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MRDH Roadmap Next Economy – Energy
Author: Arash Aazami

This position paper is written for the MRDH Roadmap Next Economy. It is aimed at inspiring the MRDH to define strong, visionary and inclusive pathways towards an energy system that serves all stakeholders, including shareholders, citizens, and the environment.

1. Energy in Zuid Holland – the facts

Energy-wise, the MRDH shows **an enormous footprint.** The province of Zuid-Holland consumes 1.350 PetaJoules of energy per year –41% of all Dutch energy use-, and three quarters of all energy consumption is accounted for by industrial users. No matter how many homes and schools we help to become energy-neutral, nothing will structurally improve if we do not focus on the industries. The dependence on external, non-renewable resources is large: energy imports are as high as 750 PJ. The total of energy expenses in the province –mostly in the MRDH-region- is almost € 10 billion per year. CO_2 emissions are as high as 55 megatons: one fourth of all Dutch emissions, of which 30 megatons are accounted for by the industrial main port of Rotterdam. This makes Rotterdam the most polluting city in the world with 29,8 tonnes of CO_2 emitted per capita per year (Paris emits 5,2 tonnes per capita, Rio de Janeiro emits 2,1 tonnes per capita).

2. Faster: Goals

Most policy makers agree to reach CO_2-neutrality by 2050. This is not impossible, but requires a major reversal of the current trend: instead of decreasing, Zuid-Holland's CO_2-emissions have increased since 1990. Meanwhile, the entire renewable energy potential in the province amounts to 0,4 ExaJoule, 30% of the region's energy footprint of 1,35 EJ today. This means that **either the current industry will have to leave the region, or the region will heavily rely on import** of (bio-)fuels or (sustainable) electricity. CO_2 neutrality is therefore both a matter of minimizing energy use *and* maximizing local production *and* changing energy dependence *and* a sizeable loss of jobs in the energy intensive industry (currently 70.000).

Carbon capture and underground storage (CC(u)S) may seem to be a solution, but can never be the primary weapon of choice to decrease negative environmental impact. Instead, the industry should strive to be intrinsically clean and effective, instead of quickly reverting to escapist tactics. Therefore, CC(u)S should be considered a last resort, after all other possible measures have been taken.

Another perspective: if we would choose to match our energy demand with the earth's continuous supply of resources, if we would choose to extract no more fossil resources than the earth produces by converting carbon-based materials into fuels, the required cut on fossil fuel consumption would be 99,9999%, as humanity needs approximately 500 years to deplete 500.000.000 years worth of fossil fuel production.

3. Further: Two options

Where we –by now- all seem to agree to the inevitability of a transition to a renewables-based energy system, we do not seem to have an idea whereto. Whether the transition in the region will drive us away from our industrial roots, embracing other, more rural and less interdependent economic models, or turn the MRDH into a high-tech bio-based import- and export hub is not clear. We need to find a sweet spot between the following two extremes:

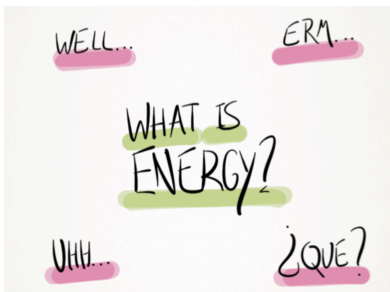
On the one end we could opt for a highly autarkic society, strongly relying on the region's potential for wind- (80 times the current production) and solar energy (240 times the current production), as well as its geothermal potential. There is neither space nor energy available for energy intensive industries, nor is there need for them, as many of the industries themselves currently exist merely for the fulfilment of our non-renewable fuel needs. 90% of the available agricultural ground would be used for energy production –energy farming-. The total energy consumption in the region decreases by 70%, to 400 PJ, of which 86 PJ will come from geothermal resources (currently the entire potential is 173 PJ, of which 30 PJ is accessible with relative ease).

The other end of the spectrum shows an entirely different landscape: By 2050 the MRDH is a **bio-based energy technology hub**. Even though CO_2-emissions are >80% lower than in 2013, much of that is reached through farming of bio-fuels and electricity outside the region, requiring as much as 18,3 times the province's available farming grounds. Energy import increases from 750 PJ to 1.000 PJ. On the other hand, the region's hub function serves a large part of the European mainland, partly justifying the vast increase in footprint.

