A Roadmap for Sustainability for a Community in The Netherlands

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A Roadmap for Sustainability for a Community in The Netherlands

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***Abstract*—The sustainability transition is a systems of systems challenge to the power 'n'. The amount of systems and organizations that is involved is inconceivable for most humans. A roadmap is a means to structure much information and to help humans and organizations to understand their role in this transition.**

This paper describes a roadmap for a local municipality in the Netherlands. It explains the roadmap contents and the current experiences in using and evolving the roadmap. The general response to the roadmap is quite positive. However, we need to evolve the roadmap to turn it into a living entity that is helping the sustainability transition.

Keywords—roadmap, sustainability, renewable energy, climate change

I. Introduction

The entire population of Earth will have to contribute to a global sustainability transition; see 2018 IPCC report summary [1]. Sustainability is a broad field, where the United Nations (UN) defined 17 Sustainability Development Goals (SDGs)[i]. The European Union has taken over these UN SDGs. The SDGs then propagate to national level, e.g. The Netherlands. Dutch regulations direct the provinces and the municipalities in their sustainability policies and actions.

In [2] and [3], we have reported how the sustainability cooperation Best Duurzaam in the Dutch town Best, in cooperation with the municipality Best created a roadmap. The objective of this roadmap is to help organizations working on sustainability projects to align their activities.

The sustainability transition is a Systems of Systems problem to the power 'n'. The amount of systems and organizations that is involved is inconceivable for most humans. A roadmap is a means to order much information and to help humans and organizations to understand their role in this transition.

Roadmapping is a method that companies use for evolution and revolution of their markets, products, technologies, and resources [4]. Miedzinski et al [5] transfer this method to the broader sustainability settings.

II. The Initial Sustainability Roadmap for Best

A roadmap for sustainability consists of 5 layers; see Fig. 1. The top layer contains objectives and trends. It is describing what is happening in the context, where we want to go/what we need. The second layer shows the solutions and required capabilities to get there. The third layer shows the means that we need to get there, such as hard and soft technologies. The fourth layer shows the resources that we need, such as human competences, education, production, and raw materials. The fifth and bottom layer shows the governance required to achieve the objectives, such as legislation, standards, and leadership.

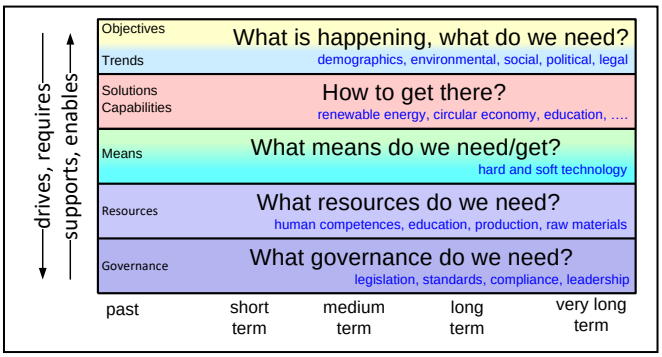

Fig. 1. The layers of a sustainability roadmap

Laura Elvebakk presented the initial roadmap that the project created to the municipality of Best and the sustainability cooperation. Fig.2 shows this roadmap as A5 miniature. In this paper, we will address each layer of the roadmap. The colored band at the bottom of the roadmap is a brief explanation of the items in the various layers. The most pregnant messages are marked with an exclamation mark.

