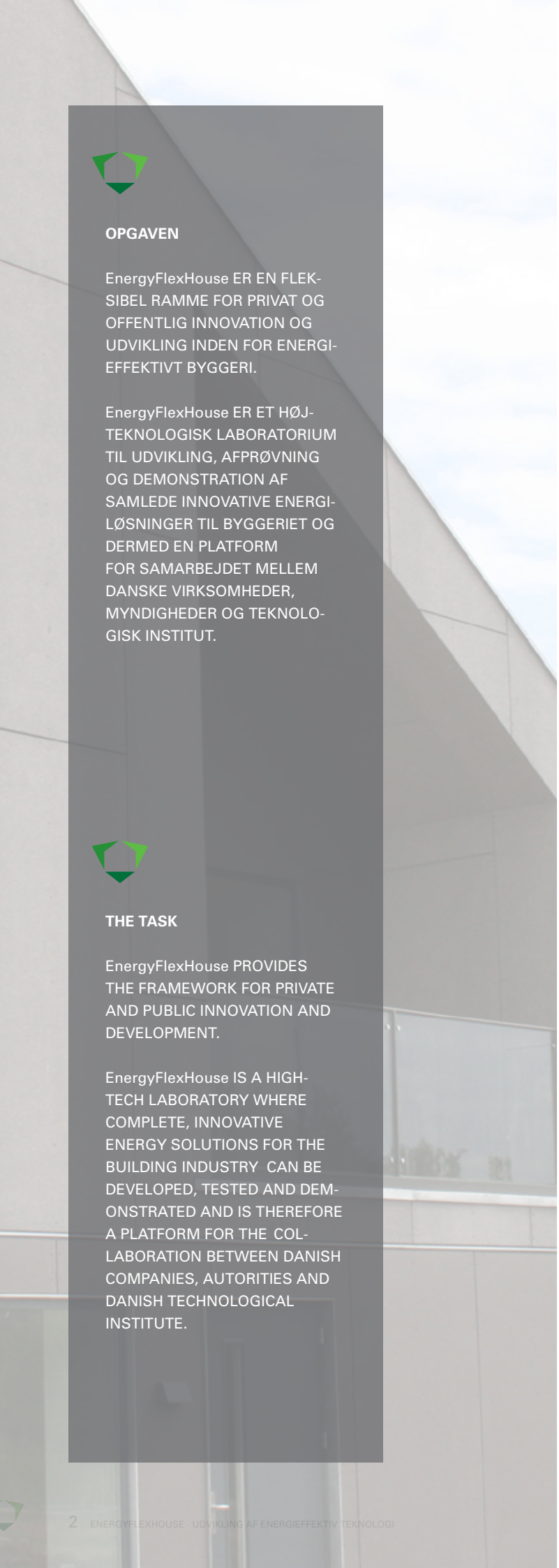
TEKNOLOGISK
INSTITUT

EnergyFlexHouse

UDVIKLING AF ENERGIEFFEKTIV TEKNOLOGI
TIL DE GLOBALE UDFORDRINGER

DEVELOPING ENERGY EFFICIENT TECHNOLOGIES
THAT MEET GLOBAL CHALLENGES

EnergyFlexHouse
TEKNOLOGISK INSTITUT



OPGAVEN

EnergyFlexHouse ER EN FLEKSIBEL RAMME FOR PRIVAT OG OFFENTLIG INNOVATION OG UDVIKLING INDEN FOR ENERGIEFFEKTIVT BYGGERI.

EnergyFlexHouse ER ET HØJTEKNOLOGISK LABORATORIUM TIL UDVIKLING, AFPRØVNING OG DEMONSTRATION AF SAMLEDE INNOVATIVE ENERGILØSNINGER TIL BYGGERIET OG DERMED EN PLATFORM FOR SAMARBEJDET MELLEM DANSKE VIRKSOMHEDER, MYNDIGHEDER OG TEKNOLOGISK INSTITUT.

THE TASK

EnergyFlexHouse PROVIDES THE FRAMEWORK FOR PRIVATE AND PUBLIC INNOVATION AND DEVELOPMENT.

EnergyFlexHouse IS A HIGH-TECH LABORATORY WHERE COMPLETE, INNOVATIVE ENERGY SOLUTIONS FOR THE BUILDING INDUSTRY CAN BE DEVELOPED, TESTED AND DEMONSTRATED AND IS THEREFORE A PLATFORM FOR THE COLLABORATION BETWEEN DANISH COMPANIES, AUTORITIES AND DANISH TECHNOLOGICAL INSTITUTE.

HVORFOR Energy Flex House?

FORORD

De globale udfordringer, der er knyttet til energiforsyning og markant reduktion af CO_2 skal opfyldes ved hjælp af energieffektivisering og udnyttelse af vedvarende energi. EU stiler mod, at de udviklede lande i 2020 skal have skåret deres drivhusgasemissioner ned med 30 % i forhold til 1990. Danmark sigter på at reducere energiforbruget med 25 % frem til 2025 og dække 30 % af energiforbruget med vedvarende energi i 2020.

Energieffektivisering, vedvarende energi og innovativ teknologiudvikling til byggeriet er derfor i fokus som aldrig før, både nationalt og globalt. Den teknologiske udfordring er dels at udvikle omkostnings- og energieffektiv teknologi og samlede systemer, dels at mestre det dynamiske samspil mellem bruger og bygning, udstyr og energiforsyning. Denne udfordring møder Teknologisk Institut med sit nye forsknings- og udviklingslaboratorium EnergyFlexHouse.

EnergyFlexHouse er en stor satsning for Teknologisk Institut. Derfor glæder det mig, at vi allerede meget tidligt fik opbakning fra Rådet for Teknologi og Innovation under Forskningsministeriet, der finansierer de første 10 udviklingsforløb i EnergyFlexHouse. Det glæder mig også, at førende danske virksomheder inden for bygningsenergiområdet fra starten har vist stor interesse og forståelse for konceptet. Denne interesse har bl.a. udmøntet sig i, at rigtig mange virksomheder har sponsoreret opførelsen med levering af udstyr og hardware, men også i, at virksomhederne aktivt medvirker i gennemførelsen af de første udviklingsforløb.

Søren Stjernqvist

Administrerende direktør
Teknologisk Institut

President
Danish Technological Institute

WHY EnergyFlexHouse?

EnergyFlexHouse udgør allerede nu grundlaget for forsknings- og udviklingsprojekter, der rækker helt frem til 2014, projekter hvor Teknologisk Institut vil komme til at arbejde sammen med hele interessentgruppen omfattende danske og udenlandske forskningsinstitutioner, arkitekter og rådgivere, private og offentlige bygherrer, udførende og sidst men ikke mindst den store underskov af små og mellemstore virksomheder, der udvikler og leverer nationalt og globalt til bygningsenergiområdet, og som skal være med at løse energi- og klimaudfordringen på byggeområdet.

EnergyFlexHouse, der er designet i samarbejde med Henning Larsen Architects, tages i brug 1. september. Vi har allerede haft rigtig mange besøgende, der ønsker at høre om byggeriet og dets muligheder. Nu ser vi frem til, at vi og vores samarbejdspartere også begynder at producere resultater, til gavn for dem og samfundet som helhed.

FOREWORD

The global challenges that are linked to energy supply and a significant reduction in CO_2 must be met through energy efficiency and renewable energy. The EU objective is that the developed countries by year 2020 shall have reduced their greenhouse gas emissions by 30 % compared to 1990. Denmark aims at reducing the energy consumption by 25 % up to year 2025 and at covering 30 % of the energy consumption through renewable energy by 2020.

That is why energy efficiency, renewable energy and the development of innovative technologies for buildings receive top priority nationally as well as globally. The technological challenge is partly to develop cost- and energy-efficient technology and combined systems, and partly to master the dynamic interaction between the consumer, the building, the equipment and the energy supplies. Danish Technological Institute is meeting the challenge with the new research and development laboratory called EnergyFlexHouse.

Danish Technological Institute is very committed to EnergyFlexHouse. Therefore, I am very pleased that the project already at an early stage was supported by the Danish Council for Technology and Innovation under the Danish Agency for Science, Technology and Innovation who agreed to co-finance the first 10 innovation projects in EnergyFlexHouse. I am also pleased that leading Danish companies within the building trade from the very beginning showed great interest in and appreciation of the concept. Due to that interest, many companies have sponsored the project by delivering equipment and hardware and the companies have also actively participated in the implementation of the initial innovation efforts.

At present, EnergyFlexHouse has already formed the basis of R&D projects that reach well into 2014. They are projects where Danish Technological Institute will co-operate with the entire group of partners comprising Danish and foreign research institutes, architects and consultants, private and public entrepreneurs, manufacturers and not least the large number of small and medium-sized companies that service the building area, nationally as well as globally, and who will now participate in solving the energy and climate challenge in the building sector.

EnergyFlexHouse was designed in co-operation with Henning Larsen Architects and it will be operational from 1 September 2009.
We have already had a lot of visitors who have been very interested in the building and its possibilities.
Now we look forward to producing results together with our co-operation partners; results that will be of benefit to our co-operation partners and to society in general.

Energy Flex House

KONCEPTET

EnergyFlexHouse er et aktivt led i innovationsprocessen fra idéudvikling, udvikling og afprøvning af prototyper og færdige produkter. Konceptet giver mulighed for at udvikle samlede omkostningseffektive løsninger som supplement til løsninger baseret på traditionel suboptimering med enkeltkomponenttest i henhold til internationale standarder.

Aktiviteterne i EnergyFlexHouse koordineres løbende med aktiviteter og erfaringer fra Teknologisk Instituts teststande og laboratorier.

Ordet "Flex" markerer, at tilpasning eller udskiftning af bygningskomponenter og installationer kan ske løbende som led i udviklingsaktiviteterne.

BYGGERIET

I EnergyFlexHouse kan tilpasning eller ændring af klimaskærm og installationer ske enkelt og let.

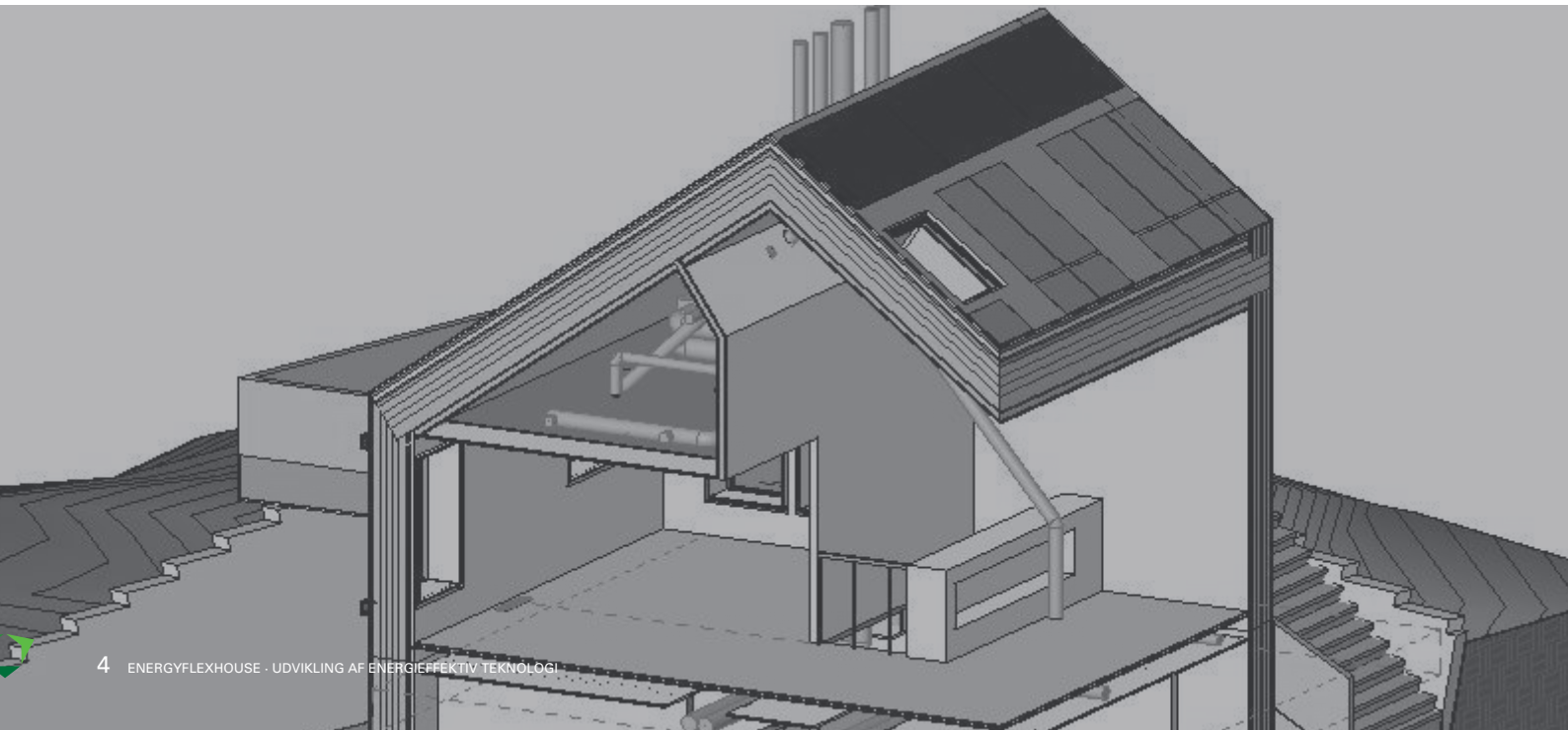
EnergyFlexHouse består af to bygninger:

EnergyFlexLab og
EnergyFlexFamily.

