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BRIEFING PAPER

SPEAKING NOTES: INTEGRATED ENERGY SYSTEM TRANSITION

FROM ONE BACKBONE TO THE NEXT

CIEP-NOGEPA GAS DAY | 7 SEPTEMBER 2017

CIEP BRIEFING PAPER 2017 | 02

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SPEAKING NOTES: INTEGRATED ENERGY SYSTEM TRANSITION

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CHECK AGAINST DELIVERY

Ladies and gentlemen,

Thank you very much for attending this 2017 Gasday. In the next twenty minutes, I will try to explain why it is important to focus on what we call *Integrated Energy System Transition.*

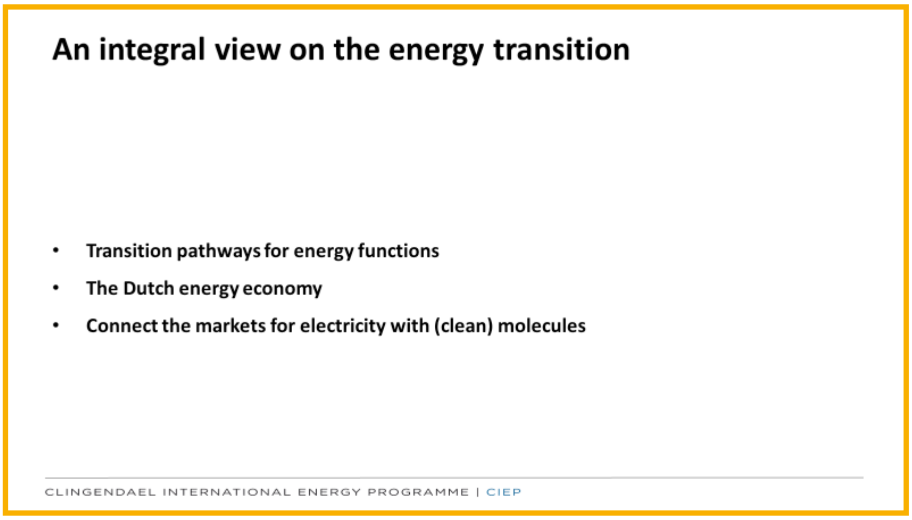
Since the Paris Agreement, the Dutch energy discourse has changed from a 'why and if' discussion to a 'how and when', and is increasingly focused on the energy and carbon efficiency of the entire system. This is an important development.

The change in thinking is also illustrated by the plans launched in the past year by various stakeholders, such as the KVGN with the 'Gas op Maat' programme, the Port of Rotterdam, VNPI, the Northern initiatives, VEMW, and others.

Besides, governments in the EU, including the Dutch government, are working hard on their policy plans to achieve the 2030 goals. These plans need to be submitted by December 2017.

At CIEP, we have been working on various issues related to changing energy markets and policies to reduce CO_2. With the insights derived from recent CIEP studies on international gas markets, European refining, the low temperature heat market and the study 'Why Energy per Carbon Matters', we began to feel a strong need to visualize the expected change. We were curious to find out how all these insights aimed to improve both energy and carbon efficiency could fit together in a new energy system.

Natural gas is a very important backbone of our energy system. We Dutch also like to tinker with molecules. It is important to realise that the energy transition should not only about clean electrons, but also about clean molecules. The natural gas, oil and petrochemical sectors – as well as other industries – can play a crucial role in improving the energy and carbon efficiency of our system in the coming decades. These stakeholders have the type of competences that are needed to build a new backbone in which decarbonized electricity can be used alongside decarbonized molecules.

