

# **PRESS KIT**

**ROSKILDE FESTIVAL 2016**

**POWERED BY DTU STUDENTS**



## 100 DTU students engineer solutions for Roskilde Festival

During one week every year, Roskilde Festival is the fourth largest city in Denmark—with 130,000 inhabitants. Precisely because this city is built up and packed away in a very short amount of time, there is a wide range of engineering challenges. For example, how to ensure that the waste produced is disposed of in the most sustainable way, or how to reduce electricity consumption.

In order to meet these challenges Roskilde Festival has collaborated with DTU students since 2010 to create an even better and more sustainable festival.

This year, about 100 students will work on a wide range of projects. This means that festival-goers will encounter DTU workshops in the camping area during the warm-up days. When the festival grounds open, they also have the opportunity to visit DTU's TechLab where students present their projects.

During the warm-up days, there will be **workshops in the camping area.**

**Sunday:** ChillCan & Soap fun // **Monday:** Mould workshop & Speakers // **Tuesday:** Soap fun & ChillCan // **Wednesday:** Speakers

From Wednesday afternoon, **DTU's TechLab** is the place to meet the students. TechLab is situated between the Avalon and Orange stages by Trade Zone West (map on the last page).

Open Wednesday 17-21 and Thursday-Saturday 12-20.

DTU's journalists are present throughout the festival and can be contacted for further information about the projects and workshops:

- Tore Vind Jensen, 3026 7710 / [tovi@adm.dtu.dk](mailto:tovi@adm.dtu.dk)
- Henrik Larsen, 2020 9523 / [hkln@adm.dtu.dk](mailto:hkln@adm.dtu.dk)

For information about the collaboration between Roskilde Festival and DTU, please contact one of DTU's journalists or Roskilde Festival's press service: 3010 8281 / [press@roskilde-festival.dk](mailto:press@roskilde-festival.dk)

### A few facts on the Roskilde Festival-DTU collaboration:

- In 2010, Roskilde Festival and DTU made a formal agreement to use the festival as a laboratory for innovative engineering solutions to the festival's challenges.
- Students earn five ECTS points during the project-period.
- Start-up companies from DTU like Volt, DropBucket, Kubio, and PeeFence were established after being tested at Roskilde Festival.

## ChillCan (workshop)

The project is a continuation of a project we did last year at Roskilde Festival. It is a workshop where participants will have the opportunity to build their own cooler that works exclusively using vaporization. The design consists basically of a metal container with foam around it. The foam is dampened and cools the container as the water evaporates.

The cooler is made of simple materials, so that participants can relatively easily and quickly build their own and bring it home to their camp.

Based on the experiences of last year's workshop, we have decided to change the design a bit, so the cooler is a little easier to build, while more robust and thus more "festival friendly".

The project allows us to have a good dialogue on science education, while helping workshop participants making the cooler. It is also a good opportunity to test the product and collect feedback on the functionality of the cooler afterwards.

For the participants, it is a great opportunity to build their own cooler, which they of course get for free.

*Workshops: Sunday 12-16 @ camping C // Tuesday 14-18 @ Campin G // Thursday 12-16 @ TechLab*



## Soap fun (workshop)

At Roskilde Festival, many people live closely together at the camping area. It may be hard to keep good hygiene when eating, drinking, and going to the toilet many times a day in those surroundings. Some use the taps after using the toilet, and some use hand sanitizer, but to effectively get rid of the bacteria before enjoying your next meal, soap is a necessity.

Many of the festival-goers may not know why soap is so important if they want to stay clean – and avoid getting sick.

Therefore, we invite all to join our workshop and make their own soap. Here, they can learn how soap is made and reacts in relation to the bacteria. During the festival, three workshops will be held, and the participants get a 100 ml container of their own soap to use for the rest of the festival.

It will also be possible to test and play with different kinds of soap bubbles of different patterns and sizes made out of steel wire.

*Workshops: Sunday afternoon @ camping C // Tuesday morning @ camping H // Friday 15-17 @TechLab*



## Speakers (workshop)

The one thing that brings all the guests of Roskilde Festival together is listening to good music. Our idea is to activate the campers of Roskilde Festival by giving them a chance to listen to music by designing their own speakers.

We will challenge them to think outside of the box and find out what shape, frame, and material give the best quality and the loudest sound. After the campers have found a feasible solution, they can keep their speaker.

Waste is an endless problem at every festival. Our goal is therefore to include the waste in our project and turn it into something fun. We will challenge the participants to dig deep and find the best waste and turn it into a working speaker that magnifies the sound from their mobile phone in the best way possible.

This idea couples different aspects of engineering: Basic physics, acoustics, materials science, and vibration science.

We will have tools and fabric to support the mobile phones, and we will assist the campers through the process of building their own speakers.

*Workshops: Monday 12 @ camping C // Wednesday 14 between camping L/N*



## Mould is beautiful (workshop)

We would like to see what types of moulds and yeasts are present in the camping area and then see if there is a health benefit of living in a 'clean' area such as Clean out Loud compared to the 'normal' camping areas. We expect to see a difference in the amount of fungal spores and the aim of the project is therefore to make the festival-goers aware that it is a good idea to keep camps and tents clean throughout the week.