I **EnergyFlexLab** udvikles og dokumenteres teknologi og samlede systemer. Bygningen er en teknisk udviklingsfacilitet, hvor klimaskærmselementer, energiinstallationer og styringssystemer udvikles og optimeres i sammenhæng. Målet er omkostningseffektiv energiteknologi til bæredygtigt byggeri.

I **EnergyFlexFamily** fokuseres på samspillet mellem brugerne og de udviklede løsninger. Det gælder bl.a. adfærd, interaktive brugerflader og styringssystemer, samspillet mellem forbruget og det overordnede energisystem samt optimeret udnyttelse af vedvarende energi.

I 2010-11 forventes EnergyFlexHouse udvidet med EnergyFlexOffice, der som EnergyFlexLab er en facilitet for udvikling af energi- og klimateknologi, men med fokus på erhvervsbyggeriets særlige forhold - konstruktioner, opvarmnings- og ventilationssystemer, indeklima, brugsmønstre og udstyr.



THE CONCEPT

EnergyFlexHouse is an active link in the innovation process from the development of ideas and prototypes, to product maturation - right up to market penetration. The concept provides an opportunity to develop complete cost-effective solutions that can supplement solutions based on traditional sub-optimisation by testing individual components in accordance with international standards.

Activities in EnergyFlexHouse are continuously coordinated with activities and experience from the energy test centre and other relevant laboratories at Danish Technological Institute.

The word "Flex" denotes that an ongoing adaptation and replacement of building components and installations can take place as part of the development activities.

THE BUILDING

The building envelope and installations in EnergyFlexHouse can be adapted or changed individually and easily.

EnergyFlexHouse comprises two buildings: **EnergyFlexLab** and **EnergyFlexFamily**.

In EnergyFlexLab, technology and combined systems are developed and documented. The building is a technical development facility where elements of the building envelope and installations are developed and optimised as a whole. The objective is cost-effective energy technology for sustainable construction.

EnergyFlexFamily focuses on the interaction between the users and the developed solutions. This applies to behaviour, interactive user interfaces and control systems, the interaction between consumption and the energy system as a whole, as well as an optimised use of renewable energy.

In 2010-2011, the EnergyFlexHouse building will be extended with EnergyFlexOffice which, like EnergyFlexLab, will be a facility for the development of energy and climate technology, but focus will be on the special conditions that apply to office buildings - design, heating and ventilation systems, renewable energy, indoor climate, working life and equipment.

EnergyFlexHouse er et højteknologisk laboratorium til udvikling, afprøvning og demonstration af samlede innovative energiløsninger til byggeriet.

EnergyFlexHouse is a high-tech laboratory where complete, innovative energy solutions for the building industry can be developed, tested and demonstrated.

DER ER MULIGHEDER I EnergyFlexHouse

EnergyFlexHouse er forsynet med omfattende måleudstyr til dokumentation af indeklima og energiforbrug. Energiforbrugets størrelse og fordeling, temperaturer og flow i installationer samt effekten af installerede komponenter, udstyr og ændret brug registreres under styrede indeklimaforhold.

EnergyFlexHouse er et eksperimentarium. Det er ikke et statisk demonstrationsbyggeri, for modsat demonstrationsbyggerier er EnergyFlexHouse et dynamisk byggeri. Bygningsdele og installationer kan fjernes, tilføjes og udskiftes – så bygningerne svarer til den del af boligmarkedet, den aktuelle teknologi skal udvikles til. Eksempelvis kan klimaskærmen ændres fra lavenergiklasse 1 til standarden i det gældende bygningsreglement eller standarden i bygningsreglementet fra 1977.

Ligeledes kan installationerne ændres – eksempelvis fra fjernvarme til kedel eller varmepumpe med varmefordeling via gulvvarme eller radiatorer. Det betyder, at komponenter og systemer kan testes under de forudsætninger, man ønsker. Er der f.eks. tale om en teknologi til eksisterende byggeri med isoleringsstandard svarende til 70'erne eller er det til et hus bygget efter nutidens energikrav? EnergyFlexHouse kan let tilpasses.

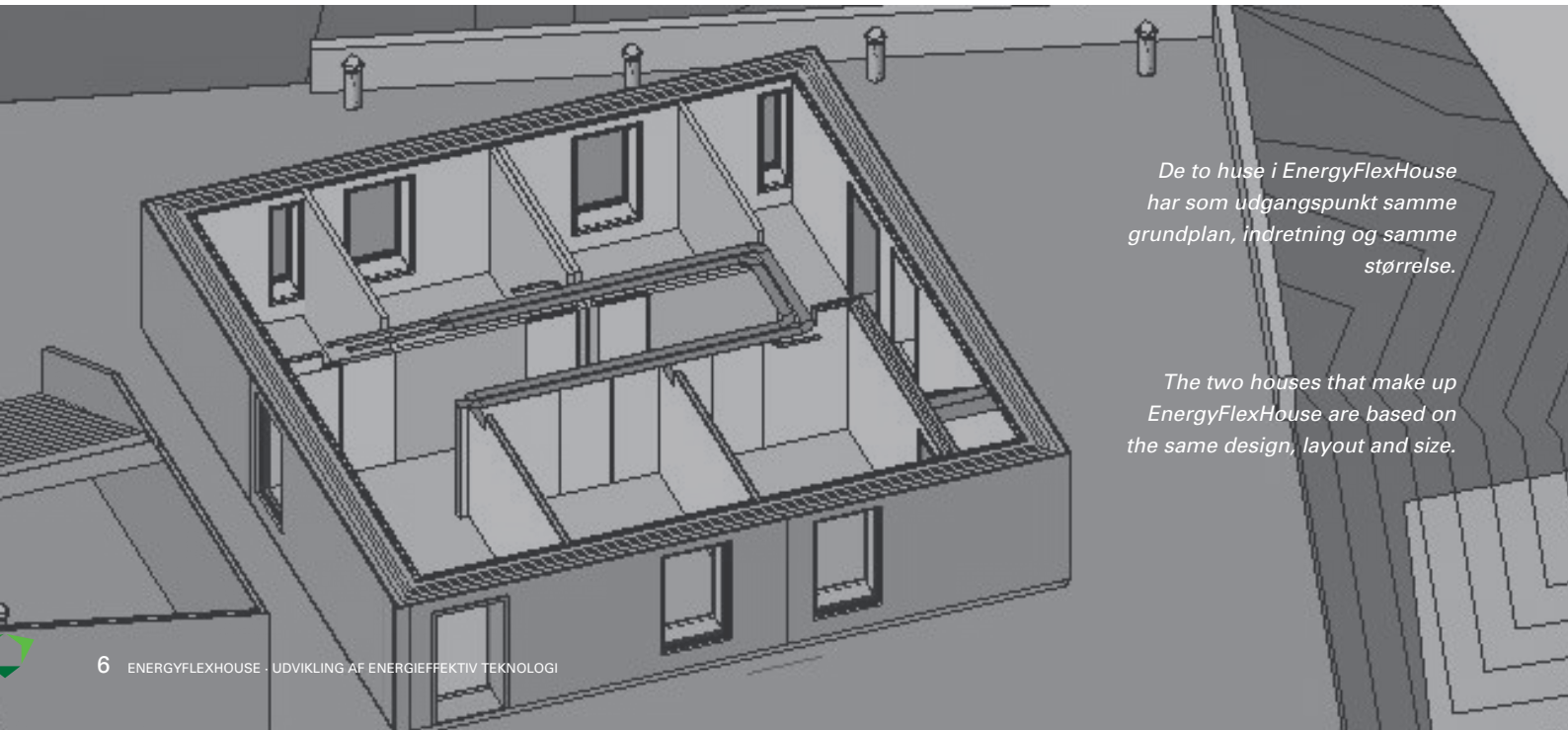
ENERGIEN DELES OP PÅ BYGNINGERS ENKELTE ELEMENTER OG DERES SAMMENSPIL

Den omfattende måleplatform i EnergyFlexHouse er konstrueret, så energiforhold og effekt kan adskilles på de enkelte elementer. Dette giver mulighed for at levere veldokumenterede resultater på alle niveauer – fra den enkelte komponent til det samlede system. Samtidig er det muligt, selv ved korterevarende målinger, at få et billede af resultatet på årsbasis - både for danske og internationale vejrforhold.

EnergyFlexHouse åbner også nye muligheder for at registrere, hvordan bygningsdele og installationer spiller optimalt sammen. De to huse har ikke mindre end 790 måle- og styringspunkter, der alle logges og samles i én database.

I husene kan man måle, registrere og regulere alle relevante data under dokumenterede vejrforhold i forbindelse med:

- Indeklima
- Klimaskærmen
- Ventilation
- Varmepumper
- Fjernvarmetilslutningen i huset
- Fjernvarmenettet i jorden
- Alternative varmeinstallationer
- Gulvvarmekredse
- Radiatorkredse
- Brugsvandsinstallationen
- Husholdningens elforbrug
- Installationernes elforbrug
- Lysforhold
- Solvarmesystemet
- Solcellesystemet



De to huse i EnergyFlexHouse har som udgangspunkt samme grundplan, indretning og samme størrelse.

The two houses that make up EnergyFlexHouse are based on the same design, layout and size.

THERE ARE POSSIBILITIES IN THE Energy-FlexHouse

EnergyFlexHouse is equipped with extensive measuring equipment for the documentation of indoor climate and energy. For example, the extent and distribution of energy consumption, temperatures and flow in installations as well as the effect of installed components, equipment and its changed use, can be registered.

EnergyFlexHouse is also an exploratorium. It is not exactly an exhibition centre because contrary to other houses EnergyFlexHouse is a dynamic building. Building components and installations can be removed, added or replaced, so the buildings correspond to the sector of the housing market for which the technology in question has to be developed. The building envelope can e.g. be changed from low-energy class 1 to the standard in the current building regulations or to the standard in the building regulations from 1977.

The installations can also be changed, e.g. from district heating to boilers or heat pumps with heat distribution through floor heating or radiators. Therefore, the components and systems can be tested under the conditions you prefer. Do you for instance want technology for the existing building with an insulation standard from the 70s, or a house built according to the present energy requirements?

ENERGY CAN BE DIVIDED INTO THE INDIVIDUAL ELEMENTS OF THE BUILDINGS AND THEIR INTERACTION

The extensive measuring platform in EnergyFlexHouse has been built so energy performance and effect can be separated for each individual element. That makes it possible to supply well-documented results at all levels – from the individual component to the complete system. It is also possible, even with short-term measurements, to get an impression of the results on a yearly basis, e.g. for Danish as well as international weather conditions.

EnergyFlexHouse also makes it possible to register the best way in which the building components and installations work together. Combined, the two houses have no less than 790 data and control points, all logged and compiled into one database.

