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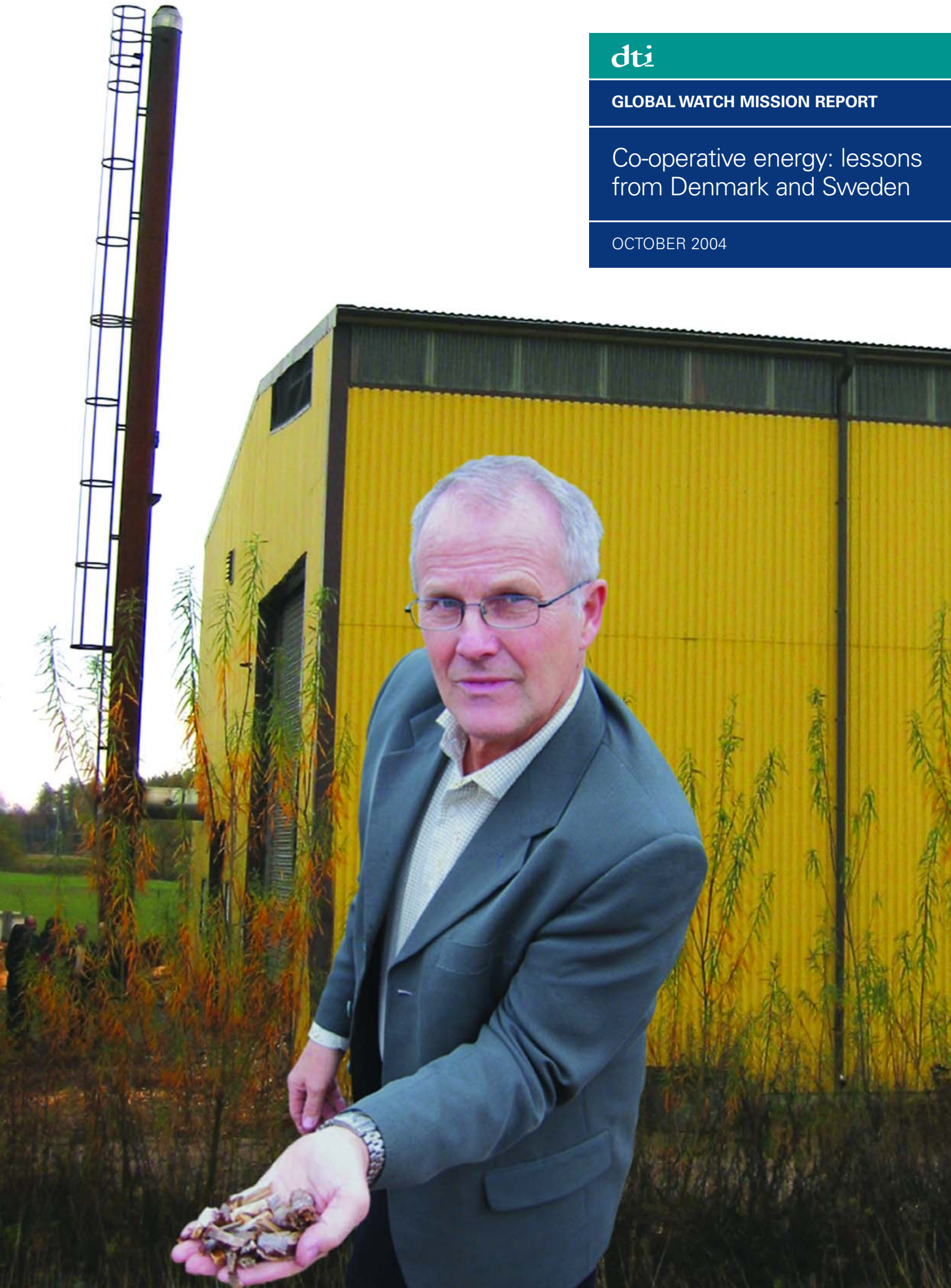
GLOBAL WATCH MISSION REPORT

Co-operative energy: lessons from Denmark and Sweden

OCTOBER 2004



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Co-operative energy: lessons from Denmark and Sweden

REPORT OF A DTI GLOBAL WATCH MISSION
OCTOBER 2004

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Co-operatives UK
THE UNION OF CO-OPERATIVE ENTERPRISES

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- And all the individuals and organisations the team visited who gave their time to host our visit, and were extremely open and willing to share their experience, answer our questions, and show us round their facilities

FOREWORD

As we grapple with the challenges of climate change, the findings of this visit to co-operatives in Denmark and Sweden are validating and inspiring.

They validate what we have thought for some time: that co-operatives are ideal vehicles for energy generation and supply.

They inspire us because the experiences in Denmark and Sweden, and scale of what is going on, are delivering real benefits for all: producer, consumer and wider community.

There is no single form of co-operative. There is a huge diversity in type, scale and structure. There are co-operatives owned by producers, by employees, by consumers, by other businesses, by the community and by a mix of these. Co-operatives are a marvellously flexible business form to jointly meet economic and social need. And here is the crunch – social need. They espouse more than just profit. They have multiple bottom lines and run the business from the viewpoint that the benefit of all stakeholders, consumer and community are vital and that the long-term approach is vital.

This is why they marry so well with the push for the production of sustainable energy, where long-term investment is crucial, long-term relationships are needed, and long-term benefits accrue.

The experience in Denmark and Sweden shows this so clearly: the co-operatives – whether they be producer or farmer driven, consumer driven or with multiple stakeholders – are accountable, responsive to local need and concerns, engage the people that are affected most, and have inter-dependence at the core of their approach.

There is much we can learn and apply in the UK. It seems that the success of the co-operative sector and their community-driven approach in the field of sustainable energy are dependent on key factors:

- **Support**: development support and technical advice provided by the people that know the fields best – the practitioners and their representatives
- **Commitment** of government and local authorities to community involvement and ownership, to a co-operative approach and to many small-scale units of all kinds
- **Public familiarity** with the range of co-operative structures
- **Public consensus** that the price for energy should not be the only driver in energy policy

I am keen that we work with all possible partners in the UK and in other EU member states to learn from the experience of Denmark and Sweden and show that co-operative and community approaches can help deliver UK government objectives.

Thank you to Nick Dodd and his team and to the DTI for giving us that opportunity.

Dame Pauline Green
Chief Executive
Co-operatives[UK]

EXECUTIVE SUMMARY

The threat of climate change, declining resources and the need for greater energy security has highlighted the need to reduce our reliance on fossil fuels. It is widely accepted that this will require greater energy efficiency and a shift to renewable forms of energy. To date, UK progress has been slow, suggesting potential underlying problems with our approach. The evidence from pioneering countries such as Denmark and Sweden is that a different approach is required – one based on genuine opportunities for democratic control, community engagement and economic participation.

Against this background, the Urban and Economic Development Group (URBED), with the support of Co-operatives[UK], co-ordinated a DTI Global Watch Mission to Denmark and Sweden. The aim was to investigate the role co-operatives have played in the successful delivery of renewable energy projects. Co-operatives are independent, democratically controlled enterprises. They are owned and governed by their members, with the aim of meeting common social, economic and environmental needs.

Denmark has the strongest co-operative energy sector in Europe, and Danish co-operatives have unique experience with a range of sustainable energy technologies. Sweden has led the way in its development of a strong bio-energy sector, with co-operation between stakeholders having enabled strong growth.

The specific objectives of the mission were therefore to:

- **Investigate** the unique benefits that can be attributed to a range of co-operative models in enabling and delivering renewable energy projects
- **Understand** the co-operative role in delivery, and the strengths/ weaknesses of the chosen co-operative structures, in relation to a number of different technologies
- **Explore** the potential for sectors of the UK co-operative movement to adopt Danish project structures and delivery mechanisms
- **Pursue** partnerships and technology transfer in order to learn from Danish experience and avoid 're-inventing the wheel', particularly in financing and developing projects

The mission also aimed to cover several different types of co-operative: consumer, agricultural, investor and secondary. The mission visited six co-operative enterprises, three co-operatively owned enterprises and five related support bodies – including a secondary co-operative and two major trade associations. Each visit was chosen to illustrate how co-operatives had delivered different energy technologies:

- Community-owned wind power
- Consumer-owned district heating
- Consumer-owned electricity supply
- Farmer-owned biogas production
- Farmer-owned biomass production and heating
- Farmer-owned biomass services

The mission provided valuable insight into two mature renewable energy sectors in which small-scale distributed energy generation and energy co-operatives play an important role. Whilst there are clearly difficulties in directly transferring some of what we saw to the UK context, there are nonetheless some clear lessons. We have distilled these down into four themes, with associated recommendations:

- Energy policy
- Co-operative culture
- Energy market
- Co-operative models

Energy policy

Sweden and Denmark have both put in place policy frameworks that have provided comprehensive and sustained support for efficient and renewable energy technologies. The two main drivers for these policies have been reduced reliance on fuel imports and sustainable development. These favourable conditions – sustained over nearly 25 years – have enabled a range of investors, including co-operatives, to make the long-term investments necessary.

Energy taxes and feed-in tariffs can be seen to have created an overall driver, with the revenue raised being used to support a range of technologies. The enabling powers of the planning system have also been extensively used to support infrastructure investment. Denmark has directed investment into district heating, creating heat markets which have enabled fuel flexibility and enhanced the viability of combined heat and power (CHP).

Recommendations

- Government should identify fiscal measures which would allow it to play a stronger role in enabling community energy projects
- Support should be made available for demonstration projects using co-operative models
- Local government should play a more proactive role in identifying and enabling projects; using planning powers, establishing co-operatives and helping to underwrite investments
- The co-operative movement should take a proactive role in developing community-owned energy projects

Co-operative culture

Denmark and Sweden's energy systems are characterised by a large number of small power stations. This distributed form of power generation means that projects must be located in many more 'back yards' – both urban and rural. This is important because it enables more efficient energy use, and wider benefits to be distributed to local communities.

To enable this to happen, a fundamental change in the perception of projects has been achieved at a local level. Key to this has been distribution of benefits to communities through co-operative ownership. The planning system also supports the aim of sustainable development, with local authorities playing a significant supporting role.

A culture of co-operation is also nurtured, starting in the education system and forming part of their enterprise culture. Co-operatives therefore represent a familiar model for projects – particularly at a community scale and for farmers. Government also provides direct support for co-operative development, and industry has also been directly engaged, creating mutual economic benefit.

Recommendations

- Wider education and awareness-raising is required to promote co-operatives as a viable business model and overcome outdated perceptions
- Greater support is needed for membership-based associations which provide mutual support and information sharing 'on the ground', whilst lobbying to overcome institutional barriers
- The co-operative movement should engage its members and stakeholders in the development of new co-operative energy projects and community investment opportunities
- Existing co-operative development agencies should work with local authorities, energy agencies and community renewables initiatives (CRIs) to develop co-operatives

Energy market

Co-operatives are able to deliver a range of benefits for consumers and producers – creating value for their members and the wider community. Key benefits can be grouped under two main themes:

- Engagement and accountability – they are responsive to the concerns and needs of local communities by virtue of their directly accountable structures. This reduces costly delays and risk caused by objections, and enables the efficient targeting of investment. Co-operatives can also raise awareness of and harness demand for local action on climate change.
- Economic development – the creation of new opportunities and the delivery of direct economic benefits for their members. Co-operatives can play an important role in co-ordinating relationships between stakeholders, enabling projects and raising investment.

However, recent energy market liberalisation has created a narrower focus on energy prices. This now favours larger scale projects and investors. This raises the question of whether a different view of the market is needed – one in which price is not the only driver, and wider social, economic and environmental benefits are valued.

Recommendations

- Government needs to shift the emphasis from price to the valuing of wider community benefits; captured through direct engagement and ownership by consumers and producers
- Greater attention should be focused on overcoming the barriers to the development of smaller scale, community-owned projects – for both generators and suppliers
- The co-operative movement should work with Danish and Swedish trade associations to learn from the experience of co-operatives in liberalised energy markets

Co-operative models

A range of co-operative models were seen in action, and each project was well suited to this approach. Each project was pragmatic rather than utopian, and co-operatives are a recognised structure for an energy business. The majority of the co-operative models ran on a non-profit or 'more-than-just-profit' basis, instead aiming to deliver direct benefits to their members. This creates a strong focus on service quality and re-investment. Where dividends were paid, this has been vital in mobilising equity from the wider community to finance projects.

Each model was specific to the needs of a project, reflecting the stakeholder relationships and level of engagement required. Five broad models were seen:

- **Community-led investment** – projects such as Middelgrunden wind farm were established by citizens wanting action on environmental issues, successfully mobilising people's time and money
- **Consumer-owned utilities** – utilities such as Høje Taarstrup (heat) and SEAS (electricity) deliver efficient, cost-effective and accountable public services, making long-term infrastructure investments
- **Farmer co-operatives** – Farmarenergi and Hashøj Biogas enabled their members to successfully respond to changing market conditions and regulations, improving their economic position and delivering wider community benefits
- **New ventures** – co-operatively owned Naturbränsle and Agrobränsle brought together industry stakeholders to develop the biomass supply chain
- **Trade associations** – member-based organisations such as the Danish Association of Wind-power Guilds (DV) and the Federation of Swedish Farmers (LRF) broker co-operation between co-operatives in order to share experience and knowledge, and develop specialised support services

These are all tried and tested models of co-operation in the UK. However, there is relatively little experience of using them to deliver energy projects, suggesting a need for more practical demonstration projects.

Recommendations

- Tailored support should be available for those wishing to establish new co-operatives, with general information available on different models
- Government support should be provided to promote model rules and 'best practice' guidance based on experience from the UK, Danish and Swedish co-operative movements
- Government should establish new investment vehicles which can be used to mobilise equity for projects from the wider community
- Partnerships with Danish and Swedish co-operatives should be developed in order to facilitate technology transfer, and share knowledge and expertise
- The co-operative movement should act as a catalyst for projects involving a range of stakeholders such as local authorities, farmers, property managers and the wider community
- The co-operative movement should establish renewable energy investment funds, including risk funds, to take projects up to planning, and these should be used to support new co-operatives

1 INTRODUCTION

1.1 Policy context

The threat of climate change has highlighted the need to reduce our reliance on fossil fuels. It is widely agreed that this will require the more efficient use of energy – with technologies such as combined heat and power (CHP) – and a shift to renewable forms of energy – such as biofuels, wind, solar and wave power. Investment is therefore needed to develop these new forms of energy supply.

With the publication in 2003 of the new Energy White Paper, action on climate change has become central to government policy. The government's energy policies are now focused on four main themes:

- **Environment** – the need to cut carbon dioxide (CO_2) emissions 60% by 2050
- **Reliability** – protecting the security and reliability of our energy supplies
- **Affordability** – making affordable energy available to the less affluent
- **Competitiveness** – maintaining competitive energy markets

With the establishment of targets for renewable energy there is undoubtedly a clear commitment to action, underlined by the introduction of new support programmes and the Renewables Obligation. However, increasing objections to the 'dash for wind' and difficulties in developing district heating have hindered progress, suggesting that there may be underlying problems with the UK's approach.

The evidence from pioneering countries such as Denmark and Sweden is that the smaller scale, distributed nature of these new forms of energy requires a different approach – one based on the principles of 'self-sustainability'. At its heart is the development of a democratic, consumer-oriented energy sector in which there are genuine opportunities for community engagement and economic participation.

Against this background, Co-operatives[UK] decided to organise a Global Watch Mission to Denmark and Sweden. The mission sought to learn from the success of Danish and Swedish energy co-operatives, investigating the unique benefits they can bring to the energy sector and the factors that have enabled them to develop.

1.2 What is a co-operative?

Co-operatives are independent, democratically controlled enterprises. They are owned and governed by their members, with the aim of meeting common social, economic and environmental needs. There is a range of different types of co-operative, reflecting the relationship between the co-operative, its members, and the products and services they provide. The largest co-operatives in the UK are the consumer co-operative societies, with their distinctive supermarket brand. Co-operatives also play a significant role in the agricultural sector, and to a lesser extent in housing and employee-owned businesses.

Co-operatives can take a number of different legal forms. In the UK, many co-operatives are registered as Industrial & Provident Societies. This requires them to demonstrate to the Financial Services Authority (FSA) that they are 'bona-fide co-operatives' – based on internationally recognised co-operative principles (see Exhibit 1.1). Co-operatives

can also be established as member-controlled companies, with company limited by guarantee being the most common form, but also adhering to co-operative principles.

Recently, there has been an increase in social enterprises as a business model. The government has developed a new legal form available to social enterprises – a community interest company (CIC). The assets of CICs would be protected in perpetuity for the good of the community. CICs also have the potential to be an appropriate legal form for co-operatives.

The co-operative principles

These are guidelines by which co-operatives put their values into practice:

- Voluntary and open membership
  Co-operatives are voluntary organisations, open to all persons able to use their services and willing to accept the responsibilities of membership.

- Democratic member control
  Co-operatives are democratic organisations controlled by their members, who actively participate in setting their policies and making decisions. Members have equal voting rights (one member, one vote). Elected representatives are accountable to the membership.

- Member economic participation
  Members contribute equitably to, and democratically control, the capital of their co-operative. At least part of that capital is usually the common property of the co-operative. Surpluses are allocated for: developing their co-operative; benefiting members in proportion to their transactions with the co-operative; and supporting other activities approved by the membership.

- Autonomy and independence
  Co-operatives are autonomous, self-help organisations controlled by their members. If they enter into agreements with other organisations, for example in order to raise capital from external sources, they do so on terms that ensure they maintain their autonomy.

- Education, training and information
  Co-operatives provide education and training for their members, elected representatives, managers and employees so they can contribute effectively to the development of their co-operatives.

- Co-operation among co-operatives
  Co-operatives serve their members most effectively and strengthen the co-operative movement by working together through local, national, regional and international structures.

- Concern for community
  Co-operatives work for the sustainable development of their communities through policies approved by their members.

Exhibit 1.1 *The co-operative principles*[1]

1 International Co-operative Alliance (ICA) (1995) *Statement on the Co-operative Identity,* www.ica.coop

1.3 The co-operative advantage

In 2003, Co-operatives[UK] – the union of UK co-operatives – published the report *Energy: the Future Generation – Co-operative Opportunities*. It explored the potential for co-operatives to establish a significant role in the UK renewable energy market. A key objective would be tackling climate change; in the process, delivering social and economic benefits to their members and the wider community.

The report found that co-operatives had the potential to overcome a number of barriers to sustainable energy through their ability to:

- **Unlock latent demand for local action**. With the establishment of programmes such as the Community Renewables Initiative and Community Action for Energy, and the involvement of local and regional government, there is increasing interest in local projects. Market research also indicates strong public support for renewable energy, and the UK's 3 million consumer co-operative members could provide a good starting point.

- **Ensure a long-term perspective on investment**. Given the relative short-termism of the power sector, co-operatives could play an important role in making the long-term investment required to develop a sustainable energy supply for future generations.

- **Deliver complex projects involving multiple stakeholders**. The co-operative ethos of working together for mutual benefit enables the risks involved in developing projects to be better shared. It also creates a transparent basis for bringing together stakeholders.

- **Deliver greater accountability through community assets**. The co-operative model provides a tried and tested framework for local accountability. This is becoming important in liberalised utility markets which have broken geographical links, generating concerns about accountability.

- **Create opportunities for rural diversification and enterprise development**. In the face of the problems facing the agricultural sector, energy projects create new opportunities. Renewable sources of energy such as biomass require the participation of farmers and landowners, and a framework for co-operation.

Whilst recognising the need to build on the experience of UK co-operatives – such as Baywind, Cmni Gwynt Teg, Oxford, Swindon & Gloucester Society, the Co-operative Group, 7Y Machinery Ring, Sundance and Renewable Energy Growers – the report also highlighted the potential to learn from the experience of co-operatives elsewhere in the European Union (EU).

1.4 Mission aims and objectives

The DTI Global Watch Mission to Denmark and Sweden took place during 25 – 29 October 2004. It enabled representatives of the UK co-operative movement to visit a range of practical projects in order to learn from the experience of successful Danish and Swedish co-operatives.

Denmark has the strongest co-operative energy sector in Europe, and its co-operatives have unique experience with a range of sustainable energy technologies. Sweden has led the way in its development of a strong bio-energy sector, with co-operation between stakeholders having enabled strong growth.

The mission was co-ordinated by Nick Dodd from the Urban and Economic Development Group (URBED) – authors of the report *Energy: the Future Generation*. URBED have been working closely with Co-operatives[UK] on energy issues. He was accompanied by:

- Harvey Tordoff, Baywind Co-operative *and* Energy4All
- Mark Sims, Peak Energy *for* Oxford, Swindon & Gloucester Co-operative Society (OS&G)
- Hamish Walls, Scottish Agricultural Organisation Society (SAOS)
- Brian Rees, Co-operative Group
- Dr Sue Hunter, Institute of Energy and Sustainable Development (IESD) – De Montfort University

The high-level aim of the mission was to investigate the role co-operatives have played in the successful delivery of energy projects. It was anticipated that this would provide practical knowledge and potential partnership opportunities to support UK projects. The specific objectives of the mission were therefore to:

- **Investigate** the unique benefits that can be attributed to a range of co-operative models in enabling and delivering energy projects
- **Understand** the co-operative role in delivery, and the strengths/weaknesses of the chosen co-operative structures, in relation to a number of different technologies
- **Explore** the potential for sectors of the UK co-operative movement to adopt Danish project structures and delivery mechanisms
- **Pursue** partnerships and technology transfer in order to learn from Danish experience and avoid 're-inventing the wheel', particularly in financing and developing projects

The itinerary was developed by URBED based on original research for Co-operatives[UK]. Additional support was provided by Nicola Smoker from Pera. The itinerary was chosen to cover four different types of co-operative:

- **Consumer** – members are consumers of the products and/or services delivered by the co-operative
- **Agricultural** – members are primary producers who come together to invest in processing equipment, distribution services and/or joint marketing
- **Investor** – members are generally drawn from the local community (though they can be from further afield) and come together to invest in specific projects
- **Secondary** – members are co-operatives who come together to further their mutual interest by pooling their collective resources and establishing shared services

Six co-operative enterprises and three co-operatively owned enterprises were visited during the mission. The itinerary also incorporated meetings with five related support bodies – including a secondary co-operative and two major trade associations.

