SETMATCH

Working at TNO

The Energy Debate

TU Delft Eco-Runner

Marketing Sustainability

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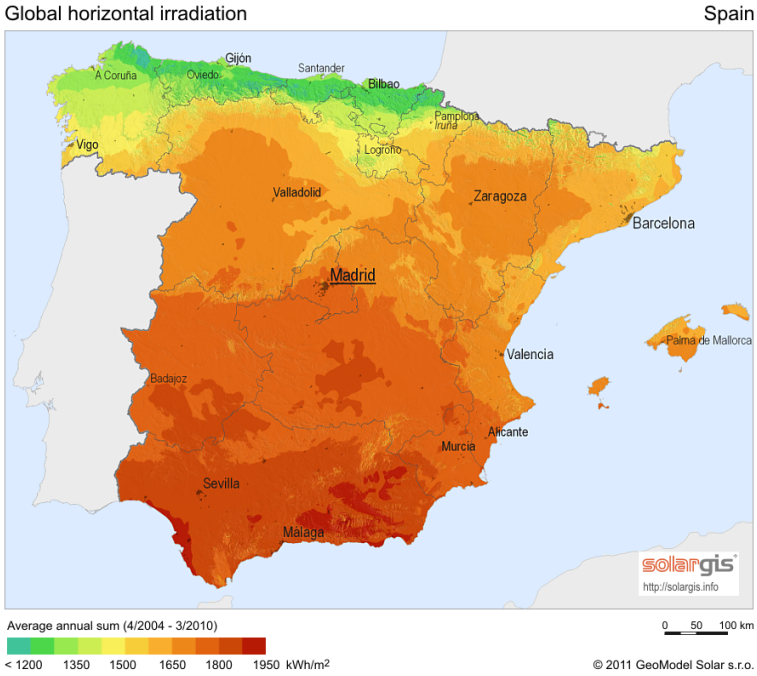
Spain's decisive step towards sustainability

Thanasis Vasileiadis-Sakatias

On Friday 5 April, Spain approved a royal decree aimed at regulating electricity self- consumption, making it yet another country to support this cause. This could prove very beneficial, especially for neighbourhood communities and industrial areas.

The country has one of the largest potentials for solar power in Europe. As can be seen in the figure below, the southern part of Spain receives more than 1,800 [kWh/m^2] of solar irradiation annually, compared to only 1,000 [kWh/m^2] received, on average, in the Netherlands. As a result of the above, it is one of the top ten countries by installed photovoltaic capacity worldwide and the first country for concentrated solar power in the world. This installed capacity grew swiftly until 2013. Since then, the growth has stagnated, leading the country to fall behind many other European countries in the development of capacity.



Annual Global Horizontal Irradiation in Spain

Another major aspect of the new offered incentives for self- consumption is to replace energy imports for Spain. As of 2016, the country imports more than 70% of its needed energy from abroad in the form of electricity, gas, coal and diesel. With each MWh that Spain can self- produce, it will be reducing the cost of billions of euros that are currently being used to cover the electricity bill. In the same time, the shift of the energy production to renewable energy sources will help to decarbonize the electrical system and reduce the CO_2 emissions by a significant margin.

Moreover, the recently published National Energy and Climate Plan (NECP) of Spain for the period

However, all this is about to change thanks to the new royal decree, which aims to regulate a set of mechanisms associated with the production and use of energy from solar power. Some of the regulations were not existent, while others were inadequate in promoting the activity of self-consumption.

The implementation of the new decree, coupled with the rapidly falling prices of photovoltaics, offers a great opportunity for Spain, since domestic and industrial self- consumption installations become more affordable. This could in turn reduce the high prices of electricity experienced in Spain since 2018, while at the same time offering an option for many companies to obtain a new income if they choose to feed the surplus energy into the grid. Moreover, the provisions reduce the administrative procedures, especially for small-consumers.

2021-2030 sets very high aims of installed energy capacity by the end of the decade. More specifically, it proposes the installation of almost 37 [GW] of solar capacity, representing a growth of 530%, compared to the 114% expected for the wind energy.

All of the above pinpoint that Spain is on the right side of history, not only investing in renewable energy sources, but also taking steps towards providing incentives for self-consumption thanks to regulation mechanisms. This example should be followed by more countries worldwide in the hope of a more sustainable future.

SETMATCH
https://delftsea.nl/magazine/
Issue 3 | Volume 3 | 2019

Should we be scared to be scared of nuclear power?