All relevant data connected with the following aspects can be measured, registered and adjusted in the houses under known and documented weather conditions:

- Indoor climate
- Building envelope
- Ventilation
- Heat pumps
- District heating installations in the house
- District heating network in the ground
- Alternative heating installations
- Floor heating circuits
- Radiator circuits
- Hot water installation
- Electricity consumption in the household
- Electricity consumption of installations
- Lighting conditions
- Solar heating system
- Photovoltaic system

SIDE-BY-SIDE

I EnergyFlexHouse kan man i detaljer se, hvad der sker, når man ændrer på enkeltkomponenter, udstyr eller styring.

Der er i husene opbygget 4 sæt såkaldte side-by-side-rum. To og to er de helt identiske rum, der udsættes for samme klimapåvirkning.

Rummene vil som udgangspunkt opføre sig ens, når man installerer de samme komponenter og det samme udstyr i dem. Det giver mulighed for at ændre én eller flere parametre i det ene af rummene, og dermed observere og måle forskellen mellem rummene på grund af denne ændring.

Man kan således let teste effekten af teknologier og løsninger i 1:1 under typiske forhold. Det kan eksempelvis være effekten af ændringer i forbindelse med vinduer, varmeisolering, Powershades, Phase Changing Materials (PCM), behovsstyret ventilation, ændrede fremløbstemperaturer og varmefordeling.

ENERGIFORBRUGET OG DET SAMLEDE ENERGISYSTEM

Olie, gas og kul skal spille en mindre rolle og vedvarende energi skal opprioriteres – bygningerne skal producere mest mulig energi til eget forbrug og en stor del af bilparken skal udskiftes til elbiler.

Disse nye udfordringer på energiområdet rejser bl.a. spørgsmål om hvordan forbrug og forsyning kan spille sammen mellem den enkelte bygning og bebyggelsen, forsyningsnettet, landsdelen og det nationale forsyningssystem.

EnergyFlexHouse bidrager til at afdække mulighederne bl.a. ved forskning og udvikling af nye fjernvarmesystemer, varmeakkumuleringssystemer, ladestationer til elbiler, nettilsluttede solceller og el- og varmelagre.

SIDE-BY-SIDE

In EnergyFlexHouse you can get a detailed impression of what happens when changes are made to individual components, equipment or controls.

The houses have four sets of so-called side-by-side rooms. Two by two they are thermo technically completely identical rooms and they are exposed to the same climatic effects.

Essentially, the rooms operate in the same way when similar components and equipment are installed. That makes it possible to change one parameter and observe and measure the difference the change produces in the rooms.

The effect of the technologies and solutions can be tested 1:1 under typical conditions. For instance a detailed documentation of the effect of changing windows, heat insulation, power shades, phase-changing materials (PCM), demand-controlled ventilation, various temperature sets and heat distribution systems.

ENERGY CONSUMPTION AND THE ENTIRE DANISH ENERGY SYSTEM

In future, oil, gas and coal will play a minor part and renewable energy will receive high priority – the buildings must produce as much energy as possible for local consumption and a large part of the vehicle fleet will be replaced by electric vehicles (EV).

The new challenges within the field of energy i.a. raise questions on how consumption and supply can interact in the individual building, in buildings, in the supply network, in a specific part of the country and nationwide.

EnergyFlexHouse will contribute to uncover possibilities, e.g. by R&D of new district heating systems, heat accumulation systems, charging points for EVs, network connected photovoltaic cells and heat storages.

Bygningsdele og installationer kan fjernes, tilføjes og udskiftes så bygningerne svarer til den del af boligmarkedet, den aktuelle teknologi skal udvikles til. Eksempelvis kan klimaskærmen ændres fra lavenergiklasse 1 til standarden i det gældende bygningsreglement eller standarden i bygningsreglementet fra 1977.

Building components and installations can be removed, added or replaced, so the buildings correspond to the sector of the housing market for which the technology in question is to be developed. For instance, the building envelope can be changed from low-energy class 1 to the standard in the current building regulations or to the standard in the building regulations from 1977.

DEN ENERGI-NEUTRALE BOLIG - Energy FlexFamily

I slutningen af 2009 flytter en familie ind i EnergyFlexFamily, som er en god og stor familiebolig – der i første fase er energineutral. Solcellerne og solfangerne på taget producerer al den energi familien skal bruge i boligen og til elbilen.

EnergyFlexFamily er et eksempel på hvordan energineutralitet kan sikres på bygningsniveau ved hjælp af kendte, tilpassede teknologier.

Nu skal alle idéer, systemer og produkter stå deres prøve. Familien skal gennem sit daglige virke teste hvordan bygningen, installationerne og udstyret fungerer – hvad er godt og hvad er skidt?

Spørgsmålene er mange og kan eksempelvis være:

- Hvordan bruges bygningen og diverse udstyr og hvad er det resulterende energiforbrug?
- Kan familien styre de tekniske installationer, så de får et godt indeklima?
- Er intelligent styring en fordel – eller er det bare til irritation?
- Hvilke oplysninger om energiforbrug og energiforsyning er familien interesseret i?
- Kan vi udvikle et overskueligt brugerpanel, som gør det enklere og interessant at følge sit energiforbrug?
- Kan en interaktiv brugerflade påvirke familiens adfærd og energiforbrug?

BRUGERADFÆRD

Et er at designe og udføre energioptimale enkeltløsninger og systemer. Et andet er at få beboerne i husene til at bruge dem rigtigt i dagligdagen. Hvis beboerne ikke kan håndtere systemerne - måske fordi de er for komplicerede eller tidskrævende - hjælper de kreative idéer og tanker bag de energieffektive løsninger og systemer ikke meget.

Det er også vigtigt at fremme bevidstheden om konsekvenserne af familiemedlemmernes handlinger og ubevidste adfærdsmønstre. Her ligger store potentialer og venter på at blive realiserede.

Testfamilierne i EnergyFlexFamily giver unikke muligheder for at kortlægge effekten af ændringer både i systemer og produkter, bl.a. vil de subjektive brugervurderinger af de fysiske eller styringsmæssige tiltag give en værdifuld viden på området.

Det at inddrage slutbrugeren på denne måde - i de virkelige omgivelser i den almindelige dagligdag - kan sikre, at de løsninger der udarbejdes, både får gennemslagskraft på markedet, og leverer de ønskede energibesparelser.

ENERGY NEUTRAL HOUSING - Energy Flex Family

At the end of 2009, a family will move into EnergyFlexFamily, the large, energy neutral family house. The photovoltaic and solar collector on the roof will produce all the energy the family needs in the house as well as the energy for the electric vehicle (EV).

EnergyFlexFamily is an example of how energy neutrality can be assured in a building by using well-known adapted technologies.

All ideas, systems and products will now be put to the test. In their everyday life, the family will test how the building, installations and equipment work. What is good and what is not so good?

There are many questions and they could e.g. be:

- How do you use the building and the equipment and what is the resulting energy consumption?
- Is the family able to operate the technical installations so a pleasant indoor climate is obtained?
- Is intelligent control an advantage – or is it just irritating?

What type of information about energy consumption and supply does the family want?

Is it possible to develop an understandable user interface so the users find it easier and more interesting to follow how much energy they consume?

Could an interactive user panel influence user behaviour and energy consumption?

Testfamilierne i EnergyFlexFamily skal afprøve anvendeligheden og effekten af de udviklede produkter og systemer.

The test families in EnergyFlexFamily are going to test the user-friendliness and the effect of the developed products and systems.

USER BEHAVIOUR

One thing is to design and perform energy optimising individual solutions and systems. Another is to get the residents to use them correctly in normal everyday life. If the residents cannot manage the systems – perhaps they are too complicated or time-consuming – then the creative ideas and thoughts behind the energy efficient solutions and systems will not be of much use. This is where there is a huge potential waiting to be realised.

It also includes the effect of encouraging the awareness of the consequences of the family's actions and subconscious behaviour patterns.

The test families in EnergyFlexFamily give a unique opportunity to analyse the actual effect of system and product changes, and the subjective user reviews of physical or control-related measures will give valuable insight into the subject.

Involving the end-user in real surroundings in everyday life will ensure that the compiled solutions gain effectiveness in the market and supply the desired energy savings.

HVAD ER EN ENERGI-NEUTRAL BYGNING?

En energineutral bygning producerer lige så meget energi, som der forbruges.

Dette betyder, at det samlede energiforbrug er 0 kWh pr. år.

EnergyFlexFamily's energi-forbrug går til:

- Opvarmning og ventilation
- Varmt brugsvand
- Belysning
- Elforbrug til husholdningsmaskiner, underholdning og it
- Transport i form af en elbil

I EnergyFlexFamily er varme- og elforbruget re-duceret ved hjælp af energieffektive systemer og teknologier, således at bygningens forbrug kan dækkes med vedvarende energi.

Energineutraliteten i EnergyFlexFamily opnås ved hjælp af:

- Varmeisolering svarende til lavenergiklasse 1
- Lufttætte konstruktioner
- Lavenergivinduer
- Intelligent og interaktiv styring
- Energibesparende hårde hvidevarer og andet udstyr
- Energieffektiv belysning
- Transport i elbil
- Nettilsluttet solcelleanlæg
- Solvarmeanlæg til varmt brugsvand
- Varmepumpe til kombineret varme- og ventilationsanlæg

Den energineutrale bygning er opført i samarbejde med Rockwool A/S, VELUX A/S, Nilan A/S, Danfoss A/S, Lindab A/S, LOGSTOR A/S og Viega A/S.

WHAT IS AN ENERGY NEUTRAL BUILDING?

An energy neutral building produces the same amount of energy as it consumes.

Therefore, the total energy consumption is 0 kWh per year.

The energy consumption of EnergyFlexFamily include :

- Heating and ventilation
- Domestic hot water
- Lighting
- Electricity consumption for electric appliances, entertainment and IT
- Transport in the form of an electric vehicle (EV)

In EnergyFlexFamily, the heating and electricity consumption are reduced through energy efficient systems and technologies so the building's consumption can be covered by renewable energy

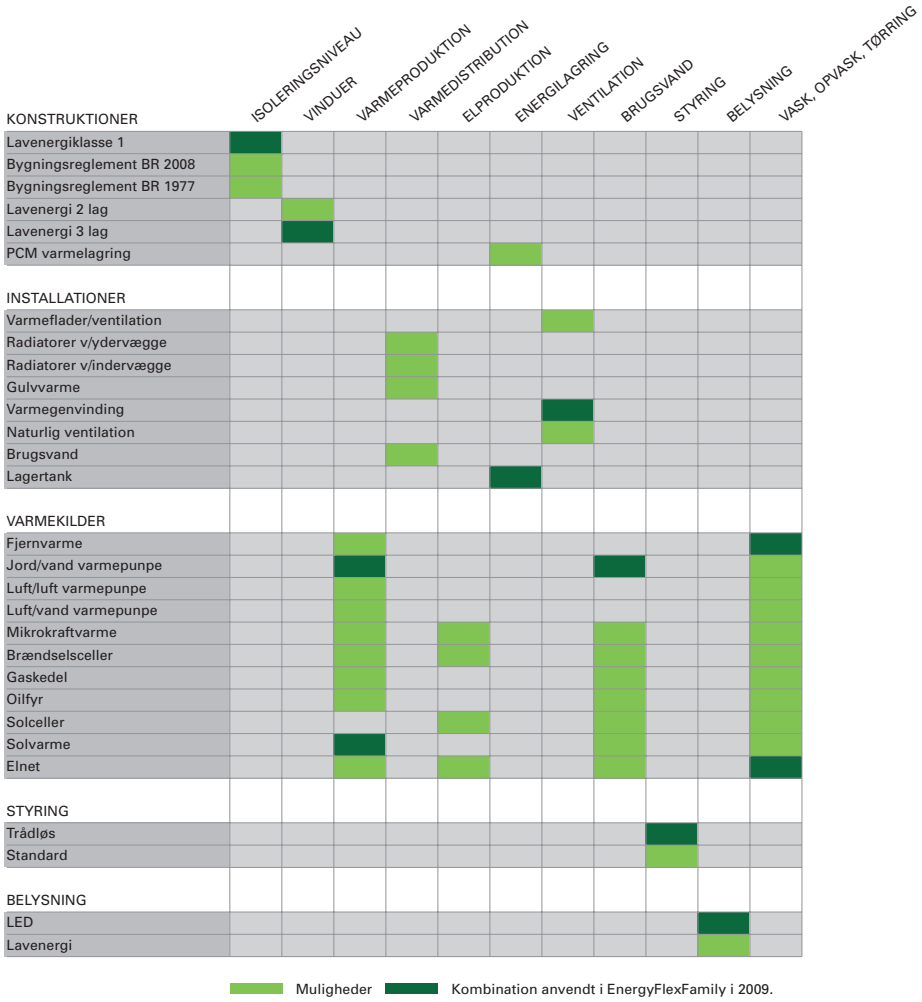
Energy neutrality in EnergyFlexFamily is achieved through:

- Heat insulation according to low-energy class 1
- Airtight buildings
- Low-energy windows
- Intelligent and interactive control
- Energy saving domestic appliances and other equipment
- Energy efficient lighting
- Transport in electric vehicle (EV)
- Grid connected photo - voltaic system
- Solar heating systems for domestic hot water
- Heat pump for a combined heating and ventilation system

The energy neutral building has been constructed in co-operation with Rockwool A/S, VELUX A/S, Nilan A/S, Danfoss A/S, Lindab A/S, LOGSTOR A/S and Viega A/S.