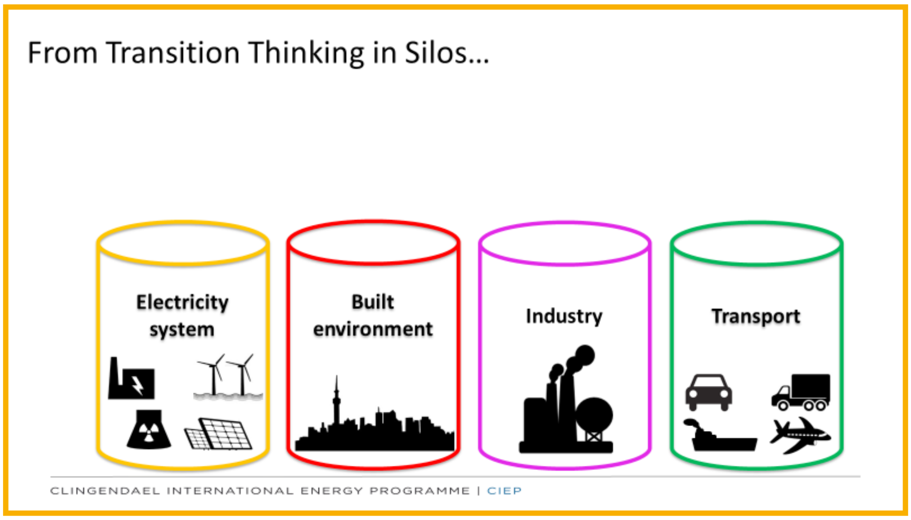


The Netherlands is deeply integrated with energy systems in neighbouring countries and world markets. This also has implications for the Dutch energy system transition, as our policy decisions may affect neighbouring countries and *vice versa.* In addition, substantial economic interests revolve around the energy sector.

In many discussions about the energy transition, the focus is predominantly on technical possibilities and on the economics of individual energy technologies. We often fail to see the energy transition as a dynamic process in which technical and socio-economic aspects interact in an interconnected energy system.

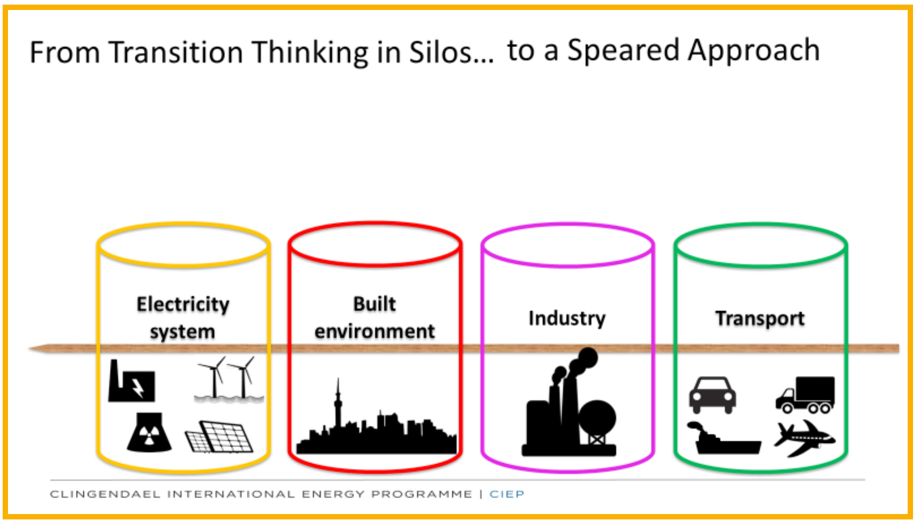
Moreover, if a new energy technology can serve more markets or demand functions, the system's absorption capacity of such technology may increase. In addition, we often discuss about our future energy system without taking into account the type of market players that will be active in a certain market and the scale at which they wish to operate.

Creating new connections between the flows of molecules and electrons through our networks – both current and new – creates and expands the opportunities to dynamically facilitate the energy system transition.



For a long time, energy policy debates were mainly approached from the supply side.

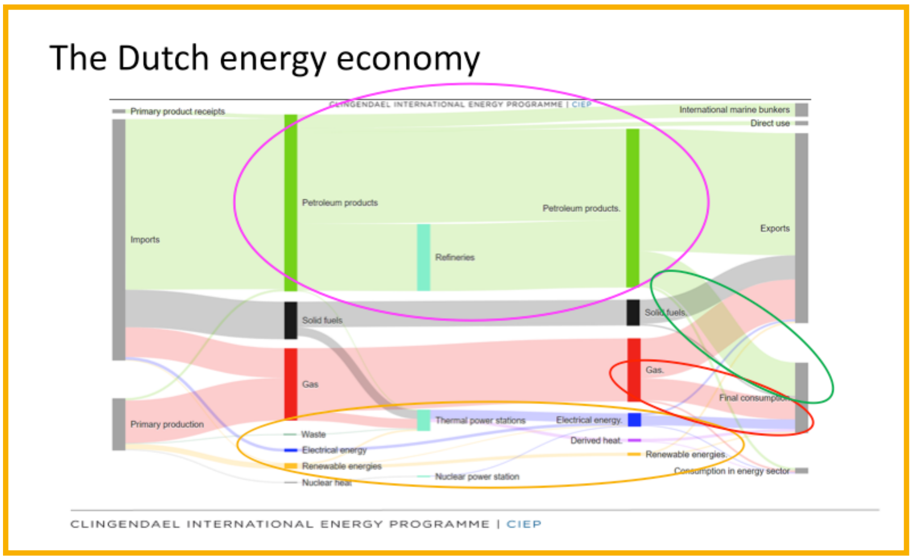
Currently, we run the danger of replacing one form of 'silo' thinking with another. Nowadays we discuss energy policy-making from a demand function perspective, with an excessive emphasis on the electricity system – which only represents about 20% of domestic energy consumption. The danger is to end up with another misleading approach, consisting in 'spearing' the demand functions to make them one – without taking into account their specificities and the complexity of their interactions.