We hope to be able to engage people and create an interest for microorganisms like fungi, by showing them how fungi appear, what they can and where they are, even when you cannot see them. Therefore, we will ask festival-goers to collect samples in their tents and camps, and show them how much fungus can grow in just a single week.

On the sampling day (Monday), we will walk around the camping areas with a handcart decorated with pictures and exciting knowledge about fungi. We will bring agar plates which we will issue to the participants who are then told how to perform the test, so they can be used for real scientific studies.

It is important to us that we also show how exciting and usable moulds and yeasts can be by providing information on both positive and negative characteristics of fungi. On Saturday, we are hosting a contest where you can vote for the best looking sample.

*Workshops: Monday all day @ camping G, H, E, J // Saturday 12-20 @ TechLab*



## Music instruments (workshop)

Our project is a workshop where festival-goers can create and play instruments. We will have materials available for building instruments as well as some large configurations that can be modified and played on.

We'll also have a video contest to motivate people and get them to showcase what they have done.

Instruments to be built by festival-goers:

- Whistles from vegetables or recycled metal rods
- Trumpets consisting of 3D-printed mouthpieces, a garden hose, and a funnel at the end
- Percussion instrument of PVC pipe
- Cigar box guitars / electric guitars
- Small speakers and amplifiers
- Electric guitar effects pedal
- A bass made of a bucket / tub, a stick, and a piece of string.

Larger installations visitors can play with:

- Drumkit: A microcontroller is connected to various fruits and the microcontroller signals to a computer that plays the music/sounds of a plant
- SoundScape: People get an electrically conductive wrist strap, and controls the music by touching metal bars while they modulate the sound by moving their hand over a distance meter.
- Spectrogram showing a 3D image of the sound
- Cajón (box drum).



## TrackSafe

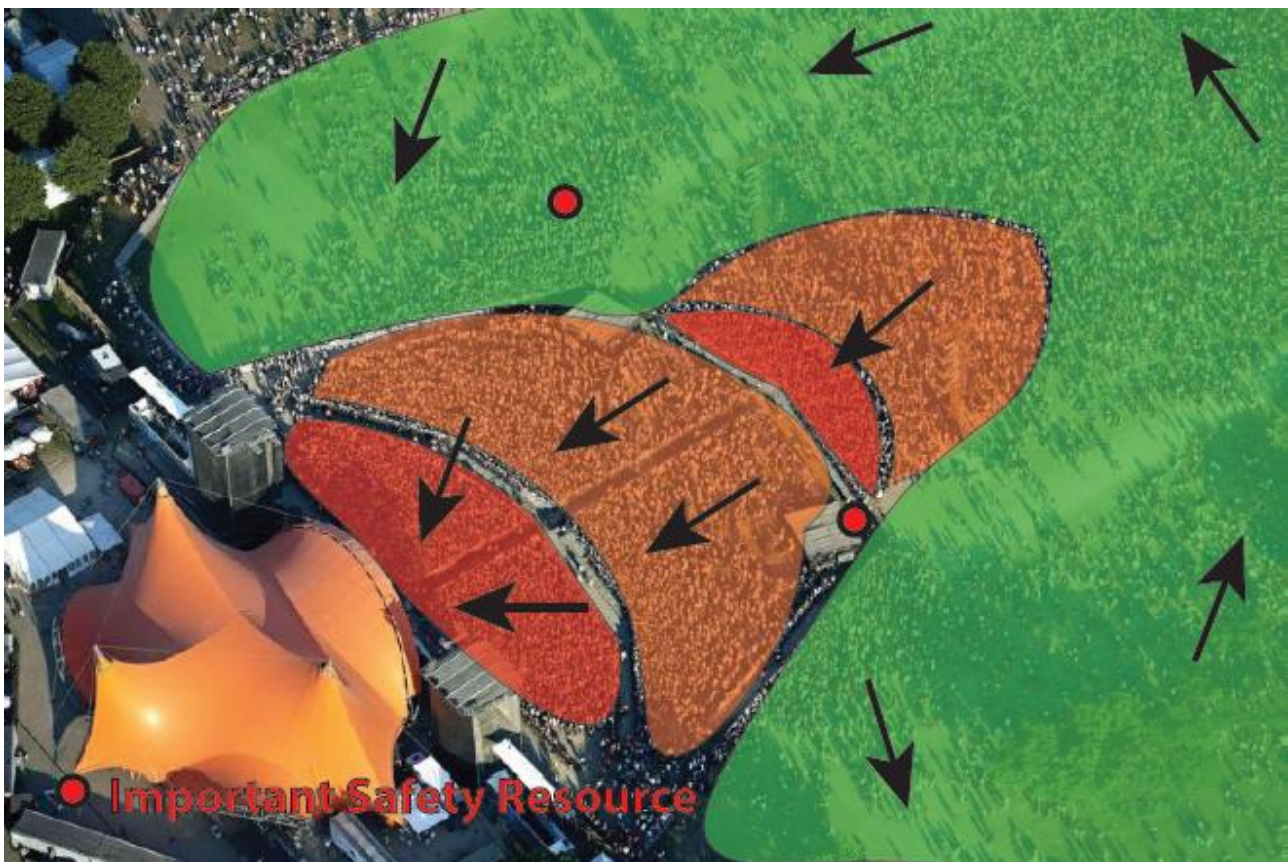
TrackSafe utilizes Wi-Fi signals from devices such as mobile phones, combined with strategically placed sensors in areas near a crowd. Combining information on radio signal strengths—gathered by several sensors—TrackSafe is able to estimate a position. Therefore, using a number of unique devices within a given area gives an indication of the crowd density. The position is tracked over time and enables the system to derive a direction of movement in the crowd.