DEN ENERGINEUTRALE
BOLIG - ENERGYFLEXFAMILY

ENERGY NEUTRAL HOUSING
- ENERGYFLEXFAMILY



Man kan kombinere, designe og teste næsten alle relevante muligheder for energieffektiviseringstiltag i EnergyFlexHouse.

I skemaet ses nogle af mulighederne. Den viste kombination er den, der er anvendt i EnergyFlexFamily i 2009.

All the relevant options for energy-efficient measures can be combined, designed and tested in EnergyFlexHouse.

The table displays some of the options. The combination shown is the one used in EnergyFlexFamily in 2009.

DER ER FULD FART PÅ UDVIKLING, TEST OG DOKUMENTATION

EnergyFlexHouse giver unikke muligheder for at gennemføre innovationsforløb, specielt for producenter af produkter og udstyr. Her kan bygningsmaterialer og tekniske installationer bl.a. testes i sammenhænge, der svarer til den normale brug på markedet.

EnergyFlexHouse erstatter simulering, som ellers er eneste alternativ. EnergyFlexHouse er dermed et vigtigt led i innovationsprocessen fra idéudvikling, udvikling af prototype, test, optimering og produktmodning – helt frem til produkternes markedsintroduktion.

Der er fuld fart på aktiviteterne i Energy FlexHouse. Allerede i 2009 gennemføres de 10 første innovationsforløb:

1. Ventilations- og varmeanlæg med varmepumpe
2. Energieffektiv varmtvandsinstallation
3. Fleksibelt elforbrug og erstatning af elforbrug med varmeforbrug i husholdningsapparater
4. Fjernvarmesystem til lavenergibyggeri
5. Lavenergivinduer og varmeisolering
6. Klimaskærmen som varmelager, PCM i beton
7. Trådløs intelligent styring
8. Samspil mellem teknologi, brug og energisystem
9. Lavenergiinstallation som plug-and-play
10. Den energineutrale bolig

De 10 innovationsforløb gennemføres i samarbejde med væsentlige aktører på markedet og medfinansieres af Rådet for Teknologi og Innovation under Forsknings- og Innovationsstyrelsen.

De første 9 innovationsforløb er kort beskrevet på siderne 16 til 21. Det tiende innovationsforløb - "Den energineutrale bolig" - er beskrevet på siderne 10-13.

FULL SPEED ON DEVELOPMENT, TESTING AND DOCUMENTATION

EnergyFlexHouse gives unique possibilities to carry out innovation straight from idea to market, especially for manufacturers of products and equipment. Building materials and technical installations can be tested in surroundings corresponding to where they are normally used.

EnergyFlexHouse replaces simulation, which otherwise would be the only alternative. Therefore, EnergyFlexHouse is an important link in the innovation process from development of the idea to prototype development, testing, optimisation and product maturation – right up to market penetration.

There is full speed on the activities at EnergyFlexHouse. In 2009, ten innovation projects will be completed:

1. Ventilation and heating systems with heat pumps
2. Energy efficient hot water installation
3. Flexible electricity consumption and replacement of electricity consumption by heating consumption in white goods
4. District heating systems for low-energy buildings
5. Low-energy windows and vacuum insulation
6. Building envelope as a heat storage, PCM in concrete
7. Wireless intelligent control
8. Interaction between technology, use and energy system
9. Low-energy installation as plug-and-play
10. Energy neutral housing

The ten innovation projects are being carried out in co-operation with relevant players in the market and are co-financed by the Danish Council for Technology and Innovation under the Danish Agency for Science, Technology and Innovation.

The first nine innovation projects are described on page 16-21. Number 10 "Energy neutral housing" is described on page 10-13.

Allerede i 2009 gennemføres de 10 første innovationsforløb i EnergyFlexHouse.

Innovation activities are already well under way at EnergyFlexHouse. In 2009, ten development activities are completed.

1
VENTILATIONS- OG VARME-ANLÆG MED VARMEPUMPER

Varmepumper er et væsentligt alternativ til andre energikilder i nybyggeriet. Der er store fordele ved at kombinere en boligventilationsvarmepumpe og en minivarmepumpe, og derfor er denne løsning etableret i en unit i EnergyFlexFamily. Minivarmepumpen er udviklet i et parallelt projekt.

Boligventilationsvarmepumpen tager energi fra ventilationsanlæggets afkastluft og overfører varmen til indblæsningsluft. Minivarmepumpen tager energi fra jordslanger og producerer varme til rumopvarmning og varmt brugsvand. Anlægget er yderligere forsynet fra ca. 5 m² solfangere.

I innovationsforløbet fokuseres på:
1. Kombination af boligventilationsvarmepumpe og ventilationssystem
2. Minivarmepumpe til rumopvarmning og brugsvand
3. Minivarmepumpe kombineret med solvarme

Samarbejdspartnere i projektet er Nilan A/S og Danfoss A/S.

2
ENERGIEFFEKTIV VARMTVANDS-INSTALLATION

I lavenergihuse udgør energiforbruget til varmt brugsvand op til 50 % af det samlede varmeforbrug.

Der er således et relativ stort reduktionspotentiale i forbindelse med brugsvandsforbrug og brugsvandsinstallationerne i lavenergihusbyggeri. Reduktion af energiforbrug til varmt brugsvand er et fokusområde i alle former for byggeri, ikke mindst ved renovering – indsatsen omfatter brug af vedvarende energi (solvarme eller varmepumper), energieffektive installationer og hensigtsmæssig brug.

Der udvikles energieffektive løsninger til produktion og fordeling af varmt brugsvand. Det drejer sig bl.a. om optimering af systemlayout, anvendelse af nye rørtyper til varmtvandscirkulation, udvikling af intelligente armaturer og reduktion af varmetab.

I innovationsforløbet fokuseres på:
1. Effektive vandvarmere
2. Metoder til reduktion af dødtider, varmetab og vandforbrug, herunder intelligent styring

Samarbejdspartnere i projektet er Viega A/S og Danfoss A/S.

3
FLEKSIBELT ELFORBRUG OG ERSTATNING AF ELFORBRUG MED VARMEFORBRUG I HUSHOLDNINGSAPPARATER

Et prisfleksibelt elforbrug kan være en fordel for forbrugeren i form af lavere priser, forbedret forsyningssikkerhed og indpasning af miljøvenlig elproduktion, eksempelvis fra vindmøller. En væsentlig del af elforbruget i hårde hvidevarer kan styres eller flyttes inden for døgnet.

Varmt brugsvand kan produceres af miljøvenlig fjernvarme, eller lokalt ved den enkelte bolig med solenergi, varmepumper eller eventuelt med billig el. Varmen kan yderligere lagres til den skal anvendes. Op til 90 % af elforbruget kan erstattes med varmeforbrug i bl.a. vaskemaskine, opvaskemaskiner og tørretumblere.

Der etableres mulighed for at styre elforbruget samt for at anvende fjernvarme/varmtvand som basisenergi til opvarmning i vaskemaskiner, opvaskemaskiner og tørretumblere. Maskinerne udstyres med nødvendig styring til flytning af elforbrug, samt med varmevekslere, som supplerer elvarmelegemerne, der tager over ved behov for meget høje temperaturer.

I innovationsforløbet fokuseres på:
1. Prototype af vaskemaskine med varmeveksler
2. Prototype af opvaskemaskine med varmeveksler
3. Automatiseret forsyningssystem for fjernvarme/varmtvand til maskinernes varmevekslere
4. Den samlede systemløsning (1+2+3)
5. Flytning af elforbrug/styring efter prissignaler

Samarbejdspartnere i projektet er Danfoss A/S og Göteborg Energi AB.

DER ER FULD FART PÅ UDVIKLING, TEST OG DOKUMENTATION

DEVELOPMENT, TESTING AND DOCUMENTATION ARE WELL UNDER WAY

1
VENTILATION AND HEATING SYSTEMS WITH HEAT PUMPS

Heat pumps are an important alternative to traditional energy sources in new buildings. Great advantages can be obtained by combining a heat pump/ventilation system with a small scale ground source heat pump and therefore that solution has been established as a unit in EnergyFlexFamily. The small scale ground source heat pump was developed in a parallel project.

The heat pump/ventilation system takes energy from the exhaust air of the ventilation system and delivers the heat into the inlet air. The small scale ground source heat pump takes energy from ground coils and produces space heating and domestic hot water. The system is also equipped with approximately 5 m² solar collectors.

The innovation project focuses on:
1. Combination of a heat pump and ventilation system
2. Small scale ground source heat pump for space heating and domestic hot water
3. Small scale ground source heat pump combined with solar heat

The co-operation partners in this project are Nilan A/S and Danfoss A/S.

2
ENERGY EFFICIENT HOT WATER INSTALLATIONS

In low-energy houses, energy consumption for domestic hot water amounts to 50 % of the total heating consumption. There is a rather high potential connected with reducing the domestic water consumption and improving domestic water installations. Focus is on reduced energy consumption for domestic hot water in all buildings, not least in connection with renovation. The effort includes the use of renewable energy (solar heat and heat pumps), energy efficient installations and appropriate use.

In EnergyFlexHouse it is possible to develop energy efficient solutions for the production and distribution of domestic hot water. The solutions will include optimisation of the system layout, application of new types of pipes for hot water circulation, the development of intelligent fittings and the reduction of heat loss.

The innovation project focuses on:
1. Effective domestic water heaters
2. Methods for reducing time delays, heat loss and water consumption

The co-operation partners in this project are Viega A/S and Danfoss A/S.

3
FLEXIBLE ELECTRICITY CONSUMPTION AND REPLACEMENT OF ELECTRICITY CONSUMPTION BY HEATING CONSUMPTION IN WHITE GOODS

Electricity consumption that is flexible with regard to price can be an advantage to the consumer in the shape of lower prices, improved reliability and the introduction of environmentally friendly electric power generation, e.g. from wind turbines. A substantial part of the power consumption in white goods can be controlled or transferred within 24 hours.

Domestic hot water can be produced from environmentally friendly district heating or locally in each house with solar energy, heat pumps or possibly with inexpensive electricity. Heat can also be stored until needed. Up to 90 % of the power consumption can be replaced by heat consumption in the white goods.

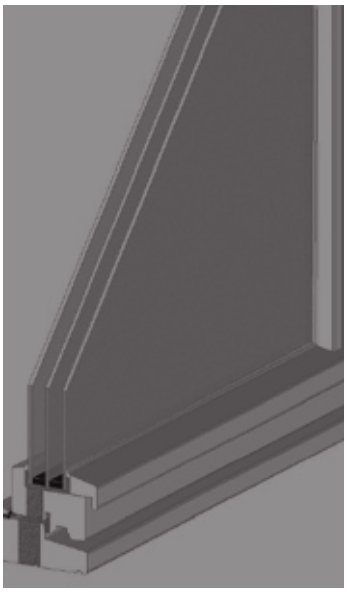
In EnergyFlexHouse it will be possible to control the power consumption and to use district heating/hot water as main energy source for heating in washing machines, dishwashers and tumble driers. The machines will be equipped with the necessary controls for transferring electricity, and with heat exchangers to supplement the electric heating elements which take over when very high temperatures are required.

The innovation project focuses on:
1. Prototype washing machine with heat exchanger
2. Prototype dishwasher with heat exchanger
3. Automated distribution system for district heating/hot water for the heat exchangers in the machines
4. Complete system solution (1+2+3)
5. Transfer of power consumption/control according to prices

The co-operation partners in this project are Danfoss A/S and Göteborg Energi AB.

