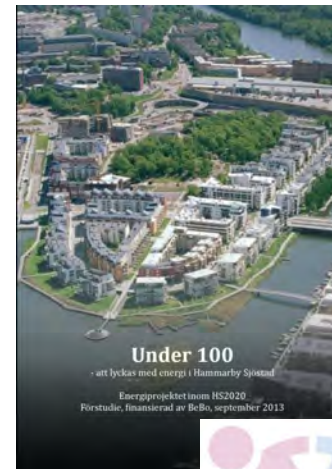


# What does it take?



**Reducing energy use and climate impacts in city district Hammarby Sjöstad, Stockholm by fifteen per cent in ten years**

Örjan Svane, Professor Emeritus in Urban Sustainable Development, KTH Strategic Sustainability Studies



*Let us assume that local actors reduced total energy use and climate impacts in Hammarby Sjöstad, Stockholm by fifteen per cent in ten years*



Local initiative ElectriCITY's aim

A similar aim in FP7 project CIVIS

Strategy for a fossil-free Stockholm 2040: Halving the impacts of producing electricity and district heating till 2025



## A backcasting scenario for 2025...

*Let us assume that local actors reduced total energy use and climate impacts in the Sjöstad, by 15 per cent, till 2025.*

**What does it take?**

- **What did change?**
- **Change by whom, and also**
- **intervention by whom?**
- **How demanding was change?**

...but is this a planning/design issue?

Planning by whom, for whom?



I samarbete mellan Sjöstadsföreningen och ElectriCITY Innovation

## What, Who, How Much...

*Let us assume that local actors reduced total energy use and climate impacts in the Sjöstad by fifteen per cent till 2025.*

**We ask:**

- What in the Sjöstad energy systems and their use did change?
- Who were the local actors, the primary change agents?
- What other actors were needed?
- How much is fifteen per cent, and fifteen per cent of what?
- How demanding was transformation?

What did change?  
Change by whom?  
How demanding was change?

Better an oops than a what if

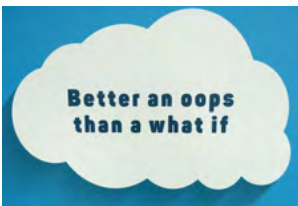
**...how to attain the aim.**

## Detailed assumptions...

*Let us assume that local actors reduced total energy use and climate impacts in the Sjöstad, by fifteen per cent till 2025.*

### We:

- Study transformation looking back from 2025,
- include energy provided to people using the buildings, via district heating and electric grid,
- consider all technically and economically feasible measures that could be taken locally,
- explore how the Sjöstad residents, businesses and real estate owners reduced their energy use and impacts,
- assume that ElectricCITY managed transformation, and
- assume that energy managers, consultants, local authorities and others also must be involved.



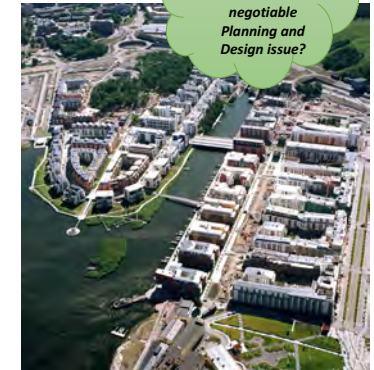
What did change?  
Change by whom?  
How demanding was change?

## The Hammarby Sjöstad Development History...

### Injecting the Environmental Programme into an ongoing process

- Planning is a municipal monopoly according to Swedish law
- Ca. 1990 prehistory: Architectural competition
- Ca. 1995 prehistory: Comprehensive plan
- Ca 1995 We want the 2004 Olympics!
- 1996 Environmental programme
- 1996 City Project Team
- 1997 No Games, but...
- Inertia from well-established routines
- Developed by 2020 ca.

What if Urban Sustainable Development were a non negotiable Planning and Design issue?



12 000 flats, 30 000 residents/locals

...change, but also inertia.