Information about festival guests and their positions in real-time can be used to measure waiting lines in front of the different food shops, distribute resources based on people behaviour, and crowd safety supervisors can monitor people density.

At Roskilde Festival 2016 we are helping Food Court by providing location analytics based on position tracking of festival guests inside the Food Court. This information helps the vendors estimate visitor behaviour during the day, to identify periods with few visitors as well as rush hours. This can help optimizing food production and potentially eliminate waste.

A Wi-Fi signal receiver is constructed using a small Raspberry Pi computer and a Wi-Fi module. The sensors only listen for Wi-Fi devices in monitor mode, which do not require any action of the device owner. Using a newly developed algorithm enables this system to fully comply with the European Data Protection law.

*Showcase: Saturday 18-20 @ TechLab*





## Music Cubes

The music cubes combine play and technology through interaction with music instruments. By rolling the large music cubes to another side, the sound effects of the instruments changes and the player can create his own version of the song playing.

Microcontrollers are placed within the cubes and detect the changes in orientation of the cubes, and send the information to a tablet that plays the song. The cubes and the tablet communicate over Bluetooth.

The music cubes will add to the playful and fun atmosphere at Roskilde by driving the festival guests to a state of play. The cubes will enable five to six guests to become DJs while playing and rolling the cubes around.

*Showcase: Thursday, Friday, Saturday 14.30-17 @ TechLab*



## Catch the gel

Hand hygiene is a widespread problem at the Roskilde Festival. The festival-goers do not spend much time washing their hands before meals or after they have been to the toilet.

Our solution is to gamify the use of hand sanitizer by having a reaction based game at the food stalls. The idea is that the game encourages festival-goers to clean their hands through the game and thus increase hand hygiene at the Roskilde Festival. In this way, waiting in the queue becomes an opportunity to have fun.

The source of poor hand hygiene is often the toilet, but it has been estimated that the cleaning of festival-goers' hands has the greatest impact at the food stalls, since it is here that diseases are transmitted orally.

The player must place his hands on either side of the large circle and when the player's hands are registered the game begins. All lamps and LED starts flashing red and suddenly 'GO' flashes green. The player must now follow the circle with diodes down along the edge. The hand sanitizer is released when the player's hands is at the bottom of the circle. The player receives the hand sanitizer and can now clean his hands. Players are rated on a scale of animals from turtle to a cheetah, and can thus compete against their friends in the queue.

The project is a test of how to motivate festival-goers to increase hygiene at Roskilde Festival. The aim is to gain insight into how games and play can be implemented in a festival atmosphere as a way to alter the behaviour of the guests.

*Showcase: Wednesday – Saturday @ TechLab*



## TalkBox

Roskilde Festival is associated with high volume levels, parties, colours and ringing in the ears when the music's over. At the same time, the festival is also a platform for new social relations and the meeting between people with different backgrounds. At the festival site it can be hard to find refuge from the sound, and we would like to do something about that.

Through small, stationary TalkBoxes spread out over the festival grounds, we will provide an oasis in the sound space and create a room for conversation. First, we would like to create a place to have a conversation without hassle, but at the same time we will also create a different experience of sound and space.

Our idea is to put up closed 'installations'—in the manner of a diving bell—where you duck to enter a space where the sound levels are reduced. The installations will have room for two people. The dome is constructed as a dodecahedron with some faces taken out, to form the hole in the bottom. It is then hung in a box made of galvanized plumbing pipes, giving it a floating appearance.

Before and during the Roskilde Festival, we will make measurements of the noise reduction obtained, and make traffic flow counts for selected time intervals and flow analysis around the installation.



# Roskilde Festival +1

Most festival-goers have tried to miss a concert they really would have liked to experience. Often because no one in the camp wanted to see the same concert.