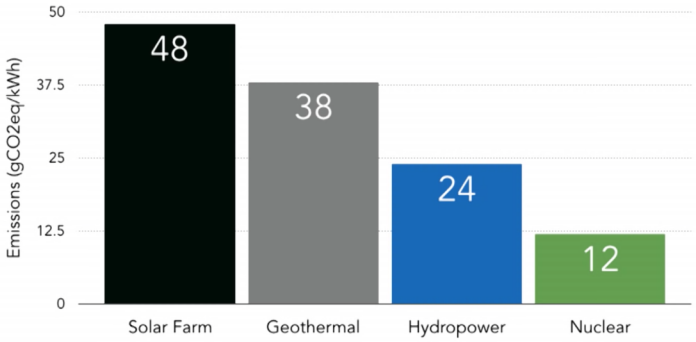
Andrew Keys

Nuclear power has been subject to decades of divided controversy. This peaked in the 1970s and 1980s when more nuclear power plants than ever were being constructed all over the world. This debate is rising in intensity again, as the risk of climate change is climbing political agendas, and the need for reliable, low-carbon electricity is more necessary than ever. Some look no further than the horrific nuclear accidents, such as Chernobyl in 1986 and Fukushima in 2011 to form their opinion on such matters. Others see nuclear power as a step closer towards the threat of a nuclear weapon attack. But is it fair for these factors to scaremonger us or is nuclear power a precious piece of the puzzle in order to overcome climate change?

To answer this question, it is useful to 'mythbust' some of the common statements that arise during this debate in order to make a more well-rounded opinion for yourself.

"Nuclear energy is not renewable, focus should be on renewable energies such as wind and solar"

Indeed, nuclear energy is not renewable, there is a finite quantity of uranium on earth that will not be replenished within our lifetime. In the context of preventing climate change, it is fair to say that the priority is to reduce carbon emissions as fast as possible to a safe level. A 2014 report published by the Intergovernmental Panel on Climate Change (IPCC) reported that electricity from solar farms produce overall four times more carbon emissions than a nuclear power plant per kilowatt-hour. So nuclear definitely ticks the box of being a low-carbon emitting technology.



The 2016 Energy Outlook conducted by BP reported that in 2016 France produced 93% of its electricity from low-carbon sources, compared to 46% from neighbouring Germany. On top of this, Germany is gradually phasing out their nuclear and coal-fired power plants with the goal to base their energy mix entirely on renewable technologies, namely solar and wind. Solar energy will grow from a 6% share of the country's electricity in 2016 to 9% in 2030. This could have the potential to provide great emission reductions, however, judging by the past, the closure of nuclear power plants has meant that emissions in Germany have only been rising since the economic recession.

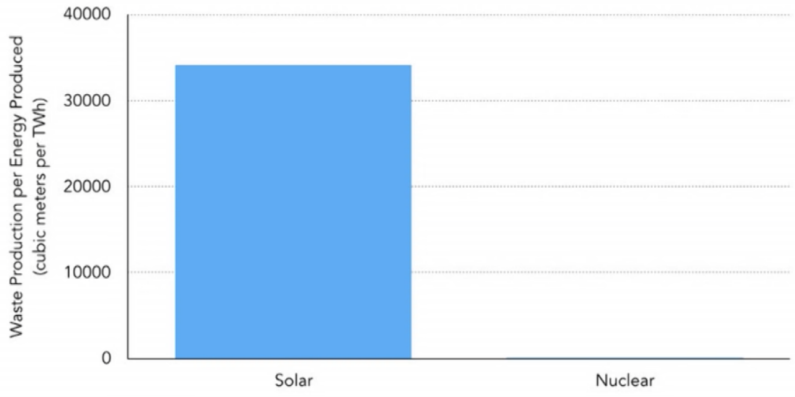
"Nuclear power is too dangerous, we have learnt our lesson from Chernobyl and Fukushima"

Firstly, let's consider the greatest nuclear accident to date, in terms of size and consequences: Chernobyl. The two most significant human fatality statistics reported by the United Nations (UN) were: 28 deaths from acute radiation syndrome (ARS) and 15 deaths from typhoid cancer over 25 years. Alongside this, the UN also reported: no effect on fertility, malformations or infant mortality, no proven increase in any other cancer, and no heritable effects. These facts are to put context to the event and in no way are suggesting the consequences were not horrifying.

To get a feel for the scale of nuclear radiation left by this disaster, the Chernobyl Tissue Bank reported that less than 0.1% of ionising radiation (the potentially harmful part of radiation that could come from a nuclear accident) that we are exposed to comes from all of the historic nuclear accidents. The majority comes from natural sources such as radon gas in the ground, which is considered to be just as harmful as coming from unnatural sources such as in a hospital, airport or from a nuclear disaster. BMC Public Health reported in 2007 that the risk of mortality from being exposed to extreme radiation conditions such as in Chernobyl is several times less than living in a large city such as Paris or London like a huge proportion of the world now do, with air pollution responsible for 7 million deaths per year.

