Mapping

The

Energy Innovation Ecosystem

Of

ZUID-HOLLAND

2022 | The Hague Tech

orgvue

THE HAGUE TECH

provincie Zuid-Holland

Berend Potjer

Regional minister Province of Zuid-Holland, for energy

Province of Zuid-Holland is excited with the results and findings of this study, in which we updated the 2018 insights on the quantities and qualities of the Energy Innovation Ecosystem in our region. The expectation that the 2022 update would "identify an even stronger ecosystem" was correct: we observed a growth of 75% in people working on energy innovation and transition activities, see large companies shifting their attention towards transition and a rapidly growing ecosystem of startups and scaleups that offer exciting opportunities to invest and grow.

The 2022 report not only provides new insights into organisations and their activities, it also offers a new range of views on the potential for economic growth and the improvements needed/required to support energy transition.

We are pleased to see the groups of opinions on the changes needed in the ecosystem:

- Regulation that is more up-to-date and applied faster and more effectively
- Education that builds on Zuid-Holland's excellence in research and adds training for the technicians and installers that our society will need in large numbers
- Governmental intervention to support market solutions – overcoming information gaps, supporting co-operative solutions to speed up energy-infrastructure development

Many of the technical solutions for energy transition in the next 10 years already exist. The challenge is stimulating co-operation and bringing actors and pillars together, to implement the technology into solutions, by bringing the techniques and technicians together with legislators, financiers and markets; and the variety of energy-Fieldlabs within our region can play an key role in doing so.

The database that has been created can be quizzed from all these angles and more. This report and the accompanying Dutch summary therefore brings out the top questions and gives quick insights. It will be available online through the website of the Province of Zuid-Holland (http://staatvan.zuid-holland.nl/energie/).

These insights provide a good base to collaborate more effectively on creating an Energy Innovation Delta as a new emerging strong economic cluster in Zuid-Holland, and especially to co-ordinate our actions: for whatever we have achieved in the last 4 years, in the next 4 years we need to do this and much more!

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Executive Summary

Overview of the current Energy Ecosystem

- The 2022 report's focus has moved from 2018 to include more startups and scaleups and to focus on Energy Innovation within Energy Transition. Using data from city-level datasets we surveyed 152 individuals from 135 separate organisations.
- **More than 22,000 Energy FTE**. The 135 interviewed organisations identified at least 22,000 Energy FTE (full-time equivalents) in the PZH energy ecosystem.
- **More than 7,500 Energy Transition FTE.** The 135 interviewed organisations identified at least 7,500 Energy Transition FTE in the PZH energy ecosystem.

Growth in Energy Transition FTEs

- **75% growth in energy transition FTE mapped.** The energy transition ecosystem of 7,650 FTE mapped in 2022 is much larger than the 4,300 FTE mapped in 2018. Partly this is due to a larger sample size but also to a genuine change in the number of positions and the activities carried out: organisations interviewed in both 2018 and 2022 had a near 90% increase in Energy Transition FTE. This aligns to their reported prioritization of Energy Transition (on average #2 priority), ahead of Circular Transition (#6 priority) and Digital Transition (#7).

Challenges & Opportunities

- **Carbon-intensive industry remains - an inheritance and an opportunity.** Of the 22,000 Energy FTE, more than half still rely on or work with carbon-based energy sources: coal, gas, and others. Most work in large energy providers (e.g. Stedin, Shell) which are starting to transition and could be encouraged to do much more.
- **Wind energy manufacturing, solar manufacturing and energy storage.** These 3 key opportunity areas indicate that some existing companies might need to reorientate. Solar energy and energy storage were also the sectors attracting most nominations for startups for investment.

Key strengths

- **The geography of the Province**, particularly the city of Rotterdam and the harbour as a business hub where quick connections can be made.
- **Knowledge**, to which Delft is the major contributor.

Key concerns

- **The government**, because of regulatory complexity which results in long procedures as well as outdated regulations and a lack of clear direction.
- **The lack of talent**, in particular technicians and skilled workers below universitiy degrees.

Key recommendations

The 6 high levels groups of recommendations are listed below with examples of the most important categories in each group.

1. **Collaborative working**, e.g. strengthen network connections
2. **Incentivise change**, e.g. lifecycle stage support
3. **Bold vision for ecosystem**, e.g. clear direction
4. **Regulatory effectiveness**, e.g. regulatory speed
5. **Education**, e.g. support talent creation
6. **Infrastructure effectiveness**, e.g. improve spatial planning

02

Introduction

In 2018, the energy innovation ecosystem in Zuid-Holland was mapped by a team of researchers based at The Hague Tech, using OrgVue software. The 2018 study interviewed over 80 people and identified at least 4,300 FTE involved in energy transition, working across Government, Business, Knowledge and Finance sectors.

Between 2018 and 2022, public interest in delivering energy transition became stronger. Governments were implementing the 2015 Paris Agreement, making new commitments in the 2021 Glasgow Climate Pact, and the Netherlands was creating its plans for a new economy. Russia's invasion of Ukraine in February 2022 made the need for greater European energy independence obvious. The energy transition plans described here are broadly consistent with the aim of energy independence, even if some elements might now have greater urgency.

All these geopolitical changes sharpened the relevance of Province of Zuid-Holland's two key questions:

> ***How have the activities and number of Energy FTEs in the ecosystem changed since 2018?***
>
> ***How can the Province best help the ecosystem meet its transition challenges and take advantage of transition opportunities?***

In the first half of 2022, the energy ecosystem in Zuid-Holland was mapped in a follow-up study, by a team also led by Giles Slinger at The Hague Tech. The team included 7 graduate and intern researchers from Leiden University's Masters in Governance of Sustainability programme. The 2022 research increased coverage with more interviews and by interviewing more people from small businesses. In answer, researchers documented:

- The nature and scale of the Zuid-Holland energy ecosystem
- Future potential for energy transition vs. current energy activities
- Key people and organisations leading the change
- Effectiveness of existing ecosystem pillars
- The actions recommended for improving the ecosystem.

The research was funded by the Province of Zuid-Holland. The results of the qualitative interviews have been handed over to the Province for further analysis. Respondents were promised that their answers would be anonymised unless they explicitly gave permission for named publication. Respondents have also been offered a copy of the final report and opportunities to strengthen their energy network connections via future events held by the Province.

03

Key Questions, Approach & Methodology

Key Questions

In 2022, the Province of Zuid-Holland asked the team at The Hague Tech to follow up its 2018 report by gathering responses to two key questions:

Have the activities and number of Energy FTEs in the energy innovation & transition ecosystem?

How can the Province best help the ecosystem meet the transition challenges and take advantage of transition opportunities?

