

9th Greening of Industry Network Conference, January 2001, Bangkok, Thailand

TOWARDS SUSTAINABLE HOUSEHOLDS: A METHODOLOGY FOR DEVELOPING SUSTAINABLE TECHNOLOGICAL AND SOCIAL INNOVATIONS

Ken Green and Philip Vergragt

*Ken Green, Professor of Environmental Innovation Management,
CROMTEC, Manchester School of Management,
UMIST, Manchester, M60 1QD, England
Tel: ++44 161 200 3432; Fax: ++44 161 200 3505
e-mail addresses: ken.green@umist.ac.uk kgreen161@aol.com*

*Philip Vergragt, Professor of Technology Assessment
TUDelft – Faculty OCP, Section Design for Sustainability,
Jaffalaan 9, 2628 BX Delft – The Netherlands.
Tel: ++31-15-2782738; Fax: ++31-15-2782956
e-mail: ph.j.vergragt@io.tudelft.nl*

ABSTRACT

To achieve environmental sustainability, some claim that we have to improve our environmental efficiency by a Factor 4, enabling the world to double its wealth while halving the environmental burden. Others argue that we will have to fulfil social needs in 2050 *twenty* times more environmentally efficiently, i.e. by *Factor 20*. A Factor 20 efficiency improvement by 2050 is in response to an assumed doubling of the world population combined with a fivefold increase of wealth per capita with a halving of the total global environmental burden. It has been argued that solutions to all environmental problems could be arrived at through good housekeeping and *technological innovation*. However, such technological solutions will have to be combined with *social innovations*, in lifestyles and cultures.

This paper describes the conclusions of the *SusHouse* (Strategies towards the Sustainable Household) Project that has been exploring possible socially and technologically innovative strategies for sustainable households. The Project has covered 3 household 'functions': Clothing Care, Shelter (Heating, Cooling and Lighting) and Food (Shopping, Cooking and Eating). These have been studied in 5 European countries (Germany, Hungary, Italy, Netherlands, and UK). The methodology of the Project has involved stakeholder workshops, the construction of *design-orienting scenarios*, environmental, economic and consumer assessment of the scenarios and strategy formulation. The paper describes:

- the methodology for devising *Design-Orienting Scenarios*, with examples from the three Functions
- the results of environmental, economic and consumer acceptability assessments of these Scenarios
- comments on how the methodology can be developed and applied.

Keywords: Sustainability, Households, Innovation, Scenarios

1. INTRODUCTION AND BACKGROUND

Environmentally sustainable development has been on the policy agenda since the Brundtland report (WCED, 1987). Much work has been done on the supply side of the production of goods: sustainable technologies for energy generation, materials mining and processing, and for product manufacture have been developed, innovated and diffused in the last decade. However, levels of *consumption* continue to rise, consumers being a notoriously difficult target for policy makers seeking to induce more sustainable practices.

This problem is even starker if we look into the far future. In 50 years, world population could double. Further, if a sustainable level of production and consumption is to be reached world-wide, the environmental burden *per capita* will go up by a factor of 5 (Weaver *et al.*, 2000). In order to *halve* the total environmental burden *per capita*, the fulfilment of a need will have to be 20-fold more environmentally sustainable than now: a Factor 20 improvement.

The Dutch Sustainable Technological Development (STD) Programme was one of the first to seek to meet this challenge. This Programme developed a methodology based on *back-casting*: that is, looking back from a desirable (in this case, sustainable) situation in the far future to the present, in order to make steps towards this future now. This methodology has been described elsewhere (Weaver, 2000; Vergragt and Jansen, 1993) However, many aspects of this methodology were in need of further elaboration and operationalisation. The methodology developed and evaluated in the *SusHouse* Project has been derived from the STD methodology, and more specifically from the Sustainable Washing Project (Vergragt and Van der Wel, 1998). However, the *SusHouse* Project has made substantial changes, namely:

- less emphasis is laid upon technology as the main agent for sustainable development; rather, a combination of *technological, social, and cultural changes* is envisaged.
- more emphasis is laid upon the *participation of non-governmental stakeholders* in the process.
- a *design orientation* is chosen, rather than a policy-making orientation.

So, the aim of the *SusHouse* Project was *to develop and test a methodology* that would

- enable companies, governmental. policy organisations and NGOs to carry out their own analyses of household functions
- identify possible product, system and social innovations which offer business opportunities and policy initiatives now
- develop scenarios for sustainable household functions using industry-consumer-government creativity groups
- develop methods of assessing the viability of these sustainable household function fulfilment.

The development of the methodology was backed up with case examples of imaginative scenarios developed during the Project, for the fulfilment of functions of the sustainable household; the scenarios were subject to environmental assessment, economic analysis and consumer acceptance analysis and have been 'endorsed' by the social partners in the Project. The Project focused on three so-called 'household functions', selected because of their heavy contribution to the environmental burden caused by households, namely: Shopping, Cooking and Eating (Food); Shelter (heating, cooling, and lighting the house); Clothing and Clothing Care.