We should take more notice, for instance, of the specific dynamics in the various industrial sectors, with their barriers to entry and exit, their fuel choices and options, and their interconnections with other industries and markets. Without these considerations, the risk is to miss the potential overlap and interaction of various energy markets - almost as if we were looking into our low carbon future with a 'bad case' of tunnel vision.

While the CO_2 emission target is defined for 2050, the process of energy system transition is a moving goal, with moving energy technologies and moving economics, and for a moving economic structure. We cannot exactly predict how the system will look like in 2050. If the aim is to facilitate energy and carbon efficiency to mature properly, we probably do not actually need nor aim to do so. We should avoid thinking only in end-solutions, but value everything that keeps us on the energy and carbon efficient track, including what turns out to be only an intermediate step.

We should thus approach transition from an integrated energy system point of view, across different fuels/energy technologies, demand functions, stakeholders and sectors. The whole is larger than the sum of its parts.



The Dutch energy economy is very large and not very typical for the EU, due to its relatively large refining and petrochemical sectors.

- Electricity has a relatively small share in final energy consumption compared to other energy functions. This share is bound to grow when more demand is electrified, but complete electrification would be too costly and hard to imagine when the total energy consumption of the economy and the seasonality of our demand are taken into account.

- Industry is a relatively large consumer of natural gas, which is used for high temperature process heat or as a feedstock. Another special feature of the Dutch energy economy is the deep penetration of natural gas in the low temperature heating market. In the Netherlands, natural gas is also an important fuel for electricity generation. This has shaped the current pattern of overall gas demand.

- Mobility is a substantial part of our energy demand and various carbon reduction technologies are becoming available.

- The relatively large size of the oil processing sector is obvious from this Sankey graph. Crude oil is both in transit to neighbouring countries and processed in the Netherlands. Oil products and feedstock are exported to neighbouring countries and elsewhere.

The Netherlands is an important energy hub in Northwest Europe. Sometimes, the energy transition is seen as a way to reduce international energy trade to a minimum, reducing dependencies and fostering domestic solutions. This, unfortunately, may also reduce the potential for producing clean energy at the most advantageous locations and moving them to those places where they are needed.

Schematic development of the energy system in transition

- What follows is a schematic development starting from today's energy system and evolving into a hybrid system, which evolves into a low carbon energy system over time when new infrastructures and production have grown and existing infrastructures have been adapted
- The schematic presentation does not represent volumes of energy, it really is a schematic presentation on how and integrated energy system can evolve, based on current technologies/insights and assuming hard 2050 CO_2 targets

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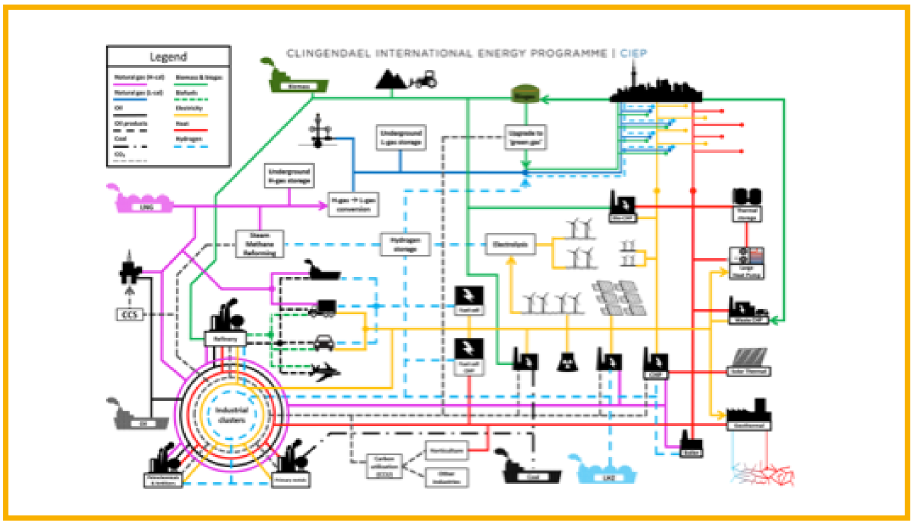
How can then the energy system evolve, integrating existing technologies and networks with new ones, connecting the different demand functions with old and new sources of supply while also guaranteeing an energy service for all (security of supply), with equal and transparent access? The following video presentation gives us an idea.