Denmark	
Monday 25 October	Danish Association of Wind-power Guilds (DV) Copenhagen Environment & Energy Office (CEEO) Middelgrunden and Lynetten (investor co-operatives)
Tuesday 26 October	Høje Taarstrup (consumer co-operative) Danish Board of District Heating (DBDH) VEKS (co-operative/local authority joint ownership) Danish Biogas Association
Wednesday 27 October	Hashøj Biogas (farmer co-operative) Hashøj Kraftvarmeforsyning (consumer co-operative) SEAS Energy Group (consumer co-operative)
Sweden	
Thursday 28 October	Federation of Swedish Farmers (LRF) Hallsthammer District Council Farmarenergi (farmer co-operative)
Friday 29 October	Naturbränsle (co-operative/private company joint ownership) Agrobränsle (Lantmännen farmers co-operative subsidiary)

Exhibit 1.2 *Mission itinerary*

Denmark

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2 DENMARK: NATIONAL CONTEXT

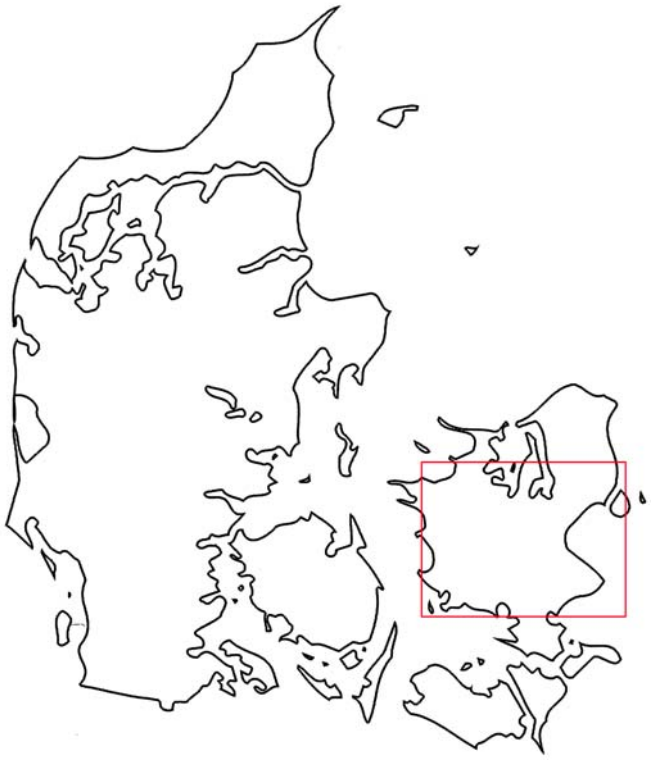


Exhibit 2.1 *Outline map of Denmark*

Exhibit 2.2 *Visit locations in Denmark*

Population	5.4 million
Land area	43,098 km^2
GDP (per person)	£17,353

Exhibit 2.3 *Denmark: national statistics*

2.1 Economy

A member of the EU since 1973, Denmark has one of the world's highest standards of living and wealth, having recently been ranked 9th in the Economist's 2004 quality of life index. The country's wealth has traditionally come from agriculture but, in more recent times, North Sea energy resources (notably gas and oil), technical expertise in key fields of science and engineering – such as energy technology – and a reputation for product design have become important. Proportionally, national expenditure on research and development (R&D) is high at 2.4% GDP (2001) compared to the UK figure of 1.89% and the EU average of 2%.

Denmark's long tradition of strong European and international trade links has successfully enabled it to export both its goods and services. Energy technology is a prime example, with knowledge and expertise developed at home now being exported across the world. Danish manufacturing industry has grown in response to the EU's growing demand for wind, biomass and district heating technology. It has also received significant targeted investment subsidy for R&D. The sector is now annually worth €3.3 billion to the Danish economy – nearly 5.5% of total exports.

The country has some of the highest levels of taxation in the world. These exist to address a number of key national priorities which reflect the national character. These include a cradle-to-grave welfare system, extensive public transport systems and, notably, environmental taxes. The country has been a pioneer in the use of environmental taxation, with a range of primary energy taxes having been introduced over the last two decades. These have been designed to reduce air pollution and CO_2 emissions, encourage energy efficiency, and support renewable forms of energy.

2.2 People and culture

The country has a strong liberal and social democratic tradition, with principles of common welfare and a respect for the environment having become deeply rooted in the national character. The Danes can also be characterised by a strong emphasis on consultation and consensus building. In the post-war period, government – with the exception of the most recent administration – has reflected this ethos, having been run by cross-party coalitions. The education system instills these values from an early age, and lifelong learning continues through unique institutions such as the country's 81 'Folk High Schools'.

There is a long tradition of co-operative ownership, reflecting the democratic principle that every stakeholder should have an equal say in decision-making regardless of the size of their stake. The roots of the Danish co-operative movement can be found in the agricultural sector. Competition from cheap imports in the mid 19th century caused great hardship. Farmers had to work together to carry out land improvements and improve their products. Co-operatives continue to maintain a strong presence in the Danish agricultural sector, investing on behalf of their members and ensuring that they are able to secure end-markets and obtain good prices for their produce. Co-operatives can also now be found in many areas of Danish life, including food retailing and public services such as utilities.

Over time, the need to compete in European markets has led to rationalisation of many co-operatives. With 1.6 million members, FDB – the Co-operative Retail and Wholesale Society of Denmark – forms part of Co-op Norden, a trading company with a turnover of £6.5 million. The increased scale of co-operative enterprise has, it has been suggested, renewed interest in smaller-scale, grass-roots forms of co-operation. Wind co-operatives – small-scale wind farms owned by local communities – benefited from this trend, and during the 1980s and 1990s their numbers expanded rapidly.

2.3 Energy policy

Renewable energy and the efficient use of energy has played a central role in Danish energy policy for over two decades. The practical application of sustainable technologies has brought tangible benefits to Danish society. Renewables now provide over 20% of electricity supply, and energy consumption has not risen during the last 20 years despite rapid economic growth. Danish industry has also benefited from a sustained level of support over two decades, and is now a world leader in sustainable technologies.

Denmark's energy policies date from the mid 1970s when the country was heavily reliant on oil for heat and power generation. The oil crises of 1973-74 led to the 1976 Energy Plan – the first of four national energy plans whose main objectives have been to reduce reliance on imported oil and achieve sustainable development:

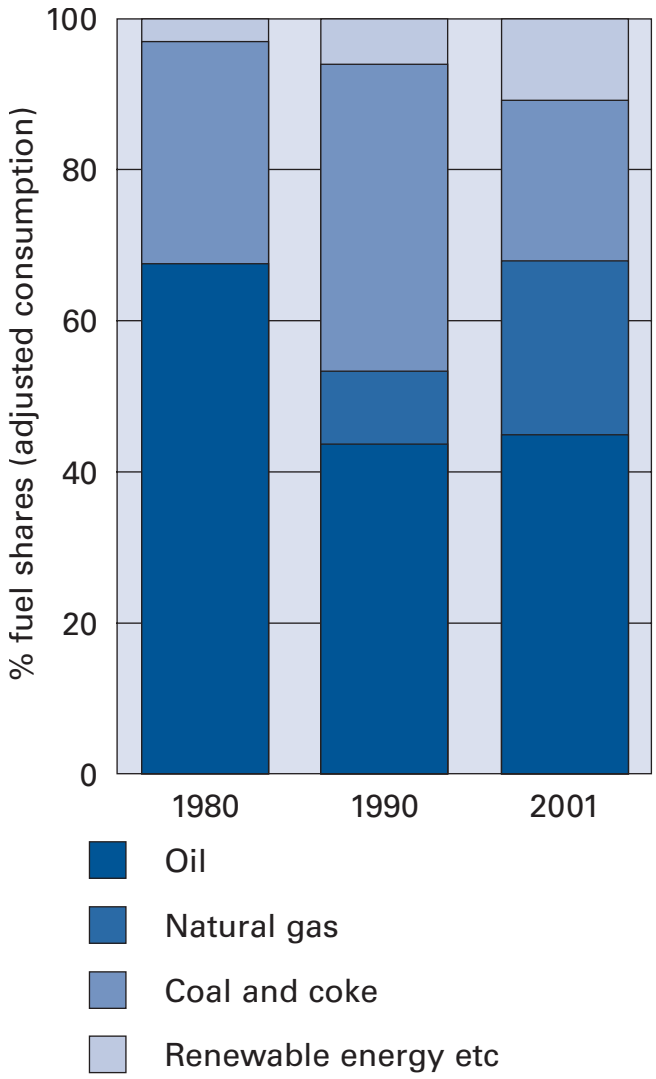


Exhibit 2.4 *Gross energy consumption by fuel in Denmark*[2]

- **Danish Energy Policy 1976**. The first plan and the subsequent Energy Act 1979 introduced an energy tax on oil and granted powers to local authorities to implement municipal district heating plans – enabling greater fuel flexibility.

- **Energy Plan 1981**. The second plan showed greater recognition of the potential role of renewable energy, introducing subsidies and/or feed-in tariffs to support wind power, district heating and the conversion of existing CHP plants to biomass.

- **Energy 2000 (1990)**. The third plan set a target of reducing CO_2 emissions 20% between 1988 and 2005. Specific targets also included the increased use of natural gas for CHP (based on North Sea resources) and 10% of electricity from wind turbines by 2005. The 1993 follow-up emphasised the role of biomass fuel.

- **Energy 21 (1996)**. The fourth plan set a new overall target of 12-14% of energy to come from renewables by 2005. This share was to increase by 1% every subsequent year, with the aim of reaching 35% by 2030. CO_2 emissions are to be halved on 1998 levels by 2030.

The outcome of the four energy plans is that Denmark is now a net exporter of energy. The country's electricity grid now has hundreds of small-scale 'distributed' generators making use of wind resources and (efficient use of) a range of fuels including wood, straw, biogas and bio-oil. Denmark's distributed form of electricity generation has required new approaches to grid co-ordination, providing a window into the future for countries like the UK.

Engagement and consumer influence have played an important role in shaping the Danish energy sector. This can be illustrated by the number of co-operatives in the sector:

- **Wind farms** – 23% (600 MW) of Denmark's wind capacity is owned by co-operatives, with 100,000 members owning over 3,200 turbines.

- **CHP/district heating** – 300 of the 400 district heating networks are owned by consumer co-operatives, ensuring accountability for a monopoly supply.

2 Danish Energy Authority (DEA) (2003) Energy Statistics 2001

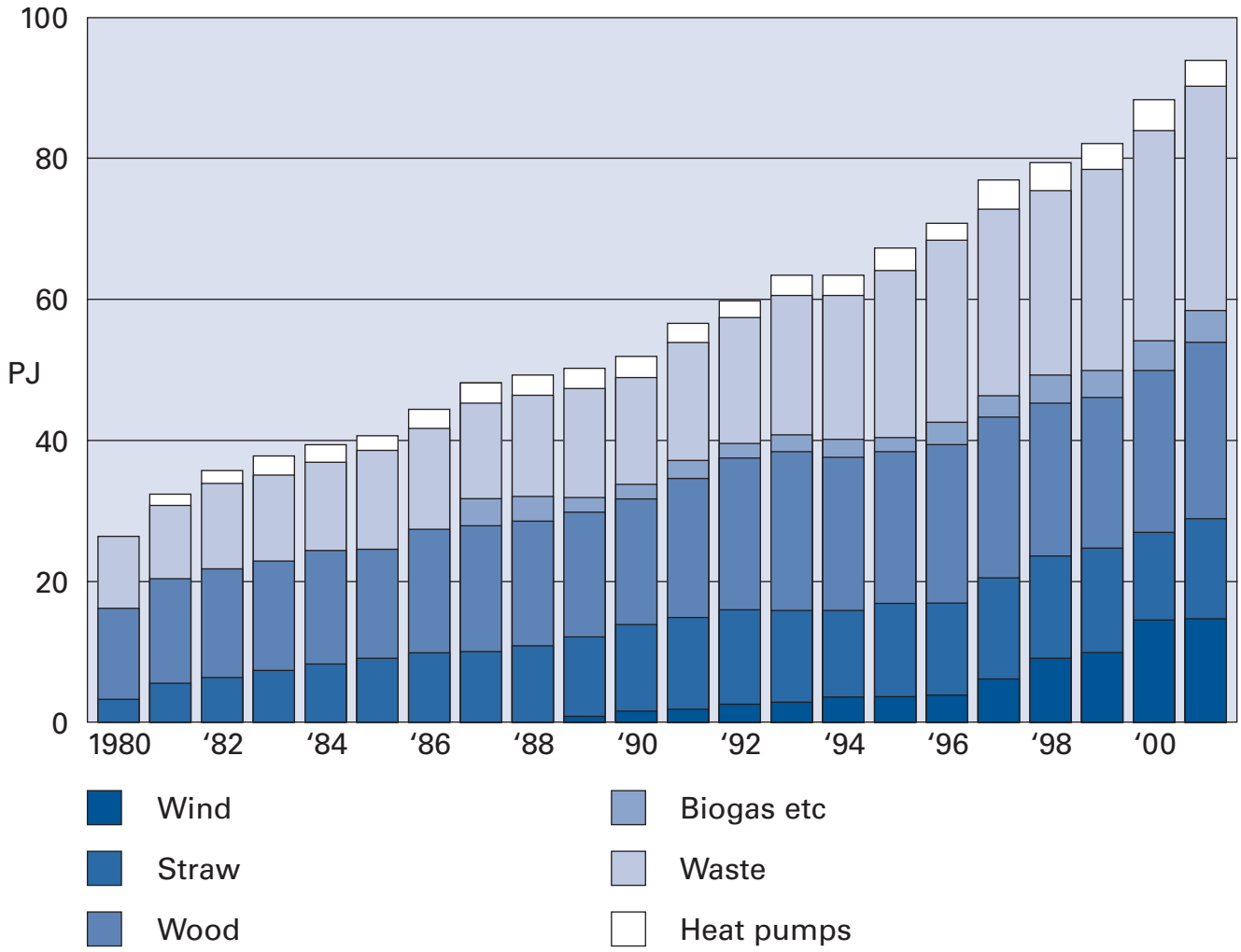


Exhibit 2.5 *Renewable energy by source in Denmark*[2]

- **Biomass fuel** – farmer co-operatives manage the fuel supply chain and own the majority of the 120 straw and woodfuel district-heating plants.

- **Anaerobic digesters** – farmer co-operatives own over 20 large-scale digester plants providing farmers with a sustainable waste-management solution.

1996's Energy 21 plan sought to ensure that 'the energy sector is well rooted in a democratic, consumer-oriented structure' and that this structure should be 'robust in relation to market developments'.
This should be based on the principles of 'self-sustainability' – to be achieved through an emphasis on consumer ownership and consumer democracy.

In key areas, such as district heating, this is also firmly based on a non-profit ethos. The self-sustainability principle has been underpinned by the creation of stable, long-term investment conditions.

In anticipation of EU requirements, a resolution was passed in 1999 to liberalise Denmark's electricity market by 2002. This was accompanied by the introduction of green certificates for renewable electricity. Many of the price subsidies introduced over the last decade were cut back following the election of a new government in 2001, and investment has subsequently slowed. This has prompted discussion as to what extent liberalisation supports the principle of 'self-sustainability'.

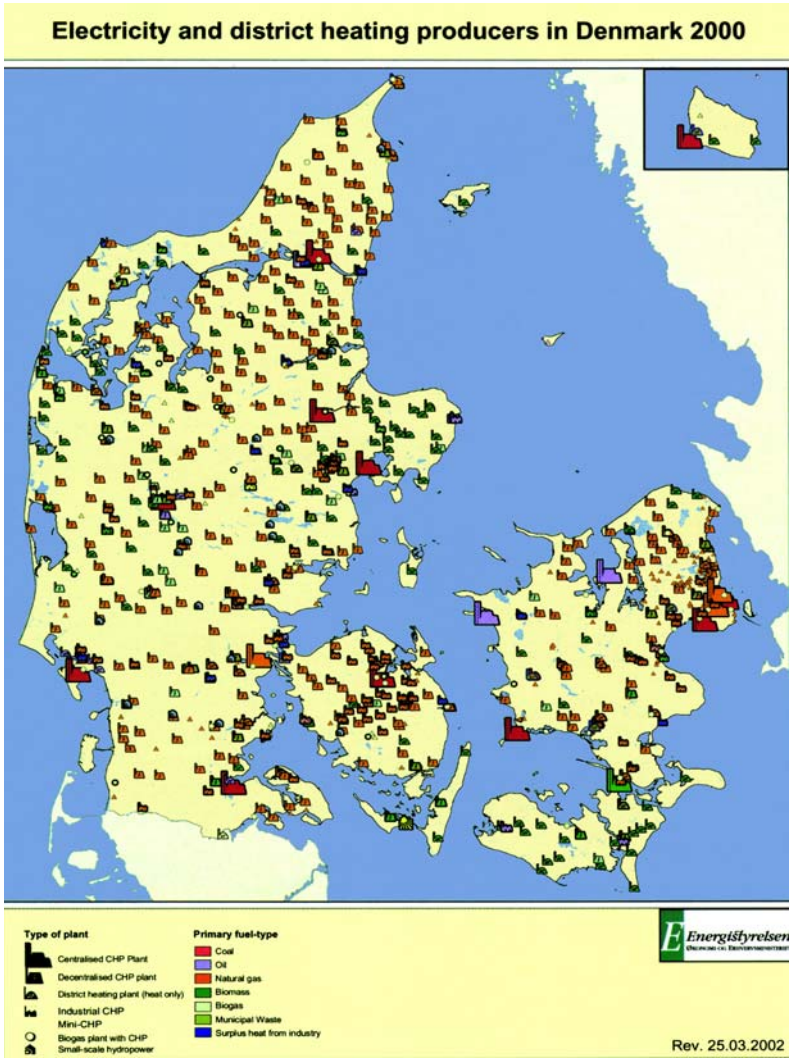


Exhibit 2.6 *Electricity and district heating producers in Denmark*[3]

Consumption (per person)	
Primary energy	166 GJ
Electricity	4,018 kWh

Natural gas	
Price (domestic)	£5.82/GJ
Energy taxation	£5.24/GJ

Electricity	
Price (pool)	2p/kWh
Price (domestic)	6.3p/kWh
Energy taxation	5.6p/kWh

CO_2 emissions	
Per person	9.42 t
% change since 1990	-13.5%

Renewables	
% primary energy consumption	14%
% electricity consumption	25%

Exhibit 2.7 *Energy statistics for Denmark*

3 Danish Board of District Heating (DBDH) (2003)

3 DENMARK: COMMUNITY-OWNED WIND POWER

Denmark is notable in that a significant proportion of its wind power capacity is owned by co-operatives (or 'guilds'). The mission team met with Hans Christian Sørenson, who is on the board of directors of the Danish Association of Wind-power Guilds (DV) – the main support agency for wind co-operatives in Denmark.

We went on to meet Jens Larsen from the Copenhagen Environment and Energy Office (CEEO) – an organisation formed under the auspices of Local Agenda 21. The CEEO had played an important role in the development of the Lynetten onshore and Middelgrunden offshore wind farms – both co-operatives are owned by citizens of Copenhagen.

3.1 Wind-power development

Agriculture has always played an important role in Danish life, and windmills have been an integral part of the rural scene. By the early 1930s it was estimated that there were 30,000 windmills in Denmark, some of them producing electricity. When small modern wind turbines started to appear in ones and twos in the 1970s, therefore, they were not controversial.

At first, they were erected and owned by farmers, but soon local communities became involved – on the principle that they could own the source of the electricity they consumed. Eventually, this principle was extended, and as wind turbines became bigger and more expensive, ownership was opened up to the whole population.

When the price of oil fell after the crisis in the 1970s, the Danish government preserved an artificially high consumer price by raising taxes, using the revenue to provide subsidies encouraging the development of alternative sources of energy. This support led to an increase in installed capacity which stimulated the Danish wind-turbine manufacturing industry, now a world leader employing some 20,000.

By 2002, the installed capacity of wind energy in Denmark was ~3,000 MW, generated from 5,600 turbines and providing 14% of the nation's electricity consumption. Just over 600 MW was owned by co-operatives. By contrast, in 2004 the UK's installed capacity, for a population ten times that of Denmark, was 777 MW. This comprised 90 projects, only one of which was owned by a co-operative, providing 0.5% of the UK's electricity.

That is not the full story, however. The co-operative share of new electricity capacity in Denmark fell from over 50% between 1978-1994 to less than 20% between 1995-2001. Since 2001, new wind-farm developments have been almost non-existent. The reduced importance of co-operatives is easily explained: farmers and other landowners began to invest in projects and, as wind turbines moved offshore, utilities and larger investors entered the market. And perhaps, with a population of just over five million, there is a limit to the number of times individuals are prepared to invest in co-operatives.

For the reason why no new wind farms are being built, however, one has to look to the role played by government. When world oil prices started to move higher in recent years, there was less tax revenue available

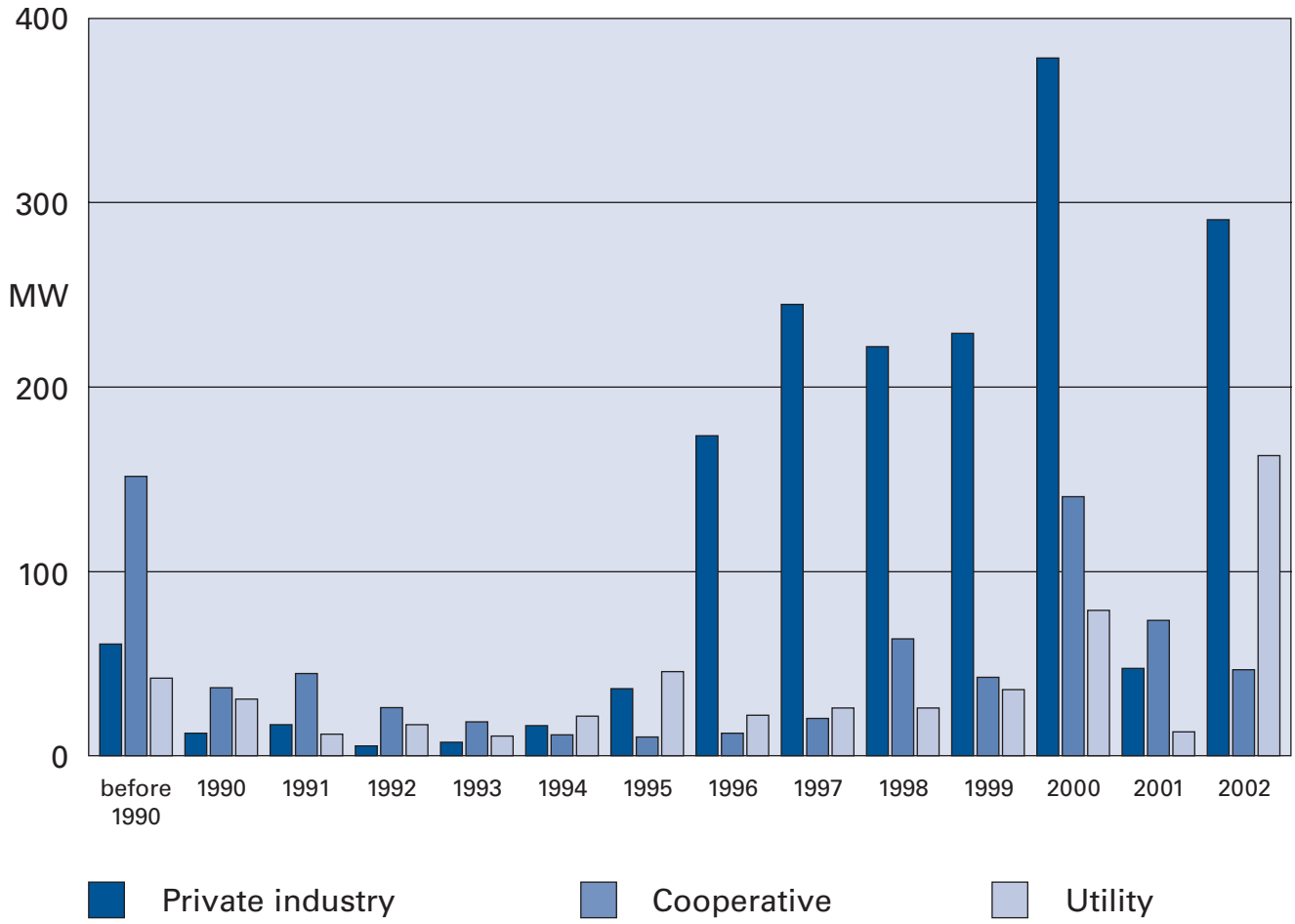


Exhibit 3.1 *Wind-farm ownership – new installed capacity in Denmark*[4]

for subsidies. The Danish government now considers the wind industry to have matured, requiring less support than other renewable technologies. Furthermore, there is now a focus on re-powering older, smaller wind farms occupying prime sites, and not optimising their wind potential.

