Arise

A

ADVANCED RESEARCH ON INNOVATIONS IN SUSTAINABILITY AND ENERGY

MISSION STATEMENT OF ARISE

RESEARCH ON SUSTAINABLE AND ENERGY-EFFICIENT SOLUTIONS FOR BUILT ENVIRONMENTS.

WHY ARISE?

Energy and sustainability are topics that are highly positioned on the present agenda of politics and research funding organizations in the Netherlands and in Europe. Naturally since we don't have a planet B, we all understand why we need to protect our environment, but still though, the deployment of fossil fuels dominates energy provision in our society. This is a context which can't be ignored as a challenge and an opportunity at the same time. Therefore we like to look for alternatives.

This will be a challenge since rapid urbanization will lead to an increasing concentration of people living in cities in the nearby future. By 2050, 89 countries are expected to become more than 80 per cent urban. At present, with 90 per cent urbanization, The Netherlands belongs to the top four of most highly urbanized countriesl in the world.

It is vital to focus on the built environment because this is the place where most of the human activities and related energy consumption takes place. In fact, according to the IEA forty per cent of the global primary energy consumption takes place in the built environment. Moreover, the global energy demand of buildings is projected to grow by an additional 30 per cent by 2035. This is due to various uses of energy. For instance, globally seen, lighting of our built environment represents almost 20 per cent of the global electricity consumption.

Additionally, the transportation sector consumes 20 per cent of the global energy consumption. And space heating and cooling account for over one-third of all energy consumed in buildings, rising to as much as 50 to 60 per cent in cold climates.

Hence, energy efficiency and use of sustainable energy in the built environment will be crucial to achieve the EU-targets for 2020 comprising 20 per cent lower greenhouse gas emissions than 1990, 20 per cent energy from renewables and 20 per cent increase in energy efficiency. These ambitions have become even more important in the framework of the climate conference COP-21, which was successfully completed in 2015 with international commitments to limit global CO_2 emissions to relatively safe levels leading to a global warming of just 2 °C with an aspiration of 1.5 °C.

These goals will only be achievable by a large scale implementation of low emission technologies.

Logically, more sustainable and energy-efficient energy solutions should be locally embedded in an urban context; namely at the location where people live, work and commute. These three aspects: living, working and transportation will be the core directions to the research and educational activities of ARISE which stands for 'Advanced Research on urban Innovations in Sustainability and Energy'.

ARISE's research focuses on the development and adoption of sustainable innovations for energy-efficient smart cities. This is research that results in the best integrated solutions for sustainability and energy-efficiency in the context of products, buildings and local infrastructures that support living, working and transportation in the built environment.

United Nations, Department of Economic and Social Affairs, Population Division, World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352), New York, 2014

International Energy Agency and United Nations Development Programme, Modernising Building Energy Codes, published by OECD/IEA, Paris, 2013

International Energy Agency, Energy Efficiency and Lighting, http://www.iea.org/topics/energyefficiency/subtopics/lighting/, 2016

U.S. Energy Information Administration of U.S. Department of Energy, International Energy Outlook 2013 with Projections to 2040, DOE/IEA-0484, Washington D.C., 2013

International Energy Agency, Technology Roadmap Energy Efficient Building Envelops, published by OECD/IEA, Paris, 2013

European Commission, 2020 Climate & Energy Package, http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm, Brussels, 2016

ARISE'S POSITION WITHIN THE UNIVERSITY OF TWENTE

ARISE is positioned in the Faculty of Engineering Technology of University of Twente where it has a profound basis in science-based engineering and design-driven research. The ARISE research center brings together specialists who focus on translation of findings from fundamental research to applications, who develop methods and tools to find the best integrated solutions and who evaluate existing and new solutions by prototyping, measurements and simulations.

ARISE is embedded in the university-wide program of Science Based Engineering (SBE) and maintains connections with various affiliated groups at University of Twente and elsewhere.

