Infographics for Smart People in Smart Cities

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1 ABSTRACT

Since 2012 the PBL Netherlands Environmental Assessment Agency has been working on a series of infographics on mobility, energy, food, water, waste and cargo flows in the Netherlands. The aim of these graphic visualisations is to create smarter and more sustainable urban environments by informing experts, policy makers and the general public about relevant urban flows and possible perspectives for action. The infographics show the scale, proportion and systemic relationship of flows on various scales, from global to local, and are based on recent scientific research by the PBL Netherlands Environmental Assessment Agency. Inspired by the work of the Austrian sociologist Otto Neurath and the German graphic designer Gerd Arntz, a first booklet on infographics on food, energy and mobility in the Netherlands has been published by PBL in 2012. Currently, the PBL Netherlands Environmental Assessment Agency is working on graphic visualisations of ten urban flows, such as mobility, energy, waste, cargo and water, that will be published and exhibited at the International Architecture Biennale Rotterdam 2014. This paper shows and describes a selection of infographics that are relevant for smart people in smart cities.

2 INTRODUCTION

In the context of rapid urbanisation and growing environmental challenges (UNEP 2013), the discourse of the smart city promises an era of innovative urban planning driven by smart urban technologies that will make cities safer, cleaner and, above all, more efficient. The promise of smart sustainable cities is predicated on the dynamics of social media alloyed to the Big Data generated by an urban infrastructure strewn with sensors. Feedback loops are supposed to engage citizens an enable behaviour change, just as real-time control systems tune infrastructure to become more energy efficient. Social media dynamics enable both self-organisation and efficient ecosystems, and reduce the need for traditional governance, and its associated costs. Behind it all is the application of ICT technologies.

However, a growing group of planners en researchers criticizes that generic technology-driven concepts that are imposed on cities will not work (see, among others, Hill 2012 and Hajer and Dassen 2014). Experimental green new towns like Songdo in South Korea, Masdar in the United Arab Emirates or Dongtan in China stand witness to what happens if we opt for sustainability but continue following the planning concepts of the 20th Century. These are, in the end, smart cities on a modernist footing, the 21st Century equivalents of Brasilia and Chandigarh. And, even though they were created in a politically ‘easy’ ‘tabula rasa’ situation, they have not lived up to their promises (Ferrão and Fernández 2013).

2.1 Smart people make sustainable and livable cities

Considering the failure of generic ‘cities from a box’ concepts, we need to think about the technologies in context. Next to smart technologies, we need smart citizens, smart planners and smart governments to make the smart, sustainable and livable city become a reality. Smart urbanism is about constant learning, inspiration, measurements, analysis and readjustments. This requires a rethinking of how public administrations operate. They will need to change. Interestingly, we see how the new civil society full of well-educated citizens raise so many astute questions and produce so many new demands that a classical bureaucracy becomes a defence industry. The classical ‘decide, announce, defend’ model is vulnerable is a world of constant learning. It could work much better in an era in which the government held the monopoly on good knowledge. But that is over. ICT technology brings information and knowledge within reach of many. Governments now face an ‘energetic society’ (Hajer 2011) of citizens that you either relate to make them part of the solution or find opposite you. 21st Century cities have increasingly have an opinionated and often well informed citizenry that will resist, quarrel, raise questions, call for amendments, oppose. And often for good reason. The art of planning is to combine the intelligence of policy makers, planners and companies with the intelligence of citizens.

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2.2 Visualizing the urban metabolism

A fundamental starting point to make citizens, planners and policy makers smarter is to create a better understanding and awareness of the way our cities work at the moment. The problem is, however, that our urban metabolism is complex and often hidden. There is little general awareness where our energy, water and food comes from and where our waste goes to? Furthermore, what effects does our way of living have on the urban surrounding and countries in other parts of the world? And finally, how can each citizen contribute to create a smarter and more sustainable city.