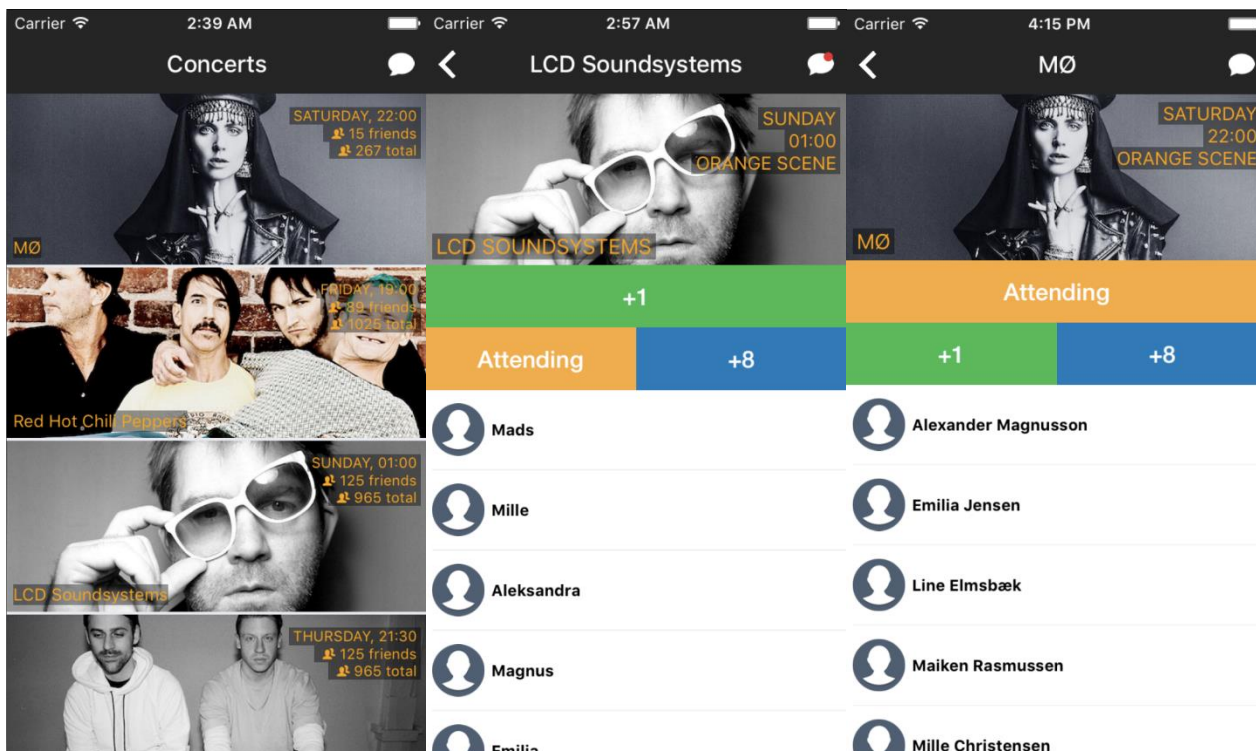
Roskilde Festival +1 is a mobile application that aims to make it easy for festival-goers to find other festival-goers who want to experience the same concert. The Roskilde Festival +1 app can help ensure that you experience all the concerts of your interests, while meeting new people, and avoid attending the show on your own.

The app has a list of the music programme, where you then have the option of selecting a concert and search for a festival-goer to be your partner or maybe even your date. Once you have found a partner, you can agree on where and when you meet. All that's left from then on is to enjoy the concert and each other's company.

Roskilde Festival +1 platform offers a social network that integrates Facebook accounts and connects people based on their taste in music and the concerts they want to see. Users of the platform make their interest in going to a concert known, and this allows you to see which Facebook friends have shown interest in the same concert. There will also be an opportunity to get in touch with other, yet unknown, festival-goers and coordinate venue and time.

Platforms: iOS/Android // [Rfplusone.dk](http://Rfplusone.dk)