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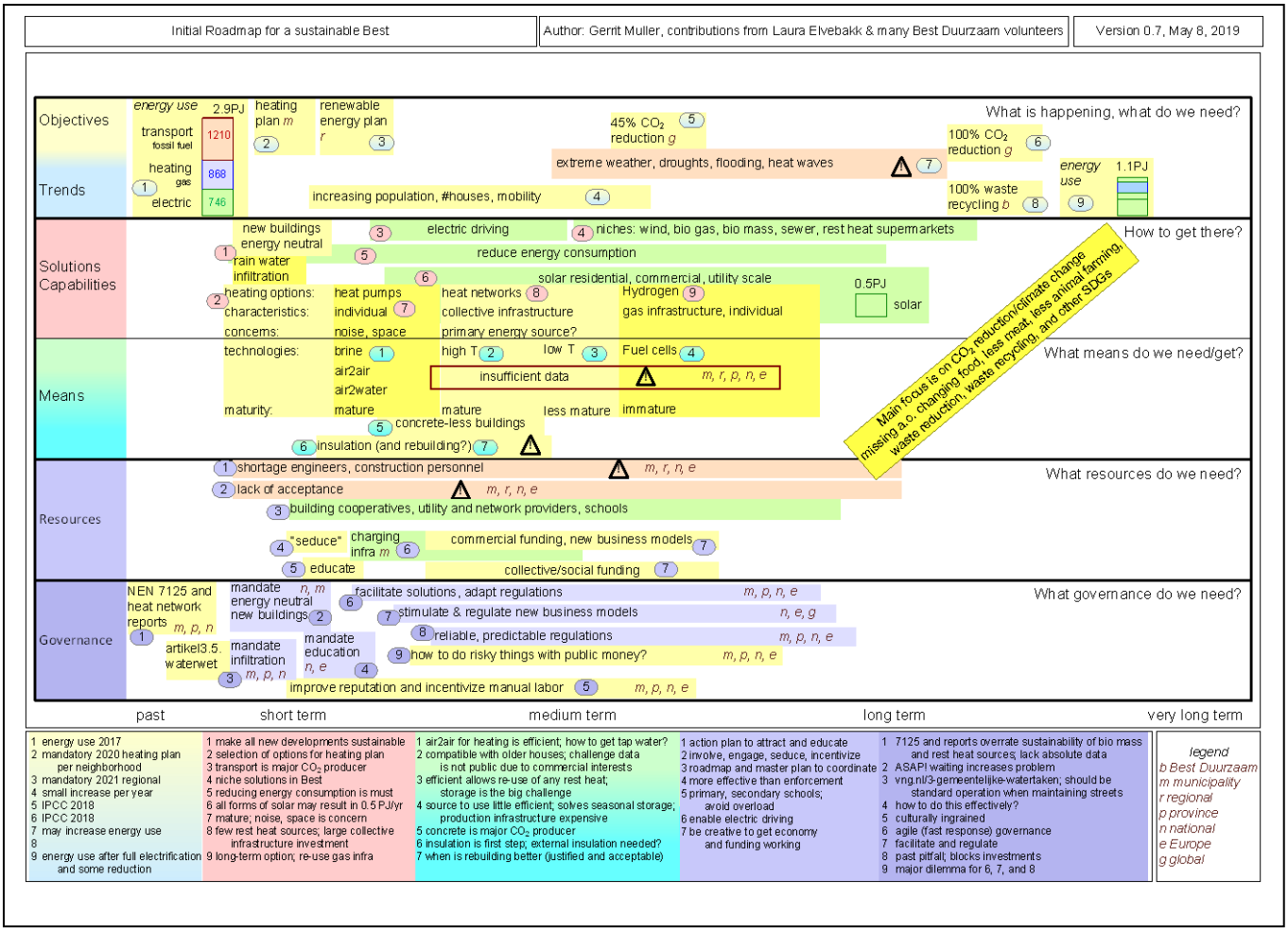

Fig. 2. Miniature representation of the roadmap, which is well readable when printed on an A3 (297*420mm)[1].

A. *Trends and Objectives*

In the trends and objectives, there are two short-term milestones for the province Noord Brabant and municipality of Best; they need to have defined policy and plans for the regional (renewable) energy and for heating (transitioning from using natural gas to other sources). The roadmap focuses mostly on energy to serve this short-term need.

Fig. 3 shows the current energy consumption of the municipality. Fig. 4 shows our back of the envelope estimate of the required energy in the long-term. This estimate makes several assumptions:

- Small vehicles and cars will become all electric
- Trucks and buses will use Hydrogen
- More energy reduction due to lower speed, and smaller and lighter vehicles
- Heat pumps and insulation will reduce heating energy use
- Other electricity use will become more efficient. Life style changes will enable some more reduction

All measures together will reduce today's use of 2.9 TJ to 1.1 TJ.