This paper presents a sketch of the methodology and some of *design-orienting scenarios* that were developed as case examples. It concludes with an evaluation of the methodology and some suggestions for how it could be taken further. (*The Full Results of the Project, with a complete set of all the Project's Reports and a PowerPoint presentation of the highlights, are available on CD-ROM from the authors of this paper.*)

2. THE METHODOLOGY

2.1 Introduction

The *SusHouse* methodology consists of a specific combination of stakeholder creativity workshops, scenario writing, environmental assessment of scenarios, economic assessment of scenarios, consumer acceptance research on scenarios, and back-casting workshops. These were carried out on the three Household Functions - Clothing and Clothing Care (CC), Shelter, and Shopping, Cooking and Eating (SCE). The main feature of the methodology is to develop scenarios which conceptualise technological and social innovations that are imaginable *now*, that might bring about sustainability in the three household Functions. Each Function was studied in three European countries, as shown in Table 1, by a multidisciplinary research teams.

Table 1: Organisation of the project: Household functions

Country	Shopping, Cooking, Eating	Clothing care	Shelter
Germany		X	@
Hungary	X		
Italy		@	X
Netherlands	X	X	
UK	@		X

@ = Function Leader

The methodology has seven phases. These were developed and evaluated over a period of two and a half years, the plan for which is shown in Table 2. When carried out by companies, governmental. policy organisations and NGOs the methodology would follow the same steps, though on a much reduced timetable.

Table 2 SusHouse Project phases 1998-2000

Phase	1	2	3	4	5	6	7
Month	1-4	5-8	9-12	1-4	5-8	9-12	1-6
Year	98	98	98	99	99	99	00
Devising Formats	X						
Developing 'Proto-		X					

scenarios'							
Creativity workshops			X				
Developing 'Design-Orienting Scenarios' (DOSs)				X			
Environmental Assessment					X		
Economic Assessment					X		
Consumer. Acceptance.					X		
Implementation Workshops						X	
Report Writing							X
Policy suggestions							X

2.2 Workshop Organisation and Stakeholder Management

One of the central issues in the *SusHouse* methodology is the involvement and enrolment of stakeholders (Quist *et al.*, 2000). This is important so as to:

- confront stakeholders with the "Factor 20" sustainability challenge
- encourage them to think in creative ways about long-term solutions
- encourage them to consider desired future states (future visioning) rather than taking the present situation as a starting point for sustainable solutions
- encourage them to think creatively beyond the barriers of their own discipline or business scope.
- create the opportunity for stakeholders to meet each other who not normally would have met each other.
- create conditions for collaboration in future oriented projects.
- enlarge the scope of their thinking about solutions, and their time horizon.

For each function studied in the five countries, two workshops were organised. The first workshop aimed at *creativity*: to generate, jointly with the stakeholders, a multitude of ideas and potential solutions for the fulfilment of a household function in the year 2050. These ideas were subsequently *clustered* into proto-scenarios, with the aim of creating 'visions' of attractive sustainable futures.

The objectives of the second (*back-casting*) workshop are to:

- get stakeholder feedback on the scenarios and assessment results
- increase stakeholder support and enthusiasm for the scenarios and results
- involve new and 'old' stakeholders relevant for the realisation of the scenarios
- identify necessary changes and related research agendas for gaps in knowledge

- elaborate implementation proposals & concrete projects
- develop concrete stakeholder co-operations around implementation proposals and projects
- develop policy recommendations supporting the necessary changes and concrete proposals.

The enrolment of stakeholders, and the consecutive nurturing of the contacts, are essential aspects of the methodology. Relevant stakeholders have to be identified, closely related to the definition of the household function itself, and its boundaries, and to its 'supply chain'. Not only relevant *present* stakeholders, but also possible *future* stakeholders, potential actors in future scenarios, have to be located. Of course, this is a methodological chicken-egg problem: stakeholders together define in a creativity workshop what the future scenarios might be, and by implication who are the relevant stakeholders in these future scenarios.

2.3 Scenario building

A second essential element of the *SusHouse* methodology is the creation of 'micro' normative scenarios for a sustainable household function. These scenarios are based on the creativity workshops and the ideas generated by the stakeholders. The scenarios are based on these general notions:

- Technological innovations are necessary but insufficient to bring about Factor 20 sustainability improvement
- A shift from products to services may offer new options for changes towards sustainability
- Sharing household activities offers a potential for sustainability gains

The scenarios are intended to generate a vision of sustainable household function fulfilment that differs radically from the present. This is why workshop participants were asked to focus on the year 2050 to envision futures that might breach current trends. Such visions may open up new ways of thinking, researching, designing and acting *in the present* (or, at least in the next few years) and thus offer a way out of the present consumption deadlock. The project developed the concept of the *Design-Orienting Scenario* (DOS), as opposed to the more common notion of the Policy-Orienting Scenario (POS) (Manzini and Jegou, 2000). A Design-Orienting Scenario is defined at the micro-level of the (future) household, rather than the whole society of economy, and is supposed to create inspiration for 'designers', whether in industry, government, universities or NGOs, to design products, services and social arrangements that might help to realise steps towards these scenarios.

