofitted in the UK for £2,653.
- Innovative roof-based RWH systems could be achieved for less than £1,000 (if a market develops)

x10 for Yuan = 10,000 RMB

- Roof- based RWH systems score more highly when appraised in a simple MCA sustainability appraisal.

Areas for Investigation:

- Realworld pilot installations will now be installed and appraised.
- Retrofitting risks (structural loading etc) most be considered
- Water quality risks need to be appraised

- Could these technologies be applied elsewhere?

Elkington, J. (2004) *Enter the Triple Bottom Line. The Triple Bottom Line: does it all add up*. Published; EarthScan: London UK.

Environment Agency (2011) Position statement - The use of rainwater harvesting systems. http://www.environment-agency.gov.uk/research/library/position/131546.aspx Accessed: 10.06.2013)

Waterwise (2009). Renew project Action a2a, Development of concept and offering. http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=RENEW_report_stakeholders.pdf (Accessed06.06.2013)