The top layer of Fig. 1 shows that we strive for 45% CO_2 reduction in 2030 and 100% CO_2 reduction in 2050. We strive for 100% waste recycling in 2050 too. The risk of extreme weather, droughts, flooding, and heat waves requires mitigation, and may cause an unforeseen increase in energy use. Over the entire period, we can expect a moderate increase in population, number of houses, and mobility.

B. *Solutions and Capabilities*

Some foreseen solutions and capabilities are obvious, e.g. all new buildings must be build energy neutral, all rain water should infiltrate in the ground, cars become electric, we reduce energy where possible, we use all available space for solar harvesting, and we use niche energy sources as much as possible, e.g. wind, bio gas, bio mass, sewer, and rest heat.

However, in the discussions with the stakeholders we hit a big area of uncertainty in the heating solutions. We identified three main options, with each main option many variants:

- Heat pumps (geothermal, air to air, air to water)
- Heat networks (high, medium, or low temperature)
- Hydrogen, or synthesized methane or other hydrocarbon, ammonia, or other chemical energy carrier

[1] The roadmap and its supporting material is at https://gaudisite.nl/SoSE2019sustainabilityRoadmapBestSlides.pdf

Best Energy use https://klimaatmonitor.databank.nl/dashboard/Dashboard/Energiegebruik/Totaal-bekend-energiegebruik--41/

	fossil fuels	gas	electric	2017 TJ/yr
Buildings				
residential		566	141	702
commercial		130	328	427
public		45	38	82
total buildings		**739**	**507**	**1211**
Traffic				
on roads	1146			1146
mobile equipment	49			49
ships	4			4
rail (diesel only)	11			11
total traffic	**1210**			**1210**
Industry and construction				
industry		103	211	312
construction		9	5	14
total industry & construction		**112**	**217**	**326**
Agriculture		**16**	**22**	**38**
Renewable energy				**68**
Other				**41**
	1210	**868**	**746**	**2894**

Fig. 3. The energy use of Best in 2017

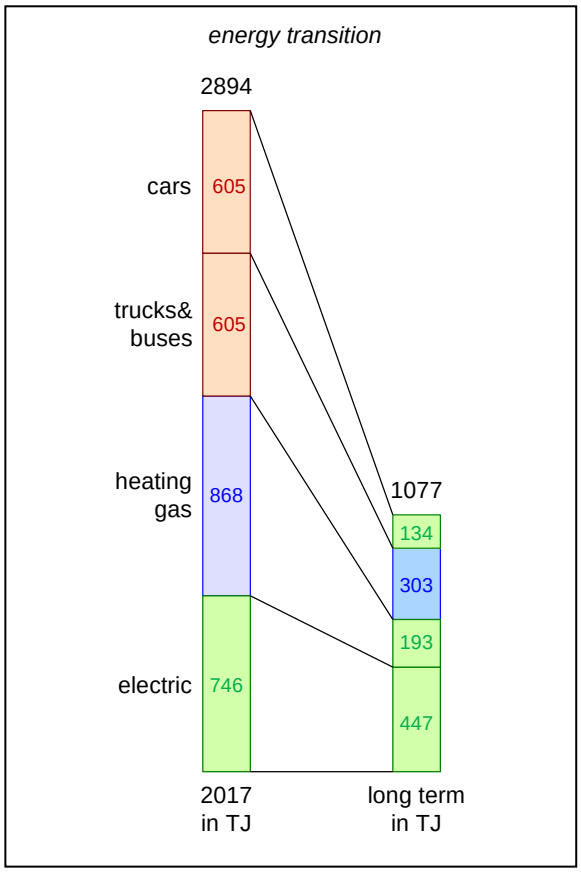

Fig. 4. Estimated long-term energy use of Best

A major problem with the heating options is that we lack much information. We have some information on heat pumps, although the Netherlands lacks experience in applying and installing them. Heating providers have a commercial interest causing them to keep information about heat networks confidential. The government and consultancies advocate heat networks. Unfortunately, we see many failed heat networks and we hear many dissatisfied consumers. Examples of failures are bankruptcies and massive use of (not sustainable) biomass. The last heating options are immature [6].