A DOS should contain the following elements:

- Various "Proposals" developed as concrete products and/or services
- A global "Vision" picturing the effect of the implementation of the Proposals and their possible impact
- The "Essential Characteristics" explaining the main effects and benefits the DOS is expected to have in terms of sustainability, economics and user acceptance.
- A story board, describing "a day in the life..." for the household function in the year 2050.

Each of the DOSs devised in the *SusHouse Project* was assessed with respect to three criteria: environmental improvement; economic viability, and consumer acceptance.

2.4 Environmental Assessment

For the environmental assessment, we adapted an Life Cycle Assessment (LCA)-type methodology so as to be able to assess future scenarios. The details of how such assessments can be carried out is described elsewhere (Bras-Klapwijk, 2000), but the main aims are to:

- gain insight into the environmental impacts of the current situation
- gain insight into the environmental impacts of the DOSs and their reduction potential
- gain insight into the strong and weak points of the DOSs
- inform the participants of the second round of workshops in which they adapted the DOSs, and made policy recommendations and concrete plans.

2.5 Economic Assessment

Each DOS was subjected to an economic assessment. This assessment was carried out by means of a questionnaire, completed with the aid by economic experts. Details of the questionnaire and its analysis can be found in Young and Simms (2000). The questionnaire focused on how industry structures will (have to) change to accommodate the DOS Proposals, which stakeholders might have an interest in bringing about the necessary innovations (as business opportunities) and whether the Proposals are viable from a macro-economic point of view, including variables as firm sizes, employment, sectoral interactions, trade and competitiveness. Lack of viability is not seen as a *negative* feature of the DOS proposals; rather it illuminates what changes in economic, regulatory and other policies would have to be enacted by governments to realise desirable household consumption patterns.

2.6 Consumer Acceptance Assessment

In addition to showing environmental gains and a business stakeholder interest, the scenarios need also to be acceptable to consumers who would have to 'live' the particular household lifestyles that the scenarios portray. Presenting the DOSs to focus group of consumers enabled the *SusHouse* researchers to carry out a 'reality check' on the scenarios, identifying possible barriers for consumer adoption of them scenarios and, crucially, getting ideas for modifying them to increase their probability of adoption.

The methodology (for details, see Bode, 2000a) involved individual questionnaires and focus groups, to whom the scenarios were presented visually and verbally as an everyday life description. The focus groups included groups of

- "green consumers"; that is those thought most likely to adopt environmentally-friendly options
- "mainstream consumers"; that is those less likely (or even unlikely) to adopt environmentally-friendly innovations
- "dynamic consumers"; that is, those representative of "future adopters" (analogous to the notion of "future stakeholders")

3. THREE HOUSEHOLD FUNCTIONS

The *SusHouse* methodology was applied to three household functions, each investigated in three countries. This section briefly presents the DOSs that were devised and the results of the assessments of them. Section 4 analyses the results comparatively.

3.1 Shopping, Cooking, and Eating

In this Function, the focus was on technological and social factors that have an impact on the shopping, cooking and eating behaviour of household members (whether conducted in their own kitchens or in restaurants) and on their use of energy-intensive, transport-intensive and chemical-agriculture-intensive materials and services (Green and Young, 2000). Shopping, Cooking and Eating was investigated in three countries - Hungary, the Netherlands and the United Kingdom (Young, 2000; Toth *et al*, 2000; Quist, 2000). Table 3 summarises the DOSs that were devised and Table 4 summarise the results of the assessment studies.

Table 3 : SCE DOSs and proposals

DOS	Main Features	Country Studying this DOS
DOS 1: Local and Green	<ol style="list-style-type: none"> 1. Local sustainable organic production systems 2. Local “taste bank” restaurant 	Hungary, Netherlands, UK
DOS 2:Hi-Tech Eating (UK)/ Robo-Kitchen and Hi-Tech Eating(Hungary/ Intelligent Cooking & Storing (Netherlands) (The DOS was named differently in the three countries)	<ol style="list-style-type: none"> 1.Wide production of quick preparation, healthy, functional and environmentally friendly products 2.Intelligent kitchen appliances 3.Development and promotion of monitoring systems for food additive detection in foodstuffs prepared by GMO for all the World. 4. New generation of packaging and waste treatment 	Hungary, Netherlands, UK
DOS 3: Neighbourhood Food Centre (‘Super-Rant’)	Combined Supermarket and Restaurant offering collective cooking and eating services	Netherlands
DOS 4: High-Tech Rural Gardens	<ol style="list-style-type: none"> 1. Development and spreading of such product groups which make easy the high-tech production in small gardens. 2. Improving services developing supplier chains 	Hungary
DOS 5: Virtual Shopping	<ol style="list-style-type: none"> 1.Home delivery of shopping. 2.Shared ordering (virtual/bulk delivery). 	UK