"Nuclear power will always produce nuclear waste, which is hazardous to all forms of life"

A true, and highly important statement. However, this is the only waste from electricity generation that is safely contained somewhere. All other waste from electricity production is left freely to be dealt with by however companies and countries decide. In terms of sustainable electricity production, solar is the biggest culprit to this waste flow, with the EU being one of the only places to consider the destiny of such material. Solar panels produce around 300 times more waste than nuclear reactors per TWh, all of which contains highly toxic heavy metals. So to paint nuclear waste with a different colour of brush than other forms of low-carbon electricity source waste may not be so black and white.



The above statements are just a few examples of aspects to consider when forming an opinion of nuclear energy in the context of overcoming climate change. The discussion may have appeared biased, and that is because in fact it is in some way biased. The objective of this article is not to persuade you to support nuclear energy, or even have any opinion about it. The real objective is that when you are forming an opinion about something, maybe the first point of contact should not be a news channel, a documentary or even a book. Consider firstly seeking the data for yourself from a reliable source such as the UN or World Bank, and then analysing this data to form your own factful opinion. It is very easy to read something based on true facts and form your ideology around it, however, it is not always this simple. It is relatively easy to use legitimate facts to persuade a reader to form a desired opinion regardless of the topic. How can one really form a solid opinion about a subject without considering all aspects of and comparing it to every other possible option?

Try reading information from a range of sources, investigate how information is derived, and try not to consider freestanding numbers – the importance of ratios, comparative references and growth rates are often overlooked. If you are interested in reading further into techniques to correctly read data to form clearer opinions about the world then I highly recommend reading Factfulness by Hans Rosling.

India is challenging China's PV Production Capacity

Leo Franco

We are all aware of the hold China has on global PV production, but now the Indian government is trying muscle in on this territory. India intends to build a solar power capacity of 100 GW by 2022. To provide some comparison, their total electricity consumption in 2017–18 was 164 GW and is expected to be 235 GW by 2021–22. To achieve this they must build more than 4 times their current capacity for the next 4 years.

In accordance with this goal the Indian government is continuing plans to aid domestic solar panel manufacturers to contest their more established Chinese counterparts. Currently 90% of all solar cells and panels are imported from China. The question is, will these actions be successful, or simply fall by the wayside like previous attempts?

Situation

On Jan 30th, the Solar Energy Corporation of India, a government body, issued a tender for 3 GW of solar capacity. The accepted bid would also have to provide new PV manufacturing facilities capable of producing 1.5 GW of new panels. This action was supported by India's central cabinet, when on Feb 5th they initiated new legislation requiring all state-owned firms to purchase 12 GW of home-made panels over the next 4 years. These both come off the back of a 25% safeguard duty applied to all imported solar modules.

Prime Minister Modi of India

Analysis

The problem is that China is already a huge player in this industry and currently produces modules of greater performance on larger economies of scale. Though this legislation is welcome news for Indian manufacturers '[it] fails to provide the much needed immediate support to the sector' as stated by Sunil Rathi, director of Mumbai-based PV manufacturer Waaree Energies. Legislation will provide relief for the next four years but it is likely to take 1 year to get off the ground, by which time these Indian manufacturers could already be finished.

What's more, there is some uncertainty as to whether these actions will violate World Trade Organisation (WTO) regulations. In 2016 the US already filed a complaint claiming that India had been favouring local manufacturers against WTO rules. It is highly possible that a similar problem may arise again. The Indian government, however, claims that this is not the case, and points out that the WTO allows for preferential treatment of locally-made products by government firms.

This is the second time the Indian government is trying a tender of this style. In May last year a more ambitious tender was proposed for a 10 GW installation alongside 5 GW of production capacity. After several deadline extensions it had to be abandoned due to a lack of interest from developers. Sadly it seems that this could be the fate of this new tender. Amit Kumar, partner at PwC says 'without long- term clarity of viability of solar manufacturing, nobody is going to put up that much capacity'.

Another twist in this tale, which will certainly help shift the balance back towards Indian manufacturers, is the reduction of support shown by China's government for its own PV manufacturers. The Chinese domestic market for solar panels has lately seen a downturn and in response to this the government has put a stop to any allocation of quotas to new projects. This move will also help bring down the 100 billion yuan (13 billion euros) deficit for the state-run renewable energy fund but more importantly will give a vital opportunity for competition in the Indian PV market.

Bhadla Park in Rajasthan desert will be 2,255 MW

Outlook

The goal of the Indian government is to reach 100 GW of installed solar capacity by 2022. They also intend to push their way into the PV production market, using these capacity goals as a manufacturing springboard. India already has 5 of the 10 largest solar parks currently under construction and with such ambitions this looks set to increase in the future. We will have to wait and see if this new legislation will help them play a similar role on the production side.