The various heating options have quite different characteristics, advantages, and disadvantages. The PESTEL framework (Political, Economic, Social, Technical, Environmental, and Legal) provides a way to think about criteria to select concepts. Fig. 5 shows this framework with specific criteria relevant for sustainability in the municipality.

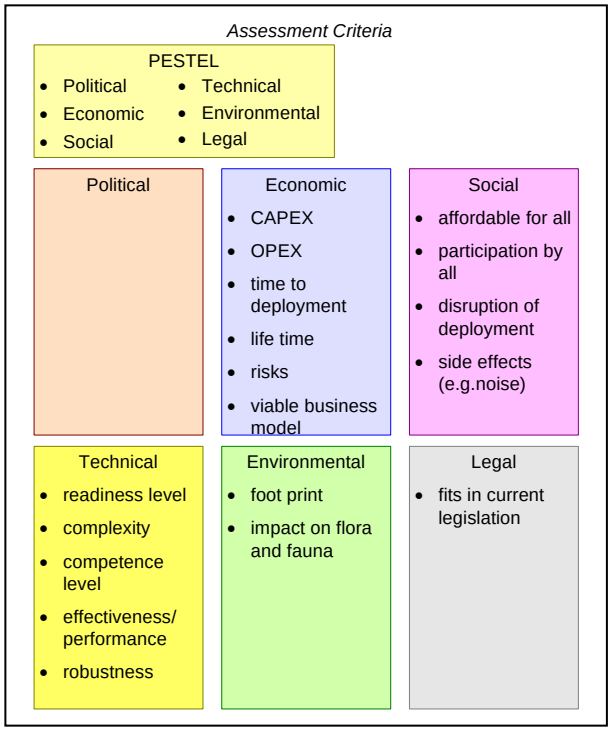

Fig. 5. Assessment criteria for solution concepts.

A major challenge is to cope with the seasonal variation in heating needs and energy supply. The main energy source for municipality Best is solar. A nearby airport, in combination with high population density makes wind energy nearly impossible. Solar energy is abundant in the summer, while our heating needs peak in the winter. We need some form of energy storage. The heating options and the storage options (not shown in the roadmap, these are even more immature) have mutual relations.

We estimated the yearly potential for harvesting solar energy, by estimating the available space for solar in commercial (155 TJ), residential (267 TJ), utility scale (59 TJ), and country side (4 TJ); the total is then 486 TJ. These are coarse estimates, indicating that we may be able to harvest roughly half of the energy that we will use long-term within the municipality. These estimates use 2018 solar performance data, e.g. W_{peak} = 0.2 kW/m2 and historic yearly solar irradiation conversion factor W_{peak} to E_{year} = 825/year. Fig 6. Shows the estimate, using maps of the residential, commercial, and countryside areas.