For each DOS tested in the three countries, an estimate was made of the scale of change that might result either in *environmental impact* or *economic impact* or the extent to which the DOS found *consumer acceptability*. The degree of environmental impact *reduction* or the size of economic changes required to bring about the DOS or the degree of consumer acceptability is indicated on a scale of Xes (1 to 5). If the environmental impact is thought likely to *increase*

or consumers find the DOS unacceptable, then this is indicated in words ("increase", "negative"). Given the significant differences between the Hungarian consumer acceptability focus groups in their evaluation of the DOSs, this is also presented in the Table)

Table 4: SCE Function - Overall Assessments

Design-Orienting Scenario (DOS)	Environmental Impact Reduction	Economic Impact	Consumer Acceptability
Local and Green	HU= XXXX NL= XXXX UK= XXXX	HU= XXX NL= XXXX UK= XXXX	HU(Dynamic Gp) = XX HU(Green Gp) = XXXX NL= XXXX UK= XXXX
High-Tech eating/ Robo-Kitchen/ Intelligent Cooking and Storing	HU= XX NL= XXXX UK= X	HU= XXX NL= X UK= X	HU(Dynamic Gp) = XXXX HU(Green Gp) = XX NL= negative UK= XX
Virtual Shopping	UK= XX	UK= XX	UK= XX
'Super-Rant'	NL= Increase	NL= XX	NL= negative
High-Tech Rural Garden	HU= XX	HU= XXX	HU= XXX

3.2 Clothing and Clothing care

In *clothing care* we include all those activities carried out by the user of clothes and/or by clothing care services on his/her behalf, at the beginning, during and at the end of the clothes-using phase. That means the boundaries of the system enclose the acquisition, maintenance and collection of the used clothes (Vezzoli, 2000). Table 5 presents the DOSs that were developed (Maschi and Sancassiani, 2000; Bode, 2000b; Knot, 2000) and Table 6 summarises the environmental saving potentials of these DOSs. The number of +s, in Table 6, indicates the size of the environmental saving potential; "large/small increase" indicates an increase in environmental impact

Table 5: Clothing Care DOSs for each country

<i>CLOTHING CARE DOS</i>	<i>Germany</i>	<i>Italy</i>	<i>The Netherlands</i>
CLOTHING CARE OUTSOURCING	<p>CLOTHING CARE OUTSOURCING</p> <ul style="list-style-type: none"> • Clothing Care Service Centre 	<p>CLOTHING & CLOTHING CARE PROVIDER</p> <ul style="list-style-type: none"> • clothing bank • metro laundry • clothes worn as uniforms 	<p>CLOTHING AND CLOTHING CARE OUTSOURCING</p> <ul style="list-style-type: none"> • 'The Clothary' • The Personal Wardrobe Lease system • Soft Wear (disposable underwear) • Dirt indicators • Stain removers
COLLECTIVE CLOTHING CARE	<p>COLLECTIVE CLOTHING CARE</p> <ul style="list-style-type: none"> • Community Clothing Care Centres 	<p>COMMUNITY SYSTEM FOR CLOTHING CARE</p> <ul style="list-style-type: none"> • a diary of a dress • polylaundry • hard & soft clothing 	<p>CLOTHING POOL</p> <ul style="list-style-type: none"> • (Semi-) self-organised Clothing Pool with shared equipment and shared clothing • Strong and durable children's clothing • Dirt indicators
			<p>CHAIN OF USERS</p> <ul style="list-style-type: none"> • Clothing databanks and body-cards • Clothing deposit system and day/wear value system • Home maintenance • Clothing service shops
MY CLOTHES MY ETERNAL FRIENDS	<p>MY CLOTHES, MY ETERNAL FRIENDS</p> <ul style="list-style-type: none"> • limited wardrobe with basic suit and individualised modules 		<p>ETERNALLY YOURS</p> <ul style="list-style-type: none"> • Limited, durable, made-to-measure wardrobes • Service contracts and financing systems • Stain removers • Fresh-up closet
SOFT CARING		<p>SOFT CARING</p> <ul style="list-style-type: none"> • climatized wardrobe • dirt detector • clothing tanks • elements of clothes 	
EASY CARE		<p>EASY CARE</p> <ul style="list-style-type: none"> • active fabrics • automatic care kiosk 	