Research Approach

For the scope of this research, we defined energy innovations as those supporting energy transition. Hence, later in the report when we refer to energy transition, we also include energy innovation.
The 2022 research built on the 2018 report with larger numbers of interviewees (>150 vs. >80) and greater scope (increased attention to start-up and scaleup businesses). 85% of responses were gathered in qualitative interviews, mostly via webconference, and 15% through online surveys.

Respondents were asked for data about their organisations (e.g. FTE and activities in energy in Zuid-Holland) and for their opinions about the Zuid-Holland Energy Innovation & Transition Ecosystem. Answers were analysed to identify common strengths, weaknesses, opportunities, and potential actions within the ecosystem, and to highlight key messages from each part of the ecosystem.

To be clear on potential bias, the researchers' starting perspective is that energy transition on the timetable laid out by the UN's SDGs is ethically vital and economically justified. The research team sees markets as usually good at allocating resources, but at risk of failing if decisions are hard to co-ordinate, if competing aims are not easily reducible to a single set of costs and benefits, or if collaboration is required to create new value[1].

Energy transition is such a situation. So the aim is to collect data along with the **weight** of opinion, the **authentic detail** of multiple voices, to identify **reasons** and potential **actions**. Hence this study provides a sense of opinions within the energy ecosystem of the Province, and the economic reasons beneath interviewees' comments, to support the Province in future policy-making situations.

Methodology

The 2022 study provides an overview of the Energy Transition Ecosystem in the Province of Zuid-Holland. Each organisation interviewed is categorised by ecosystem pillar, activity, and energy source. This categorisation is used to provide insights into the ecosystem. Organisations may have activities in multiple pillars, in multiple stages of the value chain, and may participate in the governance, operation, or maintenance of multiple energy sources.

1 Raworth, K. (2017). Doughnut economics: seven ways to think like a 21st-century economist. Chelsea Green Publishing

The Pillars of the Energy Transition Ecosystem

The study uses a model of four main pillars linked by interaction. This is inspired by the work of Frans Nauta, who identified these ingredients as the foundation of Silicon Valley's success, and is similar to the Rotterdam Erasmus Centre for Entrepreneurship's[2] ecosystem concept. It also provided continuity with the pillar model from 2018 (see Figure 1).

2 See, e.g. Van De Vrande, V., Bax, M., Fuligni, L., Hsu, K. (2022). *Study of the (cleantech) innovation ecosystem with a focus on GIST and SCALE-UP*. Erasmus Centre for Entrepreneurship.

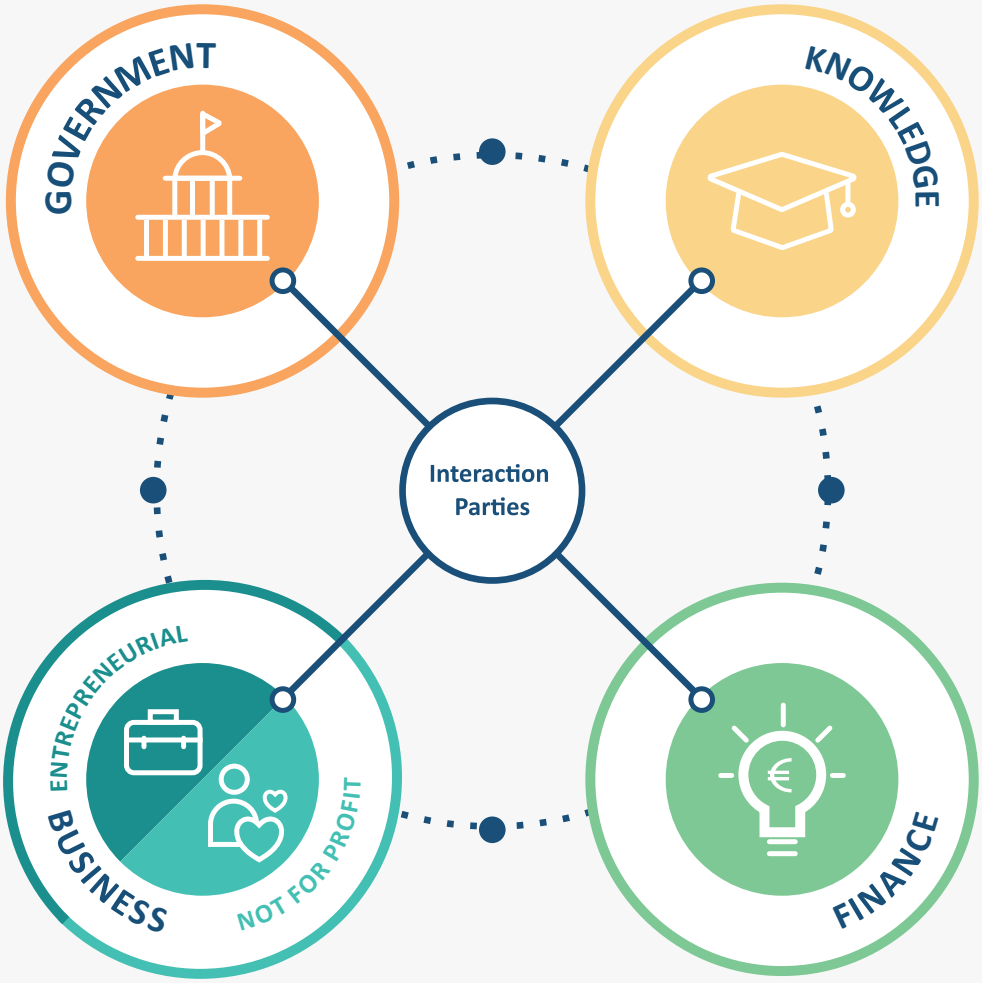

Figure 1. The Pillars of the Energy Innovation Ecosystem

Business

The Business Pillar includes entrepreneurial organisations and semi-public and public companies as well as Not For Profit organisations. This pillar is the largest and the most diverse and includes the main drivers of the sustainable energy transition. Of the 98 business organisations interviewed, approximately 10% described themselves as 'Not For Profit'.

Government

Organisations in the Government Pillar include municipalities, provinces, national and EU government bodies involved in energy ecosystem policy making and programme implementation. These bodies provide the regulatory guidance for the sustainable energy transition.

Knowledge

Organisations in the Knowledge Pillar include all of Provincie Zuid-Holland's world class educational institutions that provide exemplary talent and breakthrough research to support the sustainable energy transition. This section includes universities, vocational institutions, private research companies, and professional educational associations.

Finance

The Finance Pillar provides crucial capital for energy innovation and ecosystem investments. Banks, venture capitalists, and acceleration funds included in this pillar provide the vital funding for the sustainable energy transition.