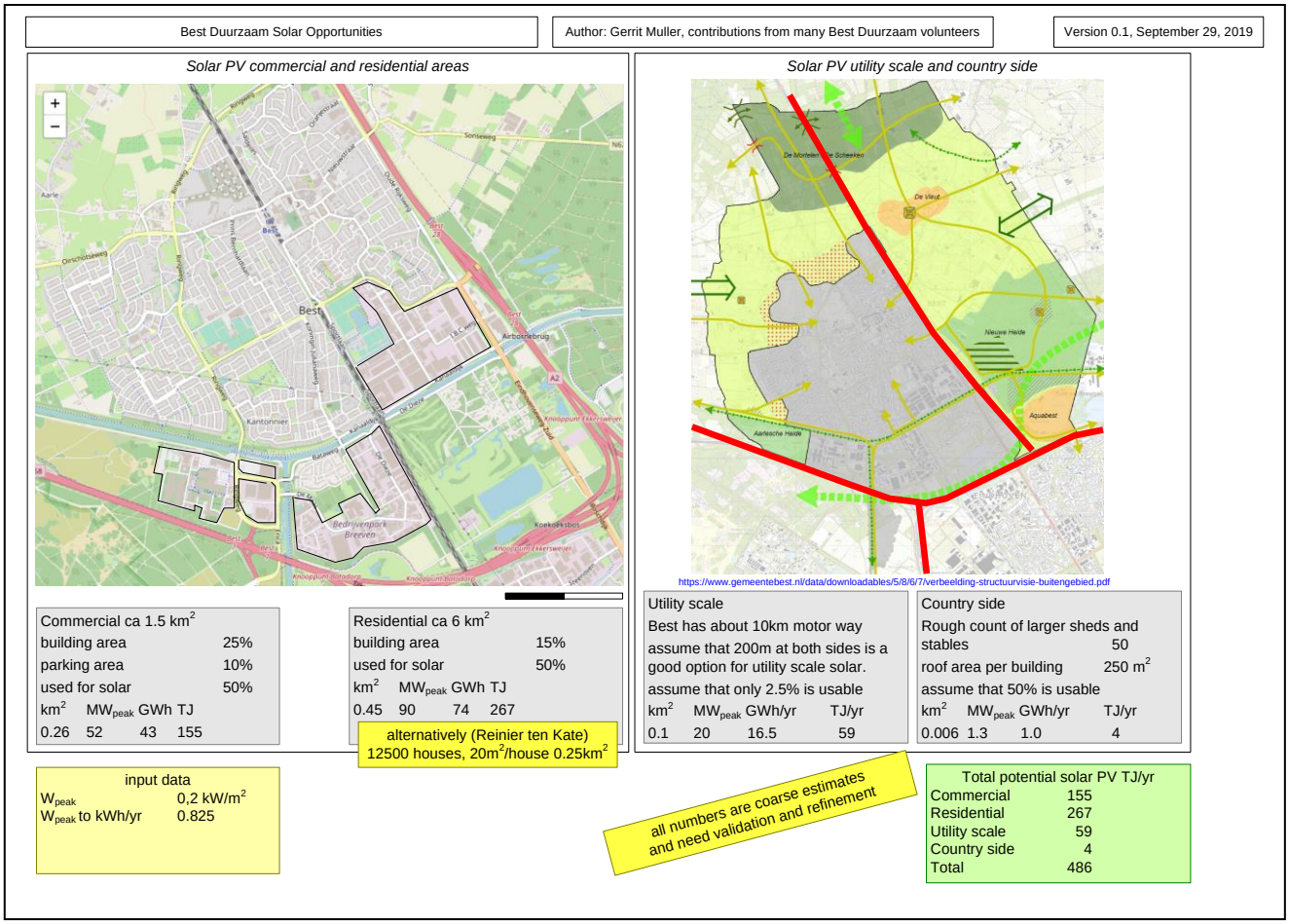

Fig. 6. The estimates for solar potential are using maps of residential, commrcial and countryside areas (original figure is A3 size)

C. *Means*

The means layer in Fig. 1 elaborates the various heating options further. For energy reduction, we need to get rid of concrete and brick. These materials produce significant amounts of CO_2 during production. Timber frame constructions are good alternatives. However, Dutch people are not used to this way of building.

Another must for energy reduction is insulation of houses. Most houses in Best have poor insulation [2]. Since heating is a major energy consumer, insulation is effective for energy reduction and gives a quick return on investment. Challenge is that older (stone) houses have limited options for insulation within the current structure. Most promising way to get significant insulation is to package houses from the outside. Consequence is that for the typical Dutch rows of houses, all house owners need to cooperate for this change. When the building cooperation owns the whole row or apartment building then the cooperation may be able to transition the whole building.

D. *Resources*

There are many organizations involved with the sustainability transition. Some main players that can contribute are the building cooperatives (e.g. to facilitate the insulation of a whole building), utility and network provides (electrification will require strengthening of the electricity network), and schools.

The biggest hurdles for the sustainability transition are in this category. From technical and economic perspective, the transition is feasible; see Jacobsen et al [7]. The socio-political hurdles are significant. The roadmap stakeholders signaled *acceptance* as major prerequisite (or lack of acceptance as blocking hurdle). One of the means to get acceptance is to make sustainable solutions appealing.

The other hurdle is a shortage of engineers and construction personnel. We lack enough people that can build heat networks, install solar panels and heat pumps, upgrade high voltage networks, et cetera. Education plays a crucial role both in educating the future generations on the importance of sustainability, as well as in educating tomorrow's personnel.