Table 6 Clothing Care DOSs: environmental saving potentials

	Germany			Italy		The Netherlands	
	<i>Clothing care outsourc.</i>	<i>Eternal cloth</i>	<i>Collective clothing care</i>	<i>Clothing care outsourc</i>	<i>Soft care</i>	<i>Eternal cloth + clothing pool</i>	<i>Clothing care outsourc.</i>
Energy	++	+++	++	+	+	++	+++
Clothing materials	++	+++	++	++	+	+++	Large increase
Water	+	+++	++	++	+	+++	+++
Transport						+++	+++
Travel	++	+++	---			++	Small increase
Household sewage	++	+++	++	+++	+++	++	+++
Detergents	++	+++	++	+++	+++	+++	+++
Washing equipment						+++	+++
Clothing waste	++	+++	++	+	+	+++	Large increase
Emissions	++	+++	++	++	+++	++ / +++	++ / +++

3.3 Shelter

The “Shelter for a Sustainable Living” Function (briefly “Shelter”) encompasses the indoor conditions of residential dwellings, namely indoor temperature and lighting. Heating/cooling makes up the major proportion of residential energy consumption; an examination of lighting offers interesting options for changing inhabitants’ behaviour as a lead-in to the topic of personal energy saving (Pfeiffer, 2000a). Table 7 presents the Shelter DOSs (Pfeiffer, 2000b; Pacchi and Panini, 2000; Anderson, 2000) and Table 8 presents the results of the assessments of the DOSs.

Table 7: Overview of the DOSs elaborated and assessed in the three Shelter Countries

DOS Title (Brief Description)	ITA	UK	GER	Cluster*
Comfort Management Service (Full home management service provided by comfort companies using energy-efficient, intelligent technology)	X	X	X	Care Outsourcing
Edumation (Education and information on <i>Shelter</i> for the private users by visualisation of personal energy consumption, consultation, and incentive programmes)	X		X	Soft Care
Natural Living (Matching lifestyle with seasonal and diurnal variations in temperature and light as well as architectural flexibility lead to households being self reliant in respect of <i>Shelter</i> needs)	–	X		High Care
Active House (Automated control of high-tech heating and lighting equipment to meet <i>Shelter</i> requirements within a compulsory energy limit)		X		Easy Care
Wearables (Residents are heated and cooled directly on the body using wearable products)	X			Soft Care
Come Together (Sharing facilities and decentralised energy supply structure)			X	Care Socialising

X = shared DOS.

– = DOS elaborated, but not assessed.

Table 8: Comparison of Assessment of Shared DOSs

COMPARISON OF SHARED DOSs	Comfort Management Service			Edumation	
	UK	Italy	Germany	Italy	Germany
Environmental Assessment (household phase)	Energy: ++ Durables: -- (-) (in UK higher increase than in IT and GER)			Energy: ++ Consumables: n.c.	Energy: +++ Consumables: ++
Economic Assessment	mainly similar: + <i>manufacturers</i> + <i>maintenance firms</i> + <i>construction industry</i> - <i>DIY sector!</i>			mainly similar: +/- <i>energy suppliers</i> + <i>manufacturers</i> delocalisation of energy supply both supply and self-product'n	
Consumer Acceptance	ranging from ☺ to ☹ tested in same consumer groups (mainstream and (green-)dynamic)			similar: ☺(!)	
	tailored ☺ vs. packages ☹ in GER	aesthetic aspect	too controlled, no nature, no DIY	tested group: mainstream	tested groups: dynamic green

Legend:

Environmental Assessment: n. c. no change
 + / - reduction/ increase up to 33%
 ++ / -- reduction / increase up to 66%
 +++ / --- reduction / increase up to 100%

Economic Assessment: + advantage
 - disadvantage

Consumer Acceptance: ☺(!) (very) positively evaluated
 ☹ negatively evaluated

4.DESIGN-ORIENTING SCENARIOS: COMPARISONS

4.1 DOS Assessments

The *Economic Assessment* showed, not surprisingly, that large structural and sectoral changes are necessary for the realisation of many of the DOSs. Table 9 gives an indication of the types of changes that may occur across each Function if the DOSs were to be implemented.

Table 9: Common DOS trends for each Function.