(see animation of schematic development of energy system transition, The Netherlands and NW Europe)



In the animation we slowly see current and new energy technologies forming the energy system in transition. These are sorted by color rather than preference for a certain order of the fuels. What we do not show here is that flows and technologies may also disappear over time. This also include the new ones, as other flows and technologies may take over their functions.

This presentation is concerned with the period of transition or pathways where ‘old’ and ‘new’ will co-exist without being concerned with a particular landing point in 2050. It just shows the potential landing points, without favoring one over another.

While the video runs and commands the attention of your eyes, I also need your ears, because while technically we can make the connections, we should ask ourselves: “why is it so important to start looking at transition pathways from a dynamic energy system perspective?”

The main reason for this lies in the dominant network characteristics of energy systems, but also in the fact that the transition must include industrial sectors.

Industry should be made part of the energy and carbon efficiency drive and not declared unsuitable for the future energy system, as some suggest. We should avoid industrial sectors being pushed into an upfront state of ‘investment lethargy’, because we lack the imagination to fit them into our 2050 picture. Instead, we should harvest both the investment and technology potential of these sectors to contribute to the energy efficient and low-carbon energy system pathway.

But let’s turn to networks first. Networks require a large capital investment and have only small variable costs. It takes a long time before they are payed-off. The more interconnection and flexibility they provide, the higher the added value and attraction to the connected users. Besides, the presence of adequate network connections supports energy producers and users in investing in new technologies and trading.

Here lies an opportunity **for institutional innovation,** like the one recently seen in offshore wind. Why not let our energy companies in public hands be part of the investments in new networks and CCS, and allow them to develop a longer view on performance? In this way, some of the new energy project risks can be redistributed over the new energy value chains and across the stakeholders.

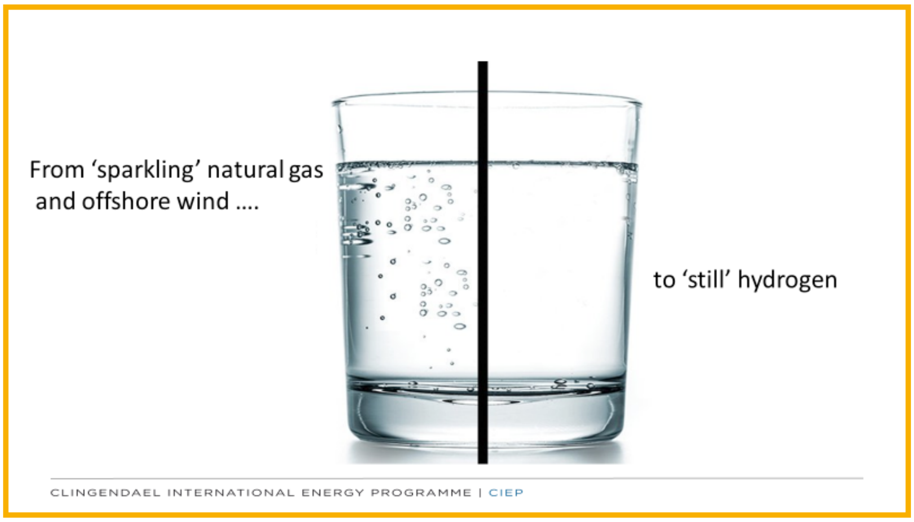
Industry has long lead times to implement new technologies and long investment cycles. This implies that a network for heat, CO_2 or hydrogen (to name a few) might initially have to be oversized to provide plants with the option to include energy and carbon efficiency gains in their next investment cycle planning. If the network is not there, nothing will happen because the costs would be too high for a single plant or factory. Once the infrastructure is there, it becomes a valuable option.