ARISE'S WEBSITE

ARISE's website can be accessed by https://www.utwente.nl/ctw/arise and http://www.arisetogether.nl It contains background information, objectives and the mission statement. It shows members, their experiences, ongoing projects and their publications. Additionally the website has a section with a news feed and interactive global map with ARISE projects in various countries.

ARISE AND STUDENTS

ARISE aims to inspire students regarding sustainability and energy topics by showing examples of past and ongoing projects on the center's website. Students can actively participate in the operation of ARISE by the execution of bachelor and master assignments. The results thereof will become part of the ARISE knowledge base and will be shared with a wider audience by the website.

OBJECTIVES OF ARISE

ARISE's objectives are related to knowledge generation and dissemination, networking and education according to the list of core objectives shown below:

◆ EXECUTION OF RESEARCH, DESIGN AND EDUCATIONAL ACTIVITIES WHICH FIT TO THE MISSION STATEMENT

◆ DISSEMINATION OF ACTIVITIES, RESEARCH RESULTS AND DESIGNS TO A WIDER AUDIENCE

◆ COLLABORATION WITH EXTERNAL PARTIES BY DEVELOPING NEW PROJECTS

◆ CREATION OF A COMMUNITY OF SUSTAINABILITY AND ENERGY SPECIALISTS TO SHARE KNOWLEDGE

◆ REALIZATION OF INTERNATIONAL EXCHANGE WITH STUDENTS AND SPECIALISTS

◆ PARTICIPATION IN EUROPEAN OR NATIONALLY FUNDED PROJECTS

These objectives are achieved by regular meetings with members, a website for external communications, collaborative acquisition of projects, education and student projects.

CESEPS: CO-EVOLUTION OF SMART ENERGY PRODUCTS AND SERVICES
BY ANGELE REINDERS

Research on innovative product-service combinations in smart grid pilots. This project will evaluate how these energy systems can be more responsive to the demands of various stakeholders in terms of performance, costs, reliability, durability and comfort. Therefore this project focuses on interdisciplinary research on stakeholders practices, energy behaviour of users, local trading of energy, customer driven products, demand side management, local production of sustainable electricity, e-mobility and forecasting techniques in the Netherlands and Austria. We will look into more than 10 existing and new smart grid pilots in these two countries. The existing pilots are typically residential smart grid pilots. The novel demonstration projects happen to be in the field of e-vehicles and their charging by solar power, fuel cells and existing means from the grid. The findings will be compared at a transnational level to boost the innovation process across national boundaries. The project is coordinated by the University of Twente and comprises an international collaboration of parties in the Netherlands and Austia comprising TU Delft, Wageningen University, Utrecht University, DNV GL, eseia, TU Graz and Austrian Institute of Technology.