Clothing Care
<ul style="list-style-type: none"> • Increase in durable & high quality clothing manufacturers. • Increase in service providers: clothing centres, clothing pools, neighbourhood centres, clothing banks & clothing care providers. • Decrease in clothing retailers. • Changes from domestic to industrial washing machine & detergent manufacturers.
Shelter
<ul style="list-style-type: none"> • Increase in new sectors such as (G)CMS & wearables. • Increase in control equipment manufacturers. • Increase in energy efficient equipment manufacturers. • Increase in local energy providers. • Decrease in network energy producers & suppliers. • Change in construction industry to the installation of equipment.
Shopping, Cooking and Eating
<ul style="list-style-type: none"> • Increase in local small shops. • Decrease in pesticide manufacturers. • Decrease in supermarkets. • Change in seed & biotechnology companies to supplying small growers. • Change in agriculture to either local supply, organic production, GMO production or a general decrease in production. • Change in food processors, either increase or decrease in size. • Change in wholesalers, either increase or decrease in size or supply households. • Change in food service & catering, either increase or decrease in size. • Change in households to either grow and process own food or eat out.

As Table 9 shows, there were similar outcomes of the different Economic Analyses in terms of increase or decrease of imports/exports, general employment, multi-national companies, SMEs, services, products, partnerships, and so on. The economic analysis highlighted that the developed DOSs would have impacts on the economies and businesses by either:

- eliminating particular sectors and, especially important, *creating opportunities* for new sectors; or,
- changing the direction/emphasis of certain sectors, for example from product to service provision.

The results of the *environmental assessment* and the *consumer acceptance* assessment are summarised in Table 10. The +s show positive evaluation of that DOS - environmental

impact reduction or consumer acceptance; the -ves should be the opposite; +/- indicates an equivocal assessment.

Table 10: Overall Assessments of SusHouse DOSs

Function	Country	DOS	Environmental assessment	Consumer acceptance
Shopping, Cooking, Eating	UK, NL, HU	Local and Green	+++	++
	UK HU NL	High Tech Eating Robo Kitchen and High-tech Eating Intelligent Cooking and Storing	++	+/-
	NL	Neighbourhood food centre	--	--
	HU	High-tech Rural gardens	+	+/-
	UK	Virtual Shopping	++	+/-
Clothing care	It, Ge, NI	Clothing Care Outsourcing	+++	+
	It, Ge, NI	Collective Clothing care	++	+/-
	Ge, NI	My clothes, My eternal friends	+++	+/-
	It	Easy clothing care		
	It	Soft clothing care	++	+
Shelter	It, UK, NI	Comfort Management Service	++	+/-
	It, Ge	Edumation	++	++
	UK	Natural living		++
	UK	Active House		+/-
	It	Wearables		-
	Ge	Come Together		-

The assessments showed that almost all the scenarios held considerable promise in achieving environmental impact, though not necessarily at a Factor 20 level. In addition, the scenarios are not all necessarily strongly supported by the consumer focus groups. Indeed the focus groups and the second stakeholder workshops argued that, only in *combination* might some of the DOSs achieve higher reductions in environmental impact and be more attractive. For example, 'Local and Green' could readily be combined with 'Virtual Shopping', the bioregionalism of the former being combined with hi-tech re-organisations of shopping. Of course, such *DOS combinations* might not necessarily lead to Factor 20 reduction either. Negative features of the combinations may outweigh the positive features. In other words, a combination of the DOSs may result in more environmental impacts as compared to the current situation. However, it is important to remember that the DOSs are intended to identify the *limits* of those choices and to identify what *design* changes - in products, technologies, systems or organisational arrangements - could be envisaged to respond to these choices, if they are seen as desirable from the point of view of environmental impact reduction.

4.1 Clustering Design Orienting Scenarios

To help gain an understanding of how the DOSs could be combined, they were clustered on a matrix presented in Figure 1, with the two axes thus:

- *social/collective* (members of the household will tend to collaborate as a social community) versus *individual* (members of the household will behave as separate individuals); and,
- *do-it-yourself* (technical infrastructure enables the members of the household to fulfil the functions on their own) versus *service* (technical infrastructure involved in the functions tends to provide the household with finished, ready-to-use products or services).

The 18 DOSs are clustered into five groups: *Care Socialising*, *Care Outsourcing*, *High Care*, *Soft Care*, and *Easy Care*. The five clusters can be characterised thus, and are listed in Table 11:

- The **Easy-Care** household is characterised by high-tech equipment helping users in their daily life.
- The **Care Outsourcing** household actually involves a certain 'deconstruction' of the household as it is traditionally conceived as a place for the fulfilment of domestic functions.
- The **High-Care** household is based on a lifestyle in line with 'natural' models.
- The **Care Socialising** households are based on a certain level of community life, of collective resources, of sharing of products and services.
- **Soft Care** describes a household characterised both by a high attention/active involvement of the household members in the fulfilment of domestic tasks and a highly sophisticated system assisting them in these tasks.