Showcase: Friday 18-20 @ TechLab

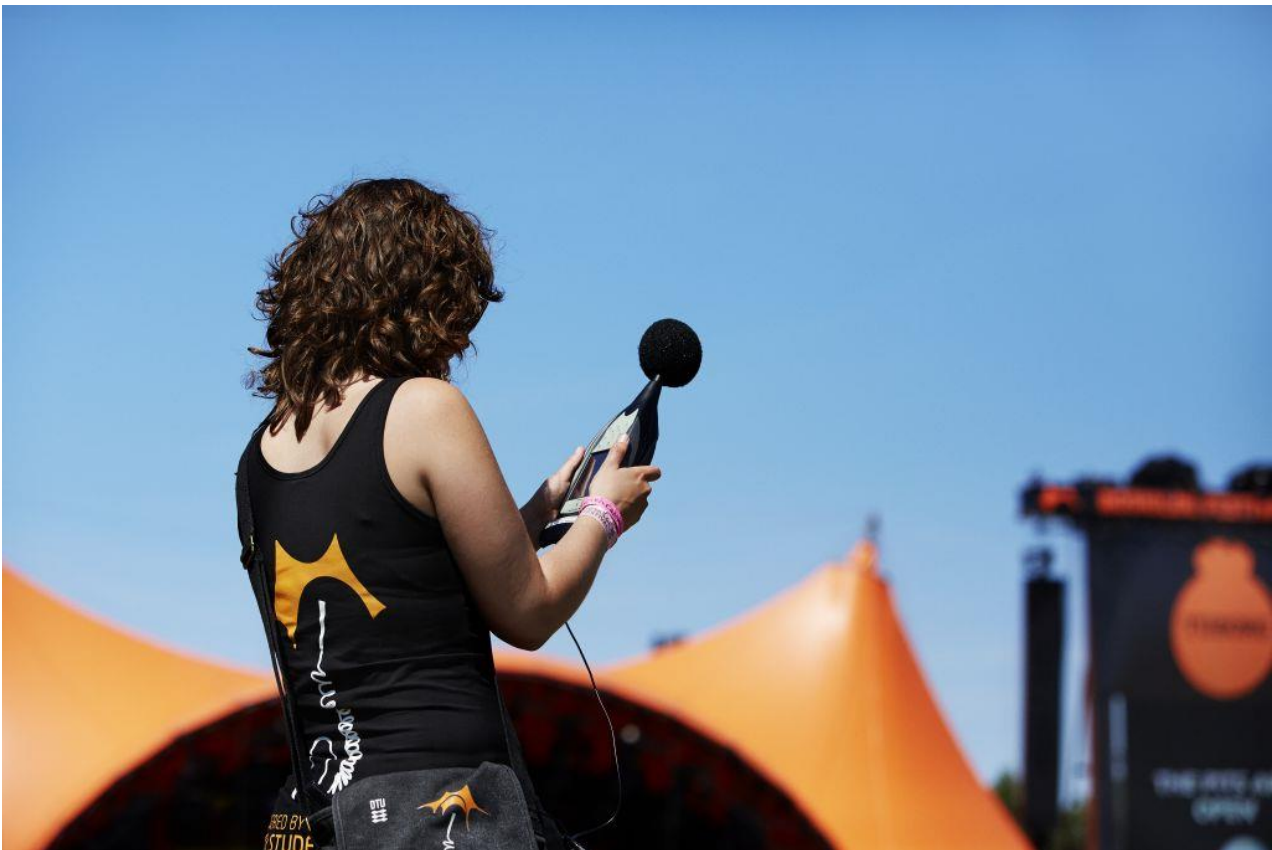


## Improving acoustic conditions between Orange and Pavilion

Occasionally, there is an overlap of sound from two stages, where the audience at one stage is bothered by music from another nearby stage. This is especially a challenge, when loud music is played at Orange, while there is an acoustic concert at Pavilion.

A number of measurements of the sound levels between Orange and Pavilion will be carried out during the festival, in order to establish the current impact on the listening experience between the two stages. The measurements will be used for developing a mathematical model of the acoustical conditions between the two stages, which in turn can be used to simulate different scenarios during the festival, as well as solutions to remedy adverse acoustics.

In the future, such a model can be useful for the Roskilde Festival to guide scheduling of bands, ad hoc corrections of unfavourable sound levels, and adjustments of physical conditions, to ultimately offer a better concert experience to audiences.



## Acoustics of Avalon

A new tent was set up over the Avalon stage this year. Various acoustic parameters of the stage and of the space around it will be measured and evaluated, while taking into account the specific sound system installation and the type of the music that is expected to be performed. A computer model will be used to investigate suggestions that would improve the acoustics of the stage.

A detailed stage mapping of the various acoustic parameters will be produced. The suitability of the stage for music performances will be assessed by comparing the parameters collected with industry standards. Subjective judgements of the group members' experiences will also be taken into account. Suggestions to improve the acoustics will be made and their impact will be investigated.

Roskilde Festival will acquire a detailed analysis of the acoustics of the stage and a well-founded assessment of its suitability for the intended music performances. The Festival will further receive suggestions aimed to improve the acoustics of the stage. These suggestions can be implemented at Avalon or taken into account as good practices on future builds or rebuilds of other stages.



## Dust abatement

We want to enable effective dust abatement at Roskilde Festival in order to reduce the nuisance for the festival guests in connection with the so-called urine dust. The concept behind the project can be divided into three aspects: prognosis, snapshot, and watering estimate.

With a forecast, we want to provide the ability to predict when unwanted dust levels will occur so that the festival can fight the dust before it becomes a significant problem. With a snapshot, we want to provide the ability in real time to see how the dust levels look at the entire festival site. With an irrigation estimate we want to offer guidance on how much water should be sprayed to achieve optimal use of these resources.

These three aspects are obtained by suspending small battery-powered boxes with sensors around the festival site, which measures the amount of dust in the air, temperature, humidity and ammonia in the air. From these parameters we want to create the data basis for making the above tools.

We will place eight small sensor boxes in camping areas L and N, and by City Centre East. In the future they will have to cover the entire camping area.

The measurements are continually uploaded to an online server, so that the data can be monitored and used in real time. In addition to the data for the dust abatement project, the sensor boxes will also measure other environmental parameters such as noise, which can be used in other projects within the same subject.

By using dust forecast, snapshot, and watering estimate in daily operations at Roskilde Festival, we expect the festival to save time and resources and to reduce the problem of so-called urine dust for the festival guests.

*Showcase: Friday 17-19 @ TechLab*



## ButtBox

At Roskilde Festival, around 1,800 tons of waste is produced each year. This substantial amount provides a waste management challenge and puts a strain on the environment. Every year, many volunteers spend days during the festival and months after collecting waste. Some of the most time-consuming waste to collect are small pieces such as glass fragments, bottle lids, and cigarette butts. We wish to address the collection of cigarette butts. Our ButtBox (*SkodBox* in Danish) project can prevent a lot of cigarette butts from ending up on the ground.

The primary goal of our project is to reduce the amount of time spent collecting cigarette butts in order to spend that time collecting other waste fractions such as hazardous waste (PVC air mattresses, car batteries etc.). Another goal for the project is to address the mindset and behaviour of the guests of the individual camps regarding the importance of collecting waste no matter its size and quantity.