Overlap Between Pillars

Organisations were allocated to only one of the four pillars, even though some split their effort between two or more pillars. For example, a government can issue funding subsidies, and an organisation can be involved in both research and business. In such cases, researchers allocated organisations to pillars according to where the greater amount of their time was spent. The categorisation of each individual organisation in this study is given in Attachment 1.

Interaction treated as part of organisations' activities

In the 2018 study, some organisations were identified as "Interaction Parties" which were defined as organisations focused on connecting players in the ecosystem. However, many organisations put some time into facilitating interaction. To capture this in 2022, all interviewees' organisations were asked whether all or part of their funding was intended to support interaction between other players in the ecosystem. To the extent that they reported being funded to support interaction, they were interpreted as having an interaction role.

Energy FTE and Transition FTE

'FTE' is 'full-time equivalent'.
Two people working half-time is 1 FTE.

Energy FTE

Are defined as full-time equivalents involved in any form of energy governance, production, delivery or managing energy consumption, either in traditional carbon-based sources and sustainable alternative technologies.

Energy Transition FTE

Are defined as full-time equivalents working on facilitating energy transition in their business and for their customers. Energy Transition FTE include those who research or develop energy transition, such as technical subject matter experts, those who provide corporate services such as sustainability managers, and those who implement new energy systems, such as technicians and installers.

Energy Sources Methodology

We asked interviewees what the ultimate source of energy was for their energy employees. As a substantial part of the Netherlands' energy supply continues to be derived from carbon-based sources, it is no surprise that much of the headcount reported still has coal or gas as its ultimate energy source. Several interviewees found the energy source question difficult - for example, they might be focused on storage or transport, irrespective of the energy source. In terms of the analytical method used, if not otherwise specified, their headcount by energy source was allocated across the range of sources used in the Netherlands.

Energy Value Chain Methodology

The energy value chain is a technical framework of activities from finding energy sources (e.g., oil, gas, wind, solar, etc.) and converting that energy by generation into a useful state (either as electricity or in a chemical form, such as natural gas, hydrogen, ammonia, or methanol). The energy is delivered through storage, distribution, and system balancing stages. Finally, energy is consumed, either as fuel or through an electrical outlet. As Figure 2 shows, the value chain steps provide a structured way to categorise energy activities so that we can comprehend how an innovative and sustainable energy transition is working.

It is useful to understand what stages of the value chain organisations are working on. Therefore, the research asked interviewees at what value chain stages their Energy FTE were working. Energy Transition FTE were those at any stage in the energy value chain whose work aimed to reduce consumption or CO2 emissions, either by switching to renewable energy sources, storing or distributing energy more effectively, or by reengineering how they consume.

Energy Value Chain in 2022 vs. 2018

Energy System Governance is an addition in this report compared with the 2018 study of energy innovation across Zuid-Holland. In 2018, some respondents highlighted their overview and governance roles which were not captured in the stages between Production and Consumption. It has been added this year to better characterise the ecosystem.

The other remaining top level energy value chain stages - Production, Delivery and Consumption - are unchanged in 2022. Some interviewees suggested

further improvements during 2022 interviews, for example:

To convert 'Systems Balancing' to 'System Integration' to better reflect the broad infrastructure activities these organisations perform across the ecosystem.
To distinguish Transmission from Distribution, as Transmission may require technically different activities.

After consideration, we kept the value chain structure consistent throughout the 2022 study, but we acknowledge that a later study might find it valuable to distinguish Transmission from Distribution.

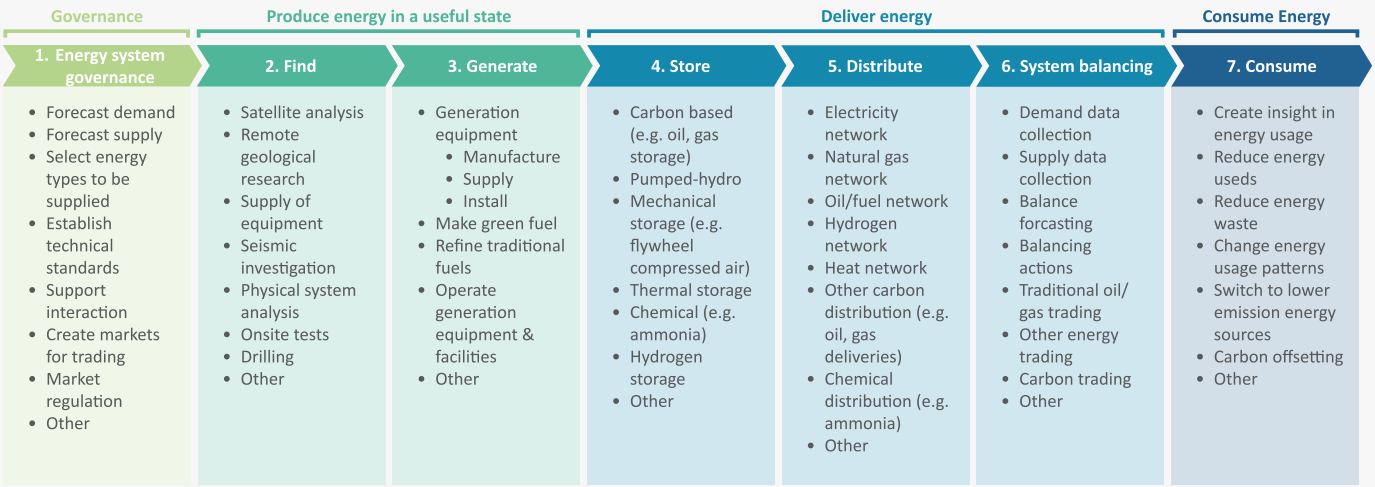

Figure 2. The Energy Value Chain

Limitations

The research method used in the 2022 study has some limitations. It covers organisations willing to be interviewed about energy transition - which is not a representative sample of the entire energy ecosystem in PZH. In addition, it analyses in terms of 4 pillars, rather than a whole system, and its scope is on the Province of Zuid-Holland.

Pillars vs. Systems

Some interviewees pointed out the importance of taking a systemic view. Is a systemic view compatible with thinking of pillars as being separate?
We found that pillars were a useful way of thinking about the different players in the system. They gave a useful structure for discussion of location, size and main concerns. System-linkages were captured through specific categories in interviewees' comments on strengths, obstacles and recommended actions. As we will see in Section 7, some interviewees also argued for treating Citizens' Initiatives as a separate pillar.

Geographical Coverage

This research's regional scope is limited to the Province of Zuid-Holland. Many issues arise at a higher level (e.g., national education policies, or EU-wide carbon pricing) and policies can only be implemented in cooperation with other regions. Some issues arise more locally - for example at the level of cities. This is a genuine limitation, so in the Section on Recommended Actions, we seek to emphasise what can be done at the Province level, and what may require coordination with higher or lower levels.