Compared with Denmark, the UK appeared on the modern wind scene quite late, and it was not until the 1990s that wind farms began to appear in any numbers. The British public did not experience such a gradual transition from windmills with sails to small clusters of wind turbines scattered across the landscape; instead, turbines have been built as larger wind farms, concentrating their visual impact.

3.2 Danish Association of Wind-power Guilds (DV)

DV was founded in 1978 as a non-profit, independent association whose aim is to take care of the wind turbine owners' mutual interests regarding local authorities, political decision-makers, utilities and wind turbine manufacturers. In February 2004, the membership stood at approximately 9,000, generating some £320,000 in subscription fees. DV also benefits from consultancy fee income of £160,000/yr. There is no equivalent organisation in the UK.

The wind industry in the UK is dominated by a small number of large players (manufacturers, developers and utilities)

4 Copenhagen Environment & Energy Office (CEEO) (2003) *The Middelgrunden Offshore Wind Farm — a Popular Initiative*

who maintain their own information on wind regimes, financial models and profitability. This creates a competitive environment, with high barriers excluding small players. It quickly became obvious that this is not the case in Denmark. DV was very open in discussions on all aspects of the wind industry.

Wind co-operatives had developed in Denmark through organic processes within local communities, and with the support of DV. Mr Sørensen described the growth of a typical small co-operative:

- A local schoolteacher has the idea of a new wind farm
- He gathers support from two or three other committed individuals
- They find two or three farmers willing to site turbines near their joint boundaries
- They gain local support at a series of public meetings
- They join DV
- DV provides advice on lobbying government and negotiating with manufacturers and utilities
- DV provides advice on legal and taxation implications
- DV assists with forming a co-op and issuing shares

There is no doubt that DV has played a pivotal role in the growth of the co-operative movement within the wind industry. In particular, DV has:

- Helped to change attitudes at a local level
- Through its member-led structure, responded to the needs of co-operatives
- Provided technical expertise that has significantly benefited the development process
- Provided political influence that has helped establish a favourable environment
- Modified manufacturers' marketing claims to more realistic expectations based on experience
- Negotiated with manufacturers and utilities to improve the competitive position of small co-operatives on issues such as prices and connection charges
- Negotiated favourable terms for insurance and financing

In Denmark, 150,000 families are members of wind-energy co-operatives. Although several small community schemes are emerging in the UK, there are only a handful of wind co-operatives, with Baywind Energy Co-operative Ltd – with its 1,350 members – being the most significant.

The UK model is based on one vote for each member, regardless of the number of shares (currently subject to a statuary limit of £20,000). Baywind has no facility for redeeming shares until the end of the project, but the newer co-ops have adopted rules permitting some share redemptions after five years. At the end of the project (typically between 20 and 25 years), the co-op will be wound up and members will be paid back their original investment money.

The Danish co-operative model is slightly different. Individuals are invited to subscribe small amounts to provide working capital for the establishment of the co-op. If the project does not go ahead, this money is not recovered, but if the project is successful this money is treated as a down payment on shares, with further money being raised to fund the turbine acquisition.

It is accepted that a wind farm is a wasting asset, and members do not expect to have their investment money returned at the end of the project. In theory, all members have unlimited liability, but as bank loans are not taken out this is not seen as a major risk. Obtaining good insurance has therefore been vital in order to minimise financial exposure to operational risks. In the Baywind model, liability of members is limited to the shares subscribed for, and is a straightforward

equity investment. The Danish model is closer to the purchase of an annuity.

Both models have their merits. The Danish approach appears more relaxed and informal, and can be relatively accessible if bank loan facilities are available for new members wanting to buy shares – as arranged for Middelgrunden co-operative (see below). Under the Baywind model, the co-op needs to accumulate large sums of cash for eventual share redemption, and the FSA pays close attention to the terms of the share offer. The accumulation of cash, however, ensures that the co-op can survive minor disasters and (subject to members' approval) invest in new projects without the need for further share offers.

Currently, however, the establishment of new energy co-operatives in the UK is restricted by the high barriers to entry. In particular, we have lacked the kind of hands-on support and negotiating role provided by DV. In Denmark, financial support for new projects has also been available at the high-risk, pre-planning stage. In the UK, Energy4All has started working to overcome some of these barriers. However, greater support is needed in order to develop the capacity of Energy4All, as well as the range of energy agencies and community renewable initiatives, to support new co-operatives.

3.3 Middelgrunden co-operative

Environment and Energy Offices (EEOs) were created throughout Denmark to provide advice on sustainability. Copenhagen EEO (CEEO) provided the project management for the co-operative part-owner of Middelgrunden Offshore Wind Farm. Two years ago, funding was withdrawn and, with the exception of Copenhagen, all the centres were closed. Copenhagen survives with a skeleton staff of five or six on training grants.

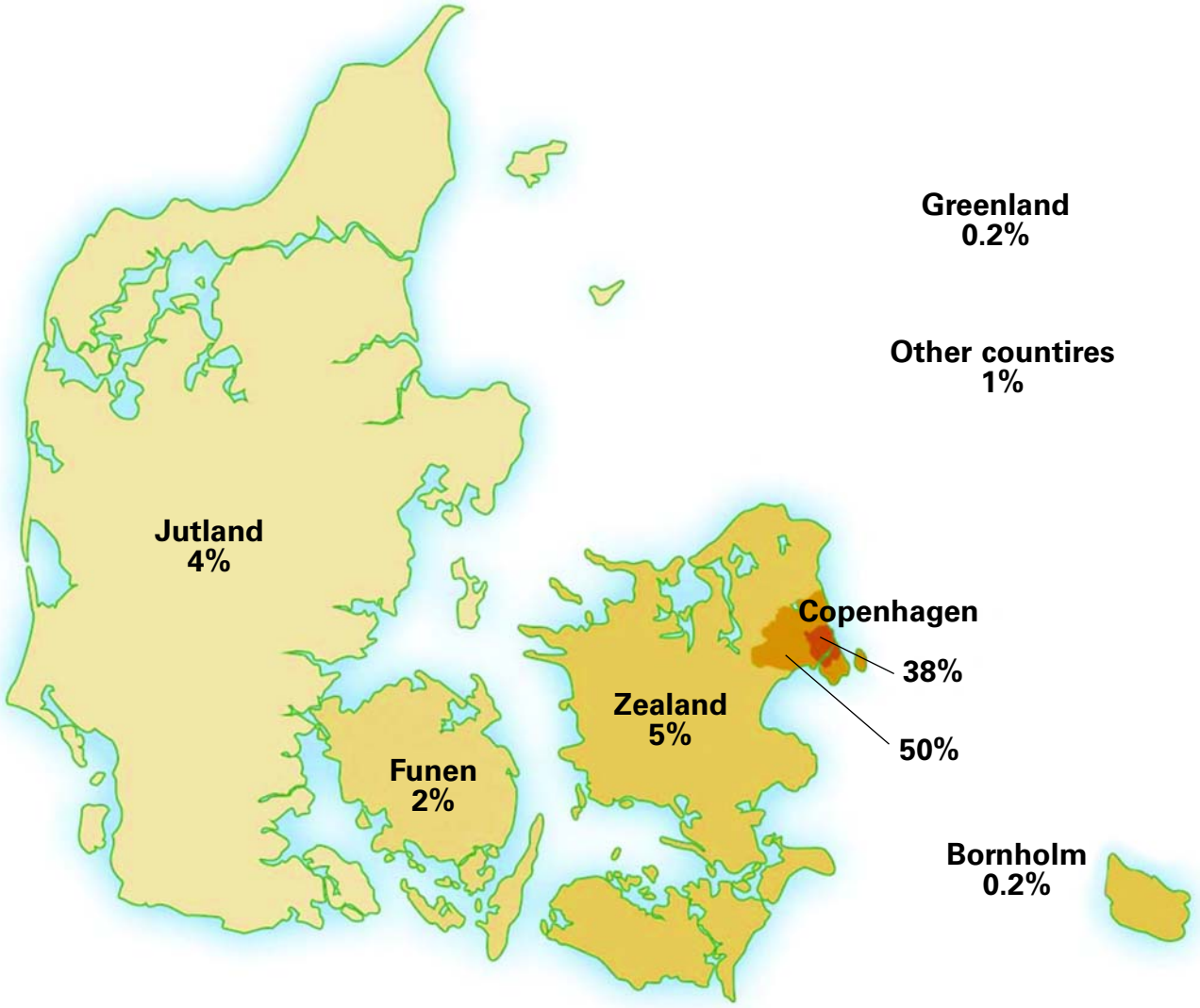
Mr Larsen explained the construction of the Middelgrunden wind farm, and then took us to see the turbines from the onshore wind farm of Lynetten. Lynetten consists of seven turbines of 700 kW (total capacity 4.9 MW), four of which are owned by Lynetten Wind Co-operative and the other three by a local power-supply company. The wind farm is located on a breakwater amidst an industrial, dockland landscape. Middelgrunden consists of 20 turbines of 2 MW each (total capacity 40 MW), ten of which are owned by Middelgrunden Wind Turbine Co-operative and ten by the local utility company.

In 1993, when the idea of Middelgrunden was born, an offshore wind farm was a relatively new concept. When CEEO formed a working group in 1996 to consider placing 27 turbines on the Middelgrunden shoals, there were many technical problems to overcome that had never been faced before. With a wind speed of 7.2 m/s, the site was good rather than spectacular, but winds tend to be more constant offshore than onshore.

It was recognised that local co-operation was vital for the scheme to be successful, and the working group (consisting primarily of local people) decided to follow the traditional Danish co-operative model, and in 1997 formed the Middelgrunden Wind Turbine Co-operative. Unlike the UK co-operative, this is a partnership, and all partners have joint and several legal liability. In Middlegrunden's case, the partnership was divided into 40,500 shares, based on the formula that one share would generate 1,000 kWh/yr (ie 90% of budget production).

Although there was majority support for 27 turbines in three rows at the first public hearing in 1997 (24 in favour; 8 against), the concerns of those opposing the project were taken seriously. An alternative scheme of 20 larger turbines in a single gentle arc was proposed, which received widespread support at a second public hearing in 1998.

Exhibit 3.2
Geographical distribution of Middelgrunden shares[4]



A full environmental impact assessment was carried out in 1999, and at the third public hearing there was very little opposition. The project began almost immediately, and production commenced in 2001.

The project has two owners – Copenhagen Energy (the local utility owned by the Municipality of Copenhagen) and the Co-operative – each taking possession of ten turbines. The Co-operative, assisted by government grant and through CEEO, contacted between 50,000 and 100,000 people in the early stages. 10,000 local people committed cash, buying 30,000 pre-subscriptions at €7 each.

Ultimately, 8,552 electricity consumers became shareholders, half of them subscribing for five shares (the maximum number to be given tax-free status). The cost of the Co-operative's share of the project was estimated at €23 million, giving a price per share of €570. The restrictions governing local ownership were lifted in 2000, but almost 90% of all shares are still held by local people and organisations. The Co-operative benefited from certain advantages not readily available in the UK:

	Middelgrunden Wind Farm Co-operative	Baywind Energy Co-operative
Production from	2002	1997
Turbines	10 by 2 MW	6 by 500 kW
Capacity	20 MW	3 MW
Theoretical output	175,200 MWh	26,718 MWh
Wind speed	7.2 m/s	5.2 m/s
Capacity factor	29%	26.5%
Actual output	50,659 MWh (2002)	7,083 MWh (2003)
Output per member	5,923 kWh	5,246 kWh
Members	8,552	1,350
Local membership	88%	48%
Capital	£16.7 million	£2 million
Bank loan	nil	£650,000
Capital cost	£835,000/MW	£869,000/MW
Turnover	£2.8 million (2002)	£419,000 (2003)
Average return members	7.5%	6.0%
Excluding depreciation	12.5%	Not applicable
Tax relief on investment	Not applicable	EIS (20%)
Tax on members' income	Nil (average member)	Standard rate
Loan available	100%	Negotiable

Exhibit 3.3 *Comparison of Middelgrunden and Baywind co-operative wind farms*

- Public and political support of the wind industry
- An infrastructure that included the Danish Environment & Energy Office
- Grant funding
- A pre-subscription model to provide additional early funding
- Public awareness of the profitability of the project
- Availability of bank loans solely on the security of the shares
- A tax-free income on investments up to €2,850

While offshore wind farms are a new field of expertise in the UK, Middelgrunden also demonstrates that such complex projects can be negotiated and delivered through a co-operative approach. The selection of a partner with complementary skills – Copenhagen Energy utility – was also key to success. Although in the UK it might be thought to make a project more difficult, the Middelgrunden wind farm actually appeared to benefit from being near to Copenhagen – creating a greater feeling of ownership by residents.

The Middelgrunden Wind Turbine Co-operative is a perfect example of people working together for the common good, being sensitive to genuine concerns, and overcoming immense technical and logistical problems. The result is an offshore wind farm of which Copenhagen residents can be proud, and which the rest of the world can admire.

3.4 Key findings

- Just over 600 MW (23%) of Denmark's wind capacity is owned by co-operatives, and 150,000 families are members of wind-energy co-operatives.
- Wind-power development in Denmark can be characterised by a gradual transition from small community- and farmer-owned wind farms scattered in many clusters across the rural landscape, to larger offshore wind farms with a range of different owners.
- Co-operatives have played an important role in the development of wind power, helping to nurture a wider acceptance of wind power in the landscape by ensuring that communities directly benefit from their development.
- Like Baywind in the UK, members of Danish wind co-operatives are able to receive a dividend on their investment. However, the community investment model used differs from the UK in a number of ways:
  - An initial subscription required as working capital
  - Asset value is depreciated so shares are treated more like annuities than equities
  - Members have unlimited liability, so greater insurance cover is required
- The support of the Danish Association of Wind-power Guilds (DV) has enabled co-operatives to develop on this scale. As a member-controlled organisation, they have brokered the support required and helped to overcome major institutional barriers.
- Middelgrunden co-operative benefited from a number of advantages not readily available in the UK:
  - Direct public and local authority support
  - Local energy office support
  - Grant funding at pre-planning stage
  - Availability of bank loans for members to buy shares
  - Tax-free investment allowance
- Complex – and potentially controversial – offshore projects can be delivered through the development of complementary partnerships with investors and utilities.

4 DENMARK: CONSUMER-OWNED DISTRICT HEATING

Denmark is a world leader in the development of district heating networks. A significant proportion of these are owned by their heating consumers. The mission team met with Mr Leif Andersson, the manager of Høje Taarstrup co-operative. Høje Taarstrup is a consumer co-operative which owns and manages a district heating network in Greater Copenhagen.

A short seminar was then hosted by Lars Bodilsen and Lars Gullev from the Danish Board of District Heating (DBDH) – the lead trade association for the Danish district heating sector – and Hans Jørgen Koch, Deputy Secretary of State for Energy. We learnt about the history of district heating development in Denmark, and were also given an overview of the joint co-operative and local-authority-owned VEKS – West Copenhagen's heat transmission grid.

4.1 District heating development

Denmark contrasts sharply with the UK in its choice of district heating rather than natural gas to heat its towns and cities. District heating currently accounts for over 50% of space heating. This level of market penetration has been achieved over a period of 20 years, almost entirely on a retrofit basis. District heating has had the advantage of allowing cheaper, lower grade fuels than oil (including municipal waste) to be used. This has enabled communities to become more resilient to fuel price fluctuations.

The 1979 Heat Supply Act stimulated major investment in heating networks. Local authorities were required to prepare heating plans – ironically at the same time as 'lead' UK cities following the Marshall Report. Local authorities were given the powers to make consumers connect to new district heating networks. This resulted in the development of heating networks in most towns and cities. However, compulsory connection was balanced by a requirement for consumer control, not-for-profit operation, and price transparency.

Schemes were delivered by local-authority-owned heating companies or consumer-owned heating co-operatives. Of the 430 district heating companies in 2001, 85% were co-operatives, accounting for 37% of the total heat sales. The largest co-operative heating network is Høje Taarstrup, and the largest co-operatively owned CHP plant is Hjørring with a capacity of 55 MW.

In 1986 the emphasis shifted to CHP, with the agreement on new power generation. This favoured the supply of heat to district heating networks from CHP plants in order to burn fuel more efficiently. During the 1980s and 1990s, new CHP plants were built near to towns and cities, with plant ranging in size from large power stations to supply cities such as Copenhagen through to 1-2 MW gas engines to supply small villages.

Price support was provided for CHP electricity. Grants were also provided towards the capital cost of installing heating networks. These were funded from energy taxes introduced at the same time. As we have already mentioned, district heating also allows for fuel flexibility. The range of fuels used by Danish district-heating co-operatives

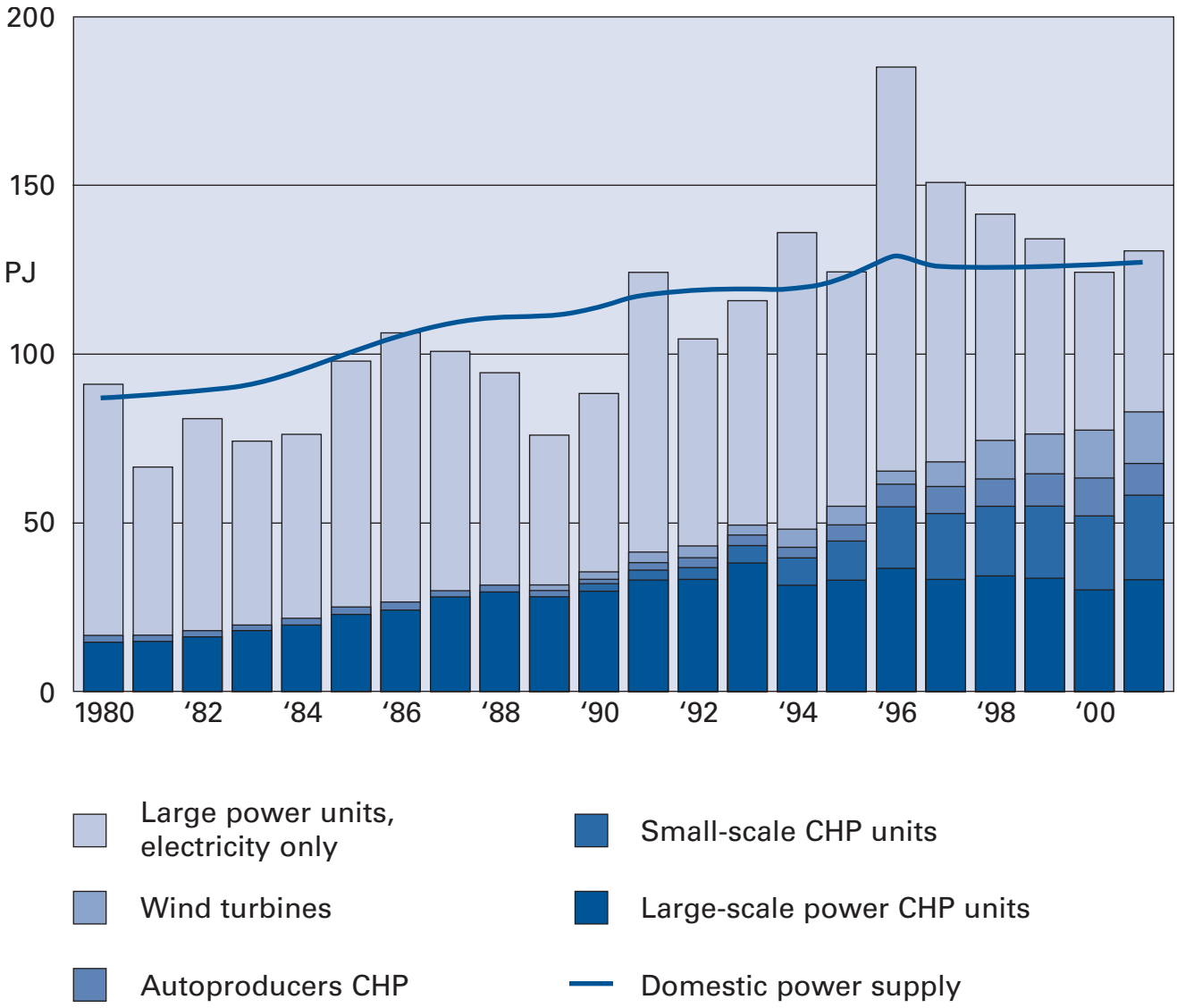


Exhibit 4.1 *Electricity production by type of producer in Denmark*[5]

Established	1992
Annual turnover	£13.7 million
Employees	14
Typical investment payback period	20 years
Consumer members	35 (elected board of representatives)
Consumer connections	4,500
Heat supplied annually	1,200 TJ
Peak load	60 MW_{th}
Heated floor area	2.6 million m^2

Exhibit 4.2 *Høje Taarstrup summary*

5 Danish Energy Authority (DEA) (2003) *Renewable Energy – Danish Solutions*

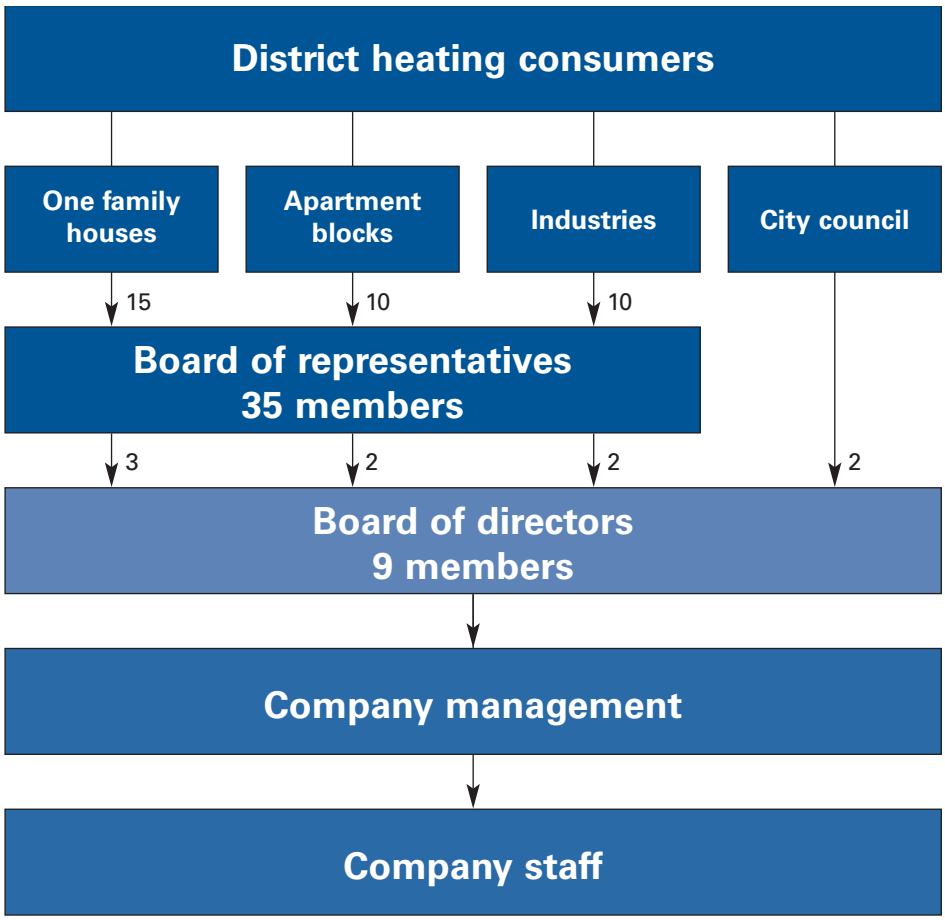


Exhibit 4.3
Høje Taarstrup co-operative structure[6]

now includes natural gas, biogas, woodchip, straw, bio-oil and even solar thermal.

