

1. INTRODUCTION

Sustainable development will become a question of climate adaptation and mitigation (IPCC, 2014) on the one hand and the lasting availability of resources on the other (Haas, 2013). Of these resources, after the basic needs for human survival – oxygen, drinking water and food – energy is the most quintessential element for human society. Without energy no element of civilization can be continued: buildings cannot be operated anymore, drinking water cannot be pumped around or poured into bottles, food cannot be transported from farms to cities and people will be limited again by travel distances they can cover by foot, bike or horse. Energy is the fuel of modern society – the end of energy will be the end of cities as we know them.

One might argue that present-day economy has built in sufficient safety and security for the continued provision of energy and all other needs, but over the past few decades various occurrences have demonstrated that cities are very vulnerable to hampering supplies. For instance, technical failures and black-outs have rendered power plants out of operation (e.g. New York City, USA, 2006), airplane accidents have cut major high-voltage lines supplying urbanized areas (e.g. the central river region, Netherlands, 2009), natural disasters have led to the destruction of power plants (e.g. Fukushima, Japan, 2010), politically driven decisions have blocked supplies (e.g. Russia versus Ukraine, 2009 and 2014), terrorist attacks have damaged energy infrastructure (e.g. Russia, 2010), and – more ‘friendly’ as we know it – market price mechanisms have influenced supplies in various ways (e.g. the Gulf War effects, late 1990s).

In the past most city regions used to be self-supporting entities: think of the Mesopotamian cities, Greek City states, yet also European mediaeval regional centres. Resource cycles used to be closed, meaning that all food, water, energy and materials came from the direct environs and waste products were reused in that same vicinity. Where this evolved out of balance, cities collapsed – think of the ancient Egyptian centres and Mayan cities on the Yucatán peninsula in Mexico. We are now in an era where none of the world’s cities is self-sufficient. Globalisation has made cities strongly dependent on supplies from elsewhere, and wastes are also treated in places mostly not known to citizens. As described with the examples of hampering supplies of energy, this implies cities presently are very vulnerable to failures in the system.

The inevitable conclusion of the previous is that for a secure, sustainable future, cities need to become resilient. A greater extent of self-sufficiency will help to achieve this. Supported by historic examples, city regions and metropolitan areas are still the most suited level at which sources and sinks can be solved locally. Therefore these form the scale on which the battle for sustainability will be won or lost, and the level at which cities can become resilient and even self-sufficient. However, how are we going to transform existing cities or emerging and growing metropolitan areas, with their non-sustainable systems, to sustainable ones?

A master plan for a sustainable energy system for city regions is not a luxury anymore. There is not one single solution that will provide the answer; enforced by successful examples this paper discusses one approach that may help.

2. ENERGY MASTER PLAN

For the research presented the authors based themselves on existing urban regions. Handling an existing city must entail a stepped approach, since commencing with an integrated design from scratch is impossible. The proposed Energy Master Plan will therefore be based on incremental steps of transition.

roofs and in urban surfaces.

5. CONCLUSION

This paper discussed an approach to energetically resilient city regions, based on various energy studies that gradually led to the stepped approach, coined as the Energy Master Plan. The examples used in this paper were from the Netherlands, but the authors think the generic approach may be applied in various countries and climates, only leading to different outcomes than the relatively cool temperate climate of the Netherlands. Since this paper argued the importance of becoming energetically resilient in detail, cities anywhere across the world may profit from a generic approach that helps them to become more self-sufficient whilst maintaining the quality of life, or even increase it, when speaking of emerging or rapidly growing metropolitan areas.

The first self-sufficient city still needs to be developed, or rather: redeveloped. Many cities across the world have made vows to become climate-neutral, carbon-neutral or energy-neutral by a certain year in the nearby future, but only few of them have their energy administration up-to-date. The authors think that using the science-based approach of the Energy Master Plan, including the method of Energy Potential Mapping, will help to realise their ambitions better than using a less-rationalised approach.

By testing the approach in its full potential, flaws or specified deviations will inevitably emerge, but it is the only way to get ahead in times when old solutions do not provide an answer anymore to new challenges.

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