To create a broader awareness and to inform citizens, planners and policy makers, the PBL Netherlands Environmental Assessment Agency has recently been working on several projects using infographics that visualize the urban metabolism and related environmental issues. In this context infographics are a powerful tool to communicate information. They can present complex information in a compact, comprehensible and attractive form. Thereby infographics make data, information and knowledge easily accessible to various target groups, such as general public, planners, stakeholders and policy makers. The PBL work with infographics has been inspired by the work of the Austrian sociologist and philosopher Otto Neurath. Already in the 1920s Neurath worked on graphic design and visual education to make the information about society and economy understandable for everybody. With the illustrator Gerd Arntz and with Marie Reidemeister, Neurath created Isotype, a symbolic way of representing quantitative information via easily interpretable icons (Vossoughian 2008). At international conventions of city planners, Neurath presented and promoted his communication tools.

In this paper two recent PBL publications with infographics are presented. The first publication, 'Nederland Verbeeld' (PBL 2012), contains infographics on food, energy and mobility issues in the Netherlands. The second publication presented in this paper is called 'Smart about Cities: Visualizing the Challenges for 21st Century Urbanism' (Hajer and Dassen 2014). 'Smart about Cities' contains visualizations of the urban metabolism in the Netherlands in relation to international environmental issues.

3 THE NETHERLANDS IN INFOGRAPHICS

The publication 'Nederland Verbeeld' contains 29 infographics combining short texts and graphic visualizations that illustrate various issues concerning the topics of food, energy and mobility in the Netherlands. Next to visualizing current trends and developments, the publication also shows perspectives for action per topic.

3.1 Food

Figures 1 to 6 show a selection of infographics concerning food and mobility issues. Figure 1 shows that the quality of our food has improved but that an average diet contains too much meat and fat, and overweight is an increasing problem. Moreover, food worth 325 Euro gets wasted per household per year. We live in an age of overconsumption and could be much more efficient about our food. Figure 2 illustrates the footprint of the Dutch consumption, including food, cotton and wood. Per person 0.6 hectare is needed which is almost a soccer field. For the whole population three times the size of the Netherlands is needed. A big part of the footprint can be found in South-America which can be attributed to land-use by cattle. Finally, figure 3 shows the effects of different personal diets. On average the footprint of an vegeterian is 30 percent smaller in land-use. The related production of greenhouse gas is about 20 percent less compared to an average diet.

3.2 Mobility

Figures 4-6 illustrate mobility issues. Figure 4 shows that about a quarter of the Dutch CO_2 emissions is caused by transport and the European Union has the ambition to reduce the amount of greenhouse gasses by 60 percent until 2050. Figure 5 illustrates our travel motives related to different modes of transport. Most of the kilometres travelled are related to commuting to work, and most of those kilometres are made by car. Figure 6 shows the CO_2 emissions caused by vacation trips. It shows that one return trip by plane to New York is as much as a quarter of the average CO_2 emissions of a Dutch person per year. It can be compared to the yearly amount of CO_2 emissions caused by travelling 35 kilometres per day.