So, in summary, CHP/district heating in Denmark developed in response to the energy crisis of the 1970s. It has allowed Denmark to make efficient use of fossil fuels such as natural gas, whilst supporting a diversity of renewable fuels. Whilst the UK is different in that it has benefited from cheap natural gas, parallels can be drawn. The 2003 Energy White Paper has focused on fuel security – suggesting that the efficient use of natural gas and fuel diversity could be strong drivers for district heating.

4.2 Høje Taarstrup Fjernvarme

Høje Taarstrup is one of 19 district-heating co-operatives in Greater Copenhagen. It is owned by its heat consumers and it manages a heating network, standby boilers and associated customer services. Copenhagen's heating co-operatives are connected together by the VEKS and CTRL city heating grids which allow the circulation of heat from a number of large power stations.

4.2.1 History and structure

Høje Taarstrup was formed in 1992, following a merger of the local-authority-owned heating plant and the co-operatively owned heating network. It has 14 employees, is owned by 35 shareholders, and has an annual turnover of £13.7 million. In Denmark, it is perceived as being a private organisation.

The co-operative's rules stipulate that it is not-for-profit. If surpluses are generated, then they must be re-invested or used to lower prices the following year. The heating prices

6 Danish Board of District Heating (DBDH) (1999) *Best Practice in Danish District Heating*, News from DBDH, No 3

are therefore calculated on a transparent basis to consumers, reflecting the actual cost of providing and maintaining the service. Prices are also benchmarked against other heating co-operatives in the area.

The co-operative's structure is based around a board of representatives, which is the main decision-making body. Each shareholder has voting rights on the board of representatives, which approves the budget and accounts. Each shareholder elects (or nominates) their representative. There is a general meeting once a year at which the board is confirmed, and this is open to all consumers. The co-operative also has an executive board with nine managers which meets six times a year. Two councillors also sit on this board.

The constituency is split three ways with households having 15 shares, housing associations 10 shares and commerce/ industry 10 shares. Elections are held once a year. It was noted that participation and interest from consumers is generally low, except when major problems or decisions arise. Because of the co-operative structure, consumers have a number of ways in which they can make a complaint internally:

- Call customer services
- Approach their board representative
- Speak at the general meeting

The closer relationship with consumers fostered by the co-operative structure is seen as being an efficient model for the investment/management of town/village-scale district heating. However, like many other heating co-operatives in Denmark, the local authority's support has been vital. First, it has planning powers to zone areas for district heating and ensure compulsory connection of consumers. Second, it has acted as a loan guarantor enabling the co-operative to secure low-cost, long-term finance.

Use of the planning system, coupled with bank guarantees and low-cost finance from local authorities, has been fundamental to Danish district-heating development. The planning system has been used to ensure that all consumers connect to heating networks. This may appear draconian, but it appears to have been accepted because of the wider social, economic and environmental benefits. The transparency provided by the co-operative model appears to have contributed to this wider acceptance.

4.2.2 Heating plant – location and appearance

The co-operative's main heating plant – an attractive, modern building – is located on an industrial estate on the edge of Taarstrup. The stack is highly visible from neighbouring areas. The plant also houses the co-operative's main office and control rooms for the heating network. On the outside of the building, the co-op did not appear to have its own unique identity, instead displaying the generic Danish symbol for a district-heating company.

Whilst the co-operative owns its own heating plant, these are now only used as standby. This is because Copenhagen's heating co-operatives are linked into a heat grid. This is managed by VEKS – a jointly owned company which distributes heat from several large CHP stations to the Greater Copenhagen area. Heat is transferred to the Taarstrup heating network via large heat exchangers.

4.2.3 Heating network and service delivery

The co-operative supplies heat to 4,500 consumers, equating to 2.6 million m^2 of heated floor area or 30,000 households. It owns the insulated pipework required to distribute heat, as well as the associated boiler plant, substations and heat meters. The heating supplied is cheaper than natural gas or oil – though not all connections would

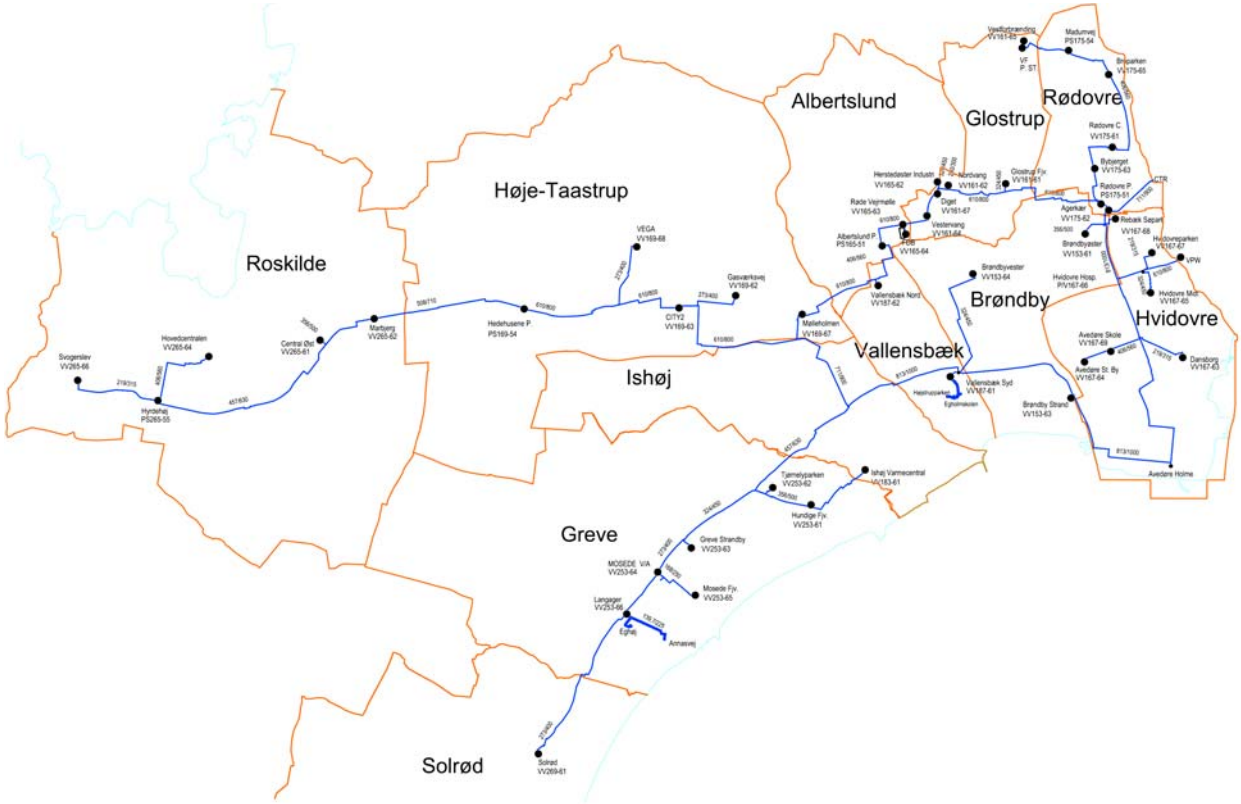


Exhibit 4.4 *VEKS supply area*[7]

be cost effective, particularly if they were low density and on the outskirts of the town.

In the UK, there has been a debate about whether district heating could be retrofitted to our towns and cities. Taarstrup's heating network was retrofitted during the 1980s and 1990s, replacing boilers running on heating oil. The co-operative has been able to charge consumers for connections to the heating network, and it has the power to take consumers to court if they refuse to connect and/or pay the charge. Low running costs, together with energy taxes on coal, oil and gas, mean that district heating is cheaper than other forms of heating – though consumers cannot now switch to other fuels.

It was apparent that efficiency and effective service delivery are key priorities in every part of the business:

- **Boiler capacity** – though 30 years old, the co-operative's boilers, which are now used only occasionally as standby capacity, were notable for being immaculately clean and well maintained
- **Heating network** – investment in features such as leak detection has steadily reduced heat losses from pipes
- **Metering and billing** – the co-operative provides consumers with state-of-the-art metering and billing services, including digital heat meters and remote meter reading that even allows consumers to profile their energy use over the Internet
- **Heat exchangers** – the co-operative supplies heat exchangers for consumers; benefits cited included savings on servicing costs for individual boilers
- **Flow and return** – consumers are penalised if they use the district heating network inefficiently, as defined by the water flow and return temperature; if customers return water at too high a temperature, then charges are levied

7 Vestegnens Kraftvarmeselskab (VEKS) (2002) *VEKS Projektstatus*

There appeared to be a high level of investment in maintenance and new technology. Investment is on a long-term basis, with 20 years quoted as the typical timeframe. In the case of shared infrastructure such as the VEKS heating network, EU sources of finance such as the European Investment Bank (EIB) had successfully been used for long-term finance and working capital for a rolling programme of investment.

4.2.4 Benefits of the consumer-ownership model

In many ways, Danish district-heating co-operatives can be likened to the UK's proposed CICs. District heating is a long-term investment (20 years appears to be the norm), and the assets and heads of terms are dedicated in perpuity to the benefit of the community. There is an additional benefit in that in they have a democratic, member-based structure. Members of the community are therefore more than just energy consumers or customers.

Danish district-heating co-operatives are not-for-profit, and heating costs are therefore calculated at cost and are agreed each year. This means that spending to deliver on quality, efficiency and price objectives is transparent and 'open book', and can be scrutinised by members. Because they cannot generate profits, any surpluses are ploughed back into the co-operative, in the form of either investment or reduced prices.

The size of larger consumer co-operatives such as Høje Taarstrup inevitably means there is greater distance between the members and the decision-making processes. This is a similar issue faced by UK consumer societies – though it could be argued that a high level of direct engagement is not needed to deliver a heating supply. Accountability is, however, built into their structure in a way that is not currently commonplace in UK utilities.

It is notable that heating networks larger than Høje Taarstrup are owned and managed by local authorities. However, the manager of Høje Taarstrup felt that this structure was not as efficient or responsive to consumers. Whilst there are pressures from the EU and the current Danish government to further liberalise energy markets, it was felt that the heating co-operatives were in a strong position because of their performance. However, liberalisation of the electricity and gas markets did create real pressures on co-operatives with CHP plants.

4.3 Key findings

- Denmark contrasts with the UK in its choice of district heating to heat its towns and cities, accounting for over 50% of space heating. This level of market penetration has been achieved in just over 20 years, almost entirely on a retrofit basis.
- There were 430 district-heating companies in 2001, 85% of which were co-operatives, accounting for 37% of the total heat sales.
- District heating has developed because local authorities were given planning powers to make consumers connect to new networks. This has been accepted because of the wider social, economic and environmental benefits.
- District heating has had the advantage of allowing fuel flexibility. It has also enabled communities to become more resilient to fuel-price fluctuations.
- Local authorities have acted as loan guarantors for heating networks, enabling co-operatives to secure low-cost, long-term finance.
- Grants were provided towards the capital cost of installing heating networks, and electricity price support was provided for CHP electricity. This support was funded using the revenue from energy taxes.
- Danish district-heating co-operatives are consumer owned – the shares and voting rights are controlled by consumers connected to their heating networks. In larger co-operatives, there are constituencies of elected representatives.
- District-heating co-operatives are run as non-profit-making organisations and they make investments over, typically, 20-year terms. Any surpluses are re-invested or used to lower prices, and heating prices reflect the actual cost of providing and maintaining the service.
- Danish district-heating co-operatives can be likened to the UK's proposed CICs, with their assets dedicated in perpetuity to the benefit of the community. However, their co-operative nature provides heat consumers with the additional benefit of a democratic structure.
- Co-operatives in Denmark are viewed as private-sector organisations. The consumer-ownership model is seen as being more efficient and responsive to consumers than local-authority ownership, whilst still being able to deliver the long-term investment required.

5 DENMARK: CONSUMER-OWNED ELECTRICITY SUPPLY

Outside Denmark's major cities, electricity supply and distribution networks have traditionally been owned by their consumers. Competition was introduced to the electricity supply when it was liberalised in 2002, but the distribution networks remain monopolies.

The mission team met with Jan Johansson, marketing director of SEAS Energy Group, a consumer-owned energy company that distributes and supplies electricity in Zealand. It had also acted as project manager for the Middelgrunden co-operative, and is providing engineering services to offshore wind-farm projects in the UK.

Staff	380
Annual turnover	£129 million
Supply area	4,856 km^2
Consumer members (distribution)	236,500
Consumer members (supply)	182,000
Total energy consumption	1,825 GWh

Exhibit 5.1 *SEAS summary*

5.1 History

SEAS is Denmark's largest consumer-owned energy company. Its supply area covers the southern part of Zealand, Møn and Lolland-Falster. Its history goes back to 1912, when SEAS was established by three landowners; the first chairman was landowner N J Andersen. It wasn't until 1989 when SEAS was reconstructed into a co-operative with limited liability, registered as SEAS Energy AmbA, from when SEAS was owned by all its customers.

The co-operative consists of five companies, established in 2000 in response to the need to streamline the organisation in preparation for liberalisation of the electricity market:

- SEAS Transmission A/S – a transmission company for the higher voltage grid
- SEAS Distribution AmbA – the parent company of the SEAS group
- SEAS Strommens Elforsyning A/S – a public service company for electricity consumers in South & East Zealand and on the neighbouring islands
- SEAS Net A/S – a distribution company for the 0.4 and 10 kV grid
- SEAS EnergiService A/S – established as a direct result of the Danish Electricity Act that stipulated the need to separate the co-op's commercial activities from that of its distribution interests; this company controls the sales of commercial products, consulting and design, as well as energy efficiency

SEAS has subsequently taken over, and continues to increase its portfolio of, town and village distribution networks which, up until the late 1990s, had largely been local-authority owned. SEAS has been able to achieve lower overall costs through the group's economies of scale. It is shortly to merge with another supply and distribution co-operative – NVE – and together they will have over 300,000 members.

5.2 Structure

SEAS is a co-operative owned by its consumers, and is non-profit-making. By being connected to the distribution network, a customer becomes a shareholder. All 182,000 customers are

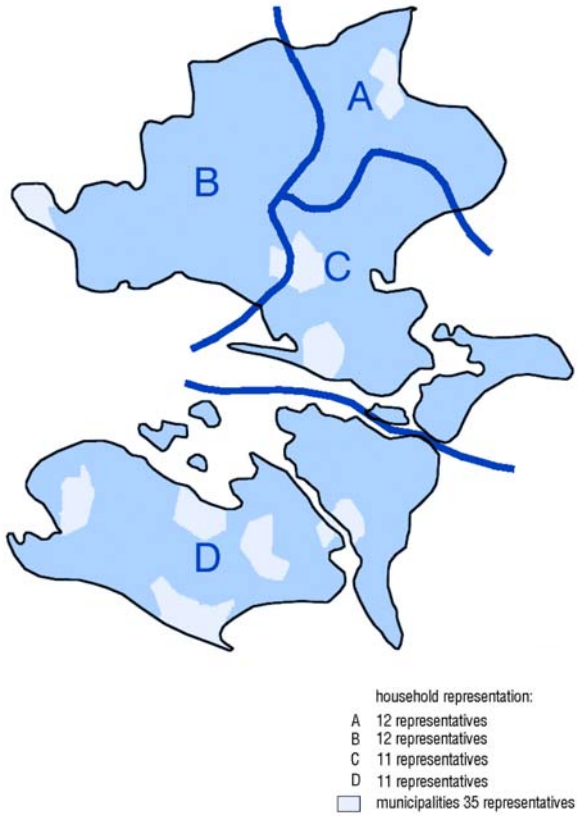


Exhibit 5.2 *SEAS supply area*[8]

132 kV	
Overhead lines	488 km
Cables	54 km
50 kV	
Overhead lines	592 km
Cables	88 km
10 kV	
Overhead lines	1,987 km
Cables	3,751 km
Low voltage	
Overhead lines	2,442 km
Underground lines	6,414 km
Substations	
132 kV stations	18
50 kV stations	70
10 kV stations	6,911

Exhibit 5.3 *SEAS physical assets*

Job title	Name	Board position
Mayor	Paul Arne Nielson	Chairman
Businessman	Niels Fog	Vice-chairman
Manager	Aage Steen Rasmussen	Board Member, Major Industries
Horticulturalist	Mogens Bjerre	Board Member, Minor Industries
Lawyer	Per Feldby	Board Member, Consumers
Farmer	Helmer Jensen	Board Member, Consumers
Town Councillor	Niels True	Board Member, Consumers
Farmer	Hartvig Svaerke	Board Member, Consumers
Assistant	Sonja Jensen	Board Member, Staff
Engineer	Finn Hansen	Board Member, Staff
Master Technician	Preben F Jensen	Board Member, Staff
Accountant	Connie Flade	Board Member, Staff

Exhibit 5.4 *SEAS board representation*

8 *SEAS (2004)*

therefore owners and members. Two General Meetings are held each year, in Spring and in Autumn. Representation is divided into four main groups of consumers:

- **Households** – four area groups (56 representatives)
- **Municipalities** – 35 representatives
- **Business** – small, medium and large (40 representatives)
- **Large industry** – 13 representatives

A members' committee is elected every four years, with eligibility determined by volume of consumption. Household representation is currently based on one representative for each 25 GWh/yr block of consumption, and one representative for each municipality. The broad constituency of the members' committee is reflected in the non-executive representation on the management board.

5.3 Benefits of the consumer-ownership model

The consumer-ownership model has a number of inherent strengths that enable it to deliver competitive distribution and supply services. In many respects, SEAS has a vision that mirrors the core values of many UK co-operatives, and that is to seek value by:

- Having satisfied customers
- Having active owners
- Active involvement in companies in which SEAS holds shares
- Having satisfied employees
- Building valuable knowledge
- Achieving results through co-operation and alliance

In the UK, there are already large distribution network operators (DNOs) resulting from consolidation of the old regional distribution companies. Margins have fallen with the increased pressure to reduce electricity prices, and this has had a knock-on effect on the levels of investment to maintain ageing networks. Private networks, where they exist in the UK, struggle to offer low-cost services, as they do not possess the economies of scale of the DNOs.

The position of SEAS as a private operator of a monopoly public service is similar to that of the UK's DNOs. However, SEAS's non-profit clause means that it has a stronger focus on re-investment in its distribution network in order to deliver a better service. New areas of business outside its distribution area have sought to harness SEAS's expertise to generate additional income for re-investment.

Consumer ownership and a structure that ensures representation means that the group is closer to the consumer, and is able to better understand their requirements. SEAS therefore benefits from stronger consumer relationships – though these have clearly developed from the group's history as a consumer-owned monopoly supplier. This is important because all its customers now have the option to choose another supplier.

In the area of supply, SEAS's non-profit clause means that it can offer lower pricing because it has lower margins. However, there is less scope for Danish electricity suppliers to differentiate based on price because the structure of the unit cost makes it very difficult to offer reduced rates. This is primarily because a significant proportion of a consumer's energy bills consist of energy taxes. The major part of the total electricity price therefore remains unaltered by the regulated market.

Network and system costs	12.6%
Green power content	12.1%
Commercial (competitive content) electricity	10.8%
Duties	44.5%
VAT	25%

Exhibit 5.5 *SEAS kWh price breakdown*

Because the competitive element of the unit price is only 10.8% of the total, any price advantage from a competitive supplier would only be very marginal with respect to the full price comparison. Any decisions made by customers to change supplier are likely to be influenced more by improved levels of service than price.

In contrast, the competitive part of the kWh unit price in the UK is between 60 and 80% of the total unit price. There is therefore more incentive on price than service to encourage customers to switch suppliers. This suggests that the co-operative movement in the UK has an opportunity to use SEAS's non-profit model to compete on price. Like SEAS, a UK co-operative supplier could seek to build on existing relationships. The most significant would be the existing membership base of the large retail societies and, potentially, also their partners and suppliers.

5.4 Key findings

- Outside Denmark's major cities, electricity supply and distribution networks have traditionally been owned by their consumers.
- SEAS is Denmark's largest consumer-owned electricity company, with 182,000 members. It is shortly to merge with NVE, and it will then have over 300,000 members.
- SEAS project-manages wind-farm developments, and had acted as project manager for the Middelgrunden co-operative. It is currently providing engineering services to offshore wind-farm projects in the UK.
- The co-operative is consumer owned – shares and voting rights are controlled by consumers connected to its electricity network. Voting rights are split into consituencies based on electricity consumption, with 144 representatives elected annually by households, municipalities, businesses and large industry.
- The co-operative's position as a private operator of a monopoly public service is similar to that of the UK's DNOs; however, its non-profit clause appears to create a stronger focus on re-investment in order to deliver a better service. It also enables it to offer lower pricing.
- New areas of business outside its distribution area have enabled SEAS to use its expertise to generate additional income for re-investment.
- Denmark's electricity market was liberalised in 2002, requiring SEAS's supply group to compete with new entrants.
- Denmark's high energy taxes mean that the competitive element of electricity prices is only 10.8%, so price advantages generated by competition are marginal. Relationships and service quality are therefore more important.

6 DENMARK: FARMER-OWNED BIOGAS PRODUCTION

As part of its policy of supporting renewable fuels for district heating, Denmark has developed a network of biogas plants. The majority of these are owned by farmers, with biogas primarily being produced using pig slurry from their farms.

The mission team met with Bruno Sander Nielsen, secretary of the Danish Biogas Association – affiliated to the Danish Agricultural Council (Landbrugsraadet). The association promotes biogas and provides support to farmers. We then visited the Hashøj biogas and CHP plant in Zealand, hosted by manager Erik Lundsgaard and a member of the co-operative.

6.1 Biogas development

In the early 1970s during the oil crisis, there was substantial interest in biogas production from animal manures as an alternative to fossil fuels. Considerable research was undertaken, and a number of farm-scale plants were established. Many of these were subsequently closed because of technical problems. However, the technology was established and, subsequently, 20 larger scale centralised biogas plants have been built across Denmark. These plants now produce 80% of Denmark's biogas production, with the residual farm-scale plants producing the remaining 20%.