04

The Ecosystem & its Activities

Overview

Out of 22,000 Energy FTEs reported in Zuid-Holland, we zoomed in on 7,600 Energy Transition FTE at 14 different sources of energy and 7 stages of the energy value chain to capture the broad spectrum of energy transition. This is a similar approach to the 2018 research, but between 2018 and 2022, our researchers nearly doubled the number of organisations interviewed and the number of energy transition FTE in the data set.

Who? An Overview of Interviewees and Organisations

In 2022, our interviewees were dominated by the Business Pillar, as we sought to include more start-up and scale-up businesses.

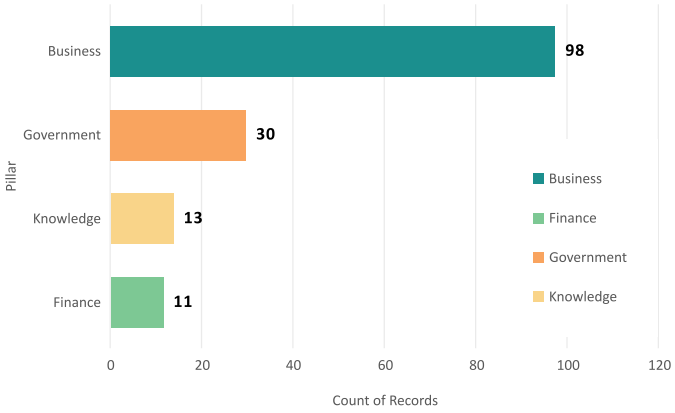

Figure 3. Count of Organisations by Pillar

The reports of Energy-focused FTE based in the Province Zuid-Holland, shown below, also indicate the dominance of the Business pillar in our sample. Figure 4 shows the Energy Transition FTE by Pillar.

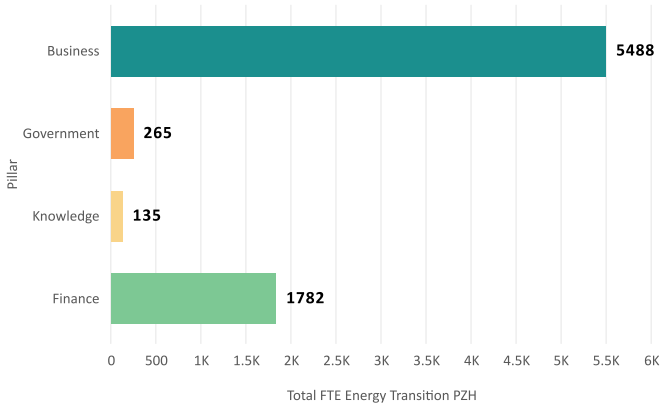

Figure 4. Energy Transition FTE by Pillar

When we break up these organisations by size (Figure 5), we see that there are many smaller organisations with fewer than 50 or even fewer than 10 Energy Transition FTEs.

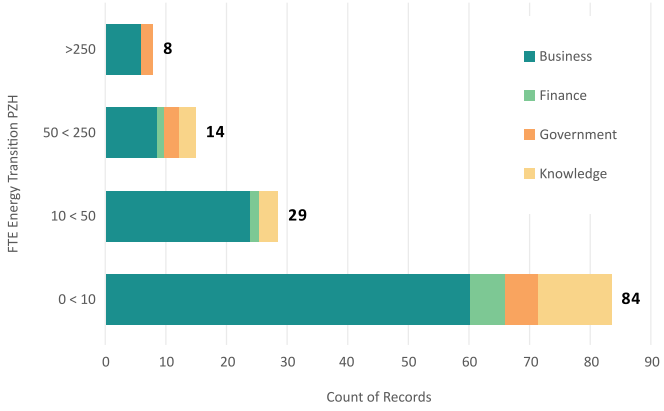

Figure 5. Count of Organisations by Size

Despite their low number, the eight largest organisations employ 5,400 Energy Transition FTEs, representing over 70% of the PZH FTE in our sample. This shows the domination by a few large organisations - heavily weighting the balance of where energy transition activities occur, increasing the risks of companies diverting processes of prioritisation, legislation and regulation, and showing the urgency and importance of forcing large companies to take action on transition.

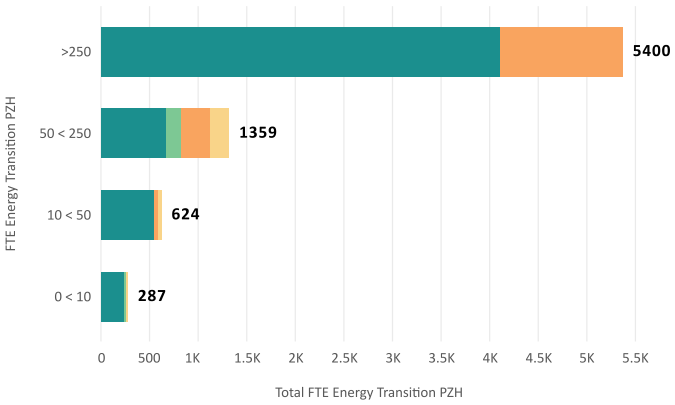

Figure 6. Transition FTE in Organisations by Size

Which pillars supported interaction?

The figure below identifies FTEs dedicated to interaction in the ecosystem. Out of all the PZH Energy FTE, only about 700 were reported as being focused on interaction. Nearly half of these come from Government organisations and another third come from Knowledge organisations. Business and Finance organisations reported lower absolute numbers involved in supporting interaction. The Business pillar in particular had a very low percentage of its FTE focusing on interaction (at most 57 out of the 5494 FTE identified). This may reflect a need for businesses to be focused on their own commercial activities. They may also see customer and supplier interaction as normal business rather than being done for the ecosystem's sake.

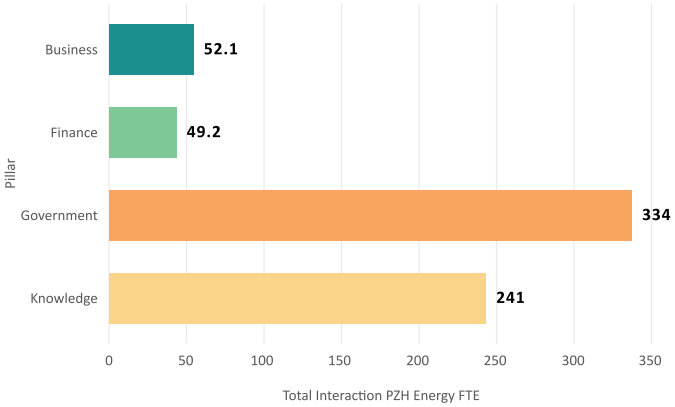

Figure 7. Interaction FTE in Organisations by Pillar

What are the priorities for the ecosystem?