STRATEGIC DECISION MAKING IN THE DEVELOPMENT OF ZERO-ENERGY TRANSFORMATION CONCEPTS

BY JOOP HALMAN

The social housing sector in the Netherlands has set itself the challenging task to transform 100,000 social houses in a timespan of seven years to zero-energy-usage homes. In this context in this project, six social housing associations have taken responsibility to provide homes, whereas each four construction companies have committed to develop their own zero-energy-usage transformation concept. The challenge was to come up with an integral zero-based energy concept that can be implemented on a large scale and assembled in a very short time frame. Until now it is rather unclear which decisions have the highest impact on the eventual successful development and realization of the intended transformation concepts. Therefore, the aim is to analyze in a comparative analysis how the decision making style – intuitive versus rational - influences the intended transformation outcome. In a second study the assembly process of the four competitive transformation concepts were evaluated on their respective potential for timely, efficient and large scale production of the transformation concepts.
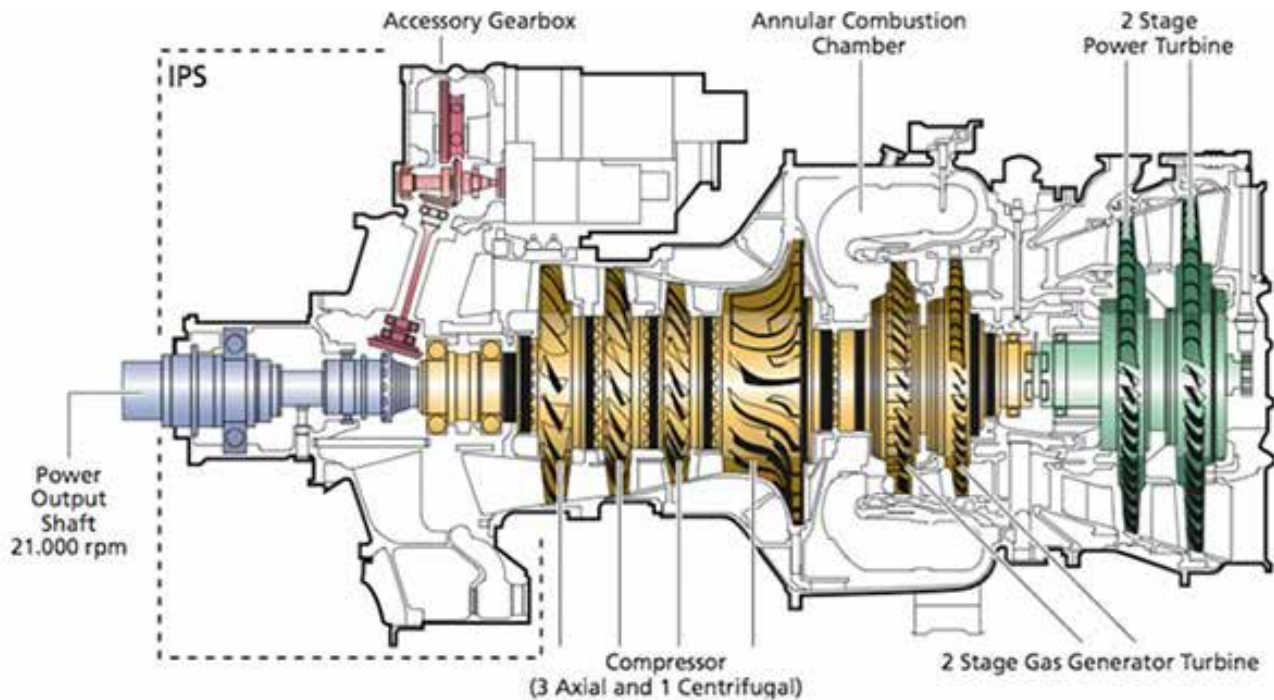
ADOPTION PROCESS OF ENERGY MEASURES IN THE BUILT ENVIRONMENT
BY BRAM ENTROP

The Dutch government has arranged multiple incentives to stimulate the implementation of Energy Techniques and Measures (ETMs) in the built environment. These ETMs lower the energy use and make use of renewable sources. Although the urge is high and the number of available ETMs is large, the rate of implementation is rather low. Within this context, research has been conducted to gain more insights on how the implementation process of these ETMs takes place and can be improved in such a way that national ambitions can be met. In this context, effects of Phase Change Materials (PCMs) in concrete on the energy use of buildings, were evaluated. PCM offer the possibility to store latent heat, like a battery stores electric energy. By applying these PCMs in buildings one can store heat to lower peak temperatures and use this heat for time periods that the surrounding temperature decreases. By this way indoor temperatures can be better balanced during conventional day-night cycles, in which an overload of heat exists during the day and a shortage of heat can be expected during the evening. Four boxes have been developed in which concrete slabs with and without PCMs were monitored for multiple seasons.

IPS

Accessory Gearbox

Annular Combustion Chamber

2 Stage Power Turbine

Power Output Shaft 21.000 rpm

Compressor (3 Axial and 1 Centrifugal)

2 Stage Gas Generator Turbine

COPA-GT PROJECT: COUPLED PARALLEL SIMULATION OF GAS TURBINES
BY JIM KOK

The project COPA-GThas been set up to provide training and research in efficient gas turbine engine (GT) design with the use of massive parallel Computational Fluid Dynamics methods. The project covered 13 PhD students for 3 years and 5 Postdoc researchers for 2 years. What is new and original in this project, is that the research fellows were trained on the integrated engine design, taking into account component performance and interaction, leading to a higher efficiency. In the past however, all training and design was focused on individual components, postponing component interaction till commissioning of the engine, which had led to severe delays and difficulties in changing operating conditions.