Fig. 1: Infographic on food 1: overview of recent developments and issues

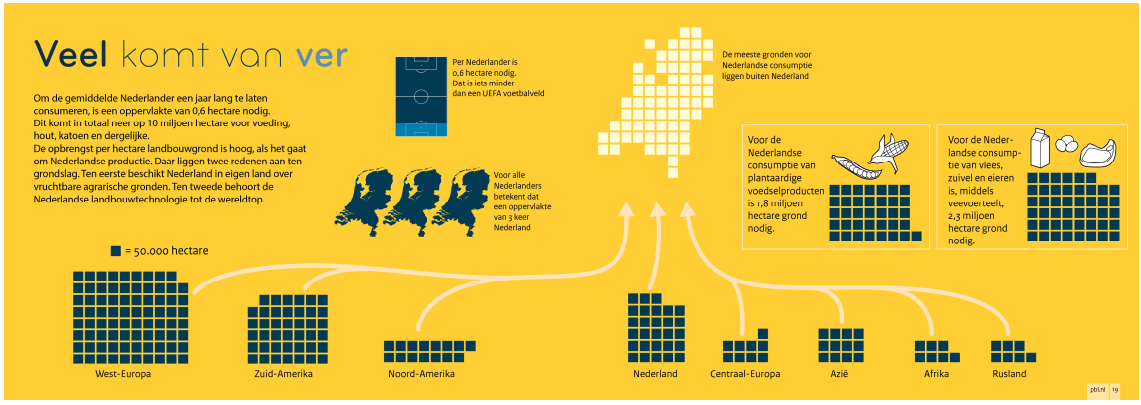

Fig. 2: Infographic on food 2: the footprint of Dutch consumption

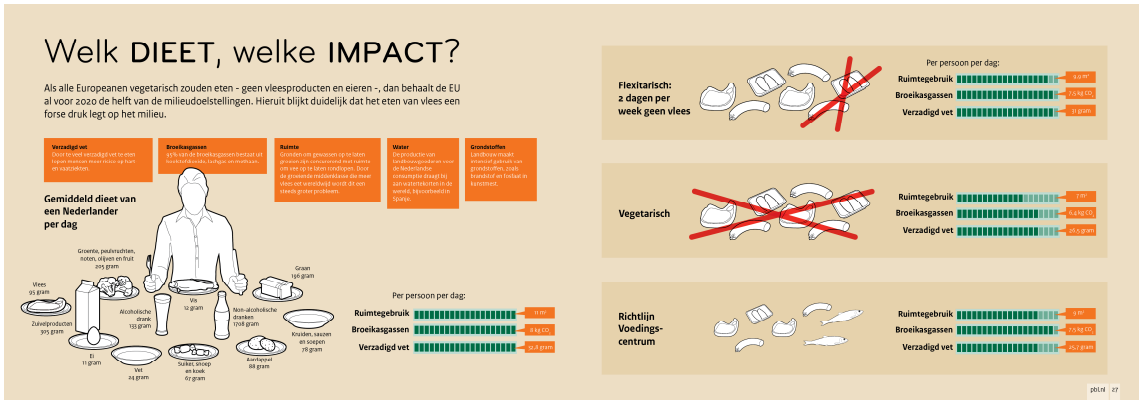

Fig. 3: Infographic on food 3: impacts of various food diets

Fig. 4: Infographic on mobility 1: overview of recent developments and issues

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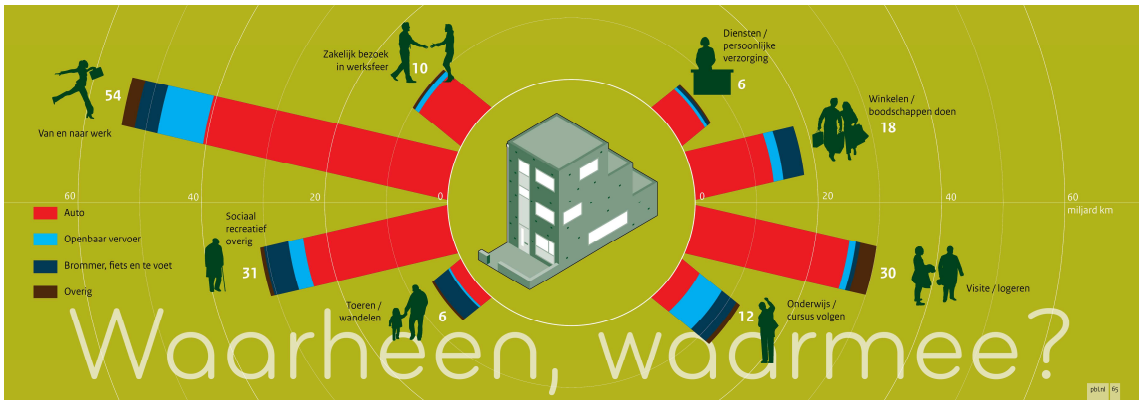

Fig. 5: Infographic on mobility 2: travel motives related to different modes of transport