In the longer term, i.e. post-2030, the presence of such infrastructure may ease/empower policy pressure to improve energy and carbon efficiency when moving from the 'carrot' (the network is developed) to the 'stick' ('why are you not delivering?') type of approach in later decades.

We are already discussing the coordination required between the various stakeholders and levels of government to manage this process, sometimes forgetting that we can and should also stimulate the market players to do some of the heavy lifting.

The option to convert from electrons to molecules and from molecules to electrons to balance the various markets is important, particularly with more intermittent supply and seasonal demand variations.

Hydrogen could be the desired flexible carrier that can be produced from solar, wind and natural gas, creating multiple sources and markets. Later in this session, Statoil will explain its hydrogen strategy, which I like to call 'tongue in cheek': *gas met en zonder prik*.



Understanding the potential of the link between electricity grids and grids for 'molecules' will certainly be of great help as a way to economize on infrastructure and energy transportation cost, while at the same time being able to let multiple sources reach multiple user markets. We can continue to solve each transition issue in isolation, or we can recognize that they are all related.

Another important insight is that the results of the CO_2 abatement efforts may come at various points in time for the different demand functions, but the starting point is the same for all: it is now.

When oil and gas markets were developed, they relied on long-term contracts to manage the various risks along the value chain. Risks and benefits were shared among the market players. In electricity systems, it was local and later regional public ownership that provided the required coordination. The question I am raising here is: "how can we provide investors with a sufficient level of comfort to invest in energy and carbon efficiency?"

- Is organizing the new flows and connections sufficient to let the market play its role in developing these new markets?
- Do we need to contemplate using agreements that mimic long-term contracting, let's say for 15 years, to manage project risks?
- Or do we need to think about new instruments such as a variation on the Contracts for Difference for ETS-sector entities, to manage the risk of carbon reducing investments?

We need to rethink the coordination of the energy system transition and pragmatically look at instruments that may stimulate the market participants to do their part too. It cannot be all government, unless we want to end up with a rather planned energy economy.

Schematic development of energy system in transition

- From technical interconnections to geographical options
- This schematic presentation presents the system in a geographical setting, again without representing volumes
- The presentation also connects the Dutch energy system to that of neighboring countries, again emphasizing integration, in this case integration across technologies and borders

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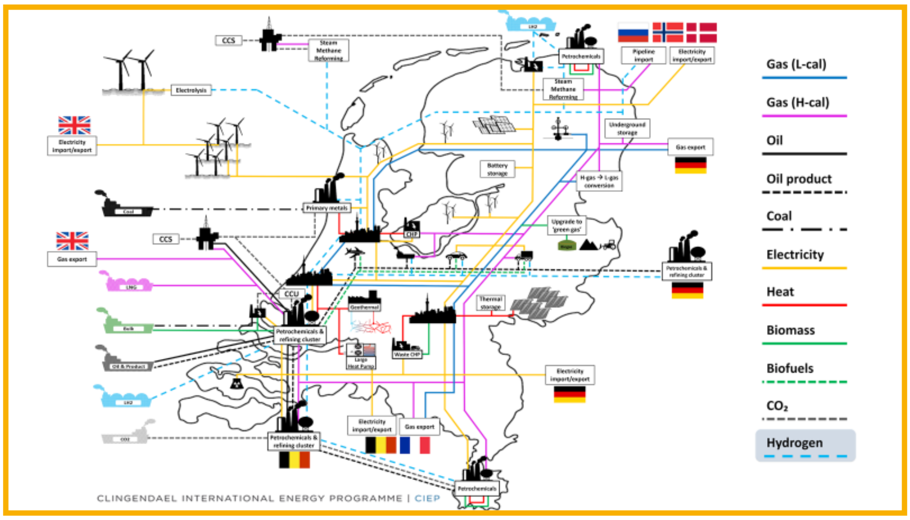
(see animation of schematic development of energy system transition, The Netherlands and NW Europe)

In the animation you can see the same schematic presentation as before, but now projected on the Netherlands and showing the interconnections with neighbouring countries and the world markets. The same impartiality adopted earlier applies here.