## EFFICIENCY IMPROVEMENT OF SEAWATER DESALINATION PROCESSES
BY JOOP HALMAN

The island of Aruba has earned throughout its history an excellent reputation for efficient applications of costly thermal seawater desalination technologies for the production of high quality drinking water. In view of the importance of reliable production and distribution of drinking water, it is of mere importance to continuously seek for improvements to increase the energy efficiency of the costly desalination process. Therefore the Water and Energy plant in Aruba, collaborates with University of Curaçao in this project on conceptual designs for desalination processes. Two patents have been registered for the conceptual designs of a carbon dioxide degassing tower and a hybrid Osmosis Reversed Osmosis desalination process. A conceptual design for an innovative environment friendly chemical free osmotic cleaning process with membranes is in the patent registering process.
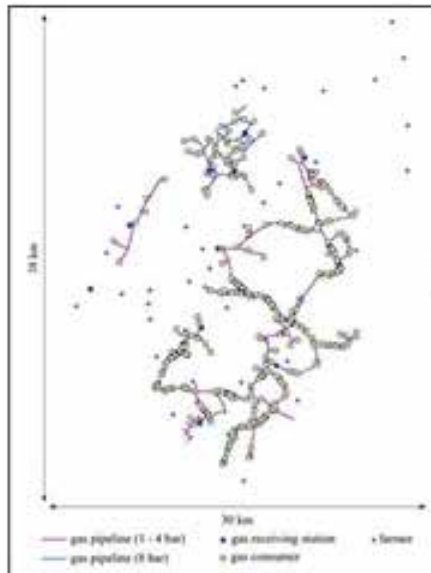
Designer Inputs an existing gas distribution network
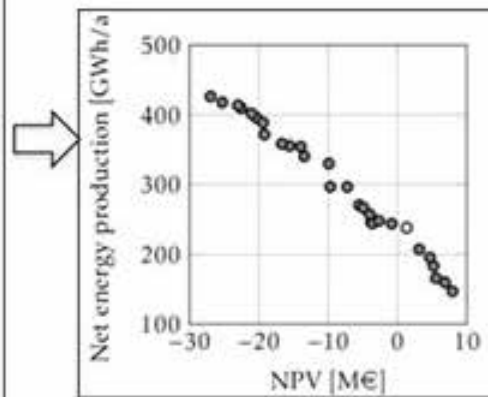
The Synthesis Tool generates pareto front of possible solution
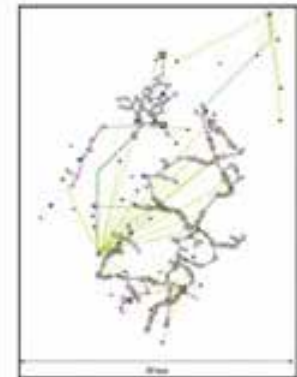
Designer chose solution from solution space

DECISION SUPPORT TOOL FOR LOCAL BIOGAS UTILIZATION
BY JUAN JAUREGUI BECKER

A Decision Support Tool (DST) was developed to aid Distribution Service Operators (DSOs) in their decision making process on which investments to make in the gas distribution grid in order to facilitate the use of biogas. The design time of such systems is reduces by more than 90% by using the new system.

