

"I would like to see more SET students start their own enterprises and disrupt the energy scenario... " page 4

"Sustainable energy technology performs quite a clean cut and separates our devices from reality." page 7



TOWARDS THE ENERGY TRANSITION **AND A SUSTAINABLE WORLD -A DUTCH ELECTION REVIEW**



On 15th March, Dutch citizens exercised their right to vote in what might be one of the most closely followed elections in recent times. 28 parties were competing for the 150 seats in the Tweede Kamer (the Dutch House of Representatives). These parties can be roughly categorized into the right, left, and centre. The right-wing parties include the People's Party for Freedom and Democracy (VVD), the Party for Freedom (PVV) and the Christian Democratic Appeal (CDA). The left-wing is represented by parties such as the Socialist Party (SP), Labour Party (PvdA) and GroenLinks (GL). Finally, Democrats '66 (D66) and Christian Union (CU) are considered centre-wing parties.

Srinivasan Gopalan, Patricia Seoane da Silva & Bas Buise

Delft

On reviewing the campaigns of all the parties, it is seen that two main positions exist when it comes to the energy transition. The far rightwing parties have promoted and defended Under these circumstances, polling day arrived energy innovation, even though further details and the results were announced on 16th March.

about how this should take place have not been provided. On the contrary, left-wing parties have not discussed this issue with frequently, but they did provide some technically-specific proposals.

"In contrast to the opinion polls before the election, the polemicist Geert Wilders' PVV was only able to win 20 seats."

The VVD, which is the party of the sitting prime minister Mark Rutte, accounted for the highest number of votes and secured a total of 33 seats in the Tweede Kamer. In contrast to the opinion polls before the election, the polemicist Geert Wilders' PVV was only able to win 20 seats. The CDA and D66 increased their vote share by 4% and each won 19 seats. While the GL made exceptional gains in their vote share by winning 14 seats, the SP also won the same number of seats which meant a small reduction as compared to the last time. In the last mandate two parties cumulatively reached a majority, but the results from this election are more fractured. This means that at least four parties need to come together to form the next Government. Thus, it is all the more important that the parties in the mix have similar views on climate change for the government to act decisively on energy transition.

"The consensus on climate change targets seems to be to reach the goals set for emissions cut by 2030 and 2050 respectively and thereby meet international treaties signed to this effect."

Most parties are committed to adopting energy efficient measures, cutting down on CO₂ emissions and aiming to reduce energy consumption in the built environment. An exception, however, is the PVV which wants to stop the energy transition.

The consensus on climate change targets seems to be to reach the goals set for emissions cut by 2030 and 2050 respectively and thereby meet international treaties signed to this effect. Here again, the PVV boldly takes a different stance by claiming that climate change is a leftist hobby.



Apart from these two core issues there are a host of other topics that are key to the energy transition. This includes policies on coal power, nuclear energy, wind energy and natural gas. In this regard differences in opinion can be clearly identified. For example, the PvdA, D66, SP and CU want to close the coal powered plants at the earliest possible opportunity. But the VVD and CDA want to keep them running and cofire them with biomass. The CDA even lobbies for subsidies for these co-fired plants. On the issue of nuclear reactors, the majority of the parties are on the side of closing them down while the VVD, D66 and PVV want to keep them running and improve their safety and efficiency. Though there are minor variations in the plans for natural gas, the general trend is to improve safety while reducing their use. All parties want to increase investment in offshore wind park technology. Similarly, most parties also want to reduce emissions from transportation and are looking to transition into cleaner fuels.

At the outset, it appears most of the parties in the mix have a similar outlook towards the energy transition. There are some minor differences that can hopefully be worked out. Adding complexity is Mark Rutte's claim made in a parliamentary debate that he would not work with Geert Wilders. So the transition towards a sustainable future will continue unabated.



SET Pub Crawl - A Series of Fortunate Events

Karan Narayan

The second SET pub crawl organised by the Delft SEA was a grand success if memory serves me right. Unfortunately, it usually doesn't during most pub crawls. But let's just say it was. The idea was simple –move through a series of bars with a group of (overworked) students who are trying to be responsible adults. There is a plan of course which is time bound (we're in the Netherlands after all) and involves a whole lot of beer (ditto). What could possibly go wrong?

It was held on March 2nd, which was a couple of weeks into the third guarter of SET. This was a good move because students had so far been lulled into a false sense of security about what lay ahead in the quarter and were still jolly about life. About as jolly as you can be in the TU anyway. Some others of course were aware of the terror that lay ahead and decided to make hay while the sun shone. The groups traversed 4 bars during the night, and each went in a different order. The first for my group was the lovely Delft establishment known as the 't Boterhuis. We were in their basement, which lends itself well to the word gezellig. A couple of beers and selfies later, it was time to move on. Next, we went to de Joffer which has a cosy sitting area in the corner and some great beers on tap. We then headed to the crowd favourites - Bebop and Willie Wort in the bustling alley of Kromstraat. Bebop is well known to students for their Jazz vibe and weekly live performances. Willie Wort is known for their legendary discounts, which only get better the more you (and the bartender) drink. By this time, it was already clear that the night was going to be a long one.