## The "Twice as Good" Objectives...

*When negotiating – what could be influenced by planning and design, what by other stakeholders, or in other parts of the area's life cycle?*

- Total energy supply 60 kWh/m<sup>2</sup> incl. max 20 kWh/m<sup>2</sup> electricity, all "green"; only renewable energy sources
- 80 % of commuting by public transport, walking or biking; 15 % of all local transport on renewables
- Waste to landfills reduced by 60 per cent; waste separation: Organics, textiles, harmful waste
- Water use reduced by 50 per cent; local treatment of storm water
- Use of virgin metals, gravel and sand reduced by 50 per cent
- All developed virgin land to be "recreated" within the area
- Outdoor noise below 40 dB(A) on one side of flats

It is never too late??

Some objectives realised, that of energy not

...who were the agents of change?

## ElectricCITY – Hammarby Sjöstad 2.0

*An ambitious Citizen Initiative turned formal – driven by the power of persuasion, needing lots of negotiation – 2011-2020*

- Sustainable transport: ElCar2020, "Charging at home"
- "Energy at Home": Below 100 kWh/m<sup>2</sup>
- Recycling
- Water
- Culture, sports, leisure
- ElectricCITY innovation platform

"Renewing a New City"

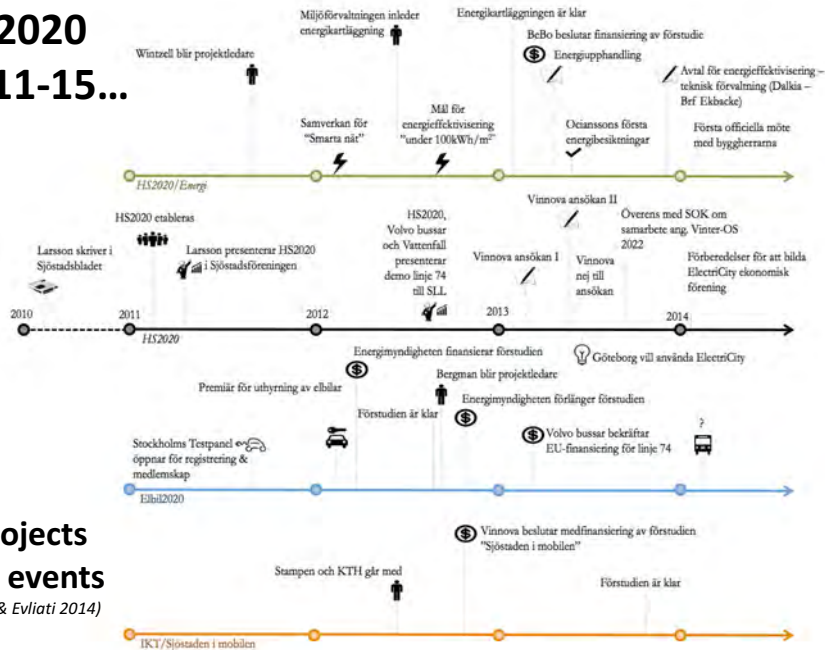
### Hammarby Sjöstad 2.0



"Att förnya en ny stad"  
Från global klimatkonferens i Paris till handlingsplan för energioch miljö i Sjöstaden



## HS2020 2011-15...



## ...projects and events

(Svane & Evliati 2014)

## Images of the Future...

### Vision 2020 – HS2020 Energy

- Smart networks controlled by ICT reduce energy use;
- Residents change their everyday habits, och
- active energy management reduces the use of district heating and electricity
- "Below 100 kWh/m²yr"



(A. Larsson, presentation february 2014)

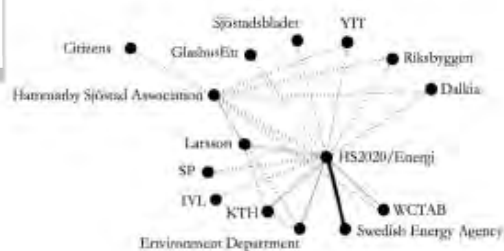
...eight visions, eight programmes.