The graph shows that the Dutch energy system – with its many interconnections to neighbouring countries and openness to world markets – may sustain its hub function in the future. Producing countries may offer their decarbonized energy to the market, storing the CO_2 in their empty oil and gas fields. When storage is cheaper in the offshore Netherlands, we can do that here. Again, I need your eyes and ears.



It is clear that the transition will not happen overnight. We have not even touched on the potential labour and capital market hurdles, certain regulatory issues, and changing safety regulations that could hinder a rapid transformation of the energy system.

Allow me, while you are watching, to make some last points on why we should look at the transition as a dynamic process and include all sectors of the economy:

- Dutch energy intensive industries (refining, petrochemicals, etc.) are highly clustered and energy efficient, which makes them internationally competitive. Rather than contribute to more carbon leakage**,** we should embrace the potential to increase their energy and carbon efficiency here in the Netherlands.
- World demand for petrochemicals is projected to grow also in 2^{0}C scenarios. Refineries deliver feedstock to the petrochemical industry and they use a lot of hydrogen. The potential to become connected to new sources of hydrogen, as

well as the benefits for offshore wind and solar to become connected to a substantial market, should not be under-estimated.

- Moreover, these industrial conversion installations may continue operations despite declining Dutch and European demand for refined oil products (transportation fuels).
- Barriers to exit play an import role in the logic of the transition pathway in the energy intensive industry. For instance, refineries can have very large exit costs which means that by 2030 most of them will still be part of our energy system.
- Industrial surplus heat increases energy efficiency and introduces low temperature heat from the ETS sector into the domestic sector.
- Extension of the current industrial CO_2 pipeline infrastructure can increase role of CO_2 as a commodity (horticulture and algae) and create diverse sources for CCS projects.
- At the same time, coupling the electrification of industrial processes (as more solar and wind power becomes available) with hydrogen as an energy carrier can enable connecting low carbon electrons with low carbon molecules. In this way, we would have a stable source of energy supply in addition to intermittent .
- Lastly, investments in new networks alongside the current system may not only facilitate incumbent industries to invest in energy efficiency and CO_2 abatement, but may also attract new (low-carbon) industries.

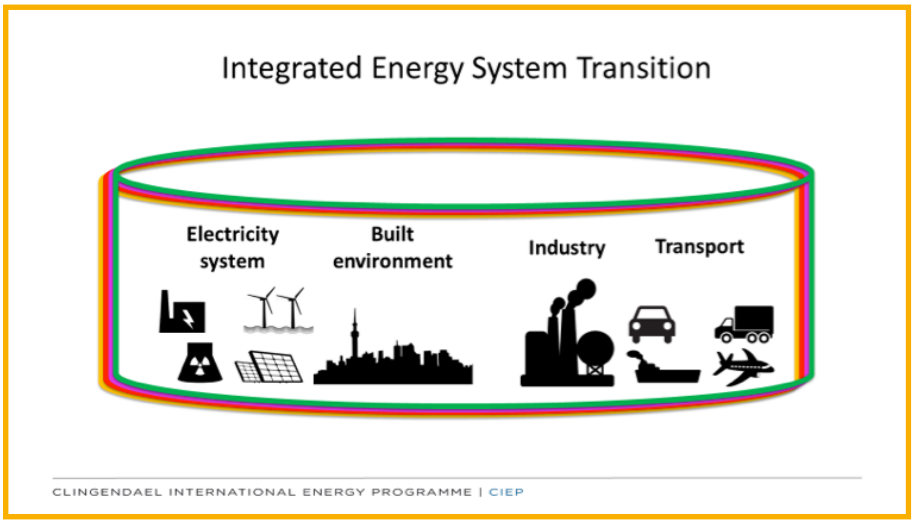
In conclusion

1 We know that each demand function will have a different CO_2 reduction trajectory. Energy system transition policies should take this into account and society should be made aware of this.

2 Government and government-owned energy entities can play an important role in facilitating market participants to realize energy and carbon efficiencies over time.

3 Creating new networks and/or – where possible – re-use old ones, can help connecting and creating a more vibrant market for low carbon electrons and molecules.

4 It would be highly beneficial to include all sectors (including industry) in the energy system transition and to allow low carbon supply-demand synergies to develop inside The Netherlands as well as with neighbouring countries and, ultimately, world markets.



I hope we have piqued your imagination about the possibilities of integrated energy system transition and that you can see, just like we did, the potential for the Netherlands and the rest of NW Europe.

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