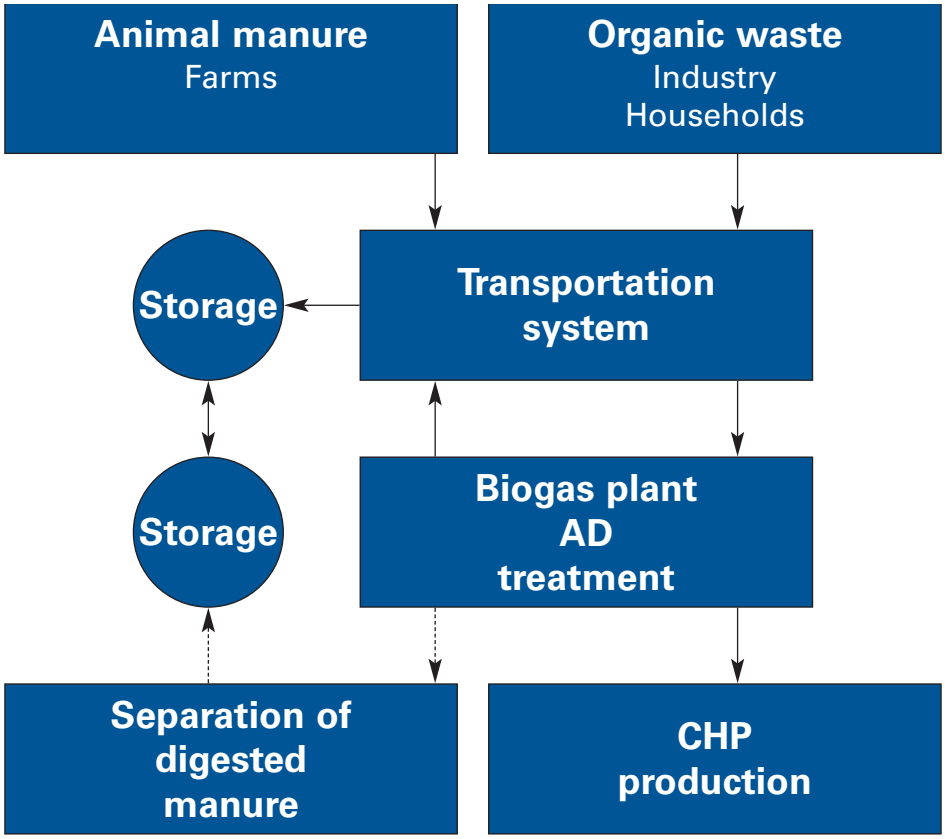


Exhibit 6.1
Centralised biogas plant concept[9]

9 Danish Institute of Agricultural and Fisheries Economics (1999) *Centralised Biogas Plants*

Besides the drive to find alternatives to fossil fuels, the development of biogas plants was driven by:

- Stricter legislation regarding the handling of manure in a country which has a highly intensive livestock sector
- Support for research to develop biogas technology
- Support for the capital costs of project implementation
- Establishment of a fiscal framework which ensured the economic viability of producing biogas against other fossil fuels, in particular natural gas

Over and above the production of a renewable energy source, there have now emerged a number of other significant environmental advantages to processing animal manures in biogas plants. The benefits include:

- Reductions in the greenhouse gas methane
- Opportunities to process other organic wastes alongside the animal manures, such as waste from the food industry
- Opportunities to remove surplus phosphates
- Protection of ground water for drinking

In addition, and by comparison to raw unprocessed manures, degassed manures can be cost-efficiently redistributed to other farms, allowing individual farmers to expand their livestock enterprises – the stocking density on Danish farms is strictly controlled and, above a certain stocking density, farmers are required to dispose of animal manures on farmland outside their own holding.

The manures are also an improved product – releasing nutrients more predictably, reducing possible leaching, and improving utilisation. They also emit less smells when they are spread. Together, these benefits provide the Danish livestock sector with flexibility and sustainable growth opportunities.

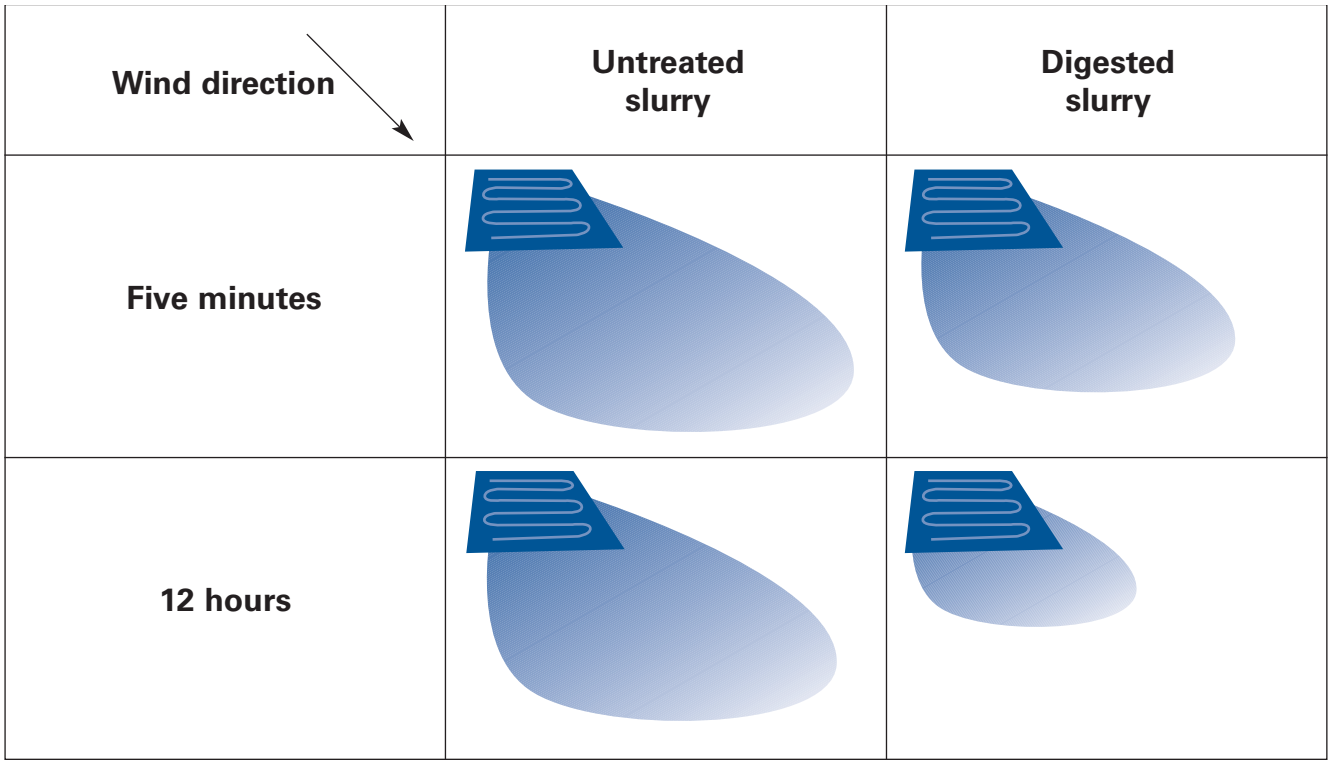


Exhibit 6.2 *Reduced smell from digested slurry* [10]

10 Danish Agricultural Advisory Centre (2000) *Centralised Biogas Plants*

6.2 Hashøj Biogas and Kraftvarmeforsyning co-operatives

The Hashøj Biogas and Hashøj Kraftvarmeforsyning are two interlinked biogas and district-heating co-operatives. The biogas co-operative makes use of pig slurry from the farms of its 21 farmer owners, together with a range of other organic wastes, to produce methane gas. The gas product is then used by Hashøj Fjernvarme – a consumer-owned district-heating co-operative – to supply heat to its 440 local consumers.

Established	1993-1994
Biogas co-operative	
Farmer members	21
Capital cost	£2 million
Investment payback period	20 years
CHP co-operative	
Consumer connections	440
CHP rating	2 MW + 760 kW
Biogas fuel contribution	75%
CHP capital cost	£5.5 million
Investment payback period	20 years

Exhibit 6.3 *Hashøj summary*

In 1993, 21 farmers sought to find better ways to store and dispose of the manure produced in their pig and other livestock enterprises. The initiative was driven by legislative changes necessitating stricter control over the storage and disposal of farm manure. A biogas production facility, based on Danish technology, was proposed and a feasibility study was conducted. The study identified that capital investment of DK21 million (£2 million) would be required. This finance was secured through a loan that was guaranteed through a variety of sources, including:

- Government: DK5 million
- Local municipality: DK15 million
- Farmers: DK1 million (the amount each individual farmer guaranteed was based on the numbers of livestock retained by their business)

At the same time as the farmers sought to find better ways of disposing of their manures, the local community of Hashøj was installing a CHP plant to generate electricity and provide district heating. This development provided an ideal outlet for the biogas plant and gave confidence to the local municipality to act as the major guarantor for the biogas project based on the availability of a secure local market.

The cost of installing all of the CHP plant and distribution infrastructure (generators, boilers, heat storage capacity and distribution systems) was approximately DK60 million (£5.5 million). This finance was secured from local heat consumers and through a loan guaranteed by the local municipality. By using planning regulations, heat consumers were obliged to pay a connection charge to the new distribution system.

6.3 Hashøj Biogas

6.3.1 Structure and relationships

Hashøj Biogas was established as a co-operative society with limited liability status. The co-op is governed by a board of five directors that is made up from the farmer membership. The board meets monthly with the co-op's full-time manager who has day-to-day management responsibility of the plant. In addition to the regular board meetings, a statutory Annual General Meeting (AGM) is held for all members.

Over and above the board meetings and statutory AGM, all members are in regular communication with the co-op to organise the dispatch and return of animal manures.

The most important relationship the co-op holds with the local community is a contract to supply biogas to the local CHP plant. The biogas price is subject to a negotiation between the two organisations.

Being located within 2 km of the settlement, there have been occasions in the past where smells from the plant have caused nuisance to local residents. Direct complaints have been received and the co-op has responded by installing scrubbers to reduce the smell problem. Additional investments to further reduce smell emissions are planned.

6.3.2 Technical description

On a daily basis, raw manure is collected in a tanker from members' farms (many of the farms are no more that 6 km from the plant, and all of them lie within 12 km). When emptied, the tanker is refilled with degassed manure and returned to the farmers' storage tanks or one of the company's storage tanks located in the countryside.

The raw manure is mixed with other organic wastes and heated to 70ºC to pasteurise the liquid. This liquid is then cooled to 37ºC and stored in reactor tanks where the gas is produced and drawn off for storage prior to being cleaned and piped 2 km to the CHP plant. The degassed manure is returned to storage tanks in the plant and awaits collection and distribution back to the farm.

Both the biogas plant and the CHP plant are managed by Erik Lundsgaard, a multidisciplinary engineer. It quickly became apparent during the visit that he played a vital role in co-ordinating and optimising the operation of the two plants. This was reflected in the high standard of maintenance and the advanced specification of the equipment.

6.3.3 Benefits of farmer ownership

The project, and therefore its members, has benefited from a co-operative approach in a number of ways. It enabled the participating farmers to:

- Pool sufficient volumes of livestock manure to justify an investment in facilities that can economically produce biogas in sufficient volumes to supply a local CHP plant
- Share their investment risk and reduce their individual investment exposure
- Gain opportunities to add value to livestock manure
- Gain opportunities to access a new market in the form of generating revenues from gate fees by processing waste from the food sector

The project has also benefited the wider community in the locality by providing a source of gas for the CHP plant. This secures cost-efficient heating and power generation for the local community. The connection between the two businesses has also created improved linkages between the residents and farmers in the local community.

6.4 Hashøj Kraftvarmeforsyning

6.4.1 Structure and relationships

Hashøj Kraftvarmeforsyning is a district heating company. It supplies heat to 440 consumers that include schools, nursing homes, sports complexes, private homes and small businesses. The co-operative's two main relationships are with the 440 district heating consumers and the local biogas plant. As loan guarantor, the local municipality is also a key stakeholder.

The co-operative is governed by a board of seven independent directors; five are elected by heat consumers, and the remaining two are appointed by the local

council. These district-heating consumers are able to contact the heating company at any time, and there is an AGM that all consumers are invited to attend.

6.4.2 Technical description

Biogas is received at the CHP plant where it is used to power two engines that generate electricity and heat. The engines are designed to run on both biogas and natural gas. In addition to the engines, there is a peak-load heat-generation capacity in the form of two boilers. One is designed to burn biogas and natural gas, while the other is designed to burn wood pellets. The CHP plant currently utilises 75% of its fuel from biogas, 15% from natural gas and 10% from woodchip. The ability to utilise different fuels ensures that a competitive and flexible energy source can be obtained.

6.4.3 Benefits of biogas and consumer ownership

The combination of consumer ownership with the use of locally produced biogas fuel has brought a number of benefits to the community. It has enabled heating consumers to:

- Have control over their heating utility within the local community
- Receive competitive heating through the shared infrastructure and through the ability to choose from a range of competing fuel sources
- Gain security by sourcing locally produced biogas that is not subject to the potential disruptions which have previously affected world energy markets

In addition to the enhanced community links to the biogas plant, the CHP plant utilises the biogas fuel at high levels of efficiency – though there are relatively high heat losses because of the community's low heat density. Overall, however, there is a net reduction in the environmental impact of their heat and power generation.

6.5 Key findings

- 20 centralised biogas plants have been built across Denmark. The majority of these are owned by farmer co-operatives, accounting for 80% of Denmark's biogas production.
- A key driver from within the farming industry has been stricter legislation regarding the handling of manure. Denmark has a highly intensive livestock sector, and waste management problems have limited its potential for expansion.
- Digestion creates an improved product which, when applied to the land, releases nutrients more predictably, reducing possible leaching and improving utilisation. The treated manure also emits less smells when spread.
- In addition to farm wastes, biogas plants create opportunities to process other organic wastes, such as from the food industry
- Hashøj Biogas is governed by a board of five directors elected by the membership, and there is an AGM. A manager with multidisciplinary engineering skills co-ordinates the operation of both the biogas plant and CHP plant, ensuring optimisation.
- The project has benefited from a co-operative approach because it has enabled the farmers to work together effectively, sharing the risks and rewards, and directly benefiting their individual businesses.
- The community has directly benefited through the availability of a local source of fuel and a plant operator that is responsive to their concerns.
- Smells from the plant have caused nuisance to local residents. However, because the farmers are part of the local community, the co-operative responded by installing abatement equipment.
- Both co-operatives have made long-term (20-year) investments to provide the necessary infrastructure.
- The local authority was the major guarantor for the biogas project, with farmers each individually providing a 5% equity stake. A grant from the government was available to cover 25% of capital costs.
- The CHP plant and heat distribution network were financed by Hashøj Kraftvarmeforsyning, with the benefit of a capital grant from the government. Price support has been available for CHP electricity.

Photo gallery

DENMARK

D.1 *Mission team*

D.2 *Lynetten wind farm in industrial landscape setting*

D.3 *Middelgrunden wind farm (courtesy Mads Eskesen)*

D.4 *Lynetten wind farm with Middelgrunden in distance*

D.5 *Wind turbines in the rural landscape*

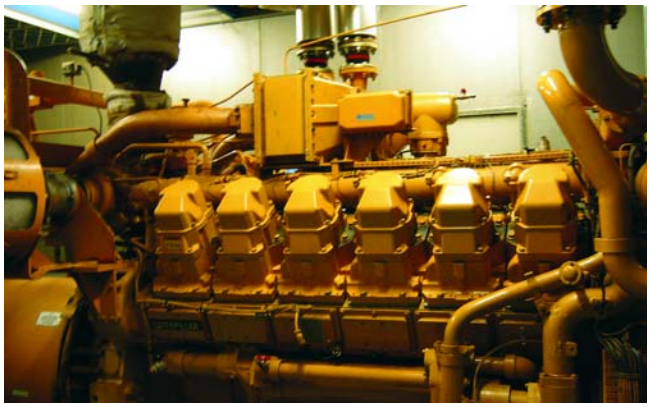
D.6 *Copenhagen Environment and Energy Office*

D.7 *Høje Taarstrup heating plant and head office*

D.8 *Consumer heating units*

D.9 *Høje Taarstrup control room*

D.10 *VEKS heat exchanger display*

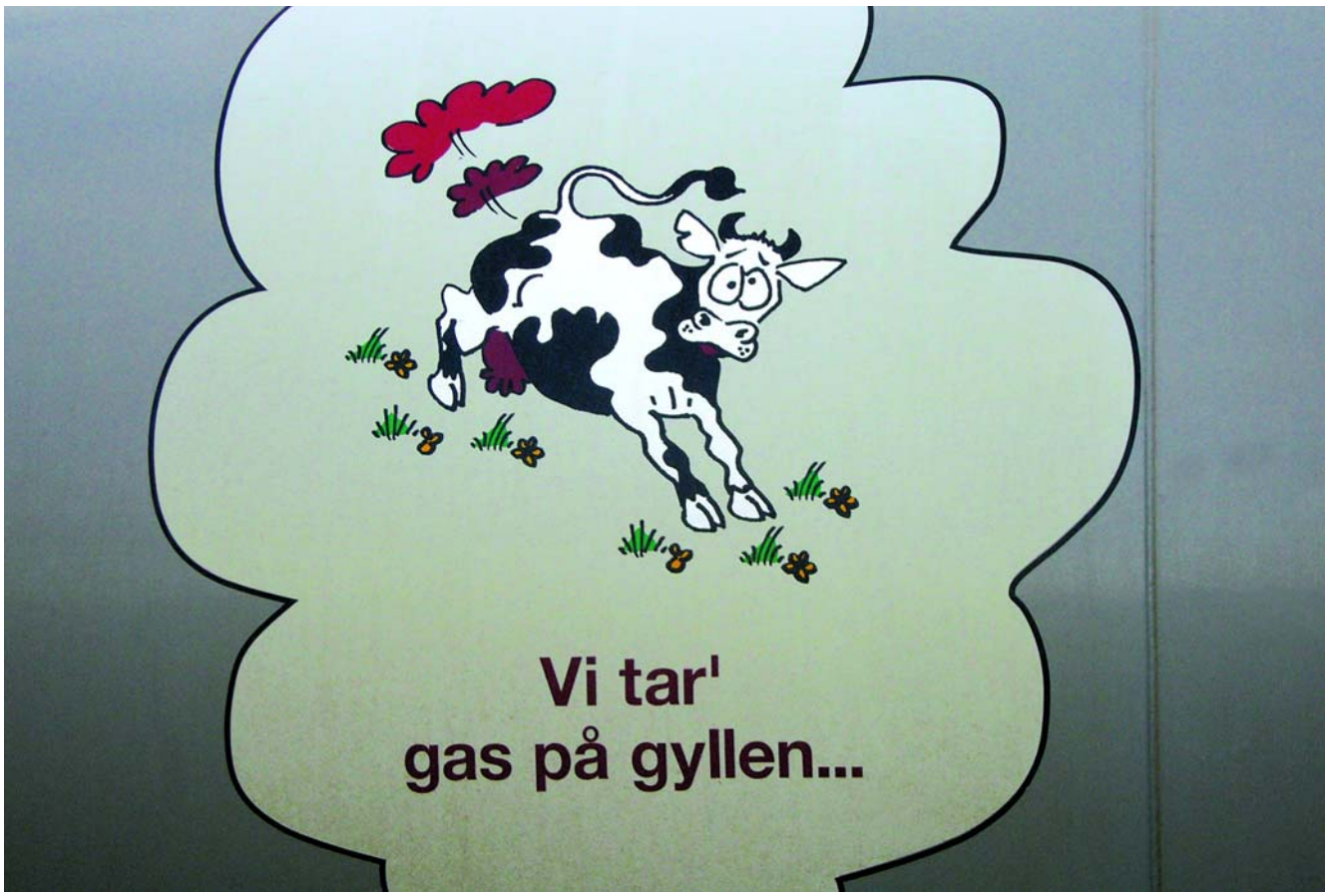


D.11 *Hashøj biogas CHP engine*

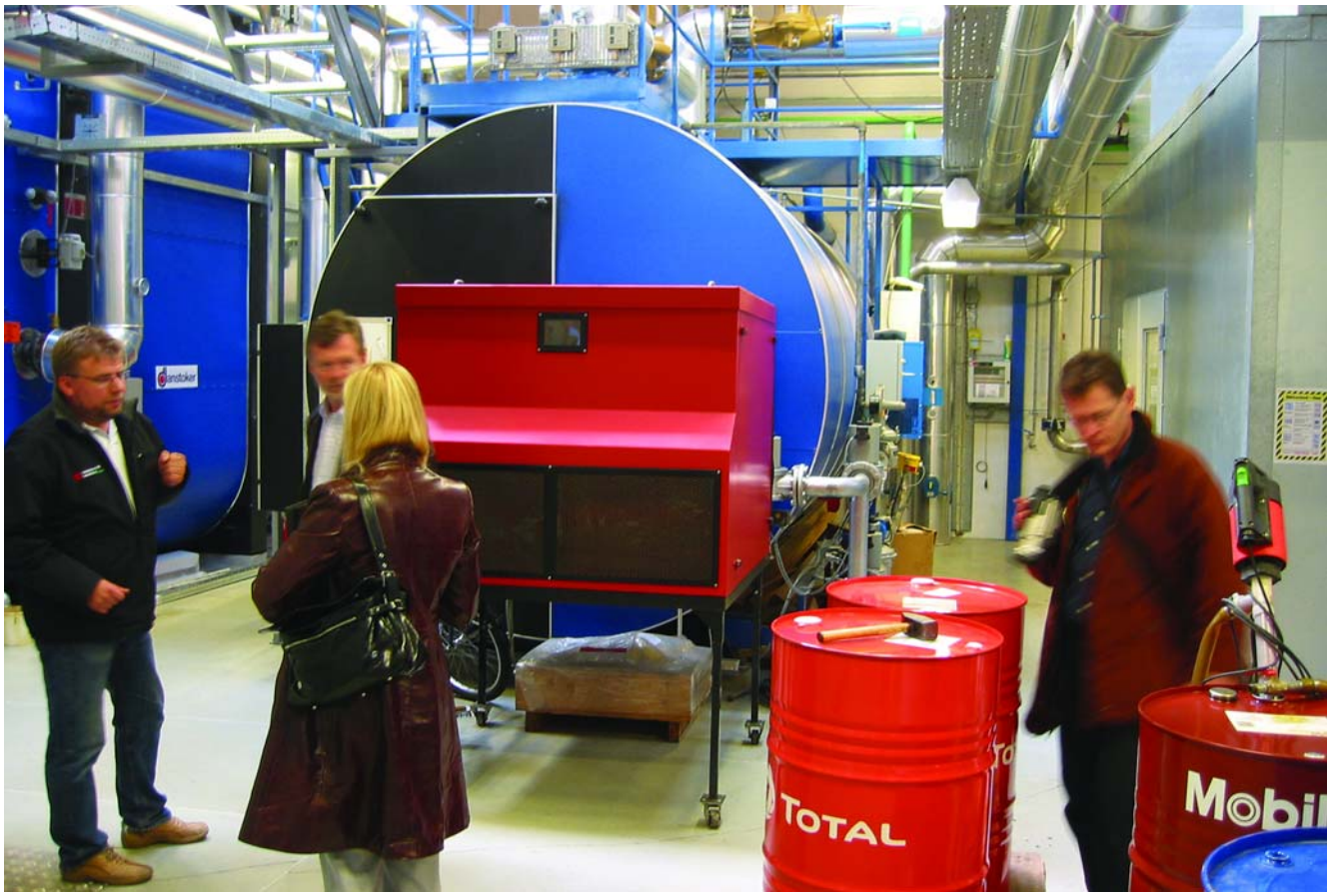
D.12 *Hashøj biogas storage tank*

D.13 *Hashøj plant and slurry tanker*

D.14 *Slurry application (courtesy Danish Agricultural Council)*



D.15 *Hashøj biogas tanker logo – life is a gas!*



D.16 *Hashøj CHP station internals*

Sweden

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7 SWEDEN: NATIONAL CONTEXT

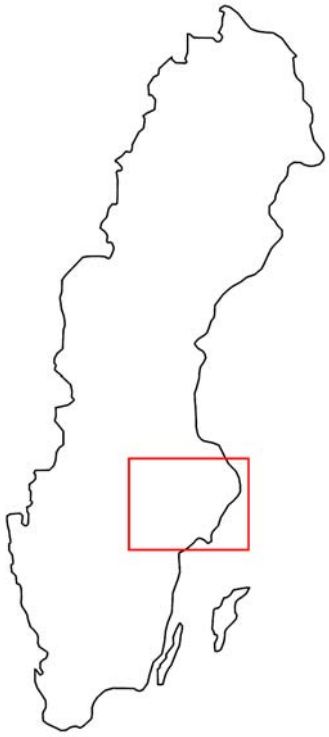


Exhibit 7.1 *Outline map of Sweden*

Exhibit 7.2 *Visit locations in Sweden*

Population	8.9 million
Land area	449,964 km^2
GDP (per person)	£16,479

Exhibit 7.3 *Sweden: national statistics*

7.1 Economy

Sweden has one of the highest standards of living and per-capita wealth in the world, having recently been ranked 5th in the Economist's quality of life index. The country's wealth has traditionally been generated by primary industries such as forestry and paper manufacturing, but in more recent times information technology (IT), science and engineering – including energy technology – and a reputation for product design have become important. National expenditure on R&D is proportionally the highest in the EU at 4.3% GDP (2001).