## Actor networks...



HS2020 Energi hösten -12  
(Ackebo m.fl. 2012)

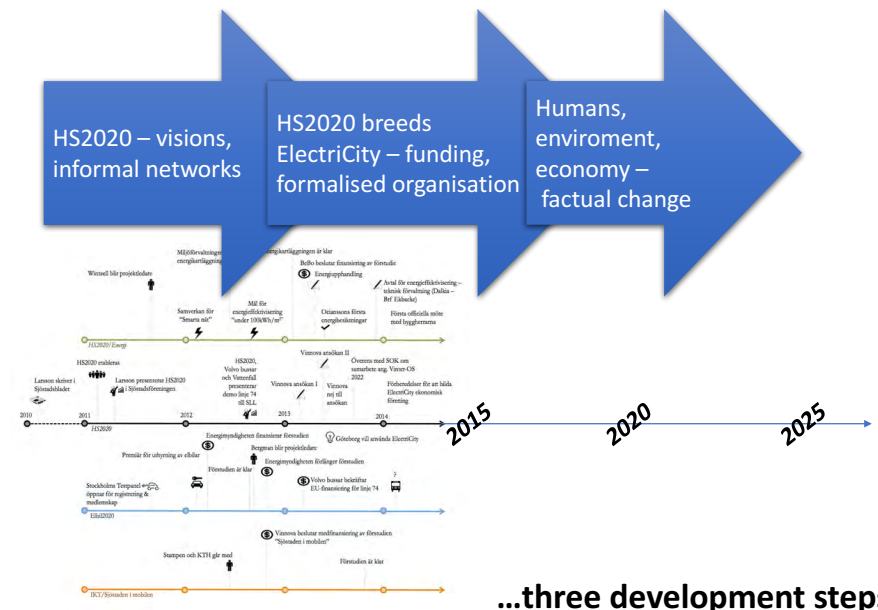
...but only the power of persuasion...



HS2020 Energi hösten -13 (Evliati 2013)

...of demand shapers and innovators.

## HS2020 is built: 2011 -20 and beyond...



...three development steps.

## A backcasting scenario for 2025...

Let us assume that local actors reduced total energy use and climate impacts in the Sjöstad, by 15 per cent, till 2025.

- What did change?
- Change by whom, and also
- Intervention by whom?
- How demanding was change?

Planning by whom, for whom?

What if Urban Sustainable Development were a non negotiable Planning and Design issue?

...but is this a planning issue?

Below 100 for the whole district ≈ reductions by 15 per cent

**Under 100 kWh  
- att lyckas med energi  
i Hammarby Sjöstad**



Arbete mellan Sjöstadsföreningen och ElectricITY Innovation

## How much...

Which is the magnitude of transformation?

We explore:

- how much energy is used in 2015,
- how big was the reduction potential,
- how much was use reduced till 2025, and
- how much did climate impacts decrease.
- Feasibility check: Is the potential greater than the aim?

CO<sub>2</sub> emissions: kg

- total
- per person
- and per year

Energy: kWh

- total
- per person
- per m<sup>2</sup>
- and per year

...quantitatively explored.

## Background data...

<b>Ytor 2015:</b>	Yta, m <sup>2</sup>	Andel, %
Lägenheter (BOA), (energi- och skattedeclarationer)	551'	75
Lokaler (54% av LOA) (energi- och skattedeclarationer)	40'	5
Garage, varma (46% av LOA) (energi- och skattedeclarationer)	37'	5
Återstående (beräknad)	109'	15
<b>Uppvärmad total (Atemp)</b> (energi- och skattedeclarationer)	<b>737'</b>	<b>100</b>

<b>Nyckeltal, årlig energianvändning, 2015:</b>	Energi, MWh	Andel, %
Värme + varmvatten, 103 kWh/m <sup>2</sup> år (Atemp)	76 000	68
Fastighetst, 15 kWh/m <sup>2</sup> år (Atemp)	11 000	10
Hushåll, el, 40 kWh/m <sup>2</sup> år (BOA)	22 000	20
Garage, el, 15 kWh/m <sup>2</sup> år (46% av LOA)	500+	<0
Verksamheter, el, 50 kWh/m <sup>2</sup> år (54% av LOA)	2 000	2
<b>TOTAL</b>	<b>111 000</b>	<b>100</b>

Tabell 1: Uppvärmade ytor, nyckeltal och total energianvändning

Heated areas as of 2015:

Total 737' m<sup>2</sup>

Key ratio energy use per year, 2015:

Total 111' MWh

<b>Total energianvändning från tabell 1</b>		
El	35 000 MWh/yr	
Fjärrvärme	76 000 MWh/yr	
<b>CO<sub>2</sub> per kWh – antagna omräkningsfaktorer</b>		
Nordisk elmix 75-100 g/kWh, Swedish elmix 15-25 g/kWh		Vi använder 20 g/kWh
(Klimatkompassen)		
Fjärrvärme, Fortum 35 g/kWh, Stockholms stad 110 g/kWh		35 g/kWh
(Uppvärmningsanläggning, Fortum värme, 2014; Miljöförvaltningen, 2016)		
<b>Beräkningar, årliga utsläpp</b>		
CO <sub>2</sub> , el: 35 000 MWh*0,02 kg/kWh		700 ton
CO <sub>2</sub> , fjärrvärme: 76 000 MWh*0,035kg/kWh		2 700 ton
<b>Total CO<sub>2</sub></b>		<b>3 400 ton</b>

Tabell 2: Beräkningar av energianvändning till klimatutsläpp

Conversion factors:  
A contested issue

The City's way of calculating

CO<sub>2</sub> per kWh electricity: 0,085 kg/kWh

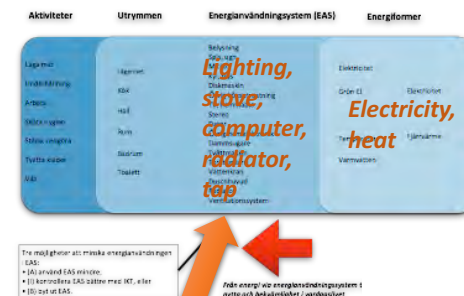
CO<sub>2</sub> per kWh district heating: 0,11 kg/kWh

CO<sub>2</sub> electricity 3 150 tons  
CO<sub>2</sub> district heating 8 350 tons  
Total CO<sub>2</sub> per year 11 500 tons

...areas, energy use, climate impacts.

## Residents as transformers...

Reduce by 10-15%:  
Save electricity,  
buy "green electricity"



The resource: electricity,  
district heat  
kWh, total, per person or m<sup>2</sup>

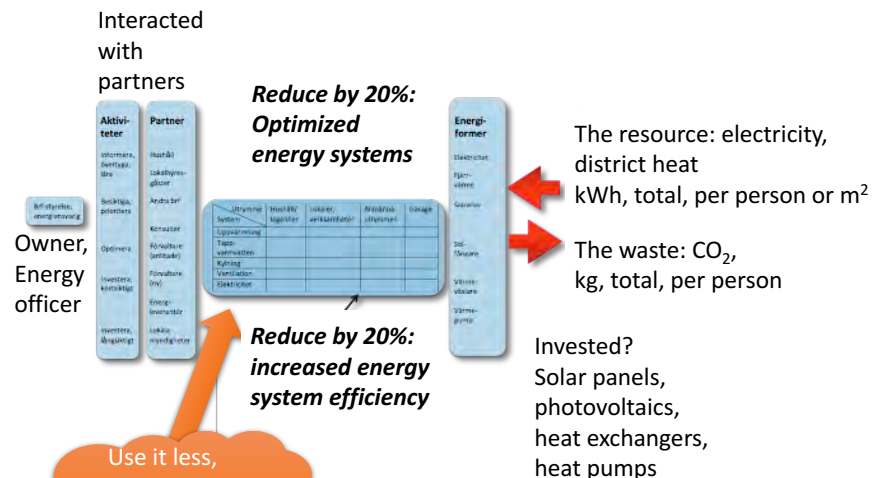
The waste: CO<sub>2</sub>,  
kg, total, per person

Use it less,  
exchange it,  
control it via ICT

Reduce by 5-10%:  
Lower indoor temperature,  
use less hot water

...essentially on their own.

## Owners as transformers...



...need professional partners.