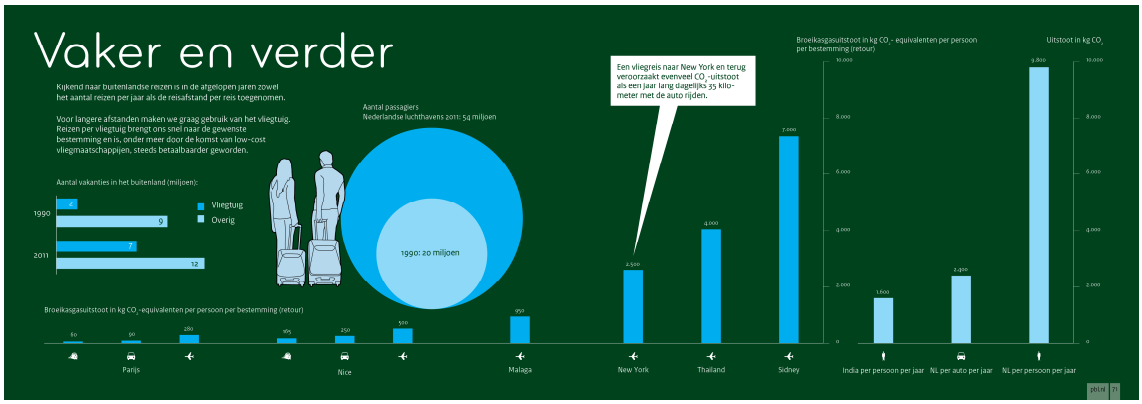

Fig. 6: Infographic on mobility 3: CO2 emissions of various vacation trips in relation to average CO2 emissions per person per year

4 SMART ABOUT CITIES

Since summer 2013 the PBL Netherlands Environmental Assessment Agency has been working on preparing the exhibition and publication ‘Smart about Cities: Visualizing the Challenges for 21st Century Urbanism’. This exhibition and publication is part of the International Architecture Biennale Rotterdam 2014 (IABR). The upcoming edition of the IABR argues that the city is an integral part of one huge urban landscape, a complex system that has become our natural environment. This point of departure has many implications for the way we plan and design this urban environment. Perceiving it as an organism opens up possibilities to develop spatial interventions that make use of its metabolism.

The contribution of the PBL contains fifty infographics on urban flows in the Netherlands, Europe and the world. The infographics have been produced by a group of PBL researchers in close collaboration with graphic designers and cover ten substantial urban flows:

- People (demographic flows)
- Mobility (traffic flows)
- Cargo
- Food
- Fresh water
- Air
- Energy
- Construction material
- Biodiversity and nature
- Waste

Per theme five infographics have been elaborated. The first infographic always shows the scale of the flow related to a person (e.g. How much energy does a person use per year? How much food does an average person eat? How much waste does a person produce?). The second infographic presents a flow chart. For

example, how much waste is produced by what kind of source and how does the waste get treated? The third infographic shows the physical infrastructure on a map of the Netherlands related to the specific flow. The fourth and fifth infographics vary per theme and present issues on a global scale and possible perspectives of action.

As an example of one the tens urban flows, the following five pages show the infographics on waste (see Figures 7-11). In the ideal world of recycling, waste does not exist. What we would call waste or rubbish simply serves as raw material for the next cycle. The question is whether this perfect world of 100% recycling has ever existed, or can ever exist. Animals, plants, and particularly human civilisations leave traces that are not erased in subsequent cycles but that remain long after they were left ¬– from dinosaur bones, to ashes and potsherds. Humans have always produced waste. However, the volume and nature of waste flows have changed over time; there is more waste today than ever before, and the amount keeps growing.

For Europe, recycling is becoming increasingly more attractive, also from an economic and geopolitical point of view. Europe depends on other countries for many raw materials, and these materials are likely to become scarcer and more expensive in the future, due to global economic and population growth. Therefore, Europe should carefully manage its current resources, including the materials present in products and waste.

A growing number of companies and regions aim for a circular economy, in which production cycles are closed as much as possible. This means that products are increasingly being designed in such a way that materials can easily be recovered at the end of the product life cycle. Waste prevention and reuse are the guiding principles of this approach. A circular economy would also allow a shift from owning to leasing goods, where producers retain ownership of the materials.