The Swedish economy could be said to be more market-oriented than in Denmark, with earlier moves towards a liberalised energy market. The country has pioneered 'the Swedish model' – a mixed economy characterised by public-private partnerships, centralised wage negotiations, and a cradle-to-grave welfare system. Whilst the fundamentals of this model remain in place, efforts to open up the economy have required cutbacks. Moves towards economic liberalisation in the early 1990s were accompanied by a rising budget deficit. This led to devaluation and entry to the EU in 1995.

Like Denmark, Sweden has some of the highest levels of taxation in the world. These exist to address a number of key national priorities which reflect the national character. They include a cradle-to-grave welfare system, extensive public transport systems and, notably, environmental taxes. Again, like Denmark, the country has been a pioneer in the use of environmental taxation,

with a range of primary energy taxes having been introduced over the last two decades.

Sweden has developed a specific expertise in the bio-energy sector, reflecting the traditionally important forestry and agricultural sectors. Technical expertise and a supporting manufacturing industry have grown in response to the growing EU demand for biomass technologies. The sector has also received significant targeted investment subsidy from the Swedish National Energy Administration for R&D – reflecting Sweden's overall high level of R&D investment.

7.2 People and culture

Like Denmark, the country has a strong liberal and social democratic tradition, with principles of common welfare and a respect for the environment being deeply rooted in the national character. The relatively low population density of the country, and its large tracts of forests and lakes, has encouraged a closeness to nature and highlighted the need for stewardship of natural resources. In more recent times, this has been reflected in concepts such as the Natural Step – an educational tool developed by a concerned scientist – and the progressive environmental policies of companies such as Electrolux and Ikea.

There is a strong tradition of co-operative ownership. The first consumer co-operatives were established around the turn of the century, with similar aims to the original Rochdale pioneers in the UK – to provide affordable, unadulterated household goods. The Swedish Co-operative Union (KF) was established in 1899 as a wholesaler for consumer co-operatives. It remains the largest co-operative body in Sweden, holding a stake in the Co-op Norden trading group.

Although less rooted in the agricultural sector than in Denmark, there is nonetheless a strong agricultural co-operative sector. There are strong links between farmers and farmer-owned food companies. In recent years, co-operatives have had to adapt to survive in a tough competitive environment, with the withdrawal of EU subsidies and foreign competition leading to rationalisation. Agricultural co-operatives such as Lantmännen have played a significant role in developing new markets, such as in bio-energy. Agricultural co-operatives are now represented by LRF – the Federation of Swedish Farmers – which plays a strong role in supporting the industry and new enterprises.

Co-operatives play a key role in the housing and social service sectors. Housing co-operatives account for a significant proportion of the housing stock – 17% during the 1990s. They now complement the rest of the housing mix, offering an alternative to owner-occupied or rented housing. The economic difficulties of the early 1990s led to an increase in the delivery of social services by co-operatives. They now provide services such as childcare and elderly care. The 24 Local Co-operative Development Agencies (LKUs) have played an important role in facilitating the establishment of these co-operatives.

7.3 Energy policy

Environmental concerns have played a major role in shaping Sweden's energy policy. Electricity is predominantly supplied by hydroelectric and nuclear power stations, although the latter are to be phased out. Heating is predominantly supplied by oil and electricity, but bio-energy is growing rapidly. Energy taxes have been put in place to encourage a shift away from fossil fuels such as coal, oil and natural gas. A tax on emissions of CO_2 from heating was introduced in 1991.

Bio-energy resources such as biomass (woodfuel) from forestry and energy crops are playing an increasingly important role. Sweden is the world's largest user of biofuels, and it has access to a plentiful supply of forestry-derived fuels. The use of biofuels doubled between 1980 and 2000, and now accounts for 20% of primary energy use – 10% of electricity generation and 50% of heating requirements. New opportunities such as willow energy crops have been directly supported. The lead organisation for the sector is the Swedish Bioenergy Association (SVEBIO).

Many power stations are smaller scale and are managed by local authorities who also supply electricity (there is less of a tradition of co-operatives in the energy market). This means that they are able to supply heat via district heating networks, using statutory powers to require connections and preclude the use of electric heating where district heating is available. Like Denmark, the majority of the country's district heating networks have been developed in the last 20 years, enabled by government policies on fuel security and sustainable development. This has subsequently enabled them to make effective use of locally sourced biofuels as a significant part of their fuel mix.

Competition was introduced into the electricity generating market in 1996. Full liberalisation of the electricity market for business and household consumers was introduced in 1999. Denmark's electricity grid is connected to Sweden, Norway and Finland, with electricity trading taking place in the Nordpool power exchange.

A system similar to the UK's Renewables Obligation was introduced to the electricity market in 2003, based on tradable certificates for each MWh of renewable electricity. Consumers – electricity companies – must purchase enough certificates to achieve a politically determined proportion of renewable electricity generation. This target was initially 7.4% in 2003, rising to 16.9% by 2010 – an increase of 10 TWh.

Consumption (per person)	
Primary energy	242 GJ
Electricity	4,952 kWh

Natural gas	
Price (domestic)	£6.9/GJ
Energy taxation	£4.2/GJ

Electricity	
Price (pool)	2p/kWh
Price (domestic)	6.2p/kWh
Energy taxation	1.8p/kWh

CO_2 emissions	
Per person	5.4 t
% change since 1990	-2%

Renewables	
% primary energy consumption	34%
% electricity consumption	48%

Exhibit 7.4 *Energy statistics for Sweden*

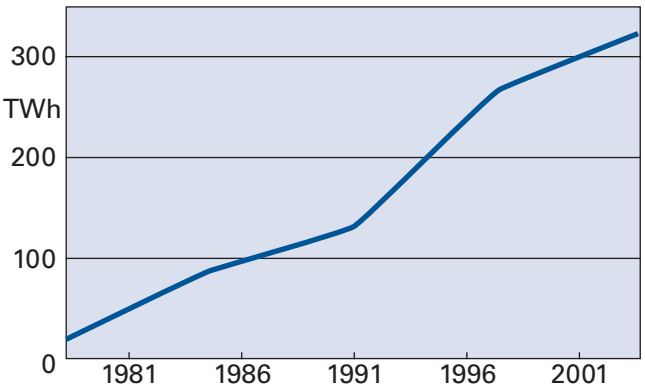


Exhibit 7.5 *Use of biofuels in Swedish district heating*[11]

11 Swedish Energy Agency (2002)

8 SWEDEN: FARMER-OWNED BIOMASS HEATING

The mission team were given an introduction to the Swedish farming and bio-energy sectors by Christoph Rinnmann and Erik Herland from LRF – the Federation of Swedish Farmers. We then visited the farmers co-operative Farmarenergi, meeting with Börje Ohlson – a farmer representing the co-operative. The co-operative harvests willow, and owns a heating plant which supplies the community of Kolback.

In connection with Farmarenergi, we also met with former Town Clerk Jan Barklund and an environmental health representative from the local municipality of Hallstahammar, who supported the establishment of the co-operative. Monica Lindkvist from the Co-operative Development Agency Kooperativ Utveckling Västmanland provided the team with an overview of the support provided to new co-operatives in the area.

8.1 Willow crop development

With Swedish farmers being exposed to increasing competition on the EU and global markets, they have diversified into non-food crops in order to maintain their income. With support from the government and farm service co-operatives, farmers have established significant plantations of short-rotation coppice (SRC) willow.

Willow has been cultivated by Swedish farmers since the 1970s, and there are now over 16,000 ha in production. The predominant variety is salix, which grows to 5-7 m in height and has a productive life span of 25-30 years. The willow is processed into woodchips which are then used as a fuel in CHP and district-heating plant (including CHP). The crop now contributes around 1% of Sweden's fuel requirements.

Plantations expanded rapidly in the 1990s with the availability of subsidies and the support of the Federation of Swedish Farmers Co-operatives. Despite a short period of decline when EU set-aside rules were changed, confidence in the crop is growing. Whilst most of the woodchip produced is used by large municipal CHP stations, farmers have also established co-operative enterprises to run community heating plants. There are 15 farmer-owned heating plants, and around 40 larger plants in which farmers have a stake, alongside farmer support bodies and service co-operatives.

8.2 Farmarenergi – farmer-owned heat production

Farmer members	19
Share value equivalent	1 ha willow = 80 shares
Heating plant rating	2 MW
Annual heat sales	7,500 MWh
Capital costs	~£400,000
Payback period on investment	15 years
Heat supply contract	Malarenergi AB (municipal heating company)
Annual harvest	10,000 m^3
Typical yield	250-300 m^3/ha
Plantation lifespan	~25 years

Exhibit 8.1 *Farmarenergi summary*

8.2.1 History

Farmarenergi was established in 1990 and is a non-profit company run on co-operative lines and owned by 19 farmers in the municipality of Hallstahammar. Its two main aims were to provide a new source of income for local farmers and to provide a renewable source of heating for the local community of Kolback. The co-operative was established against a background of falling wheat prices and the belief that willow prices would be more attractive. It was also felt that by owning a heating plant and working in partnership with the local community, the producers would receive a stable price for their product.

At the time, the local-authority-owned district-heating company Malarenergi AB was looking to install new heating plant. Its preference was for a renewable source of heat. The co-operative therefore commenced the establishment of willow plantations and constructed a new heating plant to supply hot water under contract to Malarenergi AB.

8.2.2 Structure and relationships

Though established as a company limited by guarantee, Farmarenergi uses co-operative model rules provided by the Kooperativ Utveckling Västmanland co-operative development agency. It is a non-profit co-operative which exists to run a heating plant and co-ordinate the production of fuel, with the aim of securing a stable and viable price for its members' willow crops.

The source of the fuel is willow (salix), which is processed and supplied to the company by its farmer members. All members are farmers who live within 10-km radius of Kolback. Each of the farmers owns shares in the co-operative on the basis of 80 shares for each hectare of production. In turn, this fuel is then used to supply heat, under contract with Malarenergi AB, to around a thousand homes using its district-heating network.

8.2.3 Technical description

The initial planting of the 184 ha of willow is envisaged to last for 25 years. The crop is harvested on a four-year cycle, cutting a quarter of the 184 ha each year. This amounts to an area of 10,000 m^2 and is equivalent to 300 t of fuel. It is transported directly to the plant, where it is stored on an outdoor hardcore area adjacent to the building. A member living close to the plant is contracted by the company to visit the site daily to do the routine adjustments.

Start-up subsidy	£300/ha
Payment to farmer	£7.20/m^3
Harvesting contractor	£2.05/m^3
Transportation	£0.60/m^3
Shared overheads	£0.76/m^3
Farmer's profit	£3.79/m^3
+ EU subsidy	£0.53-0.60/m^3

Exhibit 8.2 *Economics of willow harvest*

Twice a week, woodchip is loaded from the outside storage into the building, and the reception pit just inside the door is filled. From that point, the operation is fully automated. Ash is removed as necessary by skip and used as a fertiliser. The plant runs for some nine months a year, excluding June, July and August. An oil burner is used as backup. Some environmental issues are regularly addressed, mainly noise and dust levels, but neither seems to be an undue problem.

8.2.4 Benefits of farmer ownership

The co-operative's main benefit is that it has allowed relatively small producers to work together as a stronger unit for mutual advantage. This has created the critical mass to set up and supply an operation of this size, as well as providing the members with a guaranteed market in terms of volume and

price for their crops. The relatively small catchment area of the heating plant reduces the fuel required for transport. Because the farmers are members of the local community, they quickly respond to concerns relating to air pollution.

LRF highlighted a number of problems in expanding the Farmarenergi model. Whilst it has supported many feasibility studies, relatively few projects have gone ahead. Farmers have experienced difficulties securing finance, and most would not want to mortgage their farm to provide a bank guarantee. Instead, in some cases, LRF has taken a 50% stake alongside farmers.

There can also be problems apportioning the profit and responsibilities between the farmers involved. This may, however, be a broader statement on the difference between private companies and co-operatives, and the extent to which there is a culture of co-operation amongst farmers.

Exhibit 8.3 *Willow harvester*[12]

12 Agrobränsle AB (2004) *Recycling of wastewater and sludge in salix plantations*

8.3 Key findings

- With exposure to increasing competition on the EU and global markets, and reductions in EU farming subsidies, Swedish farmers have diversified into non-food crops in order to maintain their income.
- Farmarenergi is a non-profit company owned by 19 farmers. It was established in order to provide a new source of income for local farmers, and a renewable source of heating for the local community of Kolback.
- Local-authority-owned district-heating company Malarenergi AB contracts for the heat, and was able to support Farmarenergi by guaranteeing its finance. Subsidy has also been received for the willow crop from central government.
- Though established as a company limited by guarantee, Farmarenergi uses co-operative model rules provided by the local co-operative development agency.
- All members are farmers who live within 10-km radius of the heating plant. Each of the farmers owns shares in the co-operative on the basis of 80 shares for each hectare of production.
- Members of the co-operative carry out a number of designated roles, including harvesting of the crop, transport to the heating plant, and maintenance of the heating plant. Some of these roles are governed by contractual relationships with the co-operative.
- The farmers have benefited from the co-operative because it has created the critical mass needed to develop the project, as well as providing them with a guaranteed market in terms of volume and price.
- The co-operative has developed a good relationship with the local community, ensuring that the environmental impacts of the heating plant are properly addressed.
- In Sweden there have been attempts to replicate this model; however, problems have been experienced obtaining bank guarantees and establishing the relationships between farmers. The basis for co-operation therefore requires consensus before projects can develop.
- Farming support agencies and federations can support project development by co-ordinating feasibility studies and directly supporting the establishment of new enterprises, in some cases providing finance and bank guarantees.

9 SWEDEN: FARMER-OWNED BIOMASS SERVICES

With Swedish farmers being exposed to increasing competition on the EU and global markets, their service co-operatives have responded by supporting bio-energy ventures. The mission team met with Gustav Melin, the managing director of Agrobränsle, a subsidiary of the Lantmännen service co-operative. Agrobränsle is the world's leading specialist in short-rotation coppice (SRC) willow crops. The company provides a complete range of expertise and hands-on support, from genetics through to harvesting.

9.1 Lantmännen co-operative

Lantmännen is a very large Swedish farmers co-operative, owned by over 52,000 farmers. It provides a wide range of services to its members, including plant breeding, purchasing, harvesting, sales and marketing. It is profitable, with an annual turnover of around €3 billion, and employs 10,500. Dividends are kept modest, and most of the trading surpluses are re-invested in its constituent businesses.

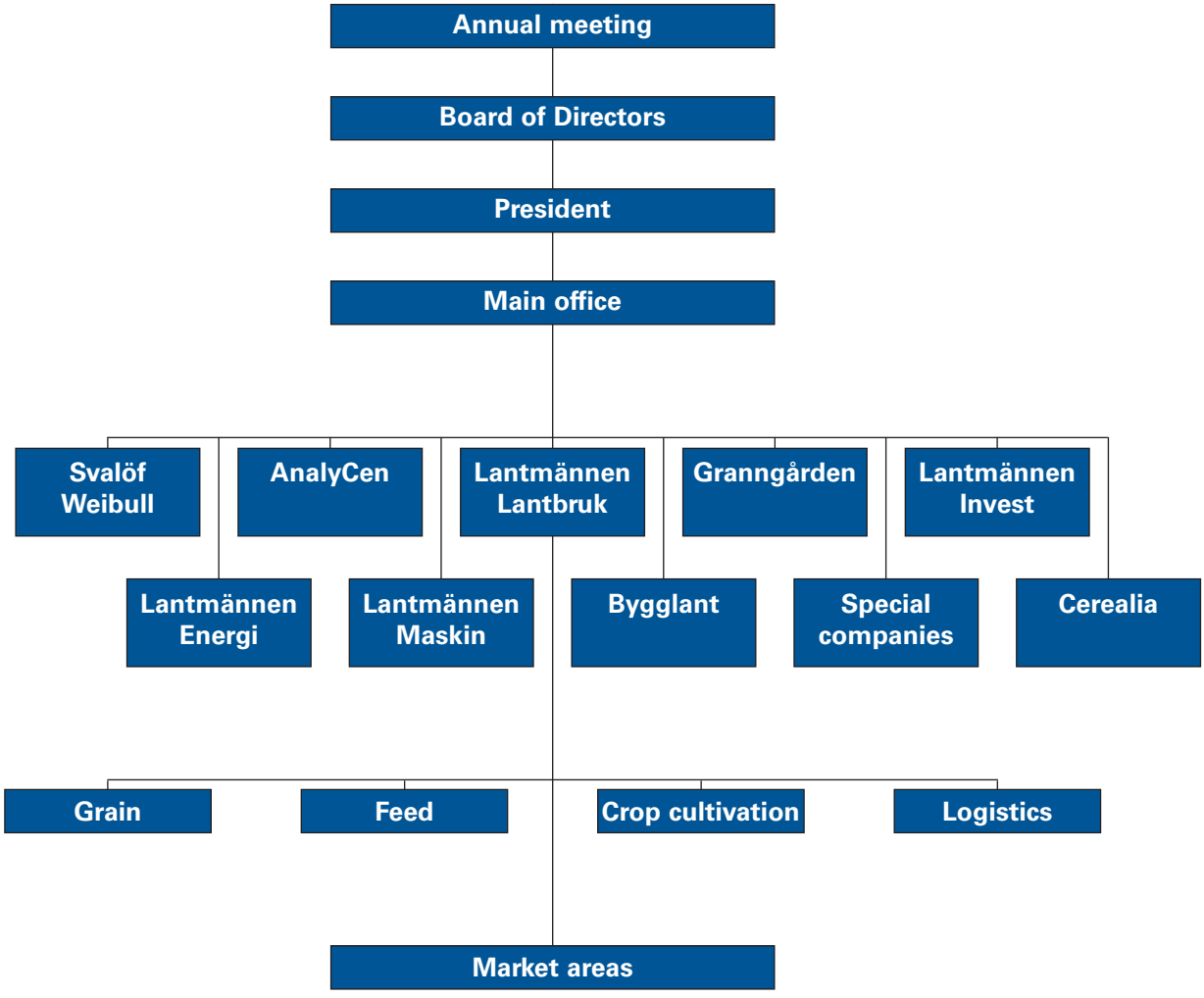


Exhibit 9.1 *Lantmännen co-operative – organisational structure*[13]

13 Lantmännen co-operative, *Annual Report 2003*

Lantmännen Energi has established a specialist company called Agrobränsle AB which is dedicated to supporting willow (salix) as an energy crop. It has been involved in R&D and marketing of willow in Sweden and the rest of Europe for over 15 years. Within Lantmännen Energi, it reports to Svensk Brikett Energi, a business producing some 450,000 t of wood briquettes and pellets out of eight plants, including one in Latvia.

9.2 Agrobränsle AB

9.2.1 Sectoral development role

Agrobränsle promotes and develops willow coppice as a profitable complement to other crops and activities on the farm. Coppice willow gives reasonable returns on arable land, without large investments in machinery and specialised labour. It believes that plantations of willow will eventually become a natural element in the landscape. It currently supports 14,000 ha of willow plantations, and carries out the following functions and activities:

- Plant breeding
- Planting
- Crop management
- Harvesting
- Selling and delivery of woodchips
- Machinery development

For many farmers, it carries out the whole process from planting through to harvesting and sale. Agrobränsle negotiates price with power stations and district heating plants and organises deliveries, as required.

The company has been carrying out an intensive programme of plant breeding. Between 40 and 50 different varieties are crossed annually, and ~10,000 plants are tested from these crossings. Developing a new strain is a long process, with one or two new varieties appearing every ten years. Great strides have been made in yields with a 50% improvement in the last ten years, with new varieties being cropped in two years rather than the more normal three or four. Plants with a greater frost tolerance are now being bred by crossing with Russian varieties. Agrobränsle operates a subsidiary company in Cambridge selling seeds, and has links with the Department of Agriculture at Aberystwyth University.

In the UK, apart from the sale of seeds, Agrobränsle is involved in the growing and marketing of 100 ha of willow near York. It has established a new company – Renewable Fuels – which has its office in York. The company is currently negotiating to sell woodchips to Drax power station – the largest coal-fired station in the UK. The woodchip will be 'co-fired' with coal to provide 3% of its fuel requirements. Co-firing is being driven by the high value of renewables obligation certificates.

It was felt that this was an important development, and will hopefully provide a UK model to support future willow plantations following the failure of the ARBRE project. However, it must be noted that a stable and sustainable price will be required in the long term, as the over-reliance on subsidy in Sweden has seen the dramatic rise and fall of cropping with the application, or removal, of subsidy.

9.2.2 Crop management and economics

A normal yield is around 32 t/ha, cropped on a three-year cycle. Minimum economic planting is 4 – 5 ha, and fields can be fertilised by the use of sewage sludge. The latter is currently being demonstrated by a partnership between farmers, Agrobränsle, and Enkoping local authority.

Variable planting subsidies are available but presently average around £400/ha. It was noted that in the UK the subsidy available is

substantially more, at £1000/ha. Typically, the costs of adapted forage harvesters are around £180,000. There is a water content of 50% in salix when harvested, which continues to remain markedly higher than in forestry material. This is reflected in the price differential.