## The ElectriCITY aim vs. the actors' potentials...

Slut-användare	Användning, MWh	Potential, procent	Besparing, MWh	Bidrag till minskning, procent
Borande, fjärrvärme, el	57 000	7,5±2,5	4 250±1 500	6±2
Lokalinnehavare, el	4 000	7,5±2,5	300±100	0,5±0,3
Fastighetsägare, fjärrvärme, el	2 000	12,5±2,5	250±50	28±3
Fastighetsägare, fjärrvärme, el	76 000	40±5	30 400±3 800	28±3
MAXIMALT MÖJIG MINSKNING I STADSDELEN	2 200	12,5±2,5	275±55	30-40 procent

If all actors do all they can, use their full reduction potential:

WHOSE potentials	Energy, per cent	CO <sub>2</sub> , per cent
All 9 000+ households	6±2	6±2
All ca. 100 businesses etc.	±0,5	≈ 1
All ca. 75 real estate owners	28±3	32±4
Actor categories together	30-40	33-45
ElectriCITY's aims	15	15

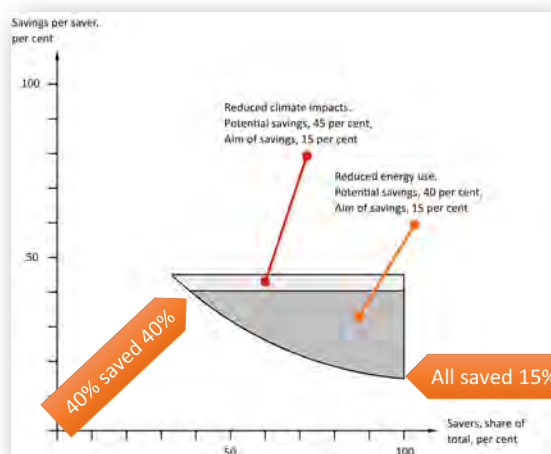
The reduction potential was more than twice the reduction aim, so it could easily be done...

Note: Buildings without flats are not included...

användare	ton CO <sub>2</sub>	procent	ton CO <sub>2</sub>	minskning, procent
Borande, fjärrvärme, el	2 000	7,5 ±2,5	150±50	6±2
Lokalinnehavare, el	450	12,5±2,5	55±11	1±0
Fjärrvärme, el	150	7,5 ±2,5	11±4	32±4
Fastighetsägare, fjärrvärme, el	275	12,5±2,5	35±7	33-45 procent
MAXIMALT MÖJIG MINSKNING I STADSDELEN	2 650	40±5	1 050±133	

...how to do it in ten years...

## But what is 15 per cent out of 35?



How to share the challenge?

...some contributed a lot, or...

...all contributed some...

Wide or Deep – which was easier to achieve?

...assuming just one change agent.

## Scenario 1, Efficient implementation...

	Share of participants, per cent	Average reduction, per cent	Contribution to transformation, per cent
Estate owners	75	32	15
AIM			15

Were they informed, persuaded? Did they collaborate? Who organised?

...55 real estate owners took action.

## Scenario 2, Helping many...

	<u>Share of participants, per cent</u>	<u>Average reduction, per cent</u>	<u>Contribution to transformation, per cent</u>
<b>Residents</b>	50	7-8	3
<b>Businesses</b>	60	10	≈0
<b>Estate owners</b>	67	28	12
<b>AIM</b>			<b>15</b>

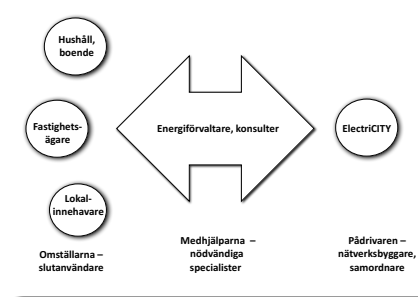
Were they  
informed,  
pesuaded?  
Did they  
collaborate?  
Who organised?

**...4 500 households, 60 businesses, 50 owners acted.**

## Transformation did not happen on its own...

***There is a gap between the primary change agents and ElectriCITY:***

- Residents have direct influence of energy use in their flats, and
- enterprises have it in their premises.
- Real estate owners can improve the buildings' energy systems and reduce energy use in its common spaces.
- ElectriCITY can initiate and coordinate, but has no direct influence over energy use.



Were the change agents informed, persuaded?  
Did they collaborate?  
Who organised?