Current: Production   Use   Recycling   Nature / Production
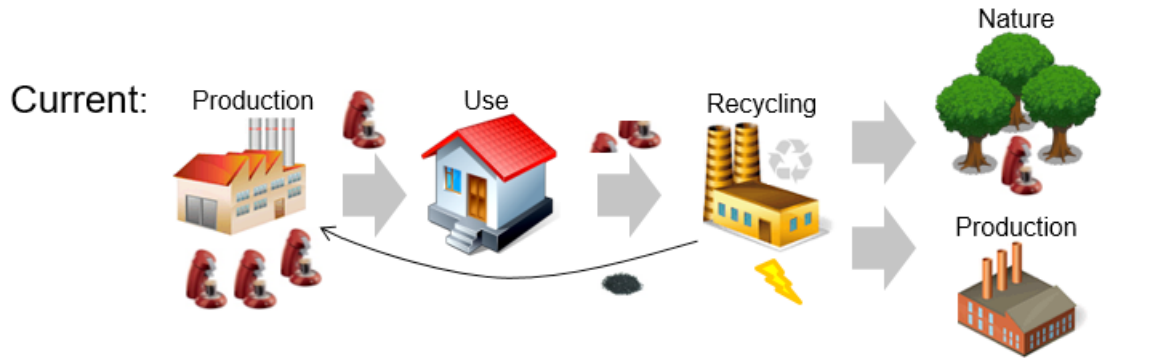
Intended:

Well recyclable products
enable **closed loop recycling**.

Production   Use   Recycling
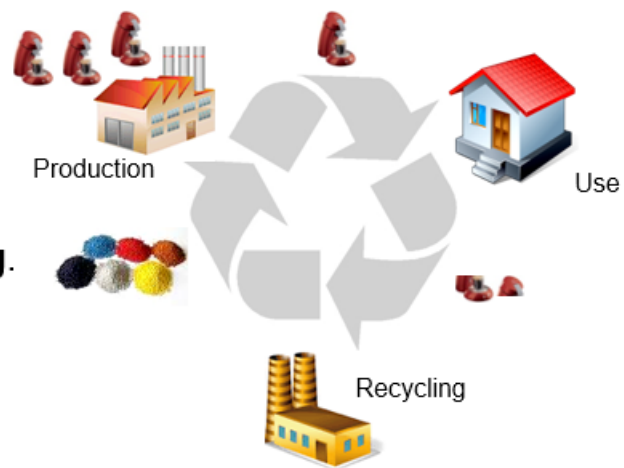
DESIGN FOR RECYCLABILITY GUIDELINES
BY MARTEN TOXOPEUS

These guidelines which stimulate recyclability interaction between recyclers and product developers were developed in a project which was executed for a large consumer electronics manufacturer. The guidelines aim to assist product developers, who are already in the conceptual design stage, with their decisions on recyclability.

JOINT DEVELOPMENT OF A KNOWLEDGE CENTRE ON SOLAR ENERGY

BY ANGELE REINDERS

This project comprised the development of a curriculum on solar energy at ITB in Indonesia, the realization of 32.4 kWp pilot PV system in Papua, research on renewable energy in Indonesia and the organization of several conferences. The research and educational activities were a collaboration with WWF-Indonesia, Institut Teknologi Bandung and several other universities and Indonesian companies.

Commissioned by INDF Facility, 2011-2014.

THE CONVENTIONAL SOLAR ENERGY COLLECTING ROOF

30-40°

A colorful leaf shaped roof tile collecting energy with LSC technology

The whole surface collects solar energy from any angle, directing it to the PV

A relatively small PV to produce electricity

▶ The roof has to be positioned to the south

THE LEAF ROOF

▶ The roof can be positioned in all directions

LEAF ROOF
BY ANGELE REINDERS

In the Leaf Roof project, luminescent solar concentrating (LSC) PV elements for building integration have been developed.
The project comprises ray-tracing simulations, selection of appropriate dyes for the LSC and design and testing of the roof tiles.
This project is a collaboration between UT and TU Eindhoven.