Finally, the financial inequality may be a hurdle for the transition. New social or collective funding models may enable inhabitants with less financial means to participate. Society will need new commercial funding and business models to operate all new systems effectively.

E. *Governance*

Today's governance is using standards for construction of buildings and infrastructure. These standards are old-fashioned and take sustainability aspects insufficient into account. A challenge is that the governance processes are inherently slow. The sector is using kind of intermediate standards to circumvent this slowness. For example, the BENG standard in the Netherlands (for Nearly Energy Neutral Buildings) is operational without being formalized.

Consequence of outdated standards is that companies and governments take decisions for the future based on the wrong rationale. A typical example is biomass. The standards

classify biomass as CO_2 free, except for the transportation. The same standards use today's energy mix to classify electricity (generated by coal power generators) as high CO_2 producers. Both classifications are wrong. Biomass needs decades to grow back; all biomass that we burn today, and produces CO_2 today, will grow back and be recycled decades from today. Therefore, the CO_2 produced by using biomass stays in the atmosphere for decades. T the other hand, the electricity mix is changing fast (or should change very fast if we follow the Paris agreement [8]). Electrified heat pumps, 10 years from now do not produce much, since they use then low CO_2 electricity.

The government, national and local, has legislation and standards as main instruments. It is clear that standards for new buildings must prescribe low energy consumption (e.g. good insulation) and low CO_2 materials (no concrete and bricks).

The government needs to enforce existing regulations. An example where this is insufficient is in the water management. The law prescribes that rainwater should be captured and infiltrated in the ground. However, most existing houses and streets drain the water to the sewers.

The government has to play a facilitating role, in which they facilitate solutions, adapt regulations, and stimulate and regulate new business models. Essential is that the government is predictable and reliable. In the past, we have had too many subsidies and arrangements that were introduced and stopped, that made people lose trust and do not dare to rely on stimulating measures.

A major challenge for governmental bodies, such as the municipality is their public responsibility. How can they do risky things with public money? Unfortunately, we have so many uncertainties and so many unknowns in the sustainability transition that the municipality and we will make some mistakes.

III. Roadmap follow-up

A. Task Force

During the creation of the roadmap, the sustainability cooperation anticipated the need to keep the roadmap alive and to evolve it. We need a forum where various stakeholders can meet and exchange sustainability related ideas and insights.

In December 2019, we had the first constituting meeting of the task force. The alderman of the municipality and some of the civil servants together with Best Duurzaam facilitate the task force. A next meeting is planned for March 2020. Unfortunately, the intelligent lock-down due to the corona virus resulted in postponing this meeting.

B. Exploration projects

As follow-up for the roadmap, we identified a number of projects that elaborate specific aspects of the roadmap. In January 2020, a Norwegian student started on his project modeling long-term energy storage solutions for Best. Another student starts in March 2020 on a project studying the acceptance of heat networks.

C. Energy projects

The municipality started a project for seasonal heat storage for utility buildings, e.g. the heating and hot tap water for the sport hall, a few schools, and a local cultural center. The source for this heat storage is a collection of heat collectors on the roof of the sports hall. This project is in the early feasibility phase. The objective is to participate in the national subsidized program to learn about thermal heating systems.

Core to this project is that the source, distribution, and storage are all in thermal energy, which means that the electricity network does not need to be enhanced for these buildings. The thermal storage should help coping with seasonal variations.

This project stranded in the council for several reasons. The main reason that political parties blocked the proposal was a lack of an energy transition framework for this project. The politicians wanted to know how this project fits in a broader program to make the transition happen in the municipality. Ironically, that is exactly the purpose of such roadmap. Such roadmap provides the input for a policy framework of the municipality.

Best has one utility size solar farm, and we participate in a solar farm at the local airport. Since the presentation of the roadmap, two commercial companies have launched plans for utility scale solar in Best. As the roadmap indicates, we need some utility scale solar. However, we also need to ensure local participation and acceptance.

IV. Observations and Discussion

The people at the presentation of the initial roadmap in May 2019 were all positive about the roadmap. The feedback was that it helped to get "the big picture", e.g. getting the overview of a rather complex transition, see what the options are, where and when.