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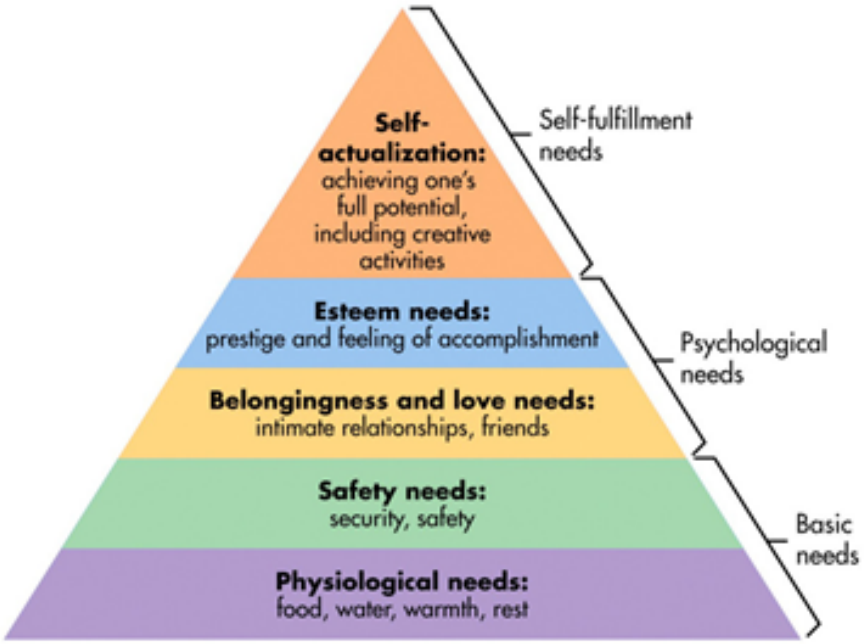
Marketing Sustainability: Are we doing it wrong?

Anurag Deherkar

In the mid 1980s and early 1990s, the dairy industry in California struggled to sell milk as the sales kept declining. It was difficult to market milk as the board's executive director Jeff Manning explained "it was white, came in gallons and people felt they knew everything there was to know about it". 1993, however, experienced a dramatic change of approach when the Goodby, Silverstein and Partners advertising agency created one of the most ingenious marketing campaigns. The campaign titled 'Got Milk?', was unique in two ways;

In contrast to previous attempts focused on getting more people to drink milk, this one focused on existing users to drink more milk. Second, instead of focusing on the benefits of milk, it chose to capture what the absence of milk meant for people. The 'Got Milk?' catchphrase and idea trended, and the milk consumption in California rose. The advertisement campaign showed that there is more to marketing a product, even the most mundane one, than the pragmatic approaches normally thought of.



Maslow's hierarchy of needs

25 years on, the approach to sell an idea needs to be rethought. This is the idea of sustainability and is the one of the key things that could solve the problem of global warming. Until now, the approaches to market sustainability can be put into two categories; one has been to draw attention to it by the demonstrating the adverse effects of global warming, and compelling people to go sustainable.

The second approach has been focused on how a sustainable lifestyle or the use of renewable resources can save them money. And the effect of these approaches has been an increase in the global consensus on the problem, only for the carbon emissions to increase in 2018. The rather disappointing statistic points to an apparent gap between awareness and action, for which a possible explanation can be found in the way sustainability is marketed today. Since the topic in contention is marketing, let's use a marketing campaign manager's favourite subject: Psychology. The Maslow pyramid, a common element of psychology studies, presented in the following figure, is used to show the hierarchy of needs of human beings. Priorities in the pyramid shift from bottom to top, as each level in the pyramid is secured.

Now take the example of the first approach which is related to safety needs on the Maslow pyramid. Try telling your cousin, whose wife just gave birth to a baby girl, that the world is dying and you need to shun meat or to make investments in sustainable energy so that your daughter's future is secure. His response will range between denying the threat to cross-examining how his daughter will be affected by it. By assessing this response you start to see the problem in this approach. Global warming is a threat so complex, so distant into the future and so widely debated, that it is not perceived as a threat to safety and security. And one cannot threaten someone to buy something unless the threat, however real it may be, is perceived to be real. Without this perception, our approach becomes a poorly constructed argument.