4. More than mere technology

Whereas the scenarios in the previous paragraph show the (im-)possibilities on the outskirts of our technological possibilities today, they do not take future developments into account. Also, no transition is merely technological in nature. Transitions change culture, and are driven by cultural change. The energy transition to **a renewables-based system fundamentally changes our perception of value, democracy, and economic growth.** Equal attention and effort should be put into this transition's technological, economic and social aspects.

5. Challenges



One of the challenges is to reduce waste to zero. When regarding waste heat as a resource, use and reuse of excess heat becomes essential. The potential is tremendous: 150 PJ of heat is lost in the Rotterdam port area alone: one sixth of all heat demands in The Netherlands. Also, production of energy-related assets such as wind turbines and solar panels will heavily rely on our ability to recycle them from written-off assets. This requires the MRDH to invest into research and development of these technologies, as well as transforming industrial production plants into recycling hubs. Gener8 for example currently develops the technology to regenerate old solar panels into new, better ones.

Another challenge is the **lack of a strong, inclusive energy narrative.** For instance, the question "What is energy?" still yields unclear answers, even from energy professionals. The dialogue would be a lot easier if stakeholders understood energy is, simply, **the ability to do work.**

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In the current dialogue, carriers and resources are not distinguished from one another. Heat and electricity are both resource-independent carriers. Oil, wind and the sun are resources. From a resource perspective, one fact stands paramount: all energy is solar. Even oil, coal and gas are forms of solar energy. Very simply put, our technological challenge can be summarized as "**cutting out the middle man**". The fewer steps we need to convert sunlight into usable forms of energy the more effectively we can benefit from the natural abundance nature provides us with.

To ensure a clear and effective energy dialogue, it is necessary to convert the four energy standards used in The Netherlands -joule, kilowatt-hour, cubic meter and litre- into **one energy standard in all communications to end users**. For example, most users do not realize that energy needs on a household level consist of 85% heat and only 15% electricity in-home. Mobility increases the household's energy need with another 50%. Focus on reduction of heat- and mobility-related consumption is therefore a lot more worthwhile than reducing electricity consumption. Lack of standardization leaves that unclear and slows down the transition.

6. Cheaper: Energy for free

An energy system that transits from non-renewable to renewable resources deeply impacts the society it serves. The economy in a non-renewable system is scarcity-based by default, while a renewables-based system runs on the abundance of available resources. **Nobody can claim, nor do they ever need to buy sunlight and wind**, which means that at zero marginal cost, there will be no commodity market. No commodity means that there is no marginality either. If the system works well, the amount of renewable resources put into it exactly matches the amount required by users, which brings the average market price down to the price of sourcing its resources: **zero**.

7. Two future energy markets

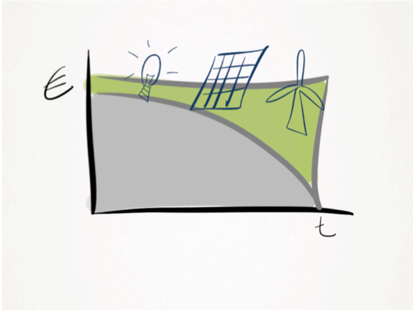
Although the market price will reach zero at one point, energy use will not be cost-free: apart from the cost of access to energy, determined by the complexity of the required energy infrastructure, users will pay for **capacity** –the maximum amount of energy they need at one point- and **flexibility** –the difference between available and required energy at any given moment-: "Energy Access As A Service". Flexibility (including storage) and capacity (including decentralized production) will therefore be the two leading energy markets by 2050.

8. Smarter: The energy sector – from volume to value

This all has tremendous impacts on the energy sector. There is no more need for volume-needy energy trader/suppliers. The market shifts **from volume to value**. The roles of Transmission System Operators and Distribution System Operators become more crucial. Flexibility and load-balancing are ensured through connecting supply directly to appliances, using (algorithmic) energy data disaggregation, making the need for a household energy meter obsolete. This requires focus on developments such as Machine-to-Machine communications, energy data disaggregation and monitoring, peer-to-peer energy exchange validation through blockchain technologies and electrification of end-use regarding households, SME's and mobility.

Prosumers will lead the energy market, acting both as inputs and outlets on the energy grid. Energy exchange will be peer-to-peer, without third-party interventions. This requires technologies to validate and administrate transfers of small amounts of energy from one user to another. Blockchain-based solutions may lead the way here.
Some technologies, like wind-electricity require scale, and therefore centralization. This generates a large amount of opposition from users. A way to mitigate "NIMBY" -not in my back yard- sentiments is to allow users, as stakeholders, to own shares in the energy producing assets in their neighbourhood. **Shared ownership increases acceptation**.