Interviewees were asked about the priorities of three currently important transitions for their organisations: Circular transition? Digital transition? Energy transition? ('CDE') For our interviewees, Energy Transition was by far the most important – ranked #1 by 63% of all organisations we spoke to (including 87% of Not-for-Profit Businesses interviewed). By comparison, Circular transition was given highest priority by 10% and Digital transition highest priority by 11% of organisations interviewed. Comparing average priorities, Energy Transition averaged #1-#2 priority, Circular Transition averaged #6 priority, and Digital transition averaged #7 priority.

Where? A Geographical View of the Ecosystem

To deliver a holistic overview of the energy ecosystem in Zuid-Holland, we interviewed individuals from 135 organisations that work in the region. This included large scale energy companies, small energy start-ups and scale-ups, financial organisations, research organisations, governments, and others that may be headquartered across the globe but have operations and FTE working on energy in Zuid-Holland. The regional distribution of the FTE in these energy companies shows clusters in Rotterdam, Den Haag, and Delft, as can be seen from the map on the right. 87% of the PZH Energy Transition FTE identified in this research are concentrated in three city areas: The Hague,

Figure 9. Regional Location of Interviewees

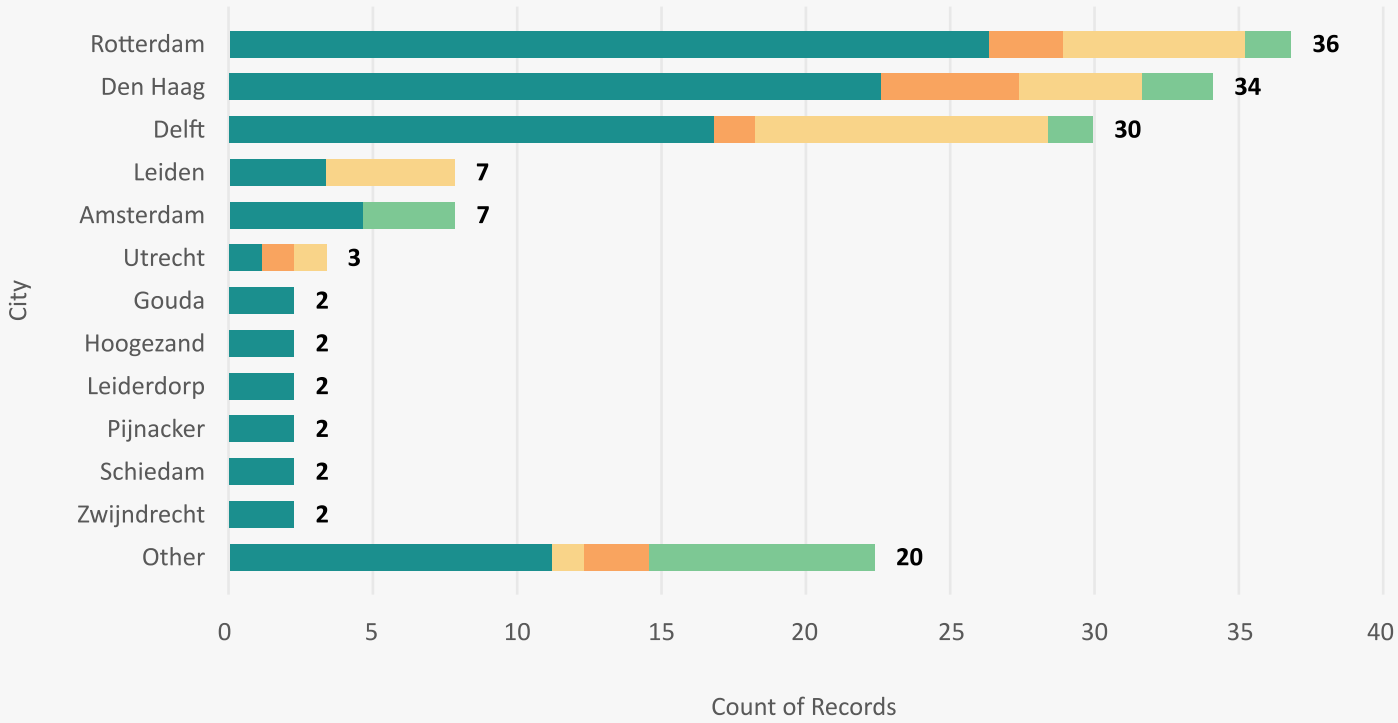

Figure 8. City Level Information for NL HQ Location

Case study
InnovationQuarter (IQ)

Number of FTEs: **120**
Number of PZH Energy FTEs: **48**
Number of PZH Energy Transition FTEs: **48**
Location: **The Hague**
Pillar: **Finance, but government-funded**

Interviewee Rafael Koene is the Fund Manager at IQ, and oversees two out of four active funds, namely ENERGIIQ which focuses on the energy transition, and another concerned with circular economy. He and his team of eight senior investment managers invest in energy start-ups and scale-ups. 'InnovationQuarter is a spider in the web: we work very closely with governments, business and universities.' IQ's main activities are making investments, internationalisation, and assisting start-ups and projects with their innovations.

Key takeaways

Most important obstacles for the energy transition:

- Physical space to build a company at the Rotterdam harbour
- Environmental space in terms of emissions permitted
- Slow permitting process

Government actions necessary:

- Speed up decision making and regulation processes
- Speed up processes to get permits, certificates and licences; 'we have to wait five or six years to get permits'

Key Quote

'In ZH we have the infrastructure, we have fundings knowledge and innovation; we should just speed up the process.'

Rotterdam, and Delft (see Figure 9).
Rotterdam employs 2,652 Energy Transition FTE. The Port of Rotterdam makes it one of the most attractive cities in Europe to establish operations for large scale international energy companies. The Port of Rotterdam has sought to brand itself as Europe's future Sustainable Powerhouse – aa important change given its current role in the arrival, production, and distribution of carbon-based energy. Additionally, the City of Rotterdam runs several programs that support energy transition like the Smart Energy Systems 2021, which allows small companies to apply for grants that can help finance their energy solutions, and the HyTransPort Project, a 32 km long hydrogen pipeline installation that will fuel the energy transition from Maasvlakte to

Pernis.
With 2,323 Energy Transition FTEs, the second largest group identified as working in the transition was found in The Hague. There are several government entities in the city including employees running programmes on energy transition at the Province of Zuid-Holland[3]. Additionally, The Hague fosters an environment of co-creation through hubs like Innovation Quarter and The Hague Tech, helping many start-ups and SMEs to build their bases there. Also, several large organisation with head offices and research functions in The Hague – e.g. Shell, GasUnie, and Siemens - claim to have many employees working on energy transition activities.