Figure 1: Integrated vision of household DOSs

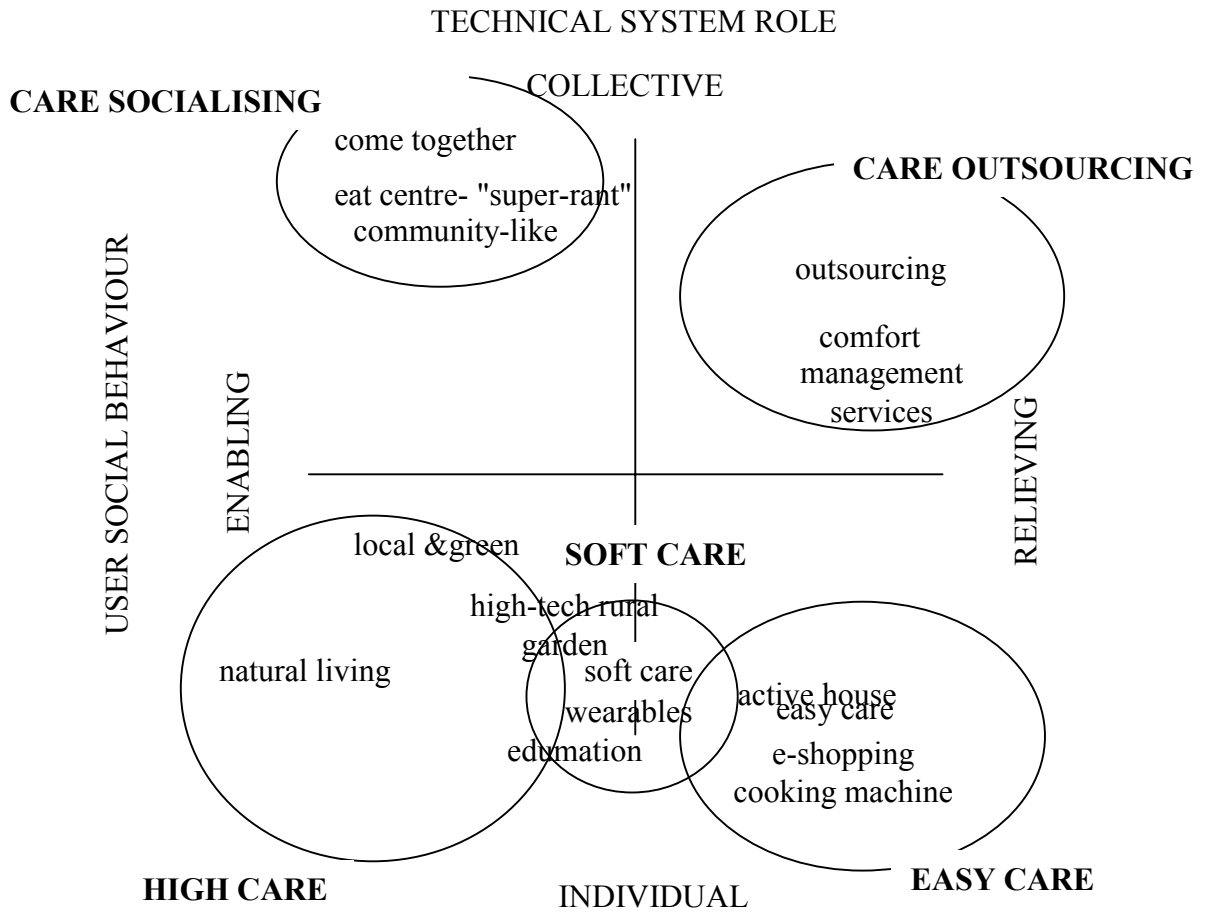


Table 9: Integrated clusters of SusHouse DOSs

Cluster	Function	Country	DOS
Easy care	Shopping, Cooking and Eating	UK Hu NI UK	High Tech eating Robo kitchen Intelligent Cooking and Storing Virtual shopping
	Clothing Care	It	Easy Clothing care
	Shelter	UK	Active House
Care Outsourcing	Shopping, Cooking and Eating	NI	Neighbourhood food centre
	Clothing care	It, Ge, NI	Clothing care Outsourcing
	Shelter	Ge, It, UK	Comfort management Service

High Care	Shopping, Cooking, and Eating	UK, NI, Hu	Local and Green
	Clothing care	Ge, NI	My clothes, my eternal friends
	Shelter	UK	Natural living
Care Socialising	Shopping, Cooking and eating	NI	Neighbourhood food centre
	Clothing care	It, Ge, NI	Collective Clothing care
	Shelter	Ge	Come together
Soft care	Shopping, Cooking, and Eating	Hu	High tech rural garden
	Clothing care	It	Soft Clothing care
	Shelter	Ge	Edumation
		It	Wearables

5. CONCLUSIONS

The main objective of the *SusHouse Project* was to develop and test a methodology that enables companies, governmental policy organisations and NGOs to carry out their own analyses of sustainable household functions. It was intended that the methodology would help such organisations to identify possible product, system and social innovations that offer business opportunities and policy initiatives now to start the transition to sustainable economies and societies.