At the same time, a common response was that this was a nice and good presentation. However, to reach a broader audience, the roadmap needs to be simplified even further. Fig. 6 shows an attempt for further simplification, highlighting about 8 main messages from the roadmap. For the general public, there is a need for further popularisation.

A clear challenge is to help stakeholders to see the big picture. Most stakeholders seem to feel more comfortable in a narrow scope, e.g. the local project. A risk is that stakeholders regress into local, short-term steps, unaware of the bigger picture. The transition needs all these small, short-term projects to build momentum. The intent of the roadmap is to align these projects such that together we get the momentum required for the transition.

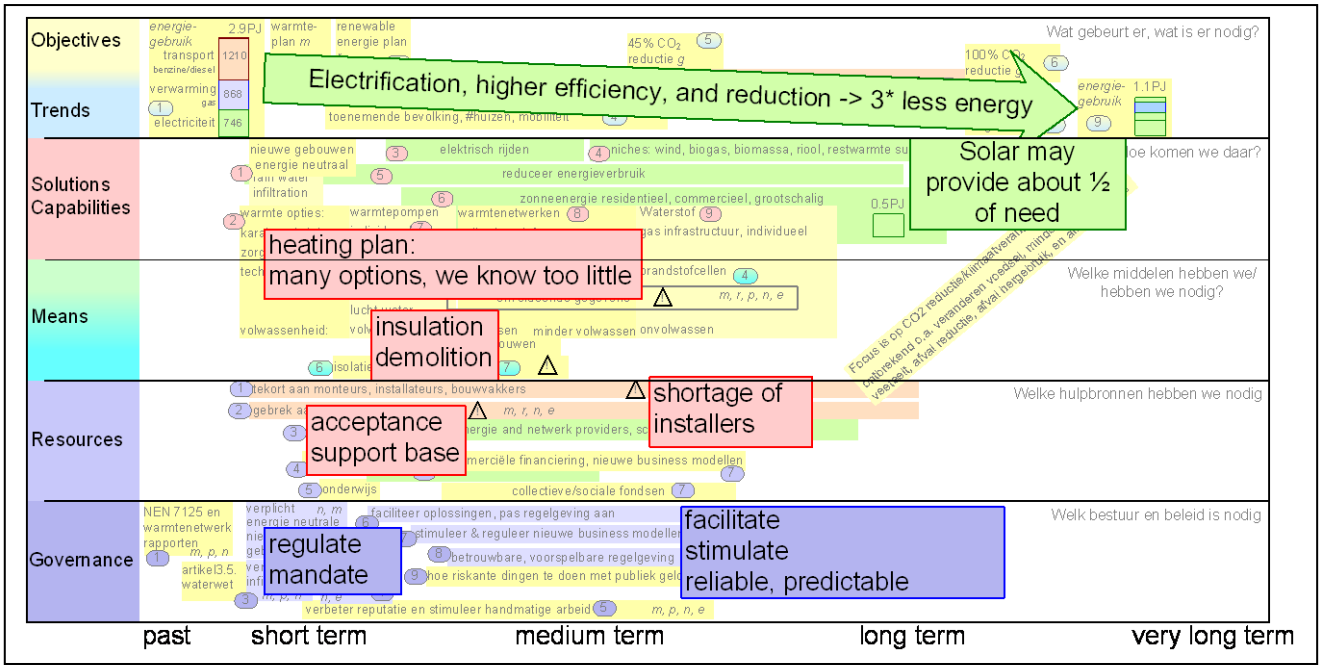

Fig. 7. Simplified roadmap for the general meeting of the cooperation

V. Conclusions

The roadmap for sustainability in Best serves the communication purpose of sustainability stakeholders. However, it needs more momentum and more substantiation to assist the transition.

The initial roadmap is one poster, and a powerful means for communication and overview. There is a large amount of work underneath the roadmap, in the form of back-of-the envelop and models and A3s that forms the foundation of the roadmap. Exploration projects must strengthen the foundation. We now need to work on the popularization of the roadmap to reach the general public.

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