Financial analysis

Rainwater harvesting system in the Metropolitan area of BCN




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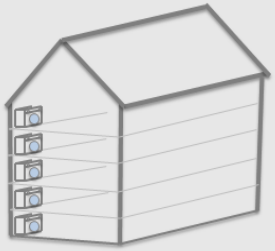
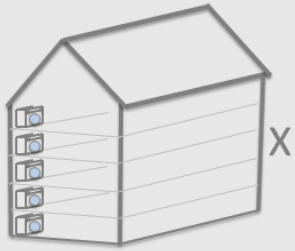
Scenario design & Rainwater offer and demand

System design

LD1, LD2, LD3	LD4	HD1, HD2, HD3	HD4
	 x 4		 x 10
250 m² collection surface 1 household 24.47 m³ of collected rainwater	1,000 m² collection surface 4 households 99 m³ of collected rainwater	700 m² collection surface 24 home – apartments 283 m³ of collected rainwater	2,800 m² collection surface 240 home – apartments 2,824 m³ of collected rainwater

	Low density				High density			
	LD1	LD2	LD3	LD4	HD1	HD2	HD3	HD4
Scale	1 Household	1 Household	1 Household	4 Household	1 Building 24 Households	1 Building 24 Households	1 Building 24 Households	10 Building 240 Households
Tank capacity	UNDERGROUND (5m³)	BELOW ROOF TANK (5m³)	DIST. ROOF (9m³)	UNDERGROUND (20m³)	UNDERGROUND (21m³)	BELOW ROOF TANK (21m³)	DIST. ROOF (37,8 m³)	UNDERGROUND (209m³)
Laundry water offered (m3)	24.47	24.47	24.47	98	283	283	283	2824
Laundry water needed (m3)	25	25	25	100	600	600	600	6000
Offer/ Demand	98%	98%	98%	99%	47%	47%	47%	47%

Data source and selection criteria

Materials

Manpower

Tools and equipment

ITeC Institut de Tecnologia de la Construcció de Catalunya

Precio Centro de la Construcción

GABINETE TECNICO APAREJADORES GUADALAJARA

Storage tank

www

aiguadepluja.cat
grafiberica.com
ebara.es
etc…

Pump (pressure control)

ECONOMIC ASSESSMENT: SELECTION CRITERIA

PRICE

1. All prices were first consulted in ITeC database.
2. Whenever possible, obtain an average price from different sources.

INPUTS VALIDATION

√ Validation phase with senior professional of water installations.

Input Inventory

LIFE STAGE	INPUT	LIFETIME (years)
Construction	Concrete tank	50
	Emplacement materials	50
	Polypropylene pipes	25
	Pump	10
	Filter	5
	Construction services	50
	Transport of materials to site	*50*
Use	Electricity	1
	Pump	10
	Filter	5
	Maintenance services	5
End-of-life	Transport of deconstructed materials	0
	Deconstruction services	0

Economic assessment

LIFE STAGE	COSTS	REVENUES = SAVINGS
Construction	Concrete tank Emplacement materials Polypropylene pipes Pump Filter **Construction services** NEW ***Transport of materials to site*** NEW	
Use	Electricity Pump Filter **Maintenance services** NEW	Detergent Fabric conditioner Water softener
End-of-life NEW	**Transport of deconstructed materials** **Deconstruction services**	

Results and discussion

LIFE STAGE	REVENUES = SAVINGS	100%
Use	**Washing additives** Laundry detergent, fabric softener and water softeners. Average prices for 2012 from three supermarkets for ten different laundry detergents, five fabric softeners and three water softeners available in Barcelona.	NEW 82%
	No tap water consumption Average cost of tap water in Barcelona is 1.25 Euros/m^3(AEAS, 2011), excluding sewer related costs	18%

All calculations were made considering:

- 220 standard washing cycles per year as described in Directive 2010/30/EU (OJ, 2010)
- an A+ eco-labelled washing machine
- 25 m^3 of water consumption per year
- Use of the recommended dose of additive provided by the manufacturer.

Financial analysis

FINANCIAL TOOLS	
NPV	Net Present Value
IRR	Internal Rate of Return
PB	Payback period

Discount rate.

FINANCIAL VALUES	NEW
Discount rate (real)	1.75%
Discount rate (nominal)	4.90%
Inflation	3.10%

Most authors applied a 5% (Liaw and Tsai, 2004; Mitchell et al., 2005; Morales-Pinzón et al., 2012a; Rahman et al., 2010).

Given the variety of countries of the different authors, we decided to use the value published by the Banco de España, 4% for nominal discount rate (Banco de España, 2013).

FINANCIALNALYSIS

Cluster construction scenarios

for low and high density (LD4 and HD4) have better outcomes than individual construction scenarios.

because cluster construction scenarios require less initial investment per user (washing machine).

Individual construction scenarios

there are differences in financial performance that are not related to the number of users but instead they are **related to the use stage in scenarios with the**:

- tank installed underground (pumping related costs)
- and the materials for the construction stage specially in scenarios LD3 and HD3 due to waterproofing materials costs

Conclusions

- High density scenarios have better outcomes from a cost-effective financial point of view.
- The best scenario is the High Density cluster construction HD4 because it has the best NPV and the second best IRR and PB.
- The savings in additive are more relevant 80% than tap water savings 20%. This depends on: The tap water price of the urban area, and the eco-efficiency of the washing machine (liters per washing cycle)
- If only one inflation rate is considered, the decision process may be affected by it.

Future research

- More scales in urban scenarios (neighbourhood, city, etc…)
- To match environmental impacts (LCA) with LCC.
- Mix : **Water prices** will tend to increase as water resources availability tends to be reduced, while potentially **technological advance** will continue to reduce energy and water consumption.
- **The end-of-life stage** in current studies is being neglected in economic or financial analyses, but following a sustainable approach, it will be necessary to consider this stage in all studies and from all study dimensions (environmental, social, economic, etc.)

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