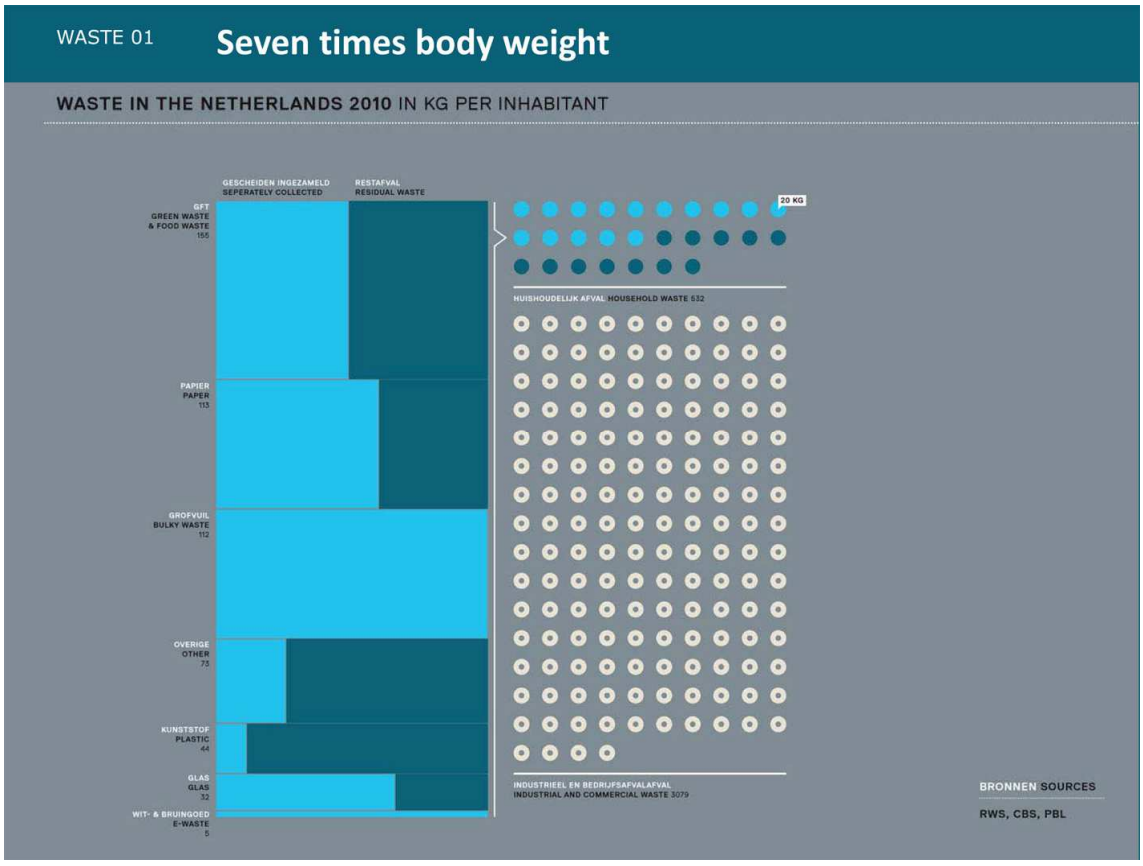

Fig. 7: Waste per person in the Netherlands

4.1 Seven times body weight

Each year, every Dutch citizen discards 530 kilograms of waste. This is seven times the average adult body weight, and four times as much as in 1950.The main components of household waste are organic items (vegetable, fruit and garden waste), paper and cardboard. Sixty per cent of all discarded paper and glass is collected separately; for plastic this is only 13%.

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Contemporary households own more things than ever before, and throw more things away. In other words, the turnover rate is higher. Goods such as clothing and furniture are much less often mended, repaired or reused than in the past. Many products now come as disposables, such as diapers and plastic packaging material. However, some waste flows have decreased or completely disappeared; the production of coal ash, for example, ceased when the Netherlands switched from burning coal over to natural gas in the 1960s.

Waste production appears to be correlated with economic prosperity. Waste growth tends to stagnate during economic downturns. This was particularly the case during the oil crisis of the 1970s and the economic recession of the 1980s, and has also been observed in recent years as a result of the present economic crisis.

Household waste is only the tip of the iceberg. The majority of waste (85%) is produced by factories, offices and businesses. This share amounts to an additional 3000 kilograms of waste per Dutch citizen per year.