The second approach is by directly targeting an individual's wallet and is therefore concerned with the physiological needs on the Maslow's pyramid. On the outside, it makes sense. Sustainable approaches, like using a cloth bag when buying groceries or a steel bottle to avoid packaged drinking water, do save money. However, does the cost of packaged drinking water, plastic bags or even energy, make major hole in your pocket? Before sustainability being a solution to an expensive product, the product has to be expensive enough to be a pressure-point. And perhaps, the widespread use and availability makes existing products so inexpensive that our approach does not necessarily solve any pressure-point. Thereby its connection with the physiological need on the Maslow pyramid isn't one hundred percent fail-proof.

The gap between awareness about global warming and action, can therefore be attributed to this loose connection between the what people consider as priorities in their life, as in the Maslow pyramid, and what aspects of sustainability are marketed to them, as in the approaches. With pragmatic approaches to market sustainability failing to create the scale and gravity of impact needed for the hour, it might not be the worst idea to look to other ways like the one proposed here. We might just be a genius 'Got Sustainable' campaign away from transitioning to a sustainable world.

Working at TNO

Bilim Atli

Bilim Atli is a research scientist within the Buildings, Infrastructure & Maritime unit of TNO. In these times of automation, she believes the scientist's human view of the future is becoming more important than ever – it's a view that TNO backs.

My department focuses on reliable, sustainable and safe solutions for the maritime & offshore, buildings & infrastructure, energy and defence sectors. I work in the Structural Dynamics expertise group, where we contribute to the development of sustainable ships built with composites, among other things. These materials have been used for years by aircraft builders for whom the main goal is to save weight, and therefore fuel. For marine and offshore applications, composites have even more advantages: you can create more complex geometric shapes and embed sensors into the hull, allowing you to monitor the vessel's behaviour throughout its entire life cycle. A ship like that is rightly called a 'smart megastructure'. We are currently in an EU project to build such composite ships. My job is to develop and carry out experiments with colleagues to demonstrate clearly how structures behave under extreme conditions. It is about pilot setups of many metres in height, so very challenging. Last year, for my research into cryogenic storage tanks I was elected Young Researcher of the Year at TNO out of four nominations. These can be found on ships powered by LNG, or liquefied natural gas, because LNG must be stored at a temperature of 163 degrees below zero. Which materials are resilient to such low temperatures? And can they withstand an impact or collision? In addition, we are seeing the world take its first steps towards a hydrogen economy. Also with hydrogen it is more efficient for many applications if it is stored in liquid form. And that requires even lower temperatures. A next goal may be to develop cryogenic tanks for this purpose.

"If you want to make a difference, you have to dare to think differently".

THANKFUL WORK

"I obtained my PhD at Penn State University with a thesis on aerospace engineering. At a career fair in Boston I ran into TNO for the first time. I was attracted by the position of TNO between business and university. In business, the focus is often on a single product. At TNO you can take a broader view: very nice if you have an inquisitive mind. Moreover, you are working on a product that will become reality in the near future. Its feasibility has already been proven at university level and it is TNO's task to demonstrate the reliability, sustainability and safety of the application. Both pragmatic and challenging, and therefore thankful work. The breadth of my work itself is also attractive. I am both a scientist and a scientific leader of a product-market combination within our unit. On the one hand, I must design and carry out tests, report on them and make suggestions for follow-up projects. On the other hand, I have to set up a project portfolio and make it fit in with our roadmap."

ALWAYS ASK FOR WHAT YOU NEED

TNO is actually a collection of more than 3000 very smart people from all backgrounds and with different areas of expertise. At the same time TNO has an eye for each individual. You can follow different career lines, and the HR department will guide you from the very beginning. At the start you also get a mentor. And you can always ask for what you need, whether it's coaching or training. What I like about starting at TNO is the traineeship. This enables you to quickly get to know the various departments and see how varied and interesting TNO's work is. Furthermore, the balance between work and private life is very good. You determine your own agenda. Flexible working hours and working from home are among the possibilities. And a mummy- or daddy day is very common here.

TNO innovation for life

Bilim Atli is a research scientist at TNO

HUMAN VIEW

My ideal working day? It starts with coffee! After that, I am happy when a day offers the combination of experiments, analyses, reports and customer dialogue. I have been working on the structural dynamics of maritime structures for about seven years now. As a research scientist, you can develop from junior to principal at TNO. I want to reach that highest level ever. In the meantime, your team grows and your portfolio changes, so there are constant challenges. And you always have to keep an eye on the future. Especially at a time when automation is booming and machines are taking over the repetitive tasks of the scientist. Your added value is your human view. If you want to make a difference, you have to think differently, be creative, see how you as a scientist can make the world a better place.