Finally, we landed at the much awaited after party in the finest discotheque (out of the three) in Delft - Ciccionina. One by one, students let their hair down and the rest of us followed suit in rapid fashion. One prominent member of the crowd proceeded to lose his bearings and gain new linguistic skills. He created a heady concoction of Dutch, French, English and Arabic which is sadly now lost to history. For many others, alcohol flowed like water and little flowers of romance blossomed in various corners. Rumour has it that some attendees even went across to the other side of the hill (canal) because the grass was greener there. Aren't joint celebrations the best?



Inevitably, reality had to come crashing down on us the next morning as most of us struggled to get up, go to class and get work done – often not in that order. It was now that we appreciated more than ever the wondrous drink called coffee. The President of the SEA even took to Instagram to remind all of us that men belong in the kitchen, and so do women, and so does everyone else – because the kitchen has food. At the end of it all, we can agree that it was worthwhile. No one's sure because no one really remembers it all. All we know is that occasionally, SET students need a break from trying to save the world and just get together for a night they will always forget. To most, the next time couldn't come any sooner. We have good news - it will be in the 3rd week of April, just after the next round of exams. Until then - stay hungry, stay sober.



Dr. Wiebren in his office

Manoj Payani & Karan Narayan

Prof. Wiebren de Jong is familiar to most SET students as the instructor for the core course Energy from Biomass, and the elective Energy Storage. He is well known for the passion in his delivery and his deep belief in the integration of research with coursework. This interview attempts to bring out the rationale and motivation behind his methods.

Can you tell us a little bit about your journey to becoming a professor here at the *TU* - your childhood, education and so on? I was born in 1968 in Rotsterhaule, which is a small village in Friesland. I did my schooling at an RSG, where I became interested in subjects like Math, Physics and Chemistry, and to a lesser extent, Biology. I then did my bachelor's in chemical engineering from the University of Twente, but in fact, I also considered medicine before coming to this conclusion. I completed my Master's at the same university in Chemical Engg. This was followed by a PdEng at Twente in collaboration with Groningen. At the time, I was unsure about doing a PhD, and a PdEng only required a commitment of 2 years, hence my decision to pursue PdEng. I concentrated there on process design and subsequently found my calling in research and academia. After the post-graduate exchange programme with the University of Stuttgart where I focused on the field of metal hydrides - mainly involving the supply and catalysis of hydrogen, I came here to TU Delft for a PhD studies in the field of biomass gasification in pressurized fluidized bed reactors, under the 3mE faculty (Process and Energy Department), and have remained here since.

What does a normal day for you look like? My day starts at 8 AM and I start with meetings with my PhD and Post-Doc students, followed by master's students doing their thesis. I then have lectures for bachelor's students in which I teach Thermal Fluids to around 750 students, and master's students in which I teach Energy Storage and Energy from Biomass. There is of course also work related to my research in large-scale energy storage.

That sounds quite busy. How do you manage your time? I like to prioritise my work in blocks and try to follow a Benedictine policy on time management. I spend most of my morning in meetings and lectures, and afternoons are generally meant for administrative work. In the evenings and other free time, I like to relax with music, books or cooking. I enjoy playing the carillon and reading about history, or the philosophy of people like Wil Derkse. I recall now a hilarious incident where in Dutch tradition I was 'kidnapped' before my wedding and taken to the Nieuwe Kerk here in Delft, where I played the church carillon!

Interview with Prof.Dr.ir.Wiebren de Jong

That sounds like quite an experience! Next, we'd like to ask which part of your job you find more fulfilling - teaching or research? I don't think of teaching and research as having exclusive needs; I believe they are interwoven, and when done right one feeds into the other. This is why I usually try to incorporate a research component into the classes I teach. This benefits both the student and me.

In terms of teaching, do you notice a change in students between now and when you first started?

I have been teaching for around 15 years, and the key difference is in how students get their information. The go-to choices are digital media and the Internet, whereas it used to be books, books and books some time ago. I think this is a useful trend, and features like Collegerama allow students to learn at their own pace. Such an approach I believe also facilitates multi-disciplinary learning, which I try to encourage through group work and projects.