In Delft, we found approximately 1,667 FTE working on energy transition, a substantial number given the relative size of the city. The Technical University of Delft is the primary contributor to this statistic, not only because it employs the majority of these FTE (more than 1,000 at the Delft Energy Initiative at TU Delft), but also because it fosters an environment of innovation and acceleration for energy companies that originate within the university network. The growing Energy Transition FTE in Delft can be credited to the combination of break-through research, development, piloting and execution, supported by the availability of finance for start-ups, and a visionary focus on sustainable energy initiatives.

Apart from these three big cities, the remaining FTE identified were spread across smaller cities and towns in Zuid-Holland. Roughly 569 Energy Transition FTE were identified in Leiden, mostly on transition-related themes at Leiden University, which is otherwise better known for bioscience and law. 10 further organisations - mostly SMEs - reported 464 FTE across other locations including Utrecht, Gouda, Rijswijk, Schiedam, Leiderdorp, Noordwijk, and Pijnacker.

The number of PZH Energy Transition FTE are shown below in the 'Geographical Cluster' diagram according to the location of their Netherlands headquarters:

3 E.g. PZH's joint programme in cooperation with Innovation Quarter: https://www.innovationquarter.nl/item/energie-en-klimaat/

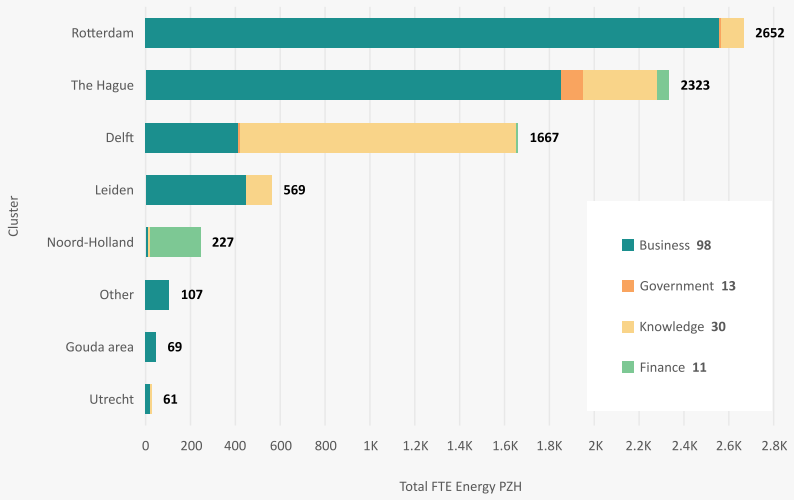

Figure 10. Count of Energy FTE by Region

How? Activities in the Energy Value Chain

The energy value chain is spread across four main stages - governance, production, delivery, and consumption. These are further divided into detailed sub-stages for organisations' work and FTE. Across the 7,781 Transition FTE we mapped in Zuid-Holland working on energy, we could identify value chain stages for 5,840. Of these, 5% oversee governance of energy systems, 27% focus on the production of energy (including finding and generating energy), 56% are charged with delivery (including storage, distribution, and systems balancing), and 12% manage how energy is consumed.

Governance encompasses essential processes relevant to energy transition, including the forecasting of demand and supply, regulation of markets, supporting interaction between different pillars, producing knowledge, and policy development. The 5% of FTE allocated to this came almost entirely from the Government pillar.

Producing energy has two main categories: finding and generating energy. Finding energy is also a low employer of FTE in the Province of Zuid-Holland (5%). This category includes services like analysis of satellite data and physical systems, geological research, onsite tests, drilling, investigation etc. Generation of renewable energy employed nearly 1,300 transition FTE (22%) in the organisations interviewed. Their work includes equipment production, generating fuel and electricity, and refining alternative fuels. All these activities within the broader spectrum of 'production' are spread across different sources of energy.

Delivering energy employs the largest part (3,256 or 56% of the total) of the transition FTE in the organisations surveyed: in distribution, storage, and system balancing. Storage accounts for 540 FTE (9%) - in energy storage, batteries, hydrogen, and other mechanical, thermal, or carbon-based methods. Distribution of energy has the largest group, with roughly 2,454 FTE (42%) managing PZH's new energy infrastructure - including setting up and running networks for energy transfer. Systems balancing employs roughly 262 FTE (4%), and includes functions of demand and supply data collection, balancing forecasts and actions, and energy trading across sources.

The last stage of the energy value chain, Consumption, includes a variety of activities that impact energy transition, such as reduction of energy usage and waste, changing of energy usage patterns, switching to low-emission energy sources, or offsetting. Approximately 702 FTE (14%) were reported to be involved in transition roles managing PZH's consumption across all parts of the energy value chain. This can include providing insights into energy usage and making energy usage more efficient, from the corporate level all the way down to individual users.

The structure of the value chain used here was kept unchanged during the 2022 work. Some participants suggested improvements, and a later study may wish to update this value chain to focus attention (for example, by differentiating transmission and distribution).

Comparison with 2018: a large rise in distribution FTE

Bringing up the results data from 2018 gives us a comparison as follows:

- Innovation FTE in 2018: 4,206 allocated to value chain stages.
- Transition FTE in 2022: 7,781, of whom 5,840 were allocated to value chain stages.

The data at first sight shows an enormous rise in transition FTE in the distribution. Does this make sense? A closer look at the data in Figure 11 shows the major sources of the change are:

- Stedin (which employs similar numbers now to 2018) now categorises many of its employees as working in 'Energy Transition' roles. Most of those are working in the Distribution stage of the value chain.
- Major companies categorised large groups of employees as working in 'Transition' roles, and in the Distribution stage at Alliander, Shell, TNO, Joulz, GasUnie, and Technolution.

Future research may seek to make definitions of the value chain stages stricter and to collect comparable data from organisations over time to detect organisation by organisation changes and explicitly discuss changes in FTE with interviewees. With a 4-year gap and different interviewees, that was not possible in the 2022 research.