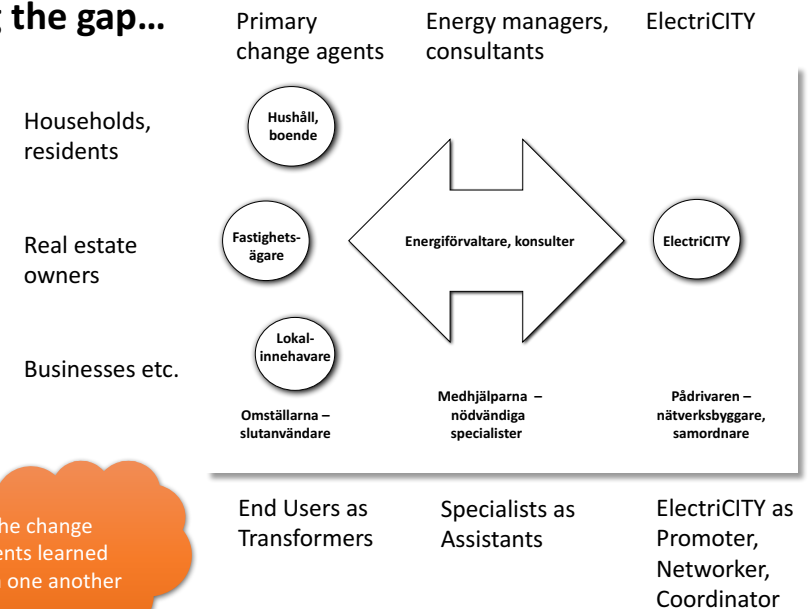
### ...how was the intervention chain forged?

## How to forge an intervention chain...



In fact it was rather an informal/formal, interactive network

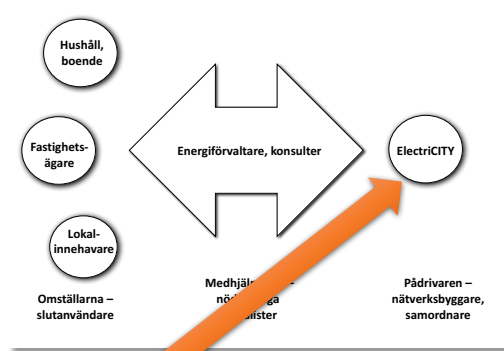
## Filling the gap...



The change  
agents learned  
from one another

## ElectriCITY as promoter...

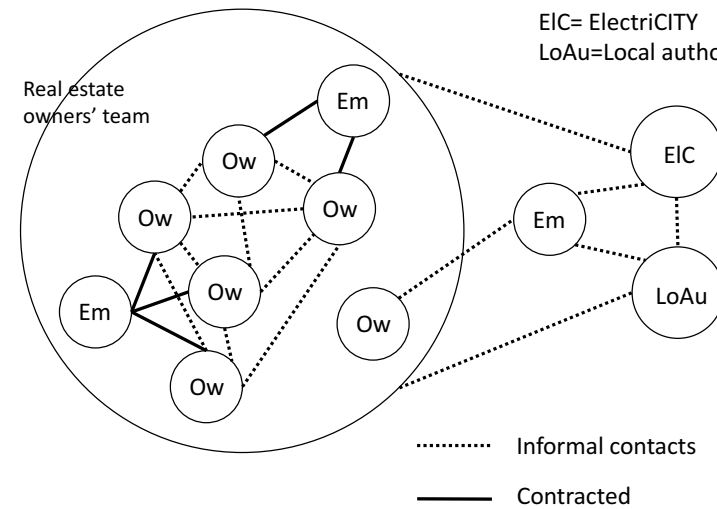
- **Informed** on energy use,
- **persuaded** on transformation,
- facilitated **match-making** between transformers and assistants,
- provided real **arenas** or visual, ICT-based ones, and
- finally became **superfluous**.



...and network builder.

## Network development...

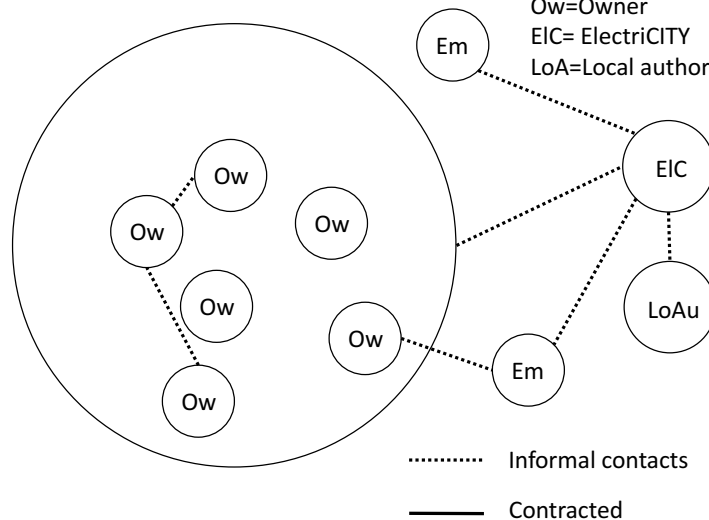
EM=Environmental manager  
Ow=Owner  
EIC= ElectriCITY  
LoAu=Local authorities



...in the early 2020s.