9.2.3 Benefits to the farming industry

In a marketplace populated by small producers facing increasing competitive pressures, joining together to reduce the risk of establishing new crops has substantial advantages. This appears to have been the case in the production and sale of willow. Agrobränsle sees the following advantages and benefits of willow for farmers:

- Easy to plant
- Grows rapidly
- Easy to harvest
- Re-sprouts after harvesting
- Represents a growing market
- Environmentally acceptable

Agrobränsle has the power and capacity to maximise sale price on behalf of its members, and provide for the economic sharing of the costs of marketing, plant breeding, harvesting equipment and transport across a large number of producers. Sweden's indigenous energy market can also be seen to provide a more stable market than for traditional food crops such as wheat, which are traded as commodities.

9.3 Key findings

- Agrobränsle is the world's leading specialist in SRC willow. It is owned by Lantmännen, a Swedish farmers co-operative with 52,000 members. Lantmännen provides a wide range of products and services to its members, and also carries out R&D.
- Agrobränsle promotes and develops willow coppice as a complement to other crops and activities on a farm. It covers the full range of functions required to commercially develop the crop, from plant breeding to machinery development and the co-ordination of harvesting.
- Great strides have been made in yields with a 50% improvement in the last ten years, with new varieties being cropped in two years rather than the more normal three or four.
- The company has been involved with a project in Enkoping designed to increase the yield of willow plantations by using sewage sludge as a fertiliser. This benefits both the farmer and the local authority, which manages wastewater treatment.
- As members of the Lantmännen co-operative, farmers have benefited from the Agrobränsle subsidiary through the sharing of the costs of marketing, plant breeding, harvesting equipment and transport across a large number of producers.
- The company is active in the UK, with a subsidiary company in Cambridge selling seeds and a subsidiary company in York supporting local farmers. It also has links with the Department of Agriculture at Aberystwyth University.
- The company's UK subsidiary is currently negotiating to sell willow woodchips grown by farmers in Yorkshire to Drax power station – the largest coal-fired station in the UK. The woodchip will be 'co-fired' with coal to provide 3% of its fuel requirements.
- The company sees co-firing for electricity generation as an important UK market for farmers following the failure of the ARBRE project. This contrasts with the Swedish market, which has been driven by district heating.

10 SWEDEN: BIOMASS INDUSTRY JOINT VENTURES

Sweden's forestry and timber industries have been at the forefront of the country's expanding biomass fuel market, producing a range of woodchip and pelletised fuels based on forestry and timber industry by-products. The mission team met with Göran Hedman, managing director of Naturbränsle – a joint venture between stakeholders in the forestry and timber industries. We were also able to visit sites where forestry residues are recovered and distributed following timber harvesting.

10.1 Naturbränsle – background

Naturbränsle is an energy company based on the Swedish forestry and timber industry. It was formed to establish a mechanism through which the forestry and timber industries could effectively service the needs of the heat and power industry. The objective of the business is to maximise the revenues from by-products of the forestry and sawmill sectors. It achieves this by organising the logistics required to recover, process and transport by-products to heat and power plants located throughout Sweden. The by-products include:

- Waste arising when plantations are thinned
- Waste arising at harvest
- Poor quality round wood not suitable for further processing
- Sawmill waste, including raw chips (not used for pulp), sawdust, bark and dry chips

The by-products produced from 1 ha of timber waste can produce 250 MWh of energy, sufficient to supply the heating requirements of 8 – 10 houses.

In addition, and to ensure a consistent supply, these by-products are augmented with coppice willow grown in Sweden, and wood pellets drawn from a variety of international sources, including the Baltic States, Russia and Canada. This allows the business to supply peak-load demand during winter months when consumer demand for heating is greatest.

10.2 Structure and relationships

Naturbränsle was established as a private company. The business operates on a not-for-profit or cost-recovery basis, and is 50% owned by Mellanskog (a forestry owners association) and 50% owned by 20 private sawmills based in central Sweden. Mellanskog represents over 28,000 private forest owners who manage more than 1.5 million ha of woodland. It is similar in structure to an agricultural co-operative.

Naturbränsle has developed relationships with four key groups that allow it to co-ordinate the production, collection and supply of energy. The four groups encompass:

- Owners of the business who supply by-product (this group encompasses the forest owners and the sawmill owners)
- External suppliers who supply willow coppice and wood pellets
- Contractors who supply chipping and transport services
- Power generators who purchase the woodfuel

Co-operation amongst the participants in this supply chain is a key factor in ensuring that the energy industry always receives the correct quantity and specification of woodfuel.

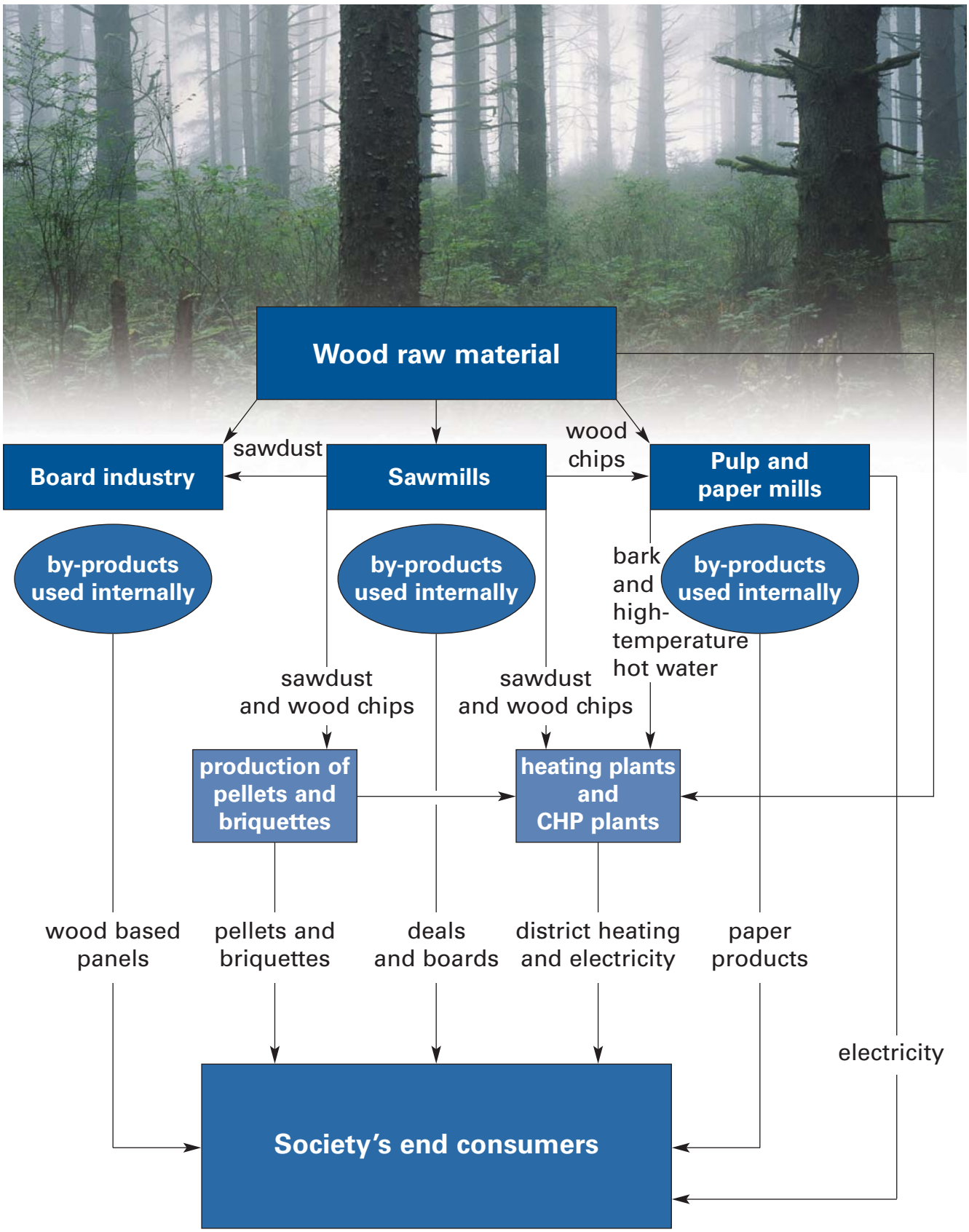


Exhibit 10.1 *Swedish forestry industry – products and by-products*[14]

14 SVEBIO (2004) Bioenergy Focus, No 3

10.3 Technical description

Naturbränsle supplies ~3,000 GWh of wood fuel annually through a well-developed multi-staged process. The process starts with the owners who supply the wood by-product. In the forestry sector, the waste is chipped by contractors on site prior to being transported directly to the customer or to a storage 'terminal'. Similarly, waste produced from the sawmills is transported directly to the customers or to the storage terminals. The waste from sawmills comes in a variety of forms, including:

- Pellets produced from sawdust
- Bark
- Reject round wood

All the reject round wood is collected and brought to the storage terminals for chipping. The transportation of raw materials is carried out using both rail and road transport (in Sweden, trucks are allowed to carry loads of up to 35 t). Storage terminals are strategically located throughout the region to balance production with customer demand. In the summer, the terminals are used to build up reserves that are then called upon during the winter months.

Naturbränsle co-ordinates all the activities required to satisfy the orders placed by customers on a weekly basis. This requires the organisation of ~50,000 deliveries per year that often have to be adjusted because of changes in the weather. Fourteen permanent staff are employed by the company to carry out this task.

10.4 Benefits of supply-chain co-operation

The main benefits of Naturbränsle are that it has enabled forest and sawmill owners to establish a market for by-product by enabling them to collectively:

- Pool sufficient volumes of by-product to service a range of large- and small-scale power generators
- Provide power generators with continuity of supply throughout the year, particularly during the winter months when demand is high
- Provide a range of fuel specifications to suit the different requirements of a range of power generators

Overall, the organisation has allowed forest and sawmill owners to share the costs of co-ordinating the supply chain and investing in improved efficiency. The wider community has also benefited from the activities of Naturbränsle because it has:

- Enabled the development and utilisation of a natural and renewable source of energy which complements the natural landscape of the country
- Provided farmers with access to new markets by providing opportunities to grow willow coppice to augment the supplies of by-product during the winter months when demand is high

The development and growth of the market for forest and timber by-products has also increased the viability and competitiveness of the whole sector, providing investment and employment opportunities for the whole of Swedish society.

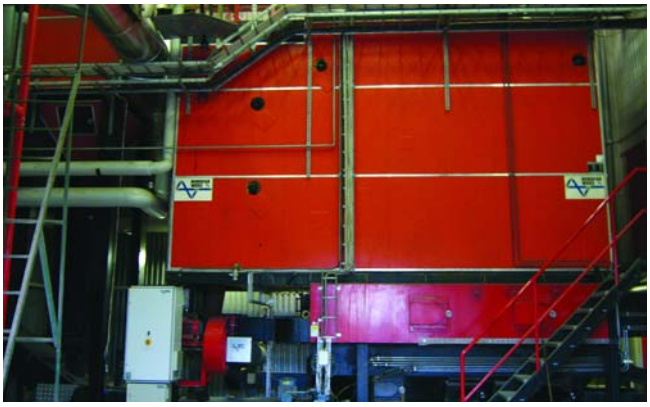
10.5 Key findings

- Naturbränsle was established to enable the forestry and timber industries to effectively service the needs of the heat and power industry. The objective of the business is to maximise the revenues from by-products arising from the forestry and sawmill sectors.
- The business manages the logistics required to recover, process and transport by-products to heat and power plants – co-ordinating supply and demand throughout central Sweden.
- It is a non-profit-making joint venture, 50% owned by Mellanskog – a forestry owners association – and 50% owned by 20 private sawmills based in central Sweden.
- Stakeholders in the supply chain for woodfuel have benefited from the co-operation brokered by the joint venture through:
  - Creation of stable markets for forestry and timber by-products
  - Access to appropriate quantities and specification of fuel
  - Utilisation of an indigenous, renewable source of energy
- The development and growth of the market for forest and timber by-products has provided valuable investment and employment opportunities for the sector, and Swedish society as a whole.

Photo gallery

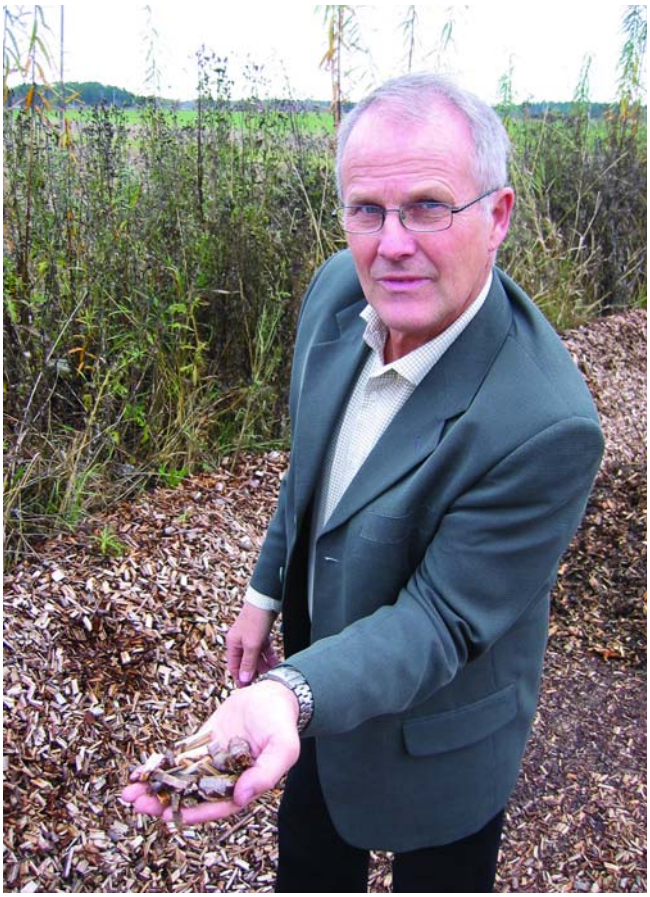
SWEDEN

S.1 *Farmarenergi: willow plantation*



S.2 *Farmarenergi: heating plant boiler*

S.3 *Farmarenergi: mission team with hosts*



S.4 *Farmarenergi: Mr Ohlson with woodchip product*

S.5 *Naturbränsle: forestry clearance with residue*

S.6 *Naturbränsle: biomass storage terminal*

S.7 *Naturbränsle: woodchip ready for transporting*

S.8 *Naturbränsle: processing of forestry residues*

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Energy policy – comprehensive and sustained support

Sweden and Denmark have put in place policy frameworks that have provided comprehensive and sustained support for efficient and renewable energy technologies. The two main drivers for these policies have been reduced reliance on fuel imports and sustainable development. These favourable conditions – sustained over nearly 25 years – have enabled a range of investors, including co-operatives, to make the long-term investments necessary.

Denmark in particular has created the conditions to support the growth of small-scale, distributed heat and power generation. The 1970s oil crisis had a profound effect, encouraging the Danes to establish radical energy policies aimed at reducing reliance on oil and gas. The main features of this have been:

- National plans and targets – long-term strategic planning and target setting
- Fossil fuel taxation – the levy of taxes on coal, gas and oil
- Use of the planning system – use of planning powers to direct investment
- Price support – feed-in tariffs for favoured technologies
- Grid connections – regulation of charges to support small generators
- Local authority engagement – direct enabling role for local authorities
- Smart technology subsidies – grants designed to support different stages of development

Energy taxes and feed-in tariffs can be seen to have created an overall driver, with the revenue raised being used to support new technologies.

The enabling powers of the planning system have also been used extensively to direct infrastructure investment. The most striking example is Denmark's use of the planning system to support district heating. Whilst this could be seen as draconian, it has:

- Created heat markets
- Enabled a range of fuels to be used – including biogas and biomass
- Supported the viability of CHP

In Sweden, a combination of energy taxes, support for district heating, and targeted subsidy has enabled the bio-energy sector to grow. This has enabled existing farmers and forestry enterprises to realise the potential of their indigenous resources.

GENERAL RECOMMENDATIONS

- Government should identify fiscal measures which would allow it to play a stronger role in enabling community energy projects.

- Efficient use of natural gas and reduced reliance on fossil fuels should be used as a key driver for investment in renewable energy and district heating.

- Co-operative demonstration projects should be supported by the government, enabling stakeholders to gain experience with different structures.

- Local authorities, together with energy agencies and CRIs should develop local strategies to support community-owned energy projects.

- Local authorities should play a more direct role as developer or enabler of projects, including acting as guarantor for infrastructure investments.

- With guidance from central government, local authorities should make greater use of the planning system to co-ordinate the development of heating networks. Consumer co-operatives should be established to deliver investment.

- Local authorities should develop district and neighbourhood heat plans to co-ordinate development and investment in heating networks.

RECOMMENDATIONS FOR THE CO-OPERATIVE MOVEMENT

- The co-operative movement should work closely with Danish organisations such as DV and DBDH to influence national and local energy strategies.

- The co-operative movement should work closely with policy think-tanks such as Mutuo and trade associations such as British Biogen to influence energy policy.

- The co-operative movement, and particularly consumer societies, should play an active role in developing local strategies for community-owned energy projects.

11.2 Building a culture of co-operation

Denmark and Sweden's energy systems are characterised by a large number of small power stations. This smaller scale, distributed form of power generation means that projects must be located in many more 'back yards' – both urban and rural. This is important because it:

- Enables more efficient energy use
- Allows a wide range of benefits to be distributed to local communities
- Reduces objections to projects because communities directly benefit

A fundamental change in the perception of projects has also occurred. This has been an important factor in enabling projects to happen, and it has been possible for a number of reasons:

- There appears to be a general acceptance of the need to tackle issues such as energy security and CO_2 emissions
- Planning regulations are, as a result of strong policy frameworks, also likely to have been less burdensome than in the UK
- Members have been able to realise the benefits of co-operatives at a community scale, eg cheaper heating, improved fertiliser, dividend on equity
- Project delivery and performance appear to have been improved through a greater level of community engagement and accountability

Co-operation at a local level is therefore beneficial. Co-operatives have been able to respond to the favourable policy conditions (as described in Section 11.1) contributing to the resolution of local concerns. They have also worked hand-in-hand with Danish industry, which has developed the technical know-how to deliver projects. Both the Danish wind and district-heating industries have benefited from the expansion of co-operatives.

The success of Denmark and Sweden's energy co-operatives raised the question: to what extent does a culture of co-operation already need to exist? In Denmark this was certainly the case, sustained through the education system. In Sweden there are co-operative development agencies in each district, and these are directly funded by the government. In both countries co-operatives

are therefore a familiar structure for projects – particularly at a community scale and for farmers.

However, it is not the case that the development of a strong co-operative role in Denmark's energy sector has occurred spontaneously in response to the favourable conditions. It has also required the direct support of membership-led trade associations acting as development agencies. Organisations such as the Danish Wind Turbine Owners' Association, Danish Biogas Association and LRF have, in addition to their policy work, provided direct 'hands-on' support for co-operatives. This contrasts with the UK, where many trade associations are technology focused.

Local authorities had also played a significant role in supporting co-operatives. For most of the projects visited, their support had played a vital role, whether through their use of the planning system or through provision of bank guarantees. Accountability to the local community also made projects more responsive to local planning and environmental health concerns – such as visual impact or odour control.

GENERAL RECOMMENDATIONS

- Wider education and awareness raising is required to promote co-operatives as a viable business model and overcome outdated perceptions.

- Greater support is needed for membership-based associations which provide mutual support and information sharing 'on the ground', whilst lobbying to overcome institutional barriers.

RECOMMENDATIONS FOR THE CO-OPERATIVE MOVEMENT

- The co-operative movement, including the Co-operative Bank and other potential stakeholders such as Triodos Bank, should work closely with organisations such as DV, DBDH and LRF to develop appropriate support mechanisms and investment frameworks.

- The co-operative movement should engage its members and stakeholders in the development of new co-operative energy projects and community investment opportunities – in both generation and supply.

- Existing co-operative development agencies and co-operative action groups should work closely with local authorities, energy agencies and CRIs to develop a stronger and more proactive role in the energy sector.

11.3 Energy markets – valuing community benefits

Much of the progress made in Denmark and Sweden was achieved during the 1980s and 1990s. However, the recent energy market liberalisation has created a sharper and, some would say, narrower focus on energy prices. This has changed the operating environment. Support tailored to the needs of specific technologies has been withdrawn. In Denmark, investment in all but the largest projects has been brought to a standstill.

Whilst the UK is a highly rated location for renewable energy investment, the energy market currently favours large-scale projects and investors, whilst discouraging longer term investment and more beneficial stakeholder relationships. This raises the question as to whether a different view of the market is needed – one in which price is not the only driver.

The mission provided evidence that co-operatives can deliver a wide range of benefits, in doing so creating value for both their members and the wider community.

The key benefits can be grouped under two main themes:

Community engagement and accountability

- Overcoming local objections or NIMBY-ism
- Responding to the concerns and needs of local communities
- Reducing costly delays and risk caused by objections
- Ensuring the efficient targeting of investment
- Raising awareness of the need for action on climate change
- Delivering key public services in partnership with local authorities
- Delivering direct accountability for stakeholders and energy consumers

Economic development

- Creating new opportunities and delivering direct economic benefits for their members
- Bringing together and co-ordinating relationships between key stakeholders
- Mobilising investment from their members and the wider community
- Supporting long-term infrastructure investment
- Developing tailored local solutions to project delivery

In the UK energy market, many of these wider benefits are not valued, and it is therefore more difficult to build the relationships required to capture them. Encouragement is therefore needed for a wider range of ownership models. This will require a change in emphasis from mechanisms focusing purely on price to mechanisms that seek to create value for communities.

GENERAL RECOMMENDATIONS

- The government needs to shift the regulatory emphasis from price to the wider community benefits achievable through co-operative models, and the direct engagement of producers and consumers.

- Greater attention should be focused on overcoming the barriers to development of smaller scale, community-owned projects. These include access to finance and technical expertise, project co-ordination, and funding up to planning.

RECOMMENDATIONS FOR THE CO-OPERATIVE MOVEMENT

- The co-operative movement should work closely with organisations such as DV, DBDH and LRF to influence regulatory policy and learn from the emerging experience of EU co-operatives operating in liberalised energy markets.

11.4 Co-operation in action

A range of co-operative models were seen in action, and each project was well suited to a collaborative approach. The achievements and means of delivery for each project were pragmatic rather than utopian. There was a widespread awareness that co-operatives were an option, and they are a recognised structure for an energy business.

The majority of the co-operative models ran on a non-profit or 'more-than-just-profit' basis, instead aiming to deliver a range of direct benefits to their members. They were also in a position to make long-term investments over periods of up to 20 years. This created a strong focus on service quality and the need for re-investment.

Where dividends were paid – as in the case of Middelgrunden and Lynetten – these had played a vital role in mobilising equity from

the wider community to finance projects. Where equity had been provided by members but dividends weren't payable – as in the case of Hashøj and Farmarenergi – the co-operative delivered direct benefits to members' bottom line, for example by securing a stable price for their produce or reducing waste management costs.

Each model we saw was specific to the needs of a project, reflecting the stakeholder relationships and level of engagement required by each technology. We were able to see five broad models of co-operation and joint venture:

- **Community-led investment** – projects such as Middelgrunden had been established by citizens wanting to see action on environmental issues. They had successfully mobilised people's time and money to enable projects to happen, with the potential for a financial return drawing in a wider audience. Accountability to stakeholders is ensured through one member one vote, a financial stake, and representative democratic structures.