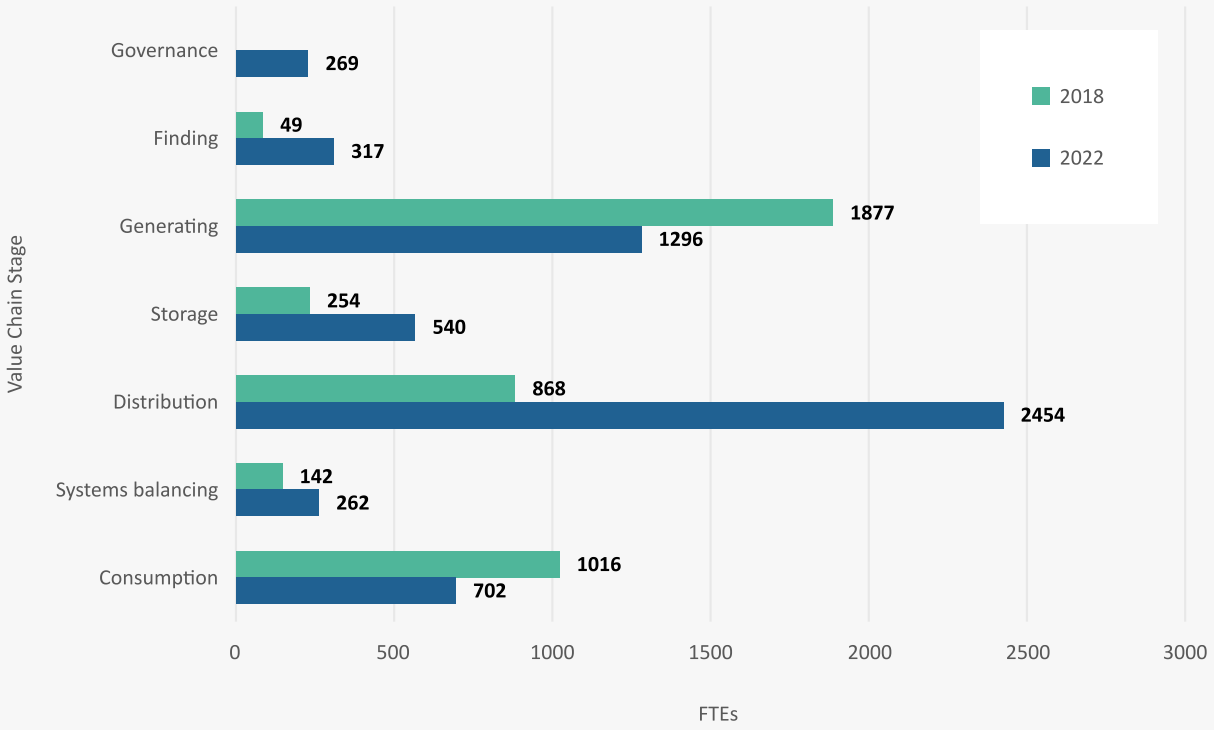

Figure 11. Innovation FTE 2018 and Transition FTE 2022

Case study
Neptune Energy: PosHYdon

Number of NL FTEs: **450**
Number of PZH Energy FTEs: **5**
Number of PZH Energy Transition FTEs: **5**
Location: **Den Haag**
Pillar: **Business**

Neptune Energy is a large privately held oil and gas E&P company, which is running PosHYdon, a research pilot on offshore green hydrogen production located 13km offshore from The Hague. Hydrogen can contribute in multiple ways to the energy transition: It can help decarbonise industries that cannot easily be electrified, e.g., steel and concrete production. Hydrogen can also be transported via pipeline, potentially even allowing energy transmission from windfarms further out at sea (>100km) and can provide storage, including potentially in decommissioned gas fields.

Key takeaways

Green hydrogen's physical and chemical characteristics give it huge potential to contribute to the transition in transport, storage, and consumption of energy.
PZH can play a key role in green hydrogen due to its proximity to the North Sea as a producer of hydrogen and Rotterdam as a producer and consumer of hydrogen.
The PosHYdon project and the North Sea Farmers trial area are already two key opportunities supported by the Province of Zuid-Holland. Leveraging the PosHYdon platform by connecting it to the North Sea Farmers test site would be an example of how the ecosystem can multiply the benefits of co-location.
Key Quote
"Offshore hydrogen production helps to solve a major bottleneck in the energy transition"

Key Quote

"Offshore hydrogen production helps to solve a major bottleneck in the energy transition"

The Impact of Large Businesses

along with research organisations like TNO, or TU Delft with its dozens of advanced research groups, covering topics like 'Energy Systems Analysis', or 'Photovoltaic Materials and Devices'.

In this study, 70% of the 7,650 PZH Energy Transition FTE were employed by these eight organisations. So while we have collected a large number of comments identifying obstacles and calls to action, a majority of the commentary comes from relatively small companies, researchers, and government institutions. Meanwhile, many of the FTE involved in energy transition are currently still employed by the major players.

Large businesses have historically been major providers of carbon-based energy and infrastructure, but still have a vital role in the operation of today's energy system. The effectiveness of their work directly impacts Dutch energy security, employment, tax revenue, and environment.

Their sheer scale means that in coming years, they have a very large potential impact on both the environment and the transition in the energy value chain, and any actions taken by PZH should include specific attention to how to motivate and encourage these large organisations to be part of the change. Here we take two specific examples, Stedin and Shell, from both public sources and interview results.

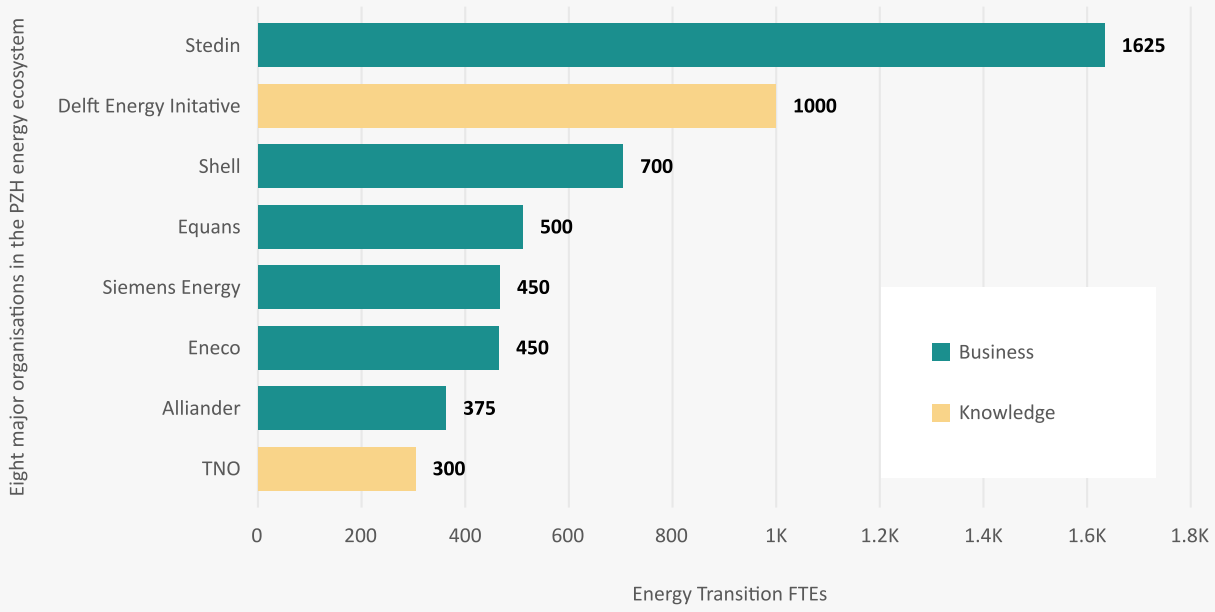

Figure 12. Total Energy Transition FTEs by Largest Organisations

Case study
Stedin

Number of NL FTEs: **5,000**
Number of PZH Energy FTEs: **3,250**
Number of PZH Energy Transition FTEs: **1,625**
Location: **Rotterdam**
Pillar: **Business (Not-for-Profit)**

Main provider of gas and electricity transmission & distribution networks in Zuid-Holland. Also plays a key role in governing the access of start-ups and scale-ups to both networks.