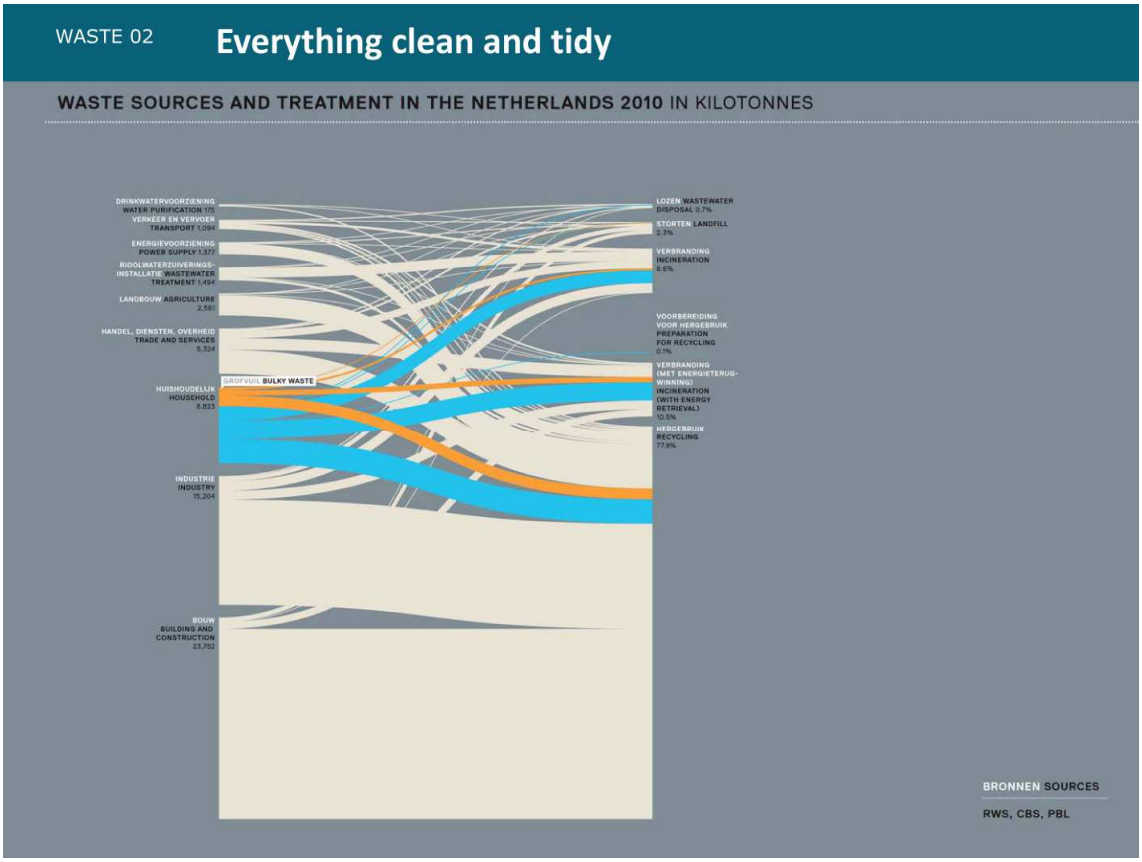

Fig. 8: Flow chart of waste sources and treatment in the Netherlands

4.2 Everything clean and tidy

Waste management in the Netherlands appears to be a problem solved; partly thanks to sophisticated logistics. Back in 1980 most household waste ended up in landfills, but now it is efficiently recycled or incinerated. Large-scale industrial waste scandals are also a thing of the past. For only a few dimes per person per day, we dispose of our waste in a clean and proper manner.

Better still, our waste is put to good use, as more than 75% is recycled, and a part of the 20% that is incinerated thus contributes to heat and electricity generation. No more than 3% ends up as landfill or is disposed of as waste water.

Waste management in the Netherlands has become so efficient that Dutch incineration plants currently have overcapacity. As a result, they are importing waste from other countries. Waste from London and southern Italy, for example, is being incinerated at the Port of Rotterdam. Thus, waste incineration generates energy as well as profit.

Fig. 9: Map of waste infrastructure in the Netherlands

4.3 Cities are wasting waste

Waste separation and recycling are effective ways to reduce the amount of residual waste. Many Dutch municipalities collect sorted waste door-to-door and have household waste recycling centres. Reuse has also gained popularity, mainly thanks to the rise of online platforms such as eBay for buying and selling used goods. These platforms also facilitate sharing and leasing.

Generally, more waste is recycled and reused in rural areas and small towns than in cities, where a larger share of plastic and organic waste ends up in incinerators. Thus, in terms of recycling there is still plenty of room for improvement in cities.

4.4 From landfills and incineration to recycling

European countries differ considerably in their waste production and waste management. Rich countries such as the Netherlands produce more municipal waste per head of population than less prosperous countries. However, waste management also significantly improves with increasing prosperity; progressing from waste dumping to well-managed landfills, from simply burning waste to waste-to-energy incineration, and finally from incineration to recycling. The richer European countries aim to further reduce the amount of waste going into landfills and incinerators; the Netherlands aims for a 50% reduction in incinerated waste, over the following decade.