The energy debate

Carlotta Ferri

DELFT, 19th of March – The Senatzaal of TU Delft is crowded with students from all faculties and nationalities. On the stage, five colored boxes are piled one upon another. They represent five out of the seventeen sustainable development goals that have been chosen as the most relevant for the energy debate at TU Delft: Industry, innovation and infrastructure (goal 9), Sustainable cities and communities (goal 11), Responsible consumption and production (goal 12), Climate action (goal 13) and Partnerships for the goals (goal 17). The speakers are a wonderful collection of inspiring and influential figures from politics, industry, academia, and business. Add to this an outstanding moderator: the former Dutch prime minister, Jan Peter Balkenende.

Representing the whole energy industry sector, Yuri Sebregts, CTO at Shell, steps on the stage. He depicts a future where more than 10 billion people will populate Earth. This will definitely require more energy but how to get it in a more sustainable way? In the most recent company's scenario, Sky, Shell gives the United States as example. In North America, each person lives with 300 GJ yearly. What is considered as a good quality life only requires 100 GJ per person per year, which means 3 times lower what is actually consumed by US citizens. Yuri challenges the audience: "Let's assume we improve the energy efficiency of global consumers of 3 times. To power a decent life for 10 billion people in 2050 we would need twice as much as the power generation of today". Not only, this energy needs to be clean. Keeping on the same path of the sky scenario. This would imply huge electrification within the energy sector with expansion of the current grid of 5 times. How is Shell working on the realization of this quite ambitious scenario? Yuri mentions innovative projects in which they have recently invested: SolarNow in Africa, HUSK in India, a project related to hydrogen fuel cell in Germany and many others around the globe.

But what does the world of research think about the energy transition? Prof. Dr. Ad van Wijk, brilliant lecturer and researcher at the TU Delft, points out an important fact: yes, renewable energy sources are cheaper, but is it not more expensive to manage a grid whose stability relies on intermittent sources? The professor shows a sharp critical mindset, typical of the academic world. The energy transition issue is not only economical but also technical: how can we overcome the natural obstacles and limitations of renewable energy sources? Prof. van Wijk claims that the energy transition will also mean giving a second chance to nuclear energy. However, this does not mean that research is not getting along with the change! He ensures that hydrogen will play a big role in a future of affordable and clean energy. And that it will come from plain water.

The energetic entrepreneur Anne-Marie Rakhorst takes the problem from a completely different perspective: what can we normal people do to make these sustainable development goals our future reality? She asks the audience an interesting question: "In the Netherlands we have a lot of money, but how do we use this money?". Anne-Marie condemned the finance and banking system that does not realize the importance of the real economy and investment in concrete projects. Additionally, she accuses the economic system, saying that we need to change how we use the products that we produce and buy, shifting to a Cradle-to-Cradle system. She pushes all the students in front of her to stop talking about changing things and instead to "go and do it!".

Last but not least, the Minister of Foreign Affair and Development, Sigrid Agnes, takes the floor. She drives the focus of the discussion to the energy sources, now contested as a source of power and threat. "Technology is seen as THE game changer; it is an input but also a source of power". And as Ben Parker said to all of us in our youth: with great power comes great responsibility. Sigrid reminds us that companies are the ones who are leading to successful development goals and, that if we want, technical solutions are and will be available. "Political populism, climate change deniers, cynics, they are not on the right path. Their approach will not bring us to the solution, which is instead based on wealth sharing and taking responsibility for our planet".

After their single speeches, the guest speakers are all invited to a panel discussion. "What are the short-term priorities of the energy transition?", Jan Peter asks. The industry speaks through Shell CTO. In his opinion energy efficiency is by far the best solution and energy education is needed in order to bring this improvement. Prof. van Wijk gives voice to the academic world claiming for a great need of leadership and guidance towards common objectives. The government, represented by Sigrid Agnes, considers the abatement of subsidies on fossil energy sources the first step towards the transition. It is made clear that a focused tax regulation will be necessary. But Anne-Marie, as spokesperson of the business world, brings on the table a completely new idea: simple measurements and open datasets to let people clearly see the progress that has already been made.

"And what about the priorities for a longer-term solution?", Jan Peter asks. The academic world and the industry agree on the fact that no single solution will be enough. Cooperation among countries with diverse energy sources will be the only way: a worldwide energy network and market.

Jan Peter continues, asking "What can students do regarding the Sustainable Development Goals?". The two women on the stage agree that the younger generation should not wait for the government to act. They should work on innovative projects and start-ups, even if their results are not economically viable yet. "In the Netherlands we have a lot of money", Anne-Marie claims, "But they are blocked in banks and are not spent in the hands of the young students and entrepreneurs! We think that it is safe, but we need instead to shape our future with our money!".

"CO2 taxes in the Netherlands", Jan Peter asks eventually, "Is it a fantasy or a real opportunity?". After having discussed all the potential of carbon capture technologies and the reintroduction of captured carbon in the production chain for example to make fertilizer, Yuri agrees that CO2 taxes will represent an incentive for both greener producers and consumers. However, the industry is concerned about the fairness of this policy in a globalized market. "It will be necessary to prevent the import of cheaper products from places where no CO2 taxes are applied".