Commissioned by 3TU.Bouw, 2015-2016.
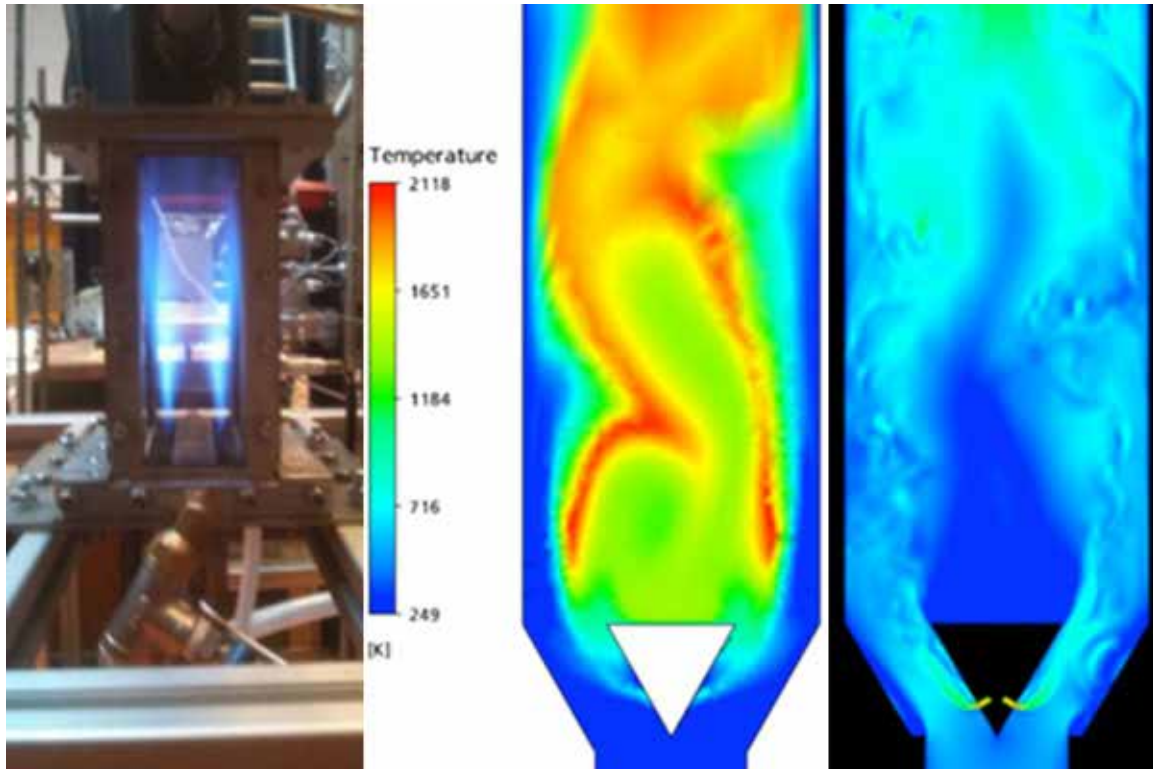
LIMOUSINE: LIMIT CYCLES OF THERMO-ACOUSTIC OSCILLATIONS IN GAS TURBINE COMBUSTORS