For Europe, recycling is becoming increasingly more attractive, also from an economic and geopolitical point of view. Europe depends on other countries for many raw materials, and these materials are likely to become scarcer and more expensive in the future, due to global economic and population growth. Therefore, Europe should carefully manage its current resources, including the materials present in products and waste.

A growing number of companies and regions aim for a circular economy, in which production cycles are closed as much as possible. This means that products are increasingly being designed in such a way that materials can easily be recovered at the end of the product life cycle. Waste prevention and reuse are the guiding principles of this approach. A circular economy would also allow a shift from owning to leasing goods, where producers retain ownership of the materials.

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A circular economy goes beyond waste-to-energy incineration and recycling. In this system, waste is no longer viewed as waste, but as a resource for new products.

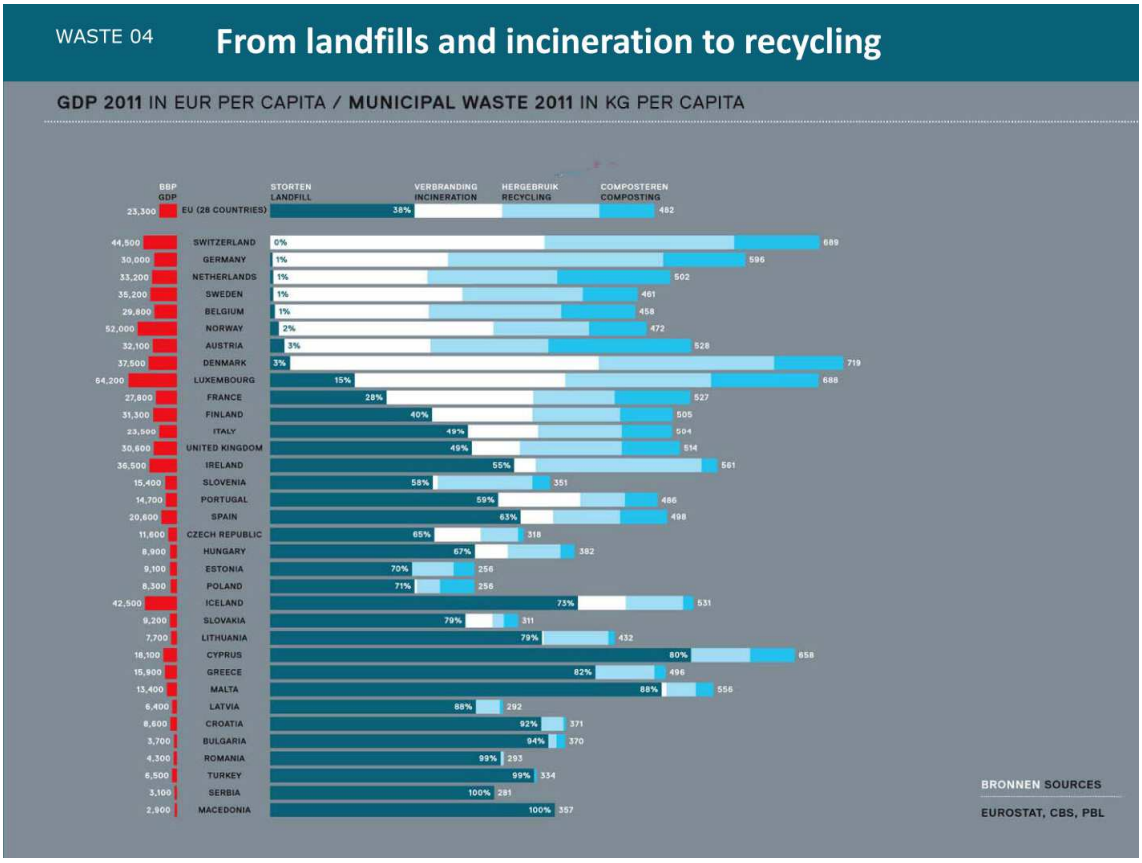

Fig. 10: European comparison of waste production and waste treatment

Fig. 11: Global issues related to waste Waste

4.5 Waste travels the world

Across the globe, population growth and increasing prosperity lead to growing waste flows. This is primarily an urban issue – not only because urban populations are growing so rapidly, but also because urbanites on average produce two to four times more waste per person than do rural inhabitants. The latter generally are poorer, consume less, and reuse and recycle more. In 1900, the global urban population produced 300,000 tonnes of waste per day. A hundred years later they produced ten times this amount: 3 million tonnes per day. By 2025, this figure is expected to have doubled to 6 million tonnes per day.