As we pointed out, the methodology developed and evaluated in the *SusHouse Project* was derived from the Dutch STD methodology, and more specifically from the Sustainable Washing Project (Vergragt and Van der Wel, 1998). It thus builds on techniques of 'backcasting' and scenario-building that have been developed over the last twenty years. However, it modifies these techniques in three important ways:

Firstly, it does not focus completely on *technological* solutions as being the main agent for sustainable development. Whilst technological developments, crystallised into new products or systems of household provision, are of undoubted importance, sustainability cannot be achieved by these means alone. Other changes, in social arrangements at household levels and in cultural attitudes (the latter enable the former), are also required. It is obvious that radical technological innovations cannot take root in any household practice unless there are changes in modes of organisation of the household, so that the 'technological' and the 'socio-cultural' are opposite sides of the same coin. What is less obvious is that social innovations might of themselves be of critical importance.

Secondly, in the *SusHouse* methodology more emphasis is laid upon the participation of a wide range of stakeholders in the process of scenario development and (less so) assessment. The methodology thus favours a participative and interactive way of devising policy than is usually employed in more traditional policy-making that focuses on regulation rather than on innovative behaviour by social and economic actors. (Grin and van der Graaf, 1996).

Thirdly, the methodology is concerned to lead to *designs*, of products, systems of provision, social arrangements and cultural attitudes rather than just an orientation to policy. It assumes that challenging (some would say "crazy") ideas for future system re-design will trigger the imagination and enthusiasm of stakeholders; it uses creativity

workshops and scenario development as central tools of the methodology. So, rather than coming up with broad, globally-oriented scenarios, it comes up with scenarios that are narrowly focused on the implications of household consumption practice changes for technological and social innovation - so-called *design-orienting scenarios*.

Broadly, we would claim that the Project has successfully fleshed out a methodology that can be used by many types of stakeholders, including businesses, government agencies (at local, national and supra-national levels), non-governmental organisation and professional associations. As we have demonstrated in our summary presentation of the Design Orienting Scenarios and their assessment, the conclusions of our analysis of the three household functions that we have studied provides the basis for the development of policies, strategies and designs that would be part of any movement towards sustainability.

However, though we have shown that it is possible to use structured methods to come up with 'stakeholder-endorsed' scenarios that contain challenging/crazy ideas, the next step of developing specific, actionable policy and design outcomes requires more thought and more work. On reflection, it is our view that we had *insufficient* stakeholder involvement in the Project. Stakeholders were heavily involved in the creativity workshops and in final assessment of the Project's outputs, but they were only marginally involved in the actual assessment of the scenarios themselves (though 'consumers' were methodologically involved in the consumer assessment workshops). In future 'runs' of the methodology, we would seek to obtain even more stakeholder buy-in to the scenarios and their policy/design outcomes by involving them in the environmental and economic assessments as well.

It is nevertheless true that more stakeholder involvement would not, by itself, guarantee actionable outcomes from the application of the methodology. For that, you need a specific focus from the outset on the active exploration of the possible *design* of products (that businesses might seek to develop and sell) or systems (that businesses or agencies might seek to introduce) or social action (that agencies or ngo's might campaign for or design policies for the encouragement of). For this to happen, as with all innovative design, there needs to be some organisational champion (a business, an agency, an ngo) that uses the methodology to identify the designs that emerge from the scenarios to which it might wish to commit resources.

But, the methodology we have developed recognises that designs appropriate to household sustainability cannot be developed 'in-house', inside the business or organisation. They require creative involvement of a wide range of stakeholders. Take, for example, the design of possible new ways of delivering sustainability in the Shopping, Cooking and Eating household function. It is possible to imagine that a company in the food supply chain - say an innovative food manufacturer - could conceive of environmentally-friendly re-design of its products or services by itself, seeking the advice of technical experts. However, it is our contention that to achieve the kinds of designs that might lead to the necessary jumps in sustainability (not to Factor 20 perhaps, but large), you have to think about many kinds of technological, product, social and cultural changes. Such creative resources are not available inside one organisation. It would be essential then that the central design actor gets wide stakeholder involvement, including other organisations in the relevant 'supply chain' (in our example, this would include food raw material producers, agricultural input producers, packaging firms, transport firms, supermarkets) as well as wider stakeholders with an interest in food production and consumption (in government, ngo's and professional associations). Whatever designs emerge from applying the methodology in such a focused way would of course suggest the kind of policies - regulations, tax changes etc. that might facilitate the acceptance of the design innovation proposed.

In short, we are suggesting that the *SusHouse methodology* would be especially useful to those progressive companies or agencies that are looking to find new ideas that can actually be implemented in our economies, ideas that would not be extensions of existing green trends but would offer more substantial gains in sustainability.

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