BY JIM KOK

Limousine represents a multidisciplinary initiative to strengthen the fundamental scientific work in the field of thermo-acoustic instabilities in combustion systems, and is motivated by the need for lean combustion technologies with higher effiency and reduced greenhouse gas emissions. The network comprised 12 partner institutions across Europe: 5 academic partners, 2 research institutions and 5 industrial partners. The research in Limousine focused on the limit cycle behaviour of the unstable pressure oscillations in gas turbines, and on the resulting mechanical vibrations and materials fatigue.
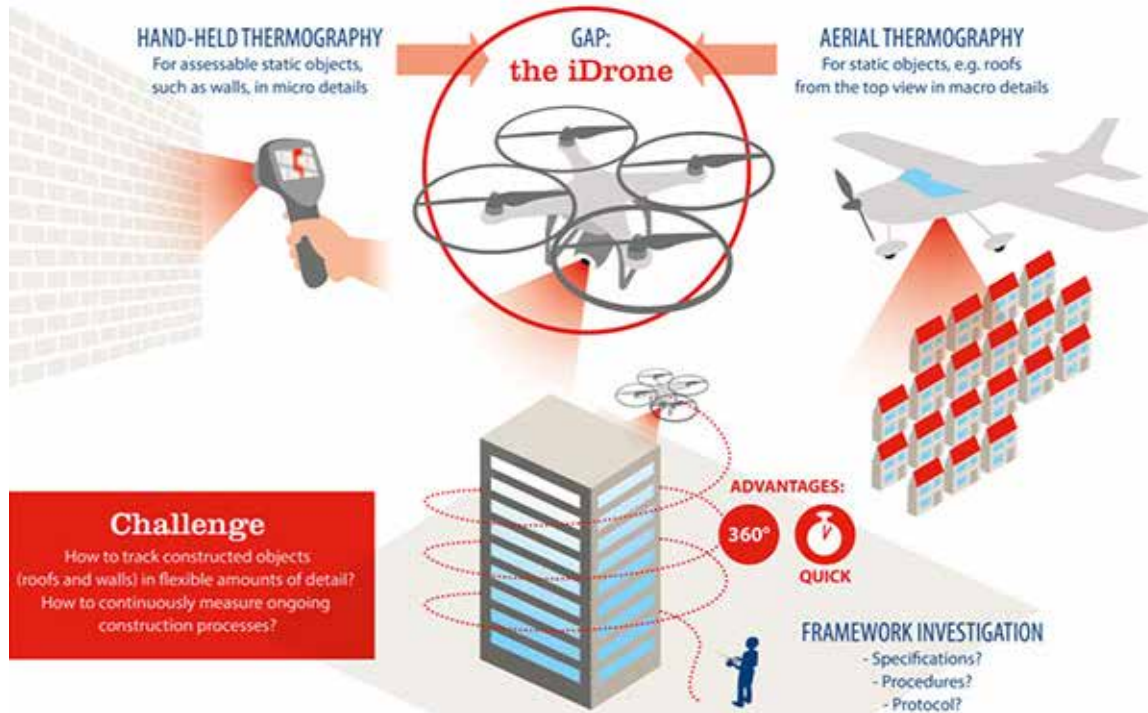
THROW IN THE IDRONE
BY BRAM ENTROP

In the last years, numerous applications for drones have been discovered in all kind of work fields. In the construction sector however the possibilities that drones can provide are not sufficiently used at the moment. Drones provide the possibility to get to places that were traditionally difficult to reach. Therefore in the "Throw in the iDrone" project, the feasibility of drones is evaluated. In particular the attention goes to drones equipped with an infrared camera for evaluations of thermal emissions by roofs.

Commissioned by 3TU.Bouw, 2015-2016.

PRODUCT CO-CREATION CENTERS (PC3)

BY JUAN JAUREGUI BECKER

Product Co-creation Centers, or PC3, is a multidisciplinary project on the development of an economically-sustainable and scalable model to boost development of small enterprises in the Base of the Pyramid (BoP) markets. More concrete, the PC3 project researchers how to stimulate BoP businessmen to undergo the processes of opportunity recognition and conceptual product development, both guided by business development methodologies for start-ups. One of the current implementations of PC3s is carried out in a medium size town in rural Colombia.

Commissioned by the University of Twente, 2011-Present.

SELECTED PUBLICATIONS BY ARISE MEMBERS

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SELECTED COURSES BY ARISE MEMBERS

ARISE members teach about sustainability, innovation and energy in the following master programs of University of Twente: Civil Engineering, Construction Management & Engineering, Industrial Design Engineering, Mechanical Engineering and Sustainable Energy Technology.

A selection of master courses comprises among others: Advanced Thermodynamics, Functional Design of Constructions, Industrialization and Innovation in Construction, Innovation and Risk Management Life Cycle Strategies, Product Design, Product Life Cycles, Public Transport, Rail Transport, Solar Energy, Sources of Innovation and Transport in Turbulent Chemically Reacting Flows.

For information and details about these courses we refer to the course catalogue of University of Twente, OSIRIS, which can be accessed by https://osiris.utwente.nl/student/OnderwijsCatalogus.do

UNIVERSITY OF TWENTE.