These quantities are an enormous burden on urban environments; particularly in less developed countries where waste management is not well-organised. In countries with many people living below the poverty line, the enormous waste flows are leading to deplorable conditions. In some cities, the slums are overflowing with rubbish. Numerous people live and work on the vast rubbish dumps of big cities. Furthermore, large quantities of plastics end up in nature areas and oceans, where they increasingly endanger the environment for both humans and animals.

Waste, however, also offers opportunities. If better recycled and reused, waste becomes a valuable resource for new products. As was common practice in the Netherlands, decades ago, many poor countries have a lively tradition of recycling and reuse. Over the years, people developed their own informal collection systems, which support a broad sub-economy based on recycling. These days, they process not only local waste, but also discarded electronic parts and equipment, known as e-waste, from Western countries. Processing e-waste is profitable because electronic devices often contain valuable metals such as copper, nickel, iron and even gold. However, great care must be taken to avoid unsafe exposure, because e-waste may contain hazardous substances. According to the United Nations Environment Programme (UNEP 2012), the available data on e-waste is limited, and in poorer countries, particularly in Africa and Asia, waste dumps are known where e-waste is not being processed safely.

5 CONCLUSIONS

Cities stand in the front line of sustainable development. They contribute most to CO2 emissions and other resource use; but they are also most capable of innovation and change. Smart technologies can help to make cities more resource efficient, but generic technology-driven concepts will not be enough. To create more sustainable and livable cities in the future it will also be necessary to combine the intelligence of policy makers, planners and companies with the intelligence of citizens. A fundamental starting point to make citizens, planners and policy makers smarter is to create a better understanding and awareness of the way our cities work at the moment. The problem is, however, that our urban metabolism is complex and often hidden. In this context infographics on urban metabolism and environmental issues are a powerful tool to communicate information, and to create a general base of awareness. Infographics can present complex information in a compact, comprehensible and attractive form. Thereby they make data, information and knowledge easily accessible to various target groups, such as general public, planners, stakeholders and policy makers.

6 ACKNOWLEDGEMENTS

The infographics in ‘Nederland Verbeeld’ (PBL 2012) and ‘Smart about Cities: Visualizing the Challenges for 21st Century Urbanism’ (Hajer and Dassen 2014) have been produced by a team of researchers and designers of the PBL Netherlands Environmental Assessment Agency in collaboration with graphic designers. The infographics in ‘Nederland Verbeeld’ have been elaborated in collaboration with Frederik Ruys (Vizualism). The infographics in ‘Smart about Cities: Visualizing the Challenges for 21st Century Urbanism’ have been produced in collaboration with Catalogue Tree, a design company specialized in the visualization of data.

7 REFERENCES

FERRÃO, P. and J. FERNÁNDEZ: Sustainable Urban Metabolism, MIT Press. Boston 2013.
HAJER, M.: Energetic society. PBL. The Hague, 2012.
HAJER, M. and T. DASSEN: Smart about Cities: Visualizing the Challenges for 21st Century Urbanism. Nai010 publishers. Rotterdam, 2014.
HILL, D.: The City that Smart Citizens Built, in: Volume #34, pp 128-132. Amsterdam 2012.
PBL The Netherlands Assessment Agency: Nederland Verbeeld/The Netherlands in Infographics. PBL. The Hague, 2012.

UNEP United Nations Environment Programme: Global Environment Outlook 5; Environment for the Future We Want. UNEP. Nairobi, 2012.
UNEP United Nations Environment Programme: City-Level Decoupling: Urban resource flows and the governance of infrastructure transitions. A Report of the Working Group on Cities of the International Resource Panel. Swilling M., Robinson B., Marvin S. and Hodson M., UNEP. Nairobi, 2013.
VOSSOUGHIAN, N.: Otto Neurath: The Language of the Global Polis. Nai Publishers. Rotterdam, 2008.