At the end of the evening, all parties agree that the future of our society depends on how successfully we – from the industry to the academia, from the government to the business worlds – will be able to meet the sustainable development goals.

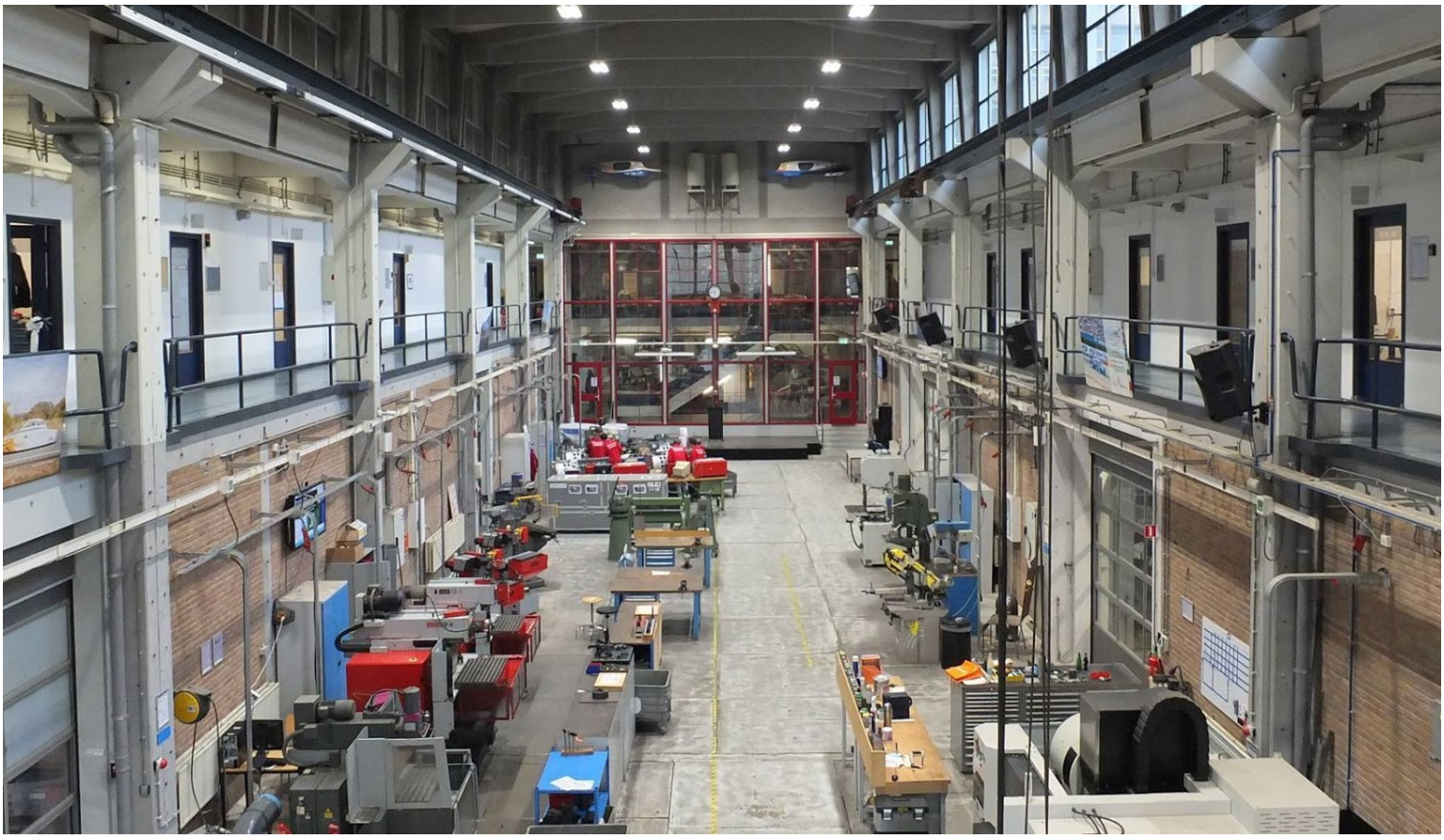
The TU Delft Eco-Runner

The most fuel-efficient car in the world?

Yitzi Snow

At first glance, the Eco-Runner doesn't look like a car at all: it looks more like a long egg, lying on its side. But this is no typical car. Powered by a hydrogen fuel cell, it could travel 8800 km on just a single kilogram of hydrogen. That makes it one of the most fuel efficient vehicles on earth.