I EnergyFlexHouse monteres lavenergivinduer af træ med kork som ekstra varmeisolering i karmene. *Se punkt 5, side 18.*

EnergyFlexHouse has low-energy windows made of wood with cork as additional heat insulation in the window frames. *See ch. 5, page 19.*



4
FJERNVARME-SYSTEM TIL LAV-ENERGIBYGGERI

Fjernvarme betragtes i dag som et væsentligt alternativ i nybyggeri. I varmeplan Danmark vurderes det, at 70 % af nybyggeriet frem mod 2020 med fordel kan forsynes med fjernvarme.

Fjernvarme kan anvende varme fra elproduktion, affald og vedvarende energi og anses som en væsentlig forudsætning for, at vi på lang sigt kan gøre os fri af fossile brændsler. Udfordringen ved fjernvarme til lavenergibyggeri er de relativt store omkostninger bundet i anlæg og varmetabene fra distributionsnettet.

Der etableres en fjernvarmeforsyning udlagt som twinrør og tilslutningsmuligheder for forskellige typer fjernvarmeunits i teknikrummet. Endelig etableres gulvvarmeanlæg og mulighed for tilslutning af radiatorer ved både yder- eller indervæg.

I innovationsforløbet fokuseres på:

1. Lavtemperaturdrift af stikledninger med meget små dimensioner og varmetab
2. Ny type fjernvarmeunit med akkumuleringsbeholder til fjernvarme
3. Vandradiatorer udviklet specielt til lavtemperaturdrift
4. Den samlede systemløsning (1+2+3)

Samarbejdspartnere i projektet er Danfoss District Heating, LOGSTOR A/S, Kamstrup A/S og Aktieselskabet Ribe Jernindustri.

5
LAVENERGIVINDUER OG VAKUUMISOLERING

De vinduer, vi i dag kender som lavenergivinduer, vil inden for en meget kort tidshorisont være et standardprodukt. Tilsvarende vil isoleringsprodukter med meget lav varmeledningsevne, eksempelvis vakuumisolering, vinde indpas i normal byggepraksis, specielt i de områder, hvor man ikke uden videre kan øge konstruktions- og dermed isoleringstykkelsen.

I EnergyFlexHouse monteres lavenergivinduer af træ med kork som ekstra varmeisolering i karmene og der etableres foranstaltninger, der kan afhjælpe udvendig kondens.

I innovationsforløbet fokuseres på:

1. Effekten af at anvende lavenergivinduer
2. Eksempler på optimeret indbygning af vinduer
3. Metoder til at nedsætte omfanget af udvendig kondensdannelse på lavenergiruder

Samarbejdspartnere i projektet er Ulsted Vinduer og Døre A/S og Barsmark A/S.

6
KLIMASKÆRMEN SOM VARMELAGER

Tunge bygningskonstruktioner kan reducere energiforbruget til opvarmning og køling, sammenholdt med lette bygningskonstruktioner. Specielt bygninger med glasfacader opfanger meget solvarme, så der bruges store mængder af energi på at køle bygningerne ned igen.

Ved at anvende tunge byggematerialer og eksempelvis faseskiftende materialer (Phase Changing Materials, PCM) i rum med store glasarealer, er det muligt at reducere energiforbruget ved at optimere udnyttelsen af solenergien, og minimere behovet for køling.

Der etableres passive varme- og kuldeakkumulerende betonkonstruktioner samt et termoaktivt betongulv med PCM.

I innovationsforløbet fokuseres på:

1. Bygningsintegreret termisk lagring til udjævning af temperaturer og reduktion af køle- og opvarmningsbehov
2. Energieffektiv køling med termoaktivt betongulv med PCM

Samarbejdspartnere i projektet er Unicon, EXPAN A/S, BASF A/S og Saint-Gobain Weber A/S.

DER ER FULD FART
PÅ UDVIKLING,
TEST OG DOKUMENTATION

DEVELOPMENT, TESTING
AND DOCUMENTATION
ARE WELL UNDER WAY

4
DISTRICT HEATING SYSTEMS FOR LOW ENERGY BUILDINGS

District heating is currently regarded as an important alternative in new buildings. 'Heat Plan Denmark' estimates that 70 % of new buildings could be fitted with district heating by 2020.

District heating can utilise heat from electricity production, waste and renewable energy and is considered to be a crucial requirement if we in the long-term are to disengage from fossil fuels. The challenges connected with district heating in low-energy buildings are the rather large costs bound in the systems and heat loss from the distribution network.

EnergyFlexHouse has a district heating system between the buildings, laid out as twin pipes, as well as the possibility to connect different types of district heating units in the technology room. Furthermore, a floor heating system is established and the option to connect radiators in either outer or inner walls.

The innovation project focuses on:
1. Low-temperature operation of DH network with very small dimensions and heat loss
2. New type of district heating unit with accumulation tank for district heating
3. Water filled radiators developed especially for low-temperature operation
4. Complete system solution (1+2+3)

The co-operation partners in this project are Danfoss District Heating, LOGSTOR A/S, Kamstrup A/S and Aktieselskabet Ribe Jernindustri.

<<

Fjernvarmenettet mellem bygningerne i EnergyFlexHouse er udført af twinrør.

The district heating system between the buildings in EnergyFlexHouse is constructed with twin pipes.

5
LOW ENERGY WINDOWS AND VACUUM INSULATION

The windows currently known as low-energy windows will become standard within a very short period of time. Similarly, insulation products with extremely low thermal conductivity, e.g. vacuum insulation, will become popular in standard construction methods, particularly in those areas where insulation and thus construction thicknesses cannot be increased.

EnergyFlexHouse has low-energy windows made of wood with cork as an additional heat insulation in the sills and measures are being taken to help prevent external condensation.

The innovation project focuses on:
1. The effect of using lowenergy windows
2. Examples of optimised integration of windows (in the wall/roof/ building envelope)
3. Methods to reduce the amount of external condensation on low-energy window panes

The co-operation partners in this project are Ulsted Vinduer og Døre A/S and Barsmark A/S.

6
BUILDING ENVELOPE AS A HEAT STORE

Heavy constructions that equalise the temperature can be obtained using phase-changing materials (PCM). These materials increase the heat accumulation, absorbing heat when changing phase, e.g. from solid to liquid state, and liberating the heat when changing from liquid to solid state. Heat accumulating constructions in buildings can reduce the energy consumption for heating and cooling particularly in buildings with a major solar gain. By using heavy construction materials and e.g. PCM in rooms with large glass areas, it is possible to reduce the energy consumption by optimising the utilisation of the solar energy and minimising the need for cooling.

Passive heat and cold accumulating concrete constructions will be established in EnergyFlexHouse along with a thermoactive concrete floor with PCM.

The innovation project focuses on:
1. Building integrated thermal storage to equalize temperatures and reduce energy consumption for cooling and heating
2. Energy efficient cooling with thermo-active concrete floors with PCM

The co-operation partners in this project are Unicon, EXPAN A/S, BASF A/S and Saint-Gobain Weber A/S.

7
TRÅDLØS INTELLIGENT STYRING

Trådløs styring af installationer, udstyr mv. i hjemmet kan reducere energiforbruget. Der findes en lang række trådløse sensorer samt overordnede hjemmestyringssystemer. En række producenter af tekniske installationer bruger trådløst netværk, og har åbnet muligheden for styring af installationer fra en hjemmestyringsenhed. Dette betyder, at der teknisk set er mulighed for intelligent, koordineret styring af eksempelvis ventilation, varme og el.

Der etableres trådløst sensornetværk til registrering af indeklima og energiforbrug samt central intelligent styring af varmeanlæg, ventilationsanlæg og elforbrugende komponenter i interaktion med brugeradfærd. Desuden etableres et system til synliggørelse af indeklima og forbrug.

I innovationsforløbet fokuseres på:
1. Modeller og parametre til optimal styring af indeklima og energiforbrug
2. Mulighederne for brugerdreven opsætning af styringsparametre
3. Kortlægning af energibesparelser ved parameterændringer

Samarbejdspartnere i projektet er Elsparefonden og Electronic Housekeeper.

8
SAMSPIL MELLEM TEKNOLOGI, BRUG OG ENERGISYSTEM - TRANSPORT PÅ VEDVARENDE ENERGI

Transportsektoren er 99 % afhængig af fossil brændstof, hvilket bl.a. medfører høj CO_2-emission og partikelforurening. Batterielbiler kan udnytte vedvarende energi fra vindmøller og solceller. Elbiler er desuden støjsvage og emissionsfri - og så udnytter de energien meget bedre end traditionelle biler. I vindstille og overskyede perioder oplades batteriet med almindelig el fra nettet.

Elbilernes nytteværdi i det samlede energisystem kan forøges, hvis energien i bilens batteri periodevis kan leveres tilbage på elnettet – kendt som "Vehicle to Grid" = V2G.

EnergyFlexFamily har en Fiat Panda elbil med batterikapacitet til 140 km. Bygningens solceller har kapacitet til at forsyne både bygning og bil med energi. Solcellerne leverer el til direkte forbrug, til nettet, til bilens batteri, eller til et husbatteri. Et styringssystem afgør, hvornår elbilen oplades fra husbatteriet eller elnettet.

I innovationsforløbet fokuseres på:
1. Familie-elbil på solcellestrøm
2. Intelligent ladning af elbil
3. Ellagring i husbatteri
4. Vehicle to Grid

Samarbejdspartnere i projektet er Energistyrelsen, Gaia Solar A/S og Lithium Balance A/S.

9
PLUG-AND-PLAY LAVENERGIINSTALLATION

Kravene om omkostningseffektiv minimering af energiforbruget i nye og eksisterende bygninger, gør det nødvendigt at nytænke bygningernes installationer. De aktuelle områder skal ses under ét og optimeres i samlede fleksible løsningspakker, der opfylder krav til energieffektivitet, industrialisering, hurtig og simpel installation og nem servicering. Løsningerne skal være omkostningseffektive både i produktions-, implementerings- og driftsfasen.

I EnergyFlexHouse arbejdes med kombinationer af:
- Varmepumper
- Solvarmeanlæg og solceller
- Fjernvarme, mikrokraftvarme eller gaskedel
- Ventilationsanlæg med varmegenvinding
- Gulvvarme eller radiatorer

I innovationsforløbet fokuseres på:
1. Skitsering af systemløsninger til typiske bygningsmodeller og energiforbrug
2. Valg af 2-4 systemløsninger og fastlæggelse af systemvarianter (varme, ventilation, køling, solvarme, solceller, radiator/gulvvarme/luftvarme)
3. Konkretisering af koncept for pakkeløsninger (produktion, markedsføring, installation, service)
4. Udvikling og afprøvning af prototyper

Samarbejdspartnere i projektet er SolarCAP A/S og Danfoss A/S.

DER ER FULD FART PÅ UDVIKLING, TEST OG DOKUMENTATION

DEVELOPMENT, TESTING AND DOCUMENTATION ARE WELL UNDER WAY

7
INTELLIGENT WIRELESS CONTROL

Wireless control for installations, equipment, etc. can together with a proper control strategy reduce the energy consumption. A wide range of wireless sensors and overall home control systems are available. A number of manufacturers of technical installations use wireless networks and have made it possible to control installations from a home control unit. That means that it is technically possible to control e.g. ventilation, heating and power. A wireless network of sensors has been set up in EnergyFlexHouse to register the indoor climate and energy consumption along with intelligent centralised control of heating systems, ventilation systems and energy-consuming components in interaction with user behaviour. In addition, a system for visualisation of indoor climate and consumption will be established.

The innovation project ocuses on:

1. Models and parameters for optimum control of indoor climate and energy consumption
2. Various options for user-driven installation of control parameters
3. Analysis of energy savings connected with parameter changes

The co-operation partners in this project are the Danish Electricity Saving Trust and Electronic Housekeeper.

8
INTERACTION BETWEEN TECHNOLOGY, USE AND ENERGY SYSTEM – TRANSPORTATION USING RENEWABLE ENERGY

The transport industry is 99 % dependent on fossil fuels, which among other things, entails high CO_2 emissions and particle pollution. Battery Electric Vehicles (BEV) can utilise renewable energy from wind turbines and photovoltaic cells. In addition, electric vehicles are comparatively noiseless and emission-free and they utilise the energy much better than traditional vehicles.