The ButtBox is made from an empty 2-litre plastic bottle with a hole in one side (Ø 5 cm) and sand or water in the bottom, so it works as a big hanging ash tray. The ButtBox is decorated for motivation.

We believe that it is important to address the issue of waste production continuously. This approach has the potential to reduce the amount of waste produced throughout the festival based on the theory that less visible waste on the ground leads to less waste production. Furthermore, the solution is cheap and easy to implement in more camps, for example through workshops in TechLab during the first days of the festival.





## Veggie food

These days, more and more people are promoting a vegetarian diet for different reasons. One of the main factors is that producing meat is very unsustainable due to the fact that it has a very large water and carbon dioxide footprint.

Roskilde Festival has made sure that multiple vegetarian or vegan food stalls are present at the festival. This report will investigate the organic waste produced by such stalls and compare it to a "normal" food stall, where meat is cooked and sold. The goal of this investigation is to determine which type of food stall is more sustainable through the quantity and different types of waste produced. Additionally, this report will try to estimate the total volume of organic waste produced by food stalls at the festival and present a solution for managing this waste.

For this investigation, a total of four food stalls (two vegetarian, two 'normal') will be selected. The organic waste produced at each food stall will be sampled at pre-determined times throughout the week of the festival. This waste will then be quantified and sorted into different categories. A comparison will then be made, looking into the difference of the organic waste produced by one food stall compared to another. Finally, through extrapolation, the total amount of organic waste generated by the festival will be estimated and possible waste management solutions will be investigated.

This investigation will determine whether vegetarian food stalls produce less waste and are more sustainable. If the results are positive, Roskilde Festival could try to promote vegetarian food stalls instead of traditional ones in order to diminish the amount of organic waste produced as well as to reduce its overall environmental footprint.



## Love in a trashcan

Large recreational events such as Roskilde Festival require a trash removal and recycling system that can maintain efficiency in dense and rapid waste producing environments. Waste management in these environments needs to be persuasive in its interaction with festival-goers and versatile in its ability to target changing types of garbage.

Our project will look at developing a new, robust, appealing, and efficient method of waste collection and disposal. The idea is to vary the fractions that are collected during the festival as a function of time, so as to maximise successful collection and recycling of these different fractions.

The fractions will be split into cardboard, metal, general waste, and bottles. Bottles as a fraction will include glass and plastic. We believe that by doing this, it will give festival-goers a clear and simpler idea of how to sort their waste, which will facilitate the recycling process. We will be implementing waste collection stations. These stations will be composed of three, highly durable plastic bins.

Signs will be placed above and behind the bins and will have a two-fold purpose. To clearly inform the festivals-goers of which waste goes where, and to act as a 'backboard', making sure that 'over-shot' waste rebounds off the sign and into the bin.

The hope is that this concept will help change the culture of waste disposal at Roskilde Festival, by establishing a robust, easy-to-use, and appealing system for waste collection, as well as helping initiate the reuse and recycling process.



## Efficient glass waste collection

Every year, Roskilde Festival attracts a huge crowd of music lovers who do not always give high priority to participating in waste management. This leads to large amounts of waste piling up, including large volumes of glass waste. As people are in a festive spirit, it is an uphill task to convince them to participate actively in proper waste disposal. Therefore, it becomes important to formulate methods to subconsciously tackle the wasteful tendency of the festival-goers.

One of the ways to achieve this is through stimulation by visual means of communication. People are more likely to retain and learn information presented to them visually than any other sensory stimulus. Further, visuals are processed much faster than text and have an effect on our emotions and decision-making. This aspect of human psychology can be exploited to our advantage in order to tackle this issue. The project aims to create visual engagement through the implementation of two models at the festival.

### Garbage monster

The bins can be decorated in the shape of a 'garbage monster' which 'eats' bottled glasses. This can attract people to 'feed' the garbage monster with their empty glass bottles and can add positively to our goal of managing glass waste.



### Lighted glass bottle display

Used and empty glass bottles can be used creatively by spraying them with a 'glow in the dark' paint or by LED light. This could be done around the trash stations which are specifically designed for glass waste disposal, adding to their appeal—especially during night—motivating the festival participants to dispose their waste as a stimulus.



The above-mentioned concept and design can help us drawing comparisons between three classes of glass waste management at the festival: garbage stations where the 'garbage monster' design model was implemented; garbage stations where the 'lighted glass bottle display' design model was implemented and garbage stations where none of the above-mentioned models were implemented.

The comparisons made from the above results can be used statistically and analytically to suggest if the implementation had a positive impact on solving the issue that we are tackling and could help in ascertaining the efficacy of implementing it for the future. Positive results in this regard may prompt the Roskilde waste management team to implement it on a broader scale in future festivals.

## Green light installation

With 130,000 people each year visiting the Roskilde Festival, the festival is—albeit only for a week—Denmark’s fourth-largest city. To provide a festival of this size with electricity creates complex challenges.

This project is an attempt to create a green and sustainable solution for a lighting installation that can entertain the festival-goers while being independent of the power mains. The power source for this installation is solar energy.