The Eco-Runner is built by one of the dream teams at TU Delft. The car is designed, built, and raced entirely by students from the university. Some work part-time, while others take a full year off their studies and build the Eco-Runner full time. It's a difficult challenge, but the students are up to the task; the Eco-Runner team in Delft is consistently one of the best in the world. The most recent car is the 9th one which has been built since the dream team was founded in 2005. Every car has competed in the Shell EcoRunner marathon, and almost every team has been on the podium. In 2015, the team came in first, and they are trying to do that again.



The Dream Hall on TU Delft campus- home of the Eco-Runner and other dream teams

"The Shell Eco-Runner marathon is the Olympics of fuel efficiency competitions."

Around 40 teams travel from all over the world to compete. Even being allowed to race is quite difficult, because the cars must meet extremely strict standards for safety, disqualifying many teams before they even get the chance to race. Once they start driving around the track, cars need to follow a careful balancing act – if you go too slow, you won't complete the required number of laps within the time limit. But if you drive to fast, you will increase your drag and waste fuel. Whichever car uses the least fuel at the end wins.

The Eco-Runner team has worked hard to make every gram of hydrogen carry as much weight as possible. The body of the car is made of carbon fiber composite, and weighs only 50 kilograms. This year, they are hoping to drop that to only 43 kg. To reduce air resistance, the car is small and extremely aerodynamic. The cabin is so cramped, that nobody over 160 cm can even drive it. But despite having such a small car, the team has big plans.

The Eco-Runner in action!

Currently, the car competes with other small, three-wheeled vehicles. Although these are efficient, they aren't very practical. In the future, the Eco-Runner team is looking to move into the Urban Concept category. That would mean a larger, four-wheeled car that looks more traditional but is still incredibly efficient. The team is also looking at making the car completely autonomous, but for now the car is too small to fit the cameras, computers, and other hardware which are needed to make that happen. The team works hard outside the dream hall as well, visiting local high schools to promote science by teaching the students about hydrogen technology. Maybe someday, those students will build the next generation of Eco-Runner at TU Delft!

Want to learn more about the Eco-Runner team at TU Delft? Visit www.ecorunner.nl

Scrutinizing the Carbon Tax

Casper Eijkens

On March 13, the Dutch government made a surprising announcement by promising a CO_2 tax for the industrial sector. The fact that they made taxes sound interesting is impressive, but even more shocking is their total U-turn on climate policy. Until recently, the industrial sector was exempted from emission tariffs despite factories being responsible for 25% of Dutch emissions. Even though a carbon tax might satisfy certain revenge fantasies, a waterbed effect is imminent: when emissions are squashed here, they can emerge elsewhere.

Political tensions increased earlier this year when a new climate agreement was published in which energy taxes focused on households rather than factories. The cabinet reacted on the criticism by announcing a "reasonable" CO_2 tax for the industry. The announcement was made with the provincial elections coming up, but it is probably not just political tough talk. Recent reports showed that the current climate policy is insufficient to meet our climate goals.

What "reasonable" means in this context, is still unknown, but there are just a few options available. Groenlinks and PVDA demand a flat carbon tax which taxes every factory equally. Note, that no EU country has a flat CO_2 tariff for its industry. Other parties are vouching for a bonus-malus tax, where companies commit to an emission policy and are penalized when breaking their promise. Opposers to the latter find it too bureaucratic and thus toothless. Last week, Planbureu Leefomgeving calculated that a flat carbon tax would reduce more Dutch emissions than the bonus-malus tax, but it did not conclude whether global emissions would decrease.

A uniform carbon tax could be less effective than it looks, because there already exists an emission policy on EU- scale. In the European Emission Trading Scheme (ETS) system, which came into force in 2005, companies purchase permissions to emit GHGs. The total amount of available permissions decreases over time, forcing emissions to shrink towards desired levels. ETS is effective across the EU and thus gives a level playing field for all members of the Union. As was predicted during its design, the influence of ETS slowly grew and is now finally affecting investments.

This brings us to the main issue of a uniform CO_2 tax: it seems like a green policy, but it could actually be counterproductive in reducing emissions. A uniform carbon tax would be added on top of the ETS and due to increased prices, portions of their market share leak to other countries. Since the Netherlands has strict regulation on pollution, this could mean that demand is met by 'dirtier' industries. Such a measure would also withhold investments, making the flat tax not only detrimental for the environment but also for our economy.

Even though the flat carbon tax sounds effective, it is probably too simplistic for the tremendous task that is energy transition. However, since climate change is an urgent problem, some form of carbon tax is needed to reduce Dutch emissions. Even though the bonus-malus tax sounds less slick, it would probably be more efficient. Let us hope that our cabinet is reasonable enough to come up with a sustainable energy policy.