During non-windy and cloudy periods the battery is charged using standard electricity from the grid. The energy potential of the electric vehicle can be increased if the energy in the vehicle's battery periodically is returned to the power grid, which is known as "Vehicle to Grid" = V2G.

EnergyFlexFamily has a Fiat Panda electric vehicle with a battery capacity of 140 km. The photovoltaic cells of the building have the capacity to supply energy to the building as well as to the vehicle. The photovoltaic cells deliver electricity for direct consumption to the grid, the vehicle's battery or to a battery installed in the house.
A control system determines if the electric vehicle is to be charged from the battery in the house or the power grid.

The innovation project focuses on:

1. Family EV powered by photovoltaic cells
2. Intelligent charging of the EV
3. Storing electricity in the battery installed in the house
4. Vehicle to Grid (V2G)

The co-operation partners in this project are the Danish Energy Agency, Gaia Solar A/S and Lithium Balance A/S.

En Fiat Panda ombygget til elbil med batterikapacitet til 140 km er det individuelle transportmiddel i EnergyFlexFamily.

The individual mode of transport in EnergyFlexFamily is a Fiat Panda that has been converted to an electric vehicle with a battery capacity for 140 km.

9
PLUG-AND-PLAY LOW-ENERGY INSTALLATIONS

Demands for cost-effective minimisation of energy consumption in new and existing buildings make it necessary to re-think the installations of the building. The areas in question should be regarded as a whole and optimised in complete flexible package solutions that fulfil the demands for energy efficiency, industrialisation, quick and simple installation and easy servicing. The solutions should be cost-effective in the production, as well as in the implementation and operating phases.

EnergyFlexHouse utilizes a combination of:

- Heat pumps
- Solar heating systems and photovoltaic cells
- District heating, micro CHPs or gas boilers
- Ventilation systems with heat recovery
- Floor heating or radiators

The innovation project focuses on:

1. Outlining system solutions for typical building models and energy consumption
2. Selection of 2-4 system solutions and determination of system variations (heat, ventilation, cooling, solar heat, photovoltaic cells, radiator/floor heating/air heating)
3. Specifying the concept for package solutions (production, marketing, installation, service)
4. Development and testing of prototypes

The co-operation partners in this project are SolarCAP A/S and Danfoss A/S.

IDÉ-WORK-SHOPS - INNO-VATION CAMPS

I EnergyFlexHouse gennemføres kreative idé-workshops – innovation camps. Her udvikles og formuleres forsknings- og innovationsprojekter om fremtidens integrerede energiløsninger til bygninger.

Dette sker i et samarbejde mellem forskere, iværksættere, producenter og brugere.

I 2009 afholdes 3 workshops med temaerne:

- Boligen som energilager – i hvilke sammenhænge kan hvilke lagringsmuligheder overvejes?
- "Intelligent" energiudnyttelse – hvordan optimeres samspillet mellem bruger og teknologi?
- Energiinstallationen anno 2015 – hvilke krav skal den opfylde?

IDEA WORKSHOPS - INNOVATION CAMPS

A number of creative idea workshops/innovation camps will be carried out in EnergyFlexHouse. This is where research and innovation projects for future integrated energy solutions for buildings will be formulated and developed.

They will take place in co-operation with researchers, entrepreneurs, manufacturers and consumers.

In 2009, the following workshops will be arranged :

- The house as energy storage – under which conditions can various storage possibilities be considered?
- "Intelligent" energy utilisation – how can interaction between user and technology be optimised?
- Energy installations in the year 2015 – what demands shall they meet?

SÅDAN ER EnergyFlex-House BYGGET

EnergyFlexHouse kan tilpasses og ændres til de aktuelle udviklingsforløb. Bygningsdele, komponenter og installationer kan udskiftes, tilpasses, udbygges eller anvendes i en ny kombination.

De to bygninger kan ses som fleksible forsøgsopstillinger, der kan ændres efter behov. Dette har været et afgørende krav til konstruktionernes og byggeriets udformning.

Bygningernes konstruktioner og installationer er ved opførelsen i 2009 kort beskrevet nedenfor. Som det fremgår, er byggeriet i første fase præget af de 10 første innovationsforløb.

BYGNINGERNES UDFORMNING

Hvert hus er udformet som en énfamiliebolig på 200 m² brutto, i to etager med sadeltag. Bygningernes tagflader er orienteret mod syd og nord. I øverste etage følger loftet spærrerne, dog er der etableret et teknikloft mod nord til bl.a. ventilationssystemer. Stueetagen indeholder 4 værelser: Side-by-side-rum, to baderum samt et bryggers/teknikrum. Rummene samles af en langsgående gang, der i begge ender åbner sig mod 1. sal.

På 1. sal findes et stort fælles opholdsareal med fritliggende køkken og udgang til en østvendt terrasse og en vestvendt altan. Bygningerne har store vinduesarealer både mod syd, øst og vest. Desuden har bygningerne ovenlys.

THIS IS HOW EnergyFlex-House IS CONSTRUCTED

EnergyFlexHouse can be adapted and changed in line with existing development conditions. Building components, component parts and installations can be changed, adapted, extended or used in new combinations. The two buildings can be seen as flexible experimental set-ups that can be adapted according to requirements. That has been a crucial point when designing the building.

During construction in 2009, the design and installation of the building work was briefly described – and as appears below, construction is characterised by the current development conditions.

DESIGN OF THE BUILDINGS

Each house is designed as a single-family house with a total floorage of 200 m² in two storeys with a pitched roof. The roof of the buildings face north and south. On the upper floor, the ceiling is slanted in line with the beams. However, a technology loft has been established to the north, i.a. for the ventilation systems. The ground floor consists of two pairs of side-by-side rooms, two bathrooms and a utility/technology room. The rooms are connected by a longitudinal corridor, both ends of which open to the first floor.

There is a large common lounge area on the first floor with a separate kitchen and access to a terrace facing east and a balcony facing west. The buildings have large windows on the south, east and west. The buildings also have skylights.

EnergyFlexHouse er opført af Teknologisk Institut. Henning Larsen Architects er arkitekter på bebyggelsen, mens Enemærke & Petersen a/s er hovedentreprenører.

Byggeriet startede i efteråret 2008. Der har ikke været pauser i byggeriet i hele byggeperioden. Vinterens regn og kulde blev effektivt holdt ude af to totaloverdækninger, som gav en effektiv beskyttelse af både bygninger og håndværkere.

Den 11. december 2008 var der rejsegilde på EnergyFlexHouse. Det blev markeret med en minikonference om EnergyFlexHouse's baggrund, formål og perspektiver samt et traditionelt rejsegilde med øl og røde pølser.

Sidste arbejdstime på selve byggeriet blev anvendt i juli 2009. I september tages husene i brug - og så skal EnergyFlexHouse løbende "levere varen" i første omgang indtil 2020.

EnergyFlexHouse was created by Danish Technological Institute. Henning Larsen Architects is the architectural firm of the building, and Enemærke & Petersen a/s is the general contractor.

Construction work started in the autumn of 2008. There were no breaks in the construction work at any time during the building period. Rain and cold during winter were efficiently kept at bay by two covers that efficiently protected the building and the workmen.

The "roof tree" was put up on EnergyFlexHouse on 11 December 2008. That was celebrated with a mini conference describing the background, objectives and perspectives of EnergyFlexHouse and a traditional Danish topping-out party was also held with beer and red sausages.

The last working hour spent on actual construction work took place in July 2009.

In September the "real work" will start up. EnergyFlexHouse will continue "to deliver the goods", at first up to year 2020.

SÅDAN ER ENERGYFLEXHOUSE BYGGET

THIS IS HOW ENERGYFLEXHOUSE IS CONSTRUCTED

EnergyFlexLab er en "skrabet", men mere fleksibel version af EnergyFlexFamily. EnergyFlexLab er udelukkende en facilitet til teknologiudvikling. Bryggerset anvendes udelukkende til teknik. Der er desuden store vandrette og lodrette installationsskakte til teknikhemsen (det halve tagrum mod nord) til fremføring af installationer og teknik.

Side-by-side-rummene giver som nævnt mulighed for sammenlignende forsøg. I EnergyFlexLab kan de to etager energimæssigt set adskilles, så der kan udføres forsøg samlet for en etage. Endelig kan der gennemføres forsøg omfattende hele bygningen.

KLIMASKÆRMEN

Bygningerne er som udgangspunkt udført svarende til lavenergi klasse 1, men kan som nævnt ændres til de aktuelle BR-krav eller til BR 77-kravene.

Der er valgt et let byggesystem baseret på Kertospær. Der er 500 mm mineraluld i ydervægge, 500 mm mineraluld i taget og 400 mm polystyren i terrændækket.

Den damptætte membran er placeret ca. 50 mm inde i konstruktionen, således at den ikke bliver ødelagt af søm skruer o.l. Tagkonstruktionen er beklædt med tagpap, som er underlag for beklædningsplader mod nord og integrerede solceller og solfangere mod syd.

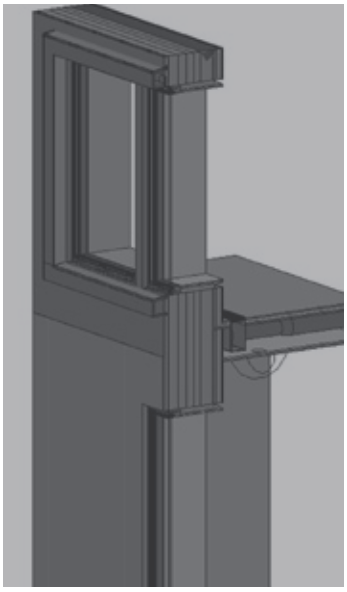
VINDUER

Vinduerne i begge huse har 3 lag glas. Hulrummet mellem glassene i ruderne er fyldt op med gasarten krypton, som isolerer bedre end almindelig luft.

Vinduerne i EnergyFlexLab og EnergyFlexFamily er forskellige – men fra samme leverandør.

I EnergyFlexLab er det leverandørens mest energirigtige vindue på markedet i dag. Vinduet er en kombination af træ og aluminium, med aluminium på ydersiden og træ på indersiden.

Vinduer i EnergyFlexFamily er endnu ikke på markedet. Vinduernes karme og rammer er fremstillet af et kompositmateriale, som minder om glasfiber.



Klimaskærmen i EnergyFlexHouse kan ændres således at den kan opfylde forskellige isoleringsstandarder.

The building envelope of EnergyFlexHouse can be adapted to various insulation standards.

EnergyFlexLab is a "no-frills" version of EnergyFlexFamily. EnergyFlexLab is solely a facility for technology development. The utility room is solely used for technology. In addition, there are large horizontal and vertical installation shafts for the technology loft (the half loft room on the north) for feed of installations and technology.

As mentioned, the side-by-side rooms allow for comparative testing. The two storeys of EnergyFlexLab can be separated for energy-related purposes, so overall tests can be carried out for one floor. Ultimately, tests covering the entire building can also be carried out.

BUILDING ENVELOPE

The buildings were originally constructed according to low-energy class 1, but can be changed according to the current building regulations or to the building regulations from 1977.

A simple construction system based on Kerto beams was selected. 500 mm mineral wool has been placed in the exterior walls, 500 mm mineral wool in the roof and 400 mm polystyrene has been placed in the floor bed. The vapour-proof membrane is placed app. 50 mm inside the building so it is not damaged

by screws etc. The roof design is covered with roof felt, which is an underlay for facing sheets on the north side, and integrated photovoltaic cells and solar collectors on the south side.