Solar cell efficiency, however, is non-linear. So we’ve developed a system that functions much like normal household solar cells: Harvesting energy from the sun during the day and storing it in a battery that runs the installation at night. The efficiency of this system can be increased by implementing Maximum Power Point Tracking (MPPT). The purpose of the MPPT is to adjust the voltage of the solar cell so that the operating point is as close to the point of maximum power point as possible.

The purpose of the installation is to put focus on solar energy and rational use of light. This is done through a quiet, but engaging tale of the genesis of energy in the tower through the day and later distribution to the light poles that light up during the night. The design is inspired by the relationship between the substation and the utility pole.



## Portable speaker

This project aims to develop a wireless speaker system for presentation DTU projects. The speaker system incorporates a commercially available wireless microphone system and a custom-made cabinet designed to best reproduce speech.

This subsystem consists generally of a small portable transmitter and a stationary receiver. On the transmitter, a headset is mounted so that the person who presents a project has both hands free during the presentation.

The recipient's primary function is to receive wireless audio signal from the transmitter, but it also has a built-in preamplifier that allows volume adjustments directly on the receiver. The power amplifier uses Class D technology, resulting in a high efficiency, and thus reduces the systems overall power consumption and extends the battery life.

The system is implemented in two parts; the first of which is for the electronics. The second part of the box which comprises the speaker cabinet is designed specifically for the four full-range drivers, and to reproduce speech. In addition, the speaker must be mounted on box-belts, so it can be worn as a backpack, and it must be relatively light weight, so it can be carried for a few hours at a time.

*Showcase: Saturday 14-16 @TechLab*



## Analysis of power consumption

In recent years, Roskilde Festival has focused on sustainability, including electricity consumption. The stalls at Roskilde consume a great deal of energy and it is in the festival's interest to motivate them to lower their consumption.

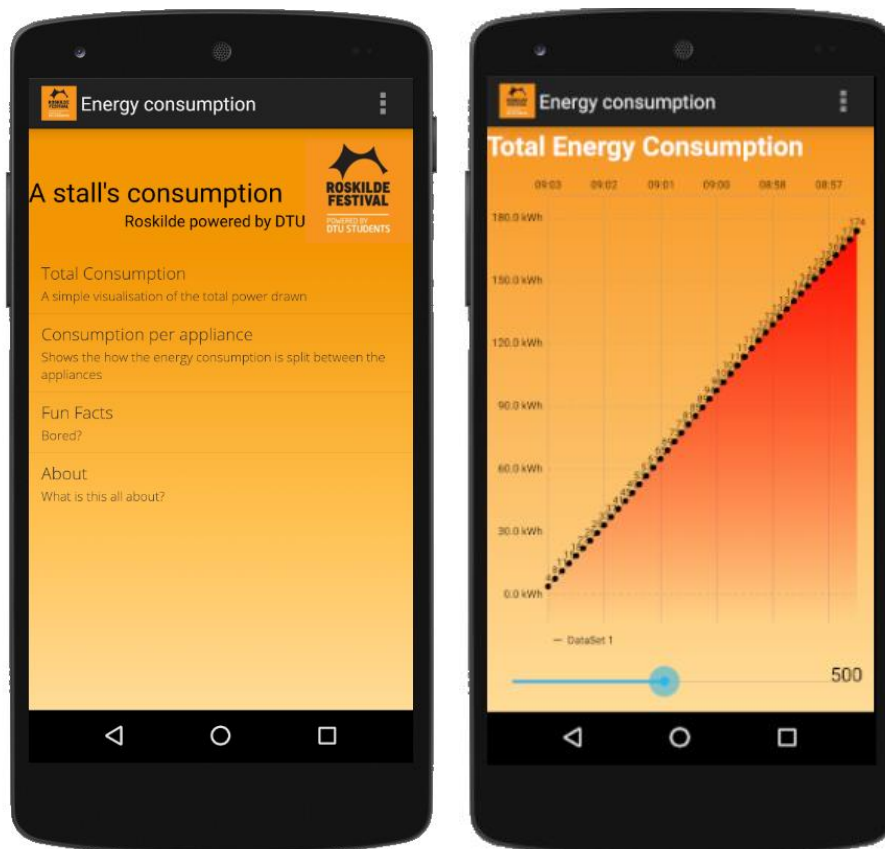
But in the current setup, this is measured only at major hubs and it is difficult to assess consumption in each of the stalls. Therefore, it is interesting to collect data for electricity consumption further down in the system in order to gain an overview of where energy is being consumed.

The concept of this project measure a stall's components, partly in an attempt to visualize how energy is consumed, partly to provide a basis for generating ideas for reducing consumption.

The basic idea is to create an app that can be downloaded by the stall staff (or by the inquisitive consumer). The app will give an overview of the consumption in a way that enables ordinary people to relate to measurements. The app will indicate the peak consumption and save today's trends, so the stall owners are aware of peak-loads and when they could potentially turn down their use of electricity.

Finally, the data can be used to analyse the current pay model and make suggestions for changes that would help the festival achieve their goal of reducing electricity consumption.