Direct Current will replace the Alternate Current network up to 1,5 KV-connections. The Internet of Things becomes **the Energy Internet**, transferring energy and data at the same time. Developments like photonics and quantum computing, both strongly rooted within Dutch knowledge institutes, will further reinforce this movement.



The impacts are tremendous: a 20-30% decrease in low- and medium voltage electricity grid investments can be ensured when load balancing is no longer a gamble. Another 20-30% are saved at end-user level through optimizing consumption patterns.

9. Multi-carrier

Electrification reaches far, but does not go all the way. Industries need a lot of energy, and heat serves them better than electricity. Also, however far industries improve their processes (and Dutch industries are already leading here), they will still produce excess heat, which should not be degraded to waste. The integration of an electricity & data-transmission Direct Current network with a low-temperature heat network provides a large opportunity: at times of electricity overproduction -pushing market prices below zero- excess electricity can be stored as heat, and be put to use at a more appropriate moment. In critical infrastructure environments, access to multiple energy carrier modalities is necessary.

10. Energy as currency

A society relying on abundant renewable resources naturally includes **democratization of value creation.** If everybody has access to resources that nobody can own, everybody can use these resources to contribute value to society. This leads the fundamental shift from the current scarcity-based monetary system, that greatly relies on centralized access to knowledge, resources and currency creation, allowing a gap between the amount of productive value added to society on the one hand, and the amount of speculated value added through interest, quantitative easing and debt-based economic models on the other hand. As energy –the ability to do work- is undeniably the main driver behind the productive economy; it is worthwhile to investigate models within which energy production adds to natural economical growth, e.g. "energy as a currency". The road to an entirely new currency system is already being paved in sub-Sahara Africa, where the lack of energy and monetary infrastructures led into the leap-frog towards an entirely new currency-system using the high concentration of mobile phones in Kenya to transfer 7% of the country's GDP and 67% of the national throughput volume through the M Pesa platform. It is a matter of time until the creation of new M Pesa will flow directly from installed renewable energy production capacity, democratizing the power to create money among citizens.

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11. All should be part of the solution

The current energy discourse is strongly divided, even though **all parties support roughly the same wishes for the long term**. Decarbonization is not a topic for debate, nor is renewable energy production. The pain experienced by existing parties like E.On is a result from business decisions made in the past, that led them into stranded assets, sunk cost dilemmas and pressure from shareholders, depriving them from actively contributing to the solution. A program for "**palliative care**" should be put into place, helping these parties to let go of their shares in loss-making scarcity-based assets in a pain-free manner, while on the other hand they are allowed to increase their interests in renewable-based technologies. E.On could be partially bailed out of its poor business decisions by the state, but rather than paying E.On in cash, the state could give E.On shares in renewable energy production. This provides them with a interest-free loan of € 800m –half of E.On's sunk cost in the MRDH- on a payback time of 30 years that E.On will then invest into renewable energy production. This scheme's calculated cost per capita in The Netherlands would be no more than € 0,13 per month, while E.On serves these same citizens with clean and renewable energy production for decades.
This idea may give direction towards a fossil-fuel amortization plan, conjoined by a renewables-based value creation plan. Meanwhile, effort should be put into replacing a culture of debate and contest with a culture of dialogue and collaboration.

A long-term vision -a higher goal- bridges the interests of short-term opponents. The MRDH certainly has what it takes to develop a clear image of what this higher goal should be, and needs to invest into the technological, economic and social components that ensure an energy landscape that serves all layers of future societies.

About the writer:

Arash Aazami (1977), born from Persian and Dutch parents, raised in West-Africa, is an entrepreneur, visionary and system innovator. After five years as a performing musician he gained experience in IT until his entry into the energy sector in 2006, when Arash became director of an energy supplier, and decided to focus on developing radically new business models. He founded the world's first energy independence company, earning more as it sold less energy in 2010. His business model, the Path to Zero, gained international attention when it was awarded by MIT in 2014, and is currently adopted by various multinational energy companies.
In 2015 Arash founded Kamangir. Its team of scientists, philosophers and artists lay a foundation for the "Next Society", developing transgenerational scopes, strategies and disruptive innovations. Kamangir currently works for multiple governments, the International Renewable Energy Agency, TwoBillionEyes, Alliander and many others. Their credo: ***Dream. Develop. Do.***