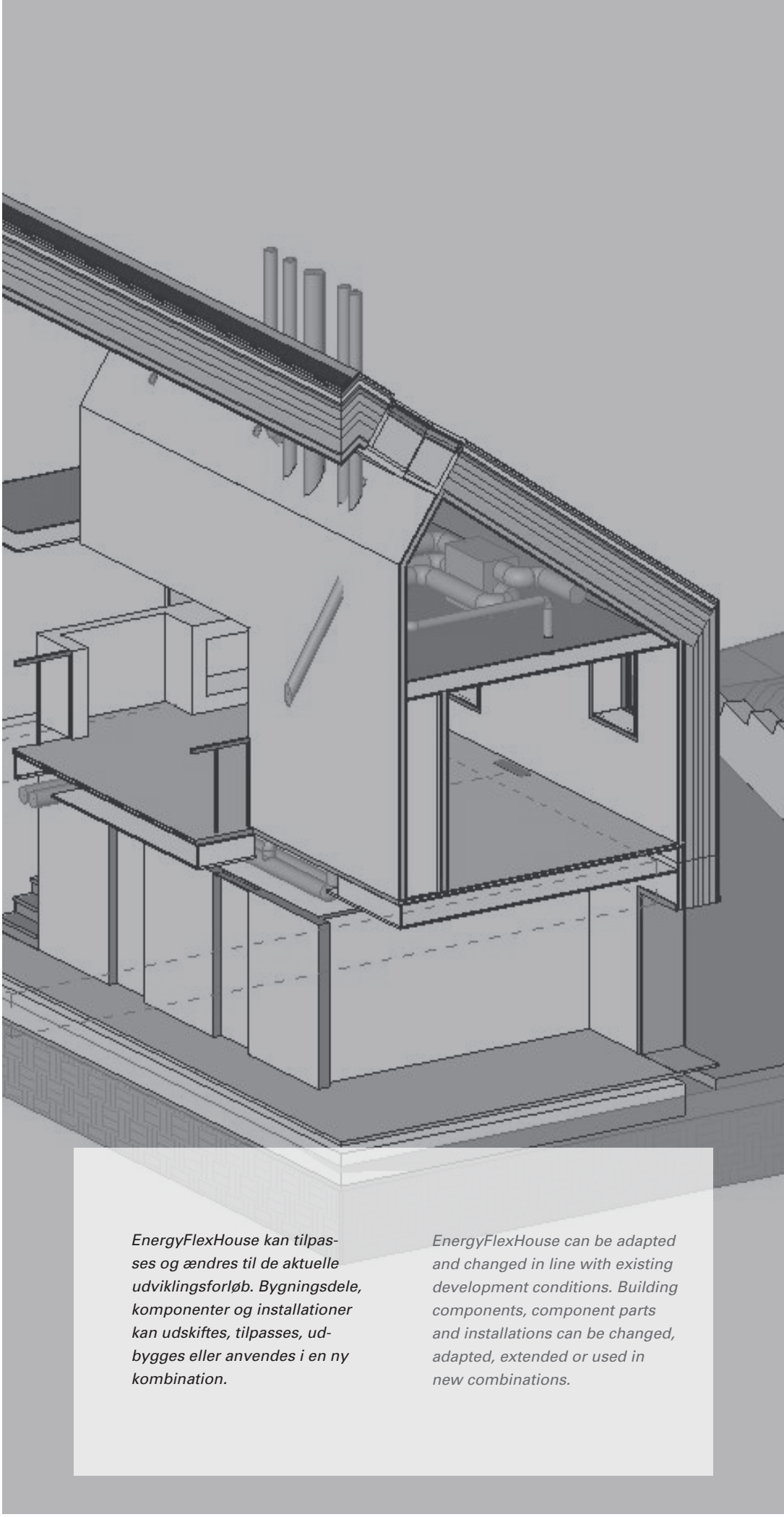
WINDOWS

The windows in both houses have tripple glazing. The spaces between the layers of glass are filled with krypton gas, which insulates better than normal air.

The windows in EnergyFlexLab and EnergyFlexFamily differ, but have been provided by the same supplier.

EnergyFlexLab uses the supplier's most energy-friendly window available today. The window is a combination of wood and aluminium, with aluminium on the outside and wood on the inside.

The windows in EnergyFlexFamily are not yet on the market. The window sills and frames are made of a composite material that is similar to glass fibre.



EnergyFlexHouse kan tilpasses og ændres til de aktuelle udviklingsforløb. Bygningsdele, komponenter og installationer kan udskiftes, tilpasses, udbygges eller anvendes i en ny kombination.

EnergyFlexHouse can be adapted and changed in line with existing development conditions. Building components, component parts and installations can be changed, adapted, extended or used in new combinations.

TÆTHED

Alle samlinger i klimaskærmen er omhyggeligt forseglede. En særlig test har vist at husenes er meget tætte. Tætheden af EnergyFlexHouse er væsentlig for at sikre de bedste resultater, specielt i forbindelse med mekanisk ventilation med varmegenvinding.

VARMEPUMPER

EnergyFlexLab er udstyret med en jord-til-vand varmepumpe, der leverer opvarmning og brugsvand. EnergyFlexFamily har en varmepumpeløsning, der kombinerer en boligventilationsvarmepumpe og en minivarmepumpe. Herudover er der etableret mulighed for at benytte en række varmepumpeløsninger, der bl.a. kan forsynes fra jordslangerne. Varmepumperne kan tilsluttes radiatoranlæg, gulvvarmeanlæg, ventilationsanlæg og varmelager.

SOLENERGI

EnergyFlexHouse er udstyret med solceller og solvarmeanlæg på husenes sydvendte tagflader.

SOLCELLER

EnergyFlexLab har et solcelleareal på 39 m². Her vil der kunne produceres omkring 5.900 kWh om året.

EnergyFlexFamily's solcelleareal er på 58 m². Solcellerne forventes her at producere 9.600 kWh pr. år. Solcellerne er nettilsluttede, således at bygningerne kan levere og modtage elektricitet fra elnettet, der her i princippet fungerer som lager.

SOLVARMEANLÆG

EnergyFlexLab har et solfangerareal på 12,9 m², mens EnergyFlexFamily har et areal 4,8 m². Solvarmeanlæggene kan tilsluttes husenes brugsvandsopvarmning, rumopvarmning eller varmelager/buffertank.

TIGHTNESS

All joints in the building envelope have been carefully sealed. A special test has shown that the houses are very tight. The tightness of EnergyFlexHouse is important in order to ensure the best results, particularly in connection with mechanical ventilation and heat recovery.

HEAT PUMPS

EnergyFlexLab is equipped with an earth to water heat pump, which together with the solar panels supplies heat and domestic water. EnergyFlexFamily has a heat pump solution that combines a heat pump/ventilation system with a ground heat pump. It is also possible to use a number of heat pump solutions that can be provided e.g. from the three ground coils. The heat pumps can be connected to radiator systems, floor heating systems, ventilation systems or heat storages.

PHOTOVOLTAIC CELLS

EnergyFlexLab has a photovoltaic cell area of 39 m². Approximately 5,900 kWh will be produced per year. The photovoltaic cell area of EnergyFlexFamily is 58 m². These photovoltaic cells are expected to produce 9,600 kWh per year. The photovoltaic cells are connected to the national grid so the buildings can supply and collect energy from the power grid, which in principle works as storage.

SOLAR HEATING SYSTEM

EnergyFlexLab has a solar collector area of 12.9 m², while EnergyFlexFamily has an area of 4.8 m². The solar heating systems can be connected to the domestic water heating of the houses, space heating or heat storage/buffer tanks.

Tagkonstruktionen er beklædt med tagpap. Det færdige tag er underlag for beklædningsplader mod nord og integrerede solceller og solfangere mod syd.

The roof design is covered with roof felt; the finished roof is an underlay for facing sheets on the north side, and integrated photovoltaic cells and solar collectors on the south.

VARMEKILDER

EnergyFlexHouse opføres med varmepumpeløsninger, men kan let ændres til en fjernvarmeløsning, eller forsyning fra oliekedel, gaskedel eller mikrokraftvarme.

LOKALT FJERNVARMENET

Der er etableret et lokalt fjernvarmenet fra en mindre varmecentral i bebyggelsens udkant. Nettet omfatter to sæt ledninger, således at systemet giver mulighed for at arbejde med energioptimal drift af både traditionelle systemer og lavtemperatursystemer. Fjernvarmenettet giver desuden mulighed for at eksperimentere med transport af varme fra bygning til bygning og med energilagring i fjernvarmenettet.

VARMEFORDELENDE SYSTEMER

EnergyFlexHouse er opført med flere varmefordelingssystemer, der kan anvendes enkeltvis eller i kombination. Der er således gulvvarme, radiatorer langs ydervæggene, radiatorer langs indervæggene og ventilationsvarmeflade.

Fordelingssystemerne kan operere med forskellige fremløbstemperatur og kan kombineres med forskellige varmekilder, så de mest energieffektive løsninger kan sammensættes.

GULVVARME

Der er i hvert hus installeret separate gulvvarmekredse til hvert rum – 10 i alt. Systemet er dimensioneret efter en lav fremløbstemperatur og en lille afkøling. Dette er både for at mindske uønsket varmetab i fordelingsrørene og for at temperaturen på gulvet skal være behagelig.

En lav fremløbstemperatur giver mulighed for at anvende lavtemperaturfjernvarme eller for energieffektive varmepumpeløsninger, evt. i kombination med solvarme.

RADIATORER

I EnergyFlexHouse er der to radiatorsystemer – et traditionelt system, hvor radiatorerne er placeret langs ydervæggene og under vinduer og et mere utraditionelt system, hvor radiatorerne er placeret langs indervæggene. Radiatorerne ved indervægge giver kortere rørtræk, mindre tryktab i systemet og mindre uønsket varmeafgivelse i fordelingsrørene. Til gengæld øger det risikoen for træk, hvis vinduerne er for dårlige.

VENTILATION

EnergyFlexHouse har mekanisk ventilation i begge huse samt naturlig ventilation og hybrid ventilation i EnergyFlexLab.

MEKANISK VENTILATION

Begge huse har et mekanisk ventilationsanlæg med høj varmegenvinding og lavt elforbrug. Der er mulighed for at placere ventilationsaggregaterne to steder i husene, enten på teknikhemsen eller i teknikrummet/bryggerset. Placeringen er væsentlig for energiforbruget, for anlægsudgiften og for serviceringen.

Systemet af ventilationskanaler giver mulighed for indblæsning og udsugning i samtlige rum. Desuden er der mulighed for individuel regulering af luftmængden til de enkelte rum.

Dette giver et helt unikt grundlag for at arbejde med behovsstyret ventilation i familieboliger. Det giver også mulighed for at gennemføre forsøg og udviklingsopgaver med varmeflader i ventilationssystemet til rumopvarmning.

NATURLIG VENTILATION

Det er også muligt at ventilere huset naturligt - uden mekanisk ventilation. Den friske luft kommer ind via ventiler i ydervægge og ventileres ud via aftrækskanaler gennem tagfladen.

HYBRIDVENTILATION

Da der både er et mekanisk og et naturligt ventilationssystem, kan man også arbejde med hybridventilation. Hybridventilation kan reducere energiforbruget til ventilation, hvis der anvendes mekanisk ventilation med varmegenvinding om vinteren og naturlig ventilation om sommeren, hvor der ikke er behov for varmegenvinding.

HEAT SOURCES

EnergyFlexHouse has been built with heat pump solutions, but can easily be changed to a district heating solution, or supply from oil boilers, gas boilers or micro-cogeneration.

LOCAL DISTRICT HEATING SYSTEM

A local district heating system has been set up between the two houses and a smaller external heat station set up on the periphery of the building. The system consists of two sets of cables so the system allows for energy optimising operations of the traditional systems and the low-temperature systems. The district heating system also allows for experimenting with the transportation of heat from one building to the other and with energy storage in the district heating system.

HEAT DISTRIBUTION SYSTEMS

It is possible to distribute heat in EnergyFlexHouse through floor heating, radiators located along the exterior walls or in the centre of the building, or by ventilation. EnergyFlexHouse has been created with several heat distribution systems that can be used individually or in combination. They are floor heating, radiators along exterior walls, radiators along interior walls and ventilating heat coils.

The distribution systems can operate with different supply temperatures and can be combined with different heat sources so the most energy efficient solutions can be created.

FLOOR HEATING

Ten separate floor heating circuits – one for every room - have been installed in each house. The system is dimensioned according to a low supply temperature and minor cooling. This is to reduce unwanted heat losses in the distribution pipes and to ensure a comfortable floor temperature.

A low supply temperature allows for use of low temperature district heating or energy efficient heat pump solutions, possibly in combination with solar heat.

RADIATORS

There are two radiator systems in EnergyFlexHouse; one traditional system where the radiators are placed along the exterior walls and under the windows, and a less traditional system where the radiators are placed along the interior walls. Radiators along the interior walls give shorter tube drawing, reduced pressure loss in the system and less unwanted emission of heat in the distribution pipes.

VENTILATION

EnergyFlexHouse has mechanical ventilation in both houses as well as natural ventilation and hybrid ventilation in EnergyFlexLab.