*Showcase: Thursday 18-20 @TechLab*

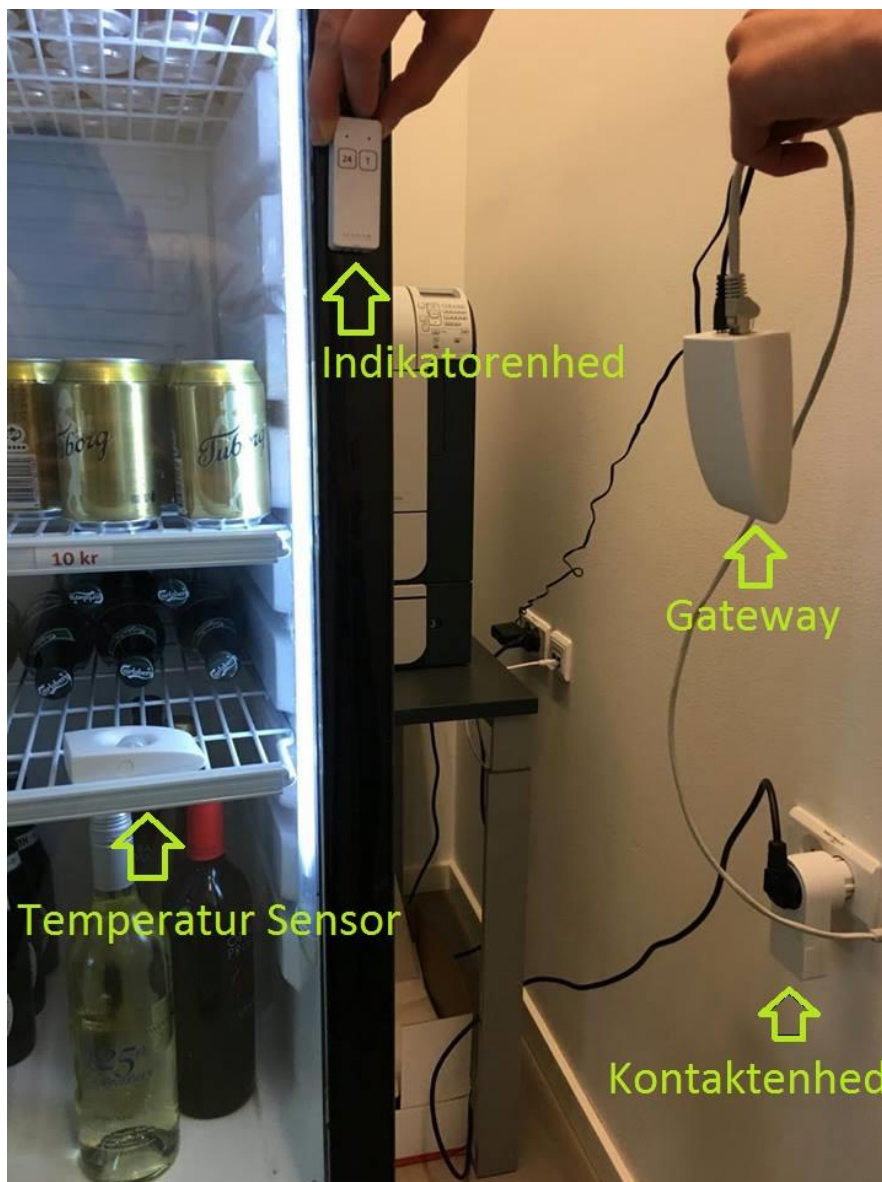


## Fridge control

The project aims to equalize power consumption and lower the maximum power demand at Roskilde Festival. We focus on the power consumption of refrigerators. At present, Roskilde Festival has to use a lot of generators when there is a high load, e.g. for large concerts. A way to even out the power consumption could lower the peak load.

To this end, we use equipment that is able to measure the temperature in fridges and turn them on (when demand is high) and off (when demand is low)—as well as being connected to the internet to monitor the refrigerator data. All this must be adapted to the users who have different foodstuff and beverages to be stored at different temperatures.

The ultimate goal is that most refrigerators at Roskilde Festival have this system installed and thereby lower the maximum power consumption. In this way, it would be possible to reduce the number of generators in use at the festival.



## Power grid mapping

Music festivals such as Roskilde Festival require installation of a short-term electric grid. The consumers—which include food stalls and small marketplaces—often have very limited knowledge about their power consumption. Therefore, electricity is bought in greater quantities than needed, and a lot of power and money is wasted.

This project involves the construction of cheap, small and accurate energy meters that measure current, voltage and power. The energy meters can be implemented at any event with the purpose of monitoring and mapping the power consumption. The device is a stand-alone unit, and the information is sent to a central processing unit, where the data can be analysed. The goal is simply to gather information about changes in the electric grids (in real time), and by doing this a lot of knowledge is available and ready to be interpreted.

Questions could include:

- How much electricity did we use on specific occasions? (busy or less-busy times)
- When is it ideal to use less power for refrigerators or ovens? (After analysis)
- How much electricity should we buy for next year?

Being able to measure at certain points and mapping this data into a chart in real time, has a great potential for 'grid balancing'. Being able to estimate the power consumption beforehand will prevent a situation where too much electricity is bought.

Our product is specified to measure up to 16 ampere of current and is therefore limited to smaller shops. Nevertheless, the project is scalable and we could easily measure higher currents. So in the coming years, the energy meters could function as consumption references, and support potential vehicle to grid connections and wind turbines.