Moving on to research. Which do you think is the energy storage system that will become dominant for short term and long term use respectively? Personally, I believe storing energy in chemical bonds is the most appealing of the existing technologies for long term storage. This could be in molecules like ammonia or methanol; I am slightly biased towards methanol because it's more of a platform chemical that can easily integrate into gasoline systems. On a daily basis, I think electrochemical storage such as batteries are the best bet because it is a mature technology and market ready. Hydrogen based storage is also very effective but it lacks infrastructure at the moment. In the future, it could become a very important player in the energy mix.

So do you think the Tesla Power-Wall is a good solution for example? It does solve the intermittency problem with renewable energy but is limited in its application to short-term storage. But I admire Elon Musk and his vision - he has made the Li-lon technology marketable through mass production and has solved a part of the puzzle in the transition to renewable energy.

What do you think are the current barriers to energy conversion and storage in the Netherlands, and around the world? According to me, there are mainly non-technical barriers such as the inconsistent energy policies both in the Netherlands and around the world. Those in power vacillate between conventional and renewable energy sources, and there isn't a policy framework strictly implemented by successive governments.

In Germany, hydrogen gas is fed directly into the natural gas grid thus adding the utility of hydrogen without the need of new and expensive infrastructure. This isn't happening in other due to a fear of material deterioration of the pipelines. Small changes like this can hugely impact our energy footprint.

With the shutting down or mothballing (cancellation/postponement) of coal plants, especially in the developed world, what future do you see for woody biomass? Among the options we have is to carbonise woody biomass so it can be reused in other industries such as steel. This is part of a wider effort to create and reinforce a circular economy using biomass.

Do you have a long term goal – something you'd like to see be accomplished in your lifetime? It's two-fold – my primary aim is to stimulate students to make their dreams come true! Also, if through this process, we could collaborate and create more startups like Gensos, I'd be thrilled. This means that students need to work in multidisciplinary teams where they're forced to think out of the box. In particular, I think SET students are the system integrators the future needs. They should be careful to not focus too much on grades, but instead on fundamentals. Ideally, I'd like to see more of them start their own enterprises and disrupt the energy scenario.

ALUMNI COLUMN

Aditya Dhathathreyan, Class of '13

6

Optimism surrounding the renewable energy industry supported by strong policies in the European Union, coupled with my personal interest in finding solutions for rural electrification were primers in my decision to apply to the SET Master's Program at TU Delft.

The program promised to provide a malleable setting to learn, work and network with some of the brightest minds in renewable energy in a culturally diverse environment. It never disappointed. From group assignments teaching me the importance of team building and compromise to individual courses that allowed for structured learning, my experience with the program was enriching to say the least. Thanks to a more international flavor and an atmosphere for interdepartmental collaboration, the program also allowed me to better understand the importance of building cross-industry relationships.

The culmination of this experience was the research thesis, which allowed students to establish a strong foundation for choosing between a research oriented career or a more business related role. As with any program that allows a reasonable degree of flexibility, my interests diversified. From wanting to work on the disbursement of residential wind power, I decided to delve into solar material research, which at the time seemed a more conducive conduit to reach my goal of working on rural electrification. The thesis experience with the then Photovoltaic Materials and Devices (PVMD) Group, along with some proactive networking helped me land a research fellowship with the Fraunhofer Center for Sustainable Energy in Boston. This was the perfect opportunity to scale knowledge and move from cell level research to module and system level design.

My experience gained from the SET Program allowed me to fit seamlessly into the new role and understand the business necessities. The next logical step towards my goal was to move into a more commercial role to understand project- and business pipeline development. I was fortunate to get an opportunity with SunEdison's Global Team in California, then the largest renewable energy developer in the world. I wasn't surprised to find many SET alumni driving the commercial development engine. This opportunity allowed me to work on the 'Eradication of Darkness' program at SunEdison – focused on electrifying underprivileged communities in India and East Africa. I now plan to move back to India and start my own venture in rural electrification/distributed generation projects and asset management – two key areas of development that are sure to surge in the near future across the world.

In retrospect, doing the SET Master's Program helped broaden my perspectives on the various kinds of upcoming clean-technologies and their associated needs. A particular area, which in my opinion needs to be addressed, is to design a course based on project finance and financial mechanisms in conjunction with the economics course already offered. While the year on year investments in clean infrastructure is showing a steady increase, the development of most renewable energy ventures is still capital intensive and requires debt heavy/subsidy funding mechanisms to offer services at grid parity. I would also encourage students pursuing the program to become extremely proactive in building industrial and cross-departmental networks to put them in a better position later on to start their own ventures or to be able to get into the industry.



OPINION: Are we educating blind giants?

Casper Hugel

Last period I took a course on complex adaptive systems and agent-based modelling. It was great. It is true. And everybody who disagrees is fake. Anyway, the notion of complexity is an interesting one. Please take a moment to consider what you think is the difference between something complex and something complicated.