MECHANICAL VENTILATION

Both houses have a mechanical ventilation system with a high level of heat recovery and low electricity consumption.

It is possible to place the ventilation units in two locations in the houses, either in the technology loft room or in the technology/utility room. The location is important with regard to energy consumption, system costs and servicing.

The system of ventilation channels allows for air intake and exhaust in all rooms. It is also possible to individually adjust the amount of air in each room. This gives a completely unique foundation for working with demand-controlled ventilation in family homes. It also provides the opportunity to carry out tests and development tasks using heat coils in the ventilation system for space heating.

NATURAL VENTILATION

It is also possible to ventilate the house naturally, i.e. without mechanical ventilation. Fresh air comes in through vents in the exterior walls and is exhausted through channels in the roof.

HYBRID VENTILATION

As the building has mechanical as well as natural ventilation systems it is possible to work with hybrid ventilation. Hybrid ventilation can reduce energy consumption for ventilation, if mechanical ventilation with heat recovery is used during winter and natural ventilation is used during summer when there is no need for heat recovery.

BRUGSVANDS-INSTALLATIONEN

I lavenergibyggeri, udgør energiforbruget til brugsvandsopvarmning en væsentlig del af hele energiforbruget til opvarmning. I EnergyFlexHouse er tappestederne for varmt vand placeret spredt, hvilket er en udfordring i forbindelse med minimering af varmetab.

Brugsvandssystemerne i EnergyFlexHouse kan anvendes med eller uden cirkulation. I EnergyFlexFamily er cirkulationssystemet udført med et dobbeltrør, hvor returrøret er placeret inde i fremløbsrøret. På denne måde mindskes længden af rørtrækket og der vil kun være varmetab fra ét rør.

STYRING OG REGULERING

En stor del af fremtidens energibesparelser findes i løsninger, hvor samspillet mellem installationer, bygning, bruger og energisystem fungerer optimalt. Dette stiller store krav til styring og regulering og fordrer desuden at styringsniveauet hæves fra enkeltsystem til overordnet totalniveau. Dette er et kardinalpunkt for EnergyFlexHouse.

Som udgangspunkt installeres komponenterne og systemerne med deres egen styring. Dermed kortlægges det hvordan huset som "standard"-installation vil fungere i energi- og indeklimamæssig sammenhæng. Efterfølgende styres systemerne samlet ud fra en overordnet styringsstrategi, som skal tilvejebringe optimale energi- og indeklimaforhold.

ELINSTALLATION

En af de spændende muligheder inden for energibesparelser kaldes "home automation". Her fungerer elinstallationen som en intelligent og hjælpende hånd. EnergyFlexFamily er forsynet med en række systemer til "home automation".

DOMESTIC WATER INSTALLATION

In low-energy buildings, energy consumption for heating domestic hot water makes up a significant part of the total energy consumption for heating. The hot water drawing points are located at various points in EnergyFlexHouse which provides a challenge when it comes to minimising heat loss. The domestic water systems in EnergyFlexHouse can be used with or without circulation.

The circulation system in EnergyFlexFamily has been constructed with a double pipe, where the return pipe is located inside the supply pipe. In that way, the length of the tube drawing is reduced and heat loss will only occur from one pipe.

CONTROL AND ADJUSTMENT

A large proportion of future energy savings can be found in solutions where interaction between installations, buildings, users and energy systems all function optimally. That places high demands on control and regulation and also requires the control level to be increased from single systems to an overall total level. That is one of the crucial points in EnergyFlexHouse.

Components and systems are originally installed with individual control. In that way, it is possible to determine how the house will function from an energy and indoor climate point of view with "standard" installations. Subsequently, the systems are controlled collectively under a complete control strategy, which should produce optimum energy and indoor climate conditions.

POWER INSTALLATION

One of the most interesting possibilities within energy saving is called "home automation". The power installation functions as an intelligent and helping hand. EnergyFlexFamily is equipped with a number of systems for "home automation".

Der er mekanisk ventilation i både EnergyFlexLab og EnergyFlexFamily. Der kan desuden etableres naturlig ventilation og hybrid ventilation.

Mechanical ventilation is fitted in both EnergyFlexLab and EnergyFlexFamily. Natural ventilation and hybrid ventilation can also be fitted.

SPONSORER OG INTERESSENTER

SPONSORS AND PARTNERS

Alfabetisk
In alphabetical order

AC Stilladser A/S
Aktieselskabet Ribe Jernindustri
Altiflex A/S
Asko Appliances AB
ASCO Valve Inc.
BANIO A/S
Barsmark A/S
BASF A/S
Beckers Maling A/S
Bosh
Brandt Nordic A/S
BSH Hvidevarer A/S
Cembrit
DAFA A/S
Danfoss A/S
Danfoss District Heating
Dansk Fjernvarme
Duravit A/S
Enemærke og Petersen a/s
Electro-Oil Int. A/S
Electronic Housekeeper
Elsparefonden
EnergiMidt A/S
Energistyrelsen
EXPAN A/S
Fjernvarme Fyn
Forsknings- og Innovationsstyrelsen
Gaia Solar A/S
Genvex A/S
Göteborg Energi AB
HAKI A/S
Hansgrohe AG
Henning Larsen Architects
Hudevad A/S
HTH Køkkener A/S
IBF
IPS Dansk Presenning A/S
Karlstad University
Kamstrup A/S
Lindab A/S
Lithium Balance A/S
LOGSTOR A/S
Miele A/S
Mälarenergi AB
National Instruments Corporation
Nilan A/S
Nordisk Wavin A/S
Nyrup plast a/s
Saint-Gobain Isover a/s
Saint-Gobain Weber A/S
SERC, university of Dalarna
SolarCAP A/S
Sonnenkraft Scandinavia A/S
Svensk Fjärrvärme
Rockwool A/S
Ulsted Vinduer og Døre A/S
Unicon
Viega A/S
VELFAC A/S
VELUX A/S

HER LIGGER EnergyFlexHouse

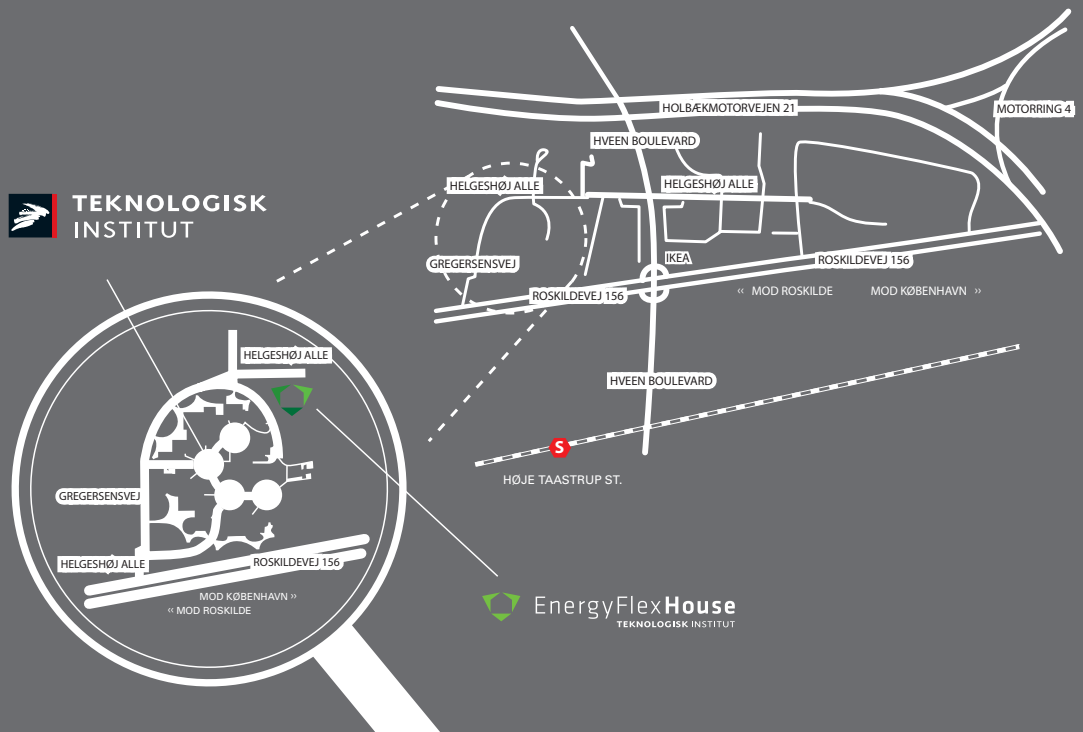
FIND YOUR WAY TO EnergyFlexHouse

EnergyFlexHouse er bygget på Teknologisk Institut i Taastrup.

Kortet nedenfor viser vejen. På www.teknologisk.dk/22926,3 vises vejen fra et vilkårligt sted til Teknologisk Institut.

EnergyFlexHouse has been built on the premises of Danish Technological Institute in Taastrup, Denmark.

The map below shows you how to get there. At www.dti.dk/23797,2 you can find your way from any location to Danish Technological Institute.



TEKNOLOGISK INSTITUT

Teknologisk Institut udvikler, anvender og formidler teknologibaseret viden til dansk erhvervsliv. Instituttet tilbyder også rådgivnings- og standardiseringsaktiviteter, der medvirker til dynamisk og harmonisk samfundsudvikling. Endelig styrker Teknologisk Institut kompetencer i private og offentlige virksomheder gennem kursus-, certificerings- og foredragsvirksomhed. Teknologisk Instituts vigtigste opgave er at sikre, at ny viden og teknologi hurtigt kan omsættes til værdi for vores kunder i form af nye eller forbedrede produkter, materialer, processer, metoder og organisationsformer.

HENNING LARSEN ARCHITECTS

Henning Larsen Architects er et internationalt arkitektfirma med stærke skandinaviske rødder. Firmaets mål er at udforme de fysiske omgivelser - fra byplan, byrum og bygninger til komponentdesign og møbler - på en sådan måde, at brugeren får et bæredygtigt, oplevelsesrigt og funktionelt robust design. Med næsten 50 års historie har Henning Larsen Architects udviklet et indgående kendskab til det samlede professionelle spektrum – fra idé- og konceptudvikling til projektering, fagtilsyn og byggeledelse. Firmaets viden og kompetencer udvikles løbende gennem nye projekter og i mødet med samarbejdspartnere, eksperter og specialister fra hele verden.

FORSKNINGS- OG INNOVATIONSSTYRELSEN

Udviklingsforløbene i EnergyFlexHouse medfinansieres af Forsknings- og Innovationsstyrelsen i 2009 og 2010.

DANISH TECHNOLOGICAL INSTITUTE

Danish Technological Institute develops and provides technology-based expertise to the Danish industry. The Institute also offers consultancy and standardisation services which contribute to dynamic, harmonious social development. Finally, Danish Technological Institute strengthens competences at private and public companies and organisations through courses, certification and lectures. The most important task of Danish Technological Institute is to ensure that new expertise and technology can quickly be converted into value for our customers in the form of new or improved products, materials, processes, methods and organisation types.

HENNING LARSEN ARCHITECTS

Henning Larsen Architects is an international architecture company with strong Scandinavian roots. With almost 50 years of experience, the company has developed a thorough insight into the dynamics of a building design and its interplay with the surroundings. Henning Larsen Architects employs a total of 150 people representing 12 different countries. Combining their managerial skills within finance, sustainability and user knowledge, the company exploits a yearlong practical experience concerning the effect of shapes, colours, materials and daylight. Situation and context play a major role in the company's work, and the projects are often carried out in cooperation with highly skilled international consultants sharing the common effort to achieve the best possible quality in all parts of the design. This value-based approach is key to the design of numerous building projects around the world – from complex masterplans to successful architectural landmarks.

THE DANISH AGENCY FOR SCIENCE, TECHNOLOGY AND INNOVATION

The development activities planned for 2009 and 2010 are cofinanced by The Danish Agency for Science, Technology and Innovation. The Danish Agency for Science, Technology and Innovation is an institution under the Danish Ministry of Science, Technology and Innovation.

EnergyFlexHouse TEKNOLOGISK INSTITUT

TEKNOLOGISK INSTITUT

Gregersensvej
DK-2630 Taastrup
Tel +45 72 20 20 00
Fax +45 72 20 20 19
info@teknologisk.dk

www.teknologisk.dk
www.dti.dk