- **Consumer-owned utilities** – utilities such as Høje Taarstrup (heat) and SEAS (electricity) supplied efficient and cost-effective public services, as well as facilitating local authority heat plans. In order to achieve this, they have had to make long-term investments in energy infrastructure and services. Accountability to their consumers is achieved through representative democratic structures.

- **Farmer co-operatives** – co-operatives such as Farmarenergi and Hashøj Biogas had been established in response to changing market conditions and regulatory requirements. By working together, members had been able to successfully diversify, so improving their economic position, and in the process delivering benefits to their community.

- **New ventures** – in Sweden, organisations such as Naturbränsle were not bound to specific communities. Instead, they bring together a range of different stakeholders from across the timber industry, including co-operatives of small woodland owners and large sawmills, across a large geographical area to develop the biomass supply chain.

- **Trade associations** – member-based organisations such as DV and LRF have brokered co-operation between co-operatives in order to share experience and knowledge. They also provided responsive support services – including negotiation with equipment suppliers and industry stakeholders – and high-level political lobbying to further their members' common objectives.

These are all tried and tested models of co-operation in the UK. However, there is relatively little experience of using them to deliver energy projects, suggesting a need for more demonstration projects.

GENERAL RECOMMENDATIONS

- Government support should be provided to promote model rules and 'best practice' guidance based on experience from the UK, Danish and Swedish co-operative movements.

- Tailored support should be available for communities wishing to establish new co-operatives, with general information made available on the potential of different co-operative models.

- Government should establish new investment vehicles which can be used to mobilise equity for projects from the wider community.

RECOMMENDATIONS FOR THE CO-OPERATIVE MOVEMENT

- The co-operative movement should undertake strategic assessments at a regional and sub-regional level of its assets and their potential to support energy projects.

- Partnerships with Danish and Swedish co-operatives should be developed in order to facilitate technology transfer, and share knowledge and expertise.

- The co-operative movement should act as a catalyst for projects involving a range of stakeholders, such as local authorities, farmers, property managers and the wider community.

- The co-operative movement should work with Energy4All and other organisations active in the field to establish renewable energy investment funds. These should include risk funds to take projects up to planning, and they should be used to support new co-operatives.

- Existing rural development agencies should work closely with local authorities, energy agencies, CRIs and the co-operative movement to develop demonstration projects.

- The Agricultural Organisation Societies, Farmcare, the Plunkett Foundation and other co-operative support agencies should work with Agrobränsle to develop pilot projects for willow production.

Appendices

CONTENTS

Appendix A

MODELS OF COMMUNITY INVOLVEMENT

WIND

Producer co-operative	Investment	Ownership structure	Risk/liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/ output
Middelgrunden Co-operative/ Lynetten Wind Cooperative, Denmark	Investment is open to all through bank loans	Share ownership. Large-scale farms owned by individuals, companies, organisations, unions, foundations and municipalities. Smaller scale owned by local people, farmers etc	Little financial risk. Liability	Municipality acts as guarantor to bank. DV acts as facilitator and gives technical advice and support (see below)	Original scale tended to be small, locally owned. Now larger farms can be invested in by more remote owners – the scale has been extended to include a wider area	Members may attend meetings and express viewpoints	1 vote regardless of number of shares held	Individuals feel involved. Highly visible structures	Dividend paid to members	Generation of electricity by wind energy

DISTRICT HEATING

Consumer co-operative	Investment	Ownership structure	Risk/ liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
Høje Taarstrup Fjernvarme, Denmark	n/a	All consumers are owners and may be elected to the board	Local authority	The municipality has acted as a loan guarantor, and has ensured compulsory connection for consumers	Locality – close to user	Through board meetings. Consumer/ owners may have access to decision making through representation on the board	Each share-holder has voting rights on the board. Households have 15 shares, housing associations 10 shares, industry 10 shares	Lower cost to consumers, clear meters in house, higher spec systems, cheap output, pollution control of central plant	The cooperative is not-for-profit – any surplus goes to lower customer charges or to be re-invested	Each consumer has a heating meter in his/her home

BIOGAS

Producer co-operative	Investment	Ownership structure	Risk/liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
Hashøj Biogas Plant, Denmark	Investment from farmers and municipality guarantee	Owned by an independent cooperative, Hashøj Biogas AmbA. Members are all farmers and slurry suppliers	Limited liability	Municipality	Locally owned catchment area beyond which un-economical (ie pipe/trucks). Contract to supply biogas to local CHP plant (see below)	Meetings, community, farmers and CHP meet four times a year	1 member 1 vote	Centralised plants make it easier to meet legislative demands. The plant provides heating for the community and maintains close contacts with local residents	Not-for-profit, although farmers can be paid for taking extra fertiliser, saving transport and labour costs	Slurry/ fertiliser

Consumer co-operative	Investment	Ownership	Risk/liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
Hashøj Kraftvarmefor-syning, Dalmose, Denmark	n/a	380 consumers in Dalmose and Flakkejerg and the municipality			Plant supplies Dalmose and Flakkejerg consumers (440)	Board of directors is made up of heat consumers and local council members. There is also an AGM that all consumers can attend	n/a	Lower heating costs to consumers within local area. Local control over business. High level of efficiency		Heat and power generation

ELECTRICITY SUPPLY/DISTRIBUTION

Consumer co-operative	Investment	Ownership structure	Risk/liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
SEAS Energy Group		Original shareholders were local farmers. Now, all consumers are automatically owners		n/a SEAS does have subsidiary businesses	Large-scale monopoly	Volume-based controlled representation of consumers. Individuals have proportionally less representation than larger businesses, industry etc		Consumer benefits from active involvement	Not-for-profit	Profit reduced across the board

BIOMASS

Producer co-operative	Investment	Ownership structure	Risk/ liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
Farmarenergi Hallstahammar AB, Sweden	Farmers invested per hectare loan through limited company and guarantor municipality	Share by number of fields invested: 1 hectare = 80 shares. Internal shares only	Limited liability	Municipality and CHP plant. Network for distribution is owned by Malarenergi AB and supplies the municipality	Local – heating net already in place	Farmers in control of decision making	1 vote	Community sees farms actively engaged and productive and receives warmth as a direct output from the heating net	Financial returns back to the farmers	Salix supplies combustion plant which supplies heat to the local community
Agrobränsle, Sweden		Owned by Swedish farmers cooperative Lantmännen and Lantmännen Energi AB	Limited liability			Farmers cooperative actively involved and in control of decision making		Promotes and develops willow coppice – aids diversification		Works with planting and marketing of salix, harvesting and marketing of chips

Secondary co-operative	Investment	Ownership structure	Risk/ liability	Partners	Scale/ connection	Level of involvement in decision making	Vote	Wider benefits	Financial structure	Physical input/output
Naturbränsle, Sweden – biofuel trading company		Company owned by Mellanskog Bränsle (the Forest Owners Association) and 20 sawmills	Limited liability	Key partners are owners of the by-product supply business, external suppliers, contractors and power generators		Collective decision making. All members have access to become actively involved should they wish		Provides access to new markets for farmers	Not-for-profit	Company organises forest fuel collection and handles the production process. Supplies fuel to CHP plant

Appendix B

MISSION TEAM PROFILES

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Established in 1976, the Urban and Economic Development Group (URBED) is a not-for-profit consultancy and research organisation specialising in regeneration, urban design, sustainability and economic development. URBED has been working closely with Co-operativesUK – the central organisation for co-operatives in the UK – to develop the potential for energy co-operatives, and were authors of the 2003 report Energy: the Future Generation.

URBED has been promoting the potential for energy co-operatives through its research and consultancy projects, with clients including local authorities, regional development agencies (RDAs) and property developers. URBED has a specific interest in district heating and domestic solar photovoltaic co-operatives.

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Baywind, established in Cumbria in 1997, is a co-operative with 1,300 members, operating Harlock Hill wind farm, and with a share in Haverigg II wind farm. The co-operative's aim is to promote the generation of renewable energy and energy conservation. Baywind has successfully carried out two share offers, raising over £1.9 million. It has also established an Energy Conservation Trust to promote energy conservation.

Energy4All is the management and development arm of Baywind, established in 2003 to replicate the Baywind model in other parts of the UK. Energy4All aims to deliver community-owned renewable-energy projects through partnership with communities, project developers, energy agencies and landowners. Energy4All is currently working on the establishment of new co-operatives in Oxfordshire, East Anglia and Scotland, and expects combined membership to rise to 10,000 over the next three years.

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Peak Energy provides support to OS&G, and represented OS&G on the mission. OS&G has an annual turnover of around £335 million, 89,000 active members and 4,566 employees. With a trading area spanning five counties, it has six trading groups: retail, motor, funeral, travel, property and corporate development (including childcare).

OS&G has been developing ideas to create new co-operative business models in the UK energy sector for over five years. It has formed a partnership of regional consumer co-ops to procure energy and to explore opportunities in the renewable-energy sector. It has recently agreed to invest in the South East Region's first significant wind-farm project, itself a co-operative venture by Energy4All, at Westmill Farm, near Swindon.

Peak Energy is a small practice specialising in the energy field. It currently has five self-employed associates and a combined turnover of <£0.5 million. The company partners with Peak Energy (Consultancy) in Texas, USA. Consultancy services range from energy management and procurement, through to on-site renewable-energy schemes. Peak Energy currently specialises in wind generation and CHP. It is a member of the Renewable Power Association.

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SAOS is the Scottish rural primary industries' own development agency, and is the membership organisation of 76 agricultural and rural co-operatives. It was founded in 1905 and is itself a co-operative. The purpose of SAOS is to strengthen the profitability, competitiveness and sustainability of Scotland's farming, food and related rural industries, through the development of co-operation and joint activity.

SAOS is owned by its members, employs 10 people, and had a turnover in 2003/4 of £690,000. Its members' combined turnover exceeded £1.3 billion in 2003/04, and accounted for more than 35% of all Scottish farm output. They collectively constitute a very significant component of the Scottish food and primary production industries, and the Scottish economy.

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Co-operative Group

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With £8 billion turnover and over 1 million members, Co-operative Group is the largest consumer co-operative society in the UK. It employs over 75,000 people, has more than 3,000 high-street outlets, and offers online and business-to-business services. Co-operative Group was established in 1863 as the North of England Co-operative Society, becoming the Co-operative Wholesale Society (CWS) in 1872, and Co-operative Group in 2001.

Co-operative Group now owns and operates food stores, the Co-operative Bank, CIS insurance, funeral branches, car dealers, travel agents, pharmacies and farms.

Farmcare – the Group's farming subsidiary – is the UK's largest farmer, owning ~29,000 acres, with additional land under management. Co-operative Group is actively exploring options for growing crops for energy generation and is developing sites for wind farms.

Brian Rees is also a director of Groundwork Trust Bridgend, which operates a subsidiary company – Welsh Biofuels Ltd – which manufactures wood-pellet fuel.

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Sue Hunter is a research fellow at the Institute of Energy and Sustainable Development (IESD) at De Montfort University. The university has two centres – Bedford and Leicester – and six faculties offering over 400 courses, with more than 23,000 students, 3,500 staff and a strong network of associate colleges.

IESD's mission is to contribute to sustainable development through research, consultancy and education. The institute is multidisciplinary, and received a 4 rating in the 2001 Research Assessment Exercise. IESD is a founder member of the Faraday Partnership for Integration of New and Renewable Energy in Buildings (INREB).

Sue is a lead researcher on the ESRC-funded project 'Community energy initiatives: embedding sustainable technology at a local level'. The project aims to evaluate the role of community initiatives in the development of sustainable energy technologies in the UK, examining the emergence of community-oriented programmes within national policy, the conditions under which community energy projects have been developed, the interpretation of 'community' within these initiatives (including more dispersed 'communities of interest'), achievement of their aims and outcomes, and the factors promoting and obstructing success.

Appendix C

HOST ORGANISATIONS – DENMARK

Danish Vindmølleforening
www.dkvind.dk

Hans Christian Sørensen
SPOK Consult
Board member of DV (Danish Association of Wind-power Guilds)

Danish Wind Turbine Owners' Association was founded in 1978 as a non-profit, independent association with the aim to take care of the wind-turbine owners' mutual interests regarding the authorities, political decision-makers, utilities and wind turbine manufacturers. The association wants to secure acceptable terms for the existing wind turbines in the future as well as reasonable conditions for establishment of new wind turbines both onshore and offshore.

The number of members is about 9,000 (February 2004), consisting of single wind-turbine owners and co-operatives. The membership of the co-operatives means that Danish Wind Turbine Owners' Association actually represents about 80,000 members. The Association negotiates on behalf of its members and also offers impartial counselling and information provided by its secretariat and consultants, who all have years of experience working with wind power.

Middelgrunden Wind Turbine Co-operative
www.middelgrunden.dk

Jens Larsen
Copenhagen Environment and Energy Office (CEEO)
Board member of Middelgrunden co-operative

The Middelgrunden Wind Turbine Co-operative was founded in May 1997 with the aim to produce electricity through the establishment and management of wind turbines on the Middelgrunden shoal, just off the coast of Copenhagen. 20 x 2-MW wind turbines were established – with a total capacity of 40 MW.

50% of the wind farm is owned by the co-operative, and nearly 90% of the shares are owned by people or companies from Greater Copenhagen. 8,552 electricity consumers are co-owners of the wind farm, most of whom live in Greater Copenhagen. Companies, organisations, unions and foundations are also members.

Høje Taarstrup Fjernvarme
www.htf.dk

Leif Andersson
Managing Director

Høje Taarstrup supplies district heating to the Copenhagen suburb of the same name. It is a co-operative owned by its consumers – of which there are 5,000 connected to its heating network. It is one of the largest consumer-owned district-heating companies in Denmark.

The co-operative is linked to the Greater Copenhagen heating grid and supplies to over 2.2 million ft^2 of industry, business, institutions and homes – the same heat requirements as 30,000 homes.

Danish Board of District Heating (DBDH)
www.htf.dk

Lars Bodilsen
DBDH Director

DBDH is a private organisation representing the leading actors within the Danish district-heating sector, including:

- Heat and CHP production companies and waste incineration companies
- Heat transmission and distribution companies
- Private consulting companies, R&D institutions and training institutes
- Manufacturing companies of plants, systems, components and products for the sector
- Contractors

DBDH implements conferences, seminars and exhibitions with the purpose of making this consolidated experience available worldwide. Further, DBDH develops and maintains co-operative agreements with district-heating organisations abroad for the purpose of exchanging information related to all aspects of district heating.

VEKS (West Copenhagen Heating Transmission Co)
www.veks.dk

Lars Gullev
VEKS/DBDH

Vestegnen is the overall term for the western suburban area of Copenhagen, including 11 municipalities. Vestegnens Kraftvarmeselskab I/S (VEKS) is a transmission company supplying heat to 19 local district-heating companies at Vestegnen.The local district-heating companies then resell the heat to private consumers, business customers and institutions.

VEKS was established in 1984 with the aim of utilising surplus heat generated from CHP plants as well as from waste incineration plants and major industrial enterprises.

Danish Biogas Association
www.biogasbranchen.dk

Bruno Sander Nielsen
Secretary of the Association

The aim of the Association is to increase the production of biogas on an economically sound and environmentally sustainable basis in Denmark and other countries. It is influencing politicians to create sound economic conditions for biogas production. The Association also works to develop environmentally and sanitary safe handling of manure and organic waste.

In order to achieve its objectives, the Association is in close contact with the politicians and central administration in Denmark. It is an organisation for public institutions, associations, enterprises and farmers. Its members cover the whole spectrum of stakeholders in Denmark: consulting engineers, contractors, biogas plants, farmers, municipalities, research institutions, etc.

Hashøj Biogas

Erik Lundsgaard
Plant Manager

The centralised biogas plant in Hashøj is owned by an independent co-operative, Hashøj Biogas AmbA, with 17 members, all farmers and slurry suppliers. The aim of the co-operative was to build and operate a biogas plant to facilitate redistribution of animal slurry in the area.

The plant is part of the demonstration programme for Danish biogas plants, aiming to demonstrate combined biogas/natural-gas fuelled CHP plant. The biogas produced is utilised for CHP production at the plant in Dalmose, where two biogas and natural-gas fuelled engines supply 440 consumers in Dalmose and Flakkebjerg with electricity and heat.

SEAS Energy Group
www.seas.dk

Jan Johansen
Marketing Director

SEAS is Denmark's largest consumer-owned energy company. It distributes and sells electricity to ~230,000 consumers in SEAS's supply area, which covers ~4,856 km^2 in southern Zealand, Møn, Lolland and Falster.

SEAS Energy Group consists of five companies:

- SEAS Distribution AmbA
- SEAS Transmission A/S
- SEAS Strømmens Elforsyning A/S
- SEAS Net A/S
- SEAS EnergiService A/S

Appendix D

HOST ORGANISATIONS – SWEDEN

LRF (Lantbrukarnas Riksförbund – Federation of Swedish Farmers)

www.lrf.se

Mr Christoph Rinnmann
International Co-operation

Mr Erik Herland
Energy and Industrial Crop and Business Development

LRF is an interest and business organisation for all those who own or work farm and forest land, and for their jointly owned companies in the Swedish agricultural co-operative movement.

With about 157,000 members, LRF's mission is to create the conditions for sustainable and competitive companies and to develop favourable conditions for life and enterprise in rural areas.

Farmarenergi

Mr Jan Barklund
Hallstahammars kommun

Mr Börje Ohlson
Farmarenergi i Hallstahammar AB

Mrs Monica Lindkvist
Kooperativ Utveckling Västmanland

Farmarenergi is a bio-energy concept where 19 local farmers have built a 2-MW combustion plant (with a 0.4-MW flue gas condensing unit) supplied with biofuels, mostly energy crops (salix). The concept is 'From arable land to distribution of heat'.

The plant, which was built in 1991 with investment costs of SEK 5.6 million, is owned by the farmers, whose individual shares are dependent on the acreage of salix that is cultivated: 1 hectare gives 80 shares. The farmers cultivate 184 ha of salix in total.

The network for distribution of hot water is owned by Mälarenergi AB and supplies the bigger buildings of the Kolbäck municipality

Naturbränsle
www.naturbransle.com

Mr Göran Hedman
Managing Director

Naturbränsle is a biofuel trading company owned by Mellanskog Bränsle (50%) and 20 sawmills. It is a member of LRF.

Mellanskog owns pellet plants (eg in Valbo). Naturbränsle organises forest fuel collection and handles the production process.

Turnover: SEK 350 million (€39 million).

Agrobränsle AB
www.agrobransle.se

Gustav Melin
Managing Director

Agrobränsle AB is owned by Lantmännen Energi AB and is part of the Swedish Farmers Co-operatives 'Lantmännen'.

Agrobränsle has 10 employees and about 40 individual contractors. The company works with planting and marketing of salix varieties, and the harvesting and marketing of salix chips. It also arranges for sewage sludge to be applied to the salix plantations, and develops machinery and systems for planting, growing, harvesting and transportation of the harvested product to heating plants.

Agrobränsle has licence rights to salix seed from Svalöf-Weibull, and markets the planting material throughout Europe.

Appendix E

LIST OF EXHIBITS

Appendix F

GLOSSARY

AD	anaerobic digestion
AGM	Annual General Meeting
ARBRE	ARable Biomass Renewable Energy (EC project, UK/Sweden)
°C	degrees Celsius
CEEO	Copenhagen Environment and Energy Office (Denmark)
CHP	combined heat and power
CIC	community interest company
CO_2	carbon dioxide
CRI	community renewables initiative
DBDH	Danish Board of District Heating
DEA	Danish Energy Authority
DNO	distribution network operator
DTI	Department of Trade and Industry (UK)
DV	Danske Vindkraftvaerker (Danish Association of Wind-power Guilds)
EIB	European Investment Bank
EIS	Enterprise Investment Scheme (UK)
ESRC	Economic and Social Research Council (UK)
EU	European Union
FDB	Co-operative Retail and Wholesale Society of Denmark
FSA	Financial Services Authority (UK)
ft	foot
GDP	gross domestic product
GJ	gigajoule (= 10^9 joule)
GWh	gigawatt-hour (= 10^9 watt-hour)
h	hour
ha	hectare (= 10,000 m^2)
ICA	International Co-operative Alliance (Switzerland)
IESD	Institute of Energy and Sustainable Development (De Montfort University, UK)
INREB	Faraday Partnership for Integration of New and Renewable Energy in Buildings (UK)
IT	information technology
J	joule
KF	Kooperativa Förbundet (Swedish Co-operative Union)
km	kilometre
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
LKU	Lokala Kooperativa Utvecklingscentrum (Local Co-operative Development Agency) (Sweden)
LRF	Lantbrukarnas Riksförbund (Federation of Swedish Farmers)
m	metre
MW	megawatt
MWh	megawatt-hour
NIMBY	not in my back yard
OS&G	Oxford, Swindon & Gloucester Co-operative Society (UK)
p	pence
PJ	petajoule (= 10^{15} joule)
R&D	research and development
RDA	regional development agency
s	second
SAOS	Scottish Agricultural Organisation Society (UK)
SEK	Swedish kroner (£1 ≈ SEK13)
SRC	short-rotation coppice
SVEBIO	Svenska Bioenergiföreningen (Swedish Bioenergy Association)
t	tonne (= 1,000 kg)
TJ	terajoule (= 10^{12} joule)
TWh	terawatt-hour (= 10^{12} watt-hour)
UK	United Kingdom
URBED	Urban and Economic Development Group (UK)
US(A)	Unites States (of America)
VAT	value added tax
VEKS	Vestegnens Kraftvarmeselskab I/S (West Copenhagen Heating Transmission Co) (Denmark)
yr	year

The DTI's Global Watch Service provides support dedicated to helping UK businesses improve their competitiveness by identifying and accessing innovative technologies and practices from overseas.

Global Watch Information
Global Watch Online – a unique internet-enabled service delivering immediate and innovative support to UK companies in the form of fast-breaking worldwide business and technology information. The website provides unique coverage of DTI, European and international research plus business initiatives, collaborative programmes and funding sources.
Visit: www.globalwatchonline.com

Global Watch magazine – the website's sister publication, featuring innovation in action. Distributed free to over 30,000 UK recipients, this monthly magazine features the latest technology developments and practices gleaned from Global Watch Service activities around the world now being put into practice for profit by British businesses.
Contact:
subscriptions@globalwatchonline.com

UKWatch magazine – a quarterly magazine, published jointly by science and technology groups of the UK Government. Highlighting UK innovation and promoting inward investment opportunities into the UK, the publication is available free of charge to UK and overseas subscribers.
Contact: subscriptions@ukwatchonline.com

Global Watch Missions – enabling teams of UK experts to investigate innovation and its implementation at first hand. The technology focused missions allow UK sectors and individual organisations to gain international insights to guide their own strategies for success.
Contact: missions@globalwatchonline.com

Global Watch Secondments – helping small and medium sized companies to send employees abroad or receive key people from another country. Secondments are an effective way of acquiring the knowledge, skills, technology and connections essential to developing a business strategically.
Contact:
secondments@globalwatchonline.com

Global Watch Technology Partnering – providing free, flexible and direct assistance from international technology specialists to raise awareness of, and provide access to, technology and collaborative opportunities overseas. Delivered to UK companies by a network of 18 International Technology Promoters, with some 6,000 current contacts, providing support ranging from information and referrals to more in-depth assistance with licensing arrangements and technology transfer.
Contact: itp@globalwatchonline.com

For further information on the Global Watch Service please visit
www.globalwatchonline.com

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