Wikipedia very eloquently describes the difference: "The stem of word the complexity i.e. 'complex' is composed of the Latin words com (meaning: together) and plex (meaning: woven). This is best contrasted with 'complicated' where plic (meaning: folded) refers to many layers."

So, complex adaptive systems are folded and intertwined. The properties of a complex system cannot all be attributed to the individual components of that system. The whole is more than the sum of its parts. So-called emergent properties are a result of interactions and actions by and between agents.

Now, why do I bring this up? Well, our master's program on sustainable energy technology performs quite a clean cut and separates our devices from reality. We genuinely perceive and design the technical systems as being isolated from the social system. From a 'university perspective' a similar silo/reductionist thinking is applicable. The analysis each faculty performs is almost 100% mono-disciplinary. This thinking contradicts with the CAS thinking in that it considers the whole as a number of parts that can be isolated from one another without any consequences. And more importantly, it leaves out the complexity that arises from these parts, which is a disgrace because, inherently we cannot begin to start understanding complex problems (the grand challenges) from a mono-disciplinary standpoint because it requires a multitude of perspectives. (D.C. Mikulecky.)

Consequently, we are persuaded to think that simply by introducing our technologies everything will be fine. But we are unaware of the huge inertia (path dependency) the system already has and the co-evolution of technology and society. The sort of thinking and acting from which climate change emerged (like infinite consumption driven growth without boundaries) cannot be simply undone by introducing some renewables alone.

I think our Master's program is way too mono-disciplinary. Basically, TU Delft is educating blind giants. We are great at solving complex engineering problems (hence the name giant) but we are blind to the social reality. So, we are like a loose cannon - great firepower but zero accuracy. The giants that would have a large potential to guide us through times of disruption are not able to do so, because they have not learned to think about complexity, about the bigger picture. We need something in our education to transform our ego-awareness to eco-awareness.



Polder Politics

Bas Buise

The Netherlands has survived their elections for the House of Representatives. The PVV was big in the opinion polls but in the end they did not win. As already explained in the cover article, the liberal party VVD won and has to form a cabinet in order to get 75+1 seats in the 150 seat 'Tweede Kamer'. The Dutch Parliament doesn't only consist of this House - there is also the Senate, or the 'Eerste Kamer' ('First Chamber' in Dutch). This edition of Polder Politics will shine a light on this vhamber which does not have much power, but sometimes plays a key role in decision making for the cabinet.

The Eerste Kamer has 75 members who are elected every four years by the representatives of the twelve provinces of the Netherlands, the so called States-Provincials. The States-Provincials are also elected every four years by the citizens. Therefore the members of the Eerste Kamer are chosen indirectly. All the parties that join in the provincial elections are then also able to join in the Eerste Kamer. Almost all major parties choose to do so. This chamber has the right to accept or reject legislative proposals, which have been accepted by the Tweede Kamer. They can be viewed as a kind of extra check on the Tweede Kamer - often bills are passed, but also sometimes not. The last cabinet (Rutte II) especially had some problems with the Senate, as their parties had lost a lot of seats there, and therefore the Eerste Kamer became more critical of them. The Senatewas founded by the first Dutch King Williem I in 1815. In those days, it served as a tool for the Crown to be able to block bills that he didn't like. The members of this chamber were also not elected, but were friends of the King and were appointed for life. The introduction of the new constitution in 1848 stopped this and from that moment monitoring the quality of legislation became its main function. The members of today don't have to spend much time in this room. They meet once a week and often have other jobs/functions along with their role as a member. Their salary is therefore much lower than that of a member of the Tweede Kamer. As the Eerste Kamer is of less importance than the other chamber, its members are less known among the Netherlands

Next time there will be an explanation on the twelve provinces, which form the backbone of what now is a united kingdom.

DID YOU KNOW

Manoj Payani

The 'Vestas V164' is the world's largest capacity wind turbine, with a capacity of 8MW, which is enough to power 7500 average homes. Each blade is 80 metres long! [1]

If solar power generation doubled every decade for 100 years, it would still be pretty far behind oil today! [2]

More than 6 million solar home systems are in operation worldwide; 3 million of which are installed in Bangladesh alone. [3]

[1] - loco2energy.com, [2] - quora.com, [3] - unfoundationblog.org

COLOFON

Third Edition of the First Volume. 70 prints

SET MATCH is the quarterly magazine of the Delft Sustainable Energy Association (chapter of ETV). The Delft S.E.A. is the official study association for the TU Delft MSc. students in Sustainable Energy Technology. w: www.DelftSEA.nl • e: DelftSEA@tudelft.nl • Faculty of EEMCS • 2016-2017

> Bas Buise Patricia Seoane da Silva Srinivasan Gopalan Karan Suresh Narayan Hemant Sharma - in the function of the chapter Manoj Payani - Chief Editor