Compared with 2018, Stedin has shown enormous growth in PZH FTE that it describes as 'working on transition activities'. Is this realistic? In terms of energy sources, Stedin still derives a substantial part of its supply from carbon-based fuels and Stedin's annual reports do not differentiate energy transition FTE from conventional energy FTE. In addition, Stedin's work on its electricity grids or gas networks and in customer services might appear to be much the same as it was 10 years ago, before energy transition became such a high priority.
On the other hand, Stedin's practices also contribute to the energy transition

- Stedin noted that 'Traditional' distribution work - for example, onsite engineers connecting up new housing developments - is now being done 80%-20% with transition-ready materials, e.g., new polyphase meters as opposed to old single phase meters;
- Stedin is making large investments specifically in energy transition systems such as Electric Vehicle charging points, and it invested €672 million in replacing 300km of electrical infrastructure;
- In terms of gas grid work, much current infrastructure work (e.g. 250km of gas pipes replaced in 2022) can be argued to prepare for energy transition by reducing leakage and being ready for future hydrogen transport.

Balancing the above arguments, we estimated the energy transition FTE within Stedin at 50%, or 1,625 of its 3,250 PZH Energy FTE. This placed Stedin as the #1 ranked energy transition player in PZH.

Key takeaways

1. The Province of Zuid-Holland "provides a very safe environment where we can experiment a lot. However, when we do hit a legal barrier, we have to work around it, lobby for change, or abandon the project. This holds back our ability to innovate."

2. The four-year election cycle places the company under pressure to achieve "quick

wins", whereas the energy system planning cycle is 30-50 years long, and Stedin plans usually have a five- or 10-year trajectory.

3. Identify and connect people who are on similar projects; "There are so many duplicates."

4. Stedin's role as a facilitator of connections to the power grids was highlighted by people within and outside Stedin as being a potential blockage, as Stedin receives 'hundreds' of proposals for projects every year.

Key Quote

'In the short- and long-term, we need to facilitate the energy transition so that energy can be available, reliable, safe and affordable'

Case study
Shell

Number of NL FTEs: **10,000**
Number of PZH Energy FTEs: **6,500**
Number of PZH Energy Transition FTEs: **700**
Location: **Den Haag**
Pillar: **Business**

Public information shows that these roles include:

- Hydrogen
- Offshore & onshore wind
- Solar
- Carbon Capture and Underground Storage
- Biofuels
- Rotterdam (commercial. E.g. Carbon trading, offsets)
- Pernis Refinery (transition work includes reducing leakage, reducing flaring etc.)

In addition, Shell has made multiple acquisitions not yet part of its group reporting, such as in car charging stations. So, although frequent public criticism and legal challenges indicate the need for much more action, we already see an important role being played, significantly greater than in 2018. The 700 FTE estimate ranks Shell as the third most important player that we identified in PZH in terms of sheer numbers of FTE working on energy transition.

We have to raise a note of caution: What is the balance of benefit from the role that large companies play in the ecosystem? To what extent does talk of transition represent real change, and to what extent is it self-comforting reassurance? Could this be deliberate deflection or even deception?

These questions should remain at the forefront of the minds of those who engineer the future ecosystem. As the large companies play such a dominant role, government and regulators should both give them attention and set extremely demanding expectations. Smaller energy transition companies have few of the financial, labour, and material reserves of the large players. Some interviewees from smaller players expressed frustration with large companies, especially as customers, partners, and funders. Start-ups and scale-ups want large companies to play a role as launch customers and to open up infrastructure for proof of concept. Better integration of large and small players does seem a reasonable suggestion for anyone interested in the overall growth of a balanced ecosystem. Options to address this are discussed in Section 8.

05

Economic Clusters and Opportunities

Section 5 describes what interviewees saw as the areas of greatest opportunity for Provincie Zuid-Holland, and compares this with existing clusters of companies to identify possible actions for Zuid-Holland.

Potential Opportunities for Zuid-Holland

What activities offer the greatest opportunities to reduce carbon emissions globally or to increase employment in Zuid-Holland? Respondents most often suggested:

- wind power manufacturing
- solar manufacturing and
- energy storage

The focus was on moving from heavy fossil industries to a range of renewables manufacturing – on what is sometimes called SWB ('Solar, Wind, Batteries'). Hydrogen, geothermal and industrial waste heat were also suggested, but less often. Finally, a few interviewees argued for rethinking the whole energy system: finding ways to reduce consumption, reducing energy losses, and addressing the resources the economy uses (for example, steel and concrete in the construction sector, the use of valuable land for airports such as Rotterdam Den Haag).

Assuming there is an opportunity to move to renewables manufacturing, to what extent is Zuid-Holland building integrated economic clusters that prepare for an energy-transition future?

Is Zuid-Holland Preparing for the Future?

To gain further insights into the activities of the Business Pillar, we analysed a larger dataset of 562 PZH energy sector businesses[4] with information about their activities. We wanted to get a better idea of activity types and to observe if there were specialised clusters of businesses working on similar activities which could be a focus of future economic support.

Our analysis connected organisations to 33 general activities, as shown in Figure 14. The most common activity is Services, linked to more than a third of all organisations. Traditional fossil fuel-based energy activities are in second place, and renewable energy activities are in third place. Energy-intensive activities like industrial engineering, transportation, and infrastructure follow shortly after. The large share of businesses involved in fossil energy and energy-intensive industries highlights PZH's huge reservoir of expertise, its potential to achieve gains during transition, and the challenges that lie ahead if it is to drive energy transition across all sectors.

4 The dataset of 562 PZH energy sector companies was kindly provided by The Hague Business Agency (THBA) and contains 2021 data including most - but not all - of the 100+ business organisations surveyed in this study. Sections 7 and 8 of this report return to the smaller dataset of 152 responses to report on clusters of opinions.