## Network development...

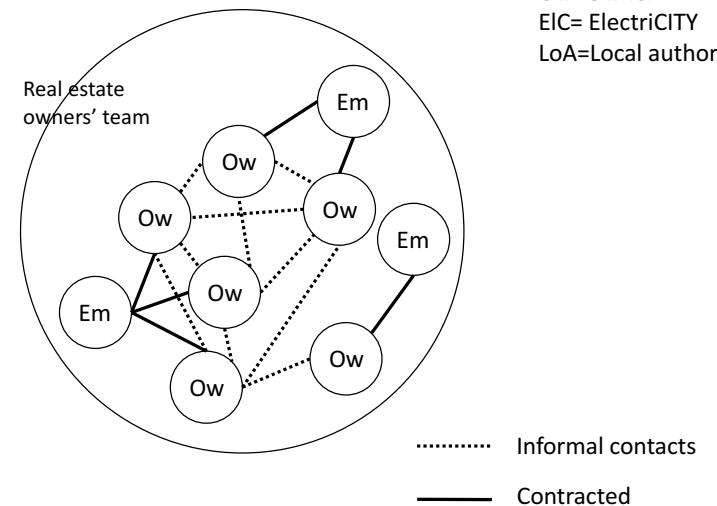
EM=Environmental manager  
Ow=Owner  
EIC= ElectriCITY  
LoA=Local authorities



...around 2015, informal ties, ECITY the spider in the web.

## Network development...

EM=Environmental manager  
Ow=Owner  
EIC= ElectriCITY  
LoA=Local authorities



...after 2025, the network builders are gone.

## Backcasting how we got there...

### Forming the intervention network – a tall order?

- an information and persuasion campaign,
- continuous meetings on arenas provided,
- targeting one-two-three categories of end users,
- at most more than 10 000 people,
- lasting ten years.

### Who were the other links of the chain?

- one coordination office for it all,
- ElectriCITY as "the spider in the web",
- separate intervention chains for each end user category,
- subdivided message towards target sub-groups,
- using general policy instruments: Taxes? Energy prices? Laws and regulations?
- using target group oriented marketing: Persuasion based on information?
- what media were used, how to repeat and vary the message?
- how to package the message of "do this, not that".



ElectriCITY is totally unique, but How to make this a generally applicable methodology?

...striking a balance between deep and wide?

## Concluding how we got there...

*It took some effort to realise the district's 15% saving aims, though they were seemingly modest and time was ample*

### The organisation:

- it took a great, concerted effort, involving many local actors,
- the end users are the key, they are the primary agents of change,
- by necessity, a large share of the potential actors were agents of change,
- the Intervention Chains were there, but as formal/informal networks,
- a "spider in the web", such as HS2020/ElectriCITY was necessary.

### The medium and the message:

- local public actors used general policy instruments,
- marketing identified target sub-groups, informed and persuaded accordingly,
- the message was repeated and changed, persistent and nagging, and
- follow-up and feedback were important, awards too.

Feasible? A district level information and persuasion project organisation

...a backcasting scenario.

## Four necessary strategies...

*Let us assume that the challenge of urban sustainable development is non-negotiable and to be realized till 2060.*

*I propose four strategies for the transformation of the building stock:*

- construction of low-impact buildings ( passive – plus houses...),
- refurbishment with impact reduction,
- management for sustainable development, and
- more efficient use of existing buildings.

Nothing on change of habits?

Provisional conclusion: All actors must do all they can whenever there's opportunity.



...each insufficient on its own.

## How and by Whom...



Örjan Svane,  
Professor Emeritus in Urban Sustainable Development,  
KTH Strategic Sustainability Studies

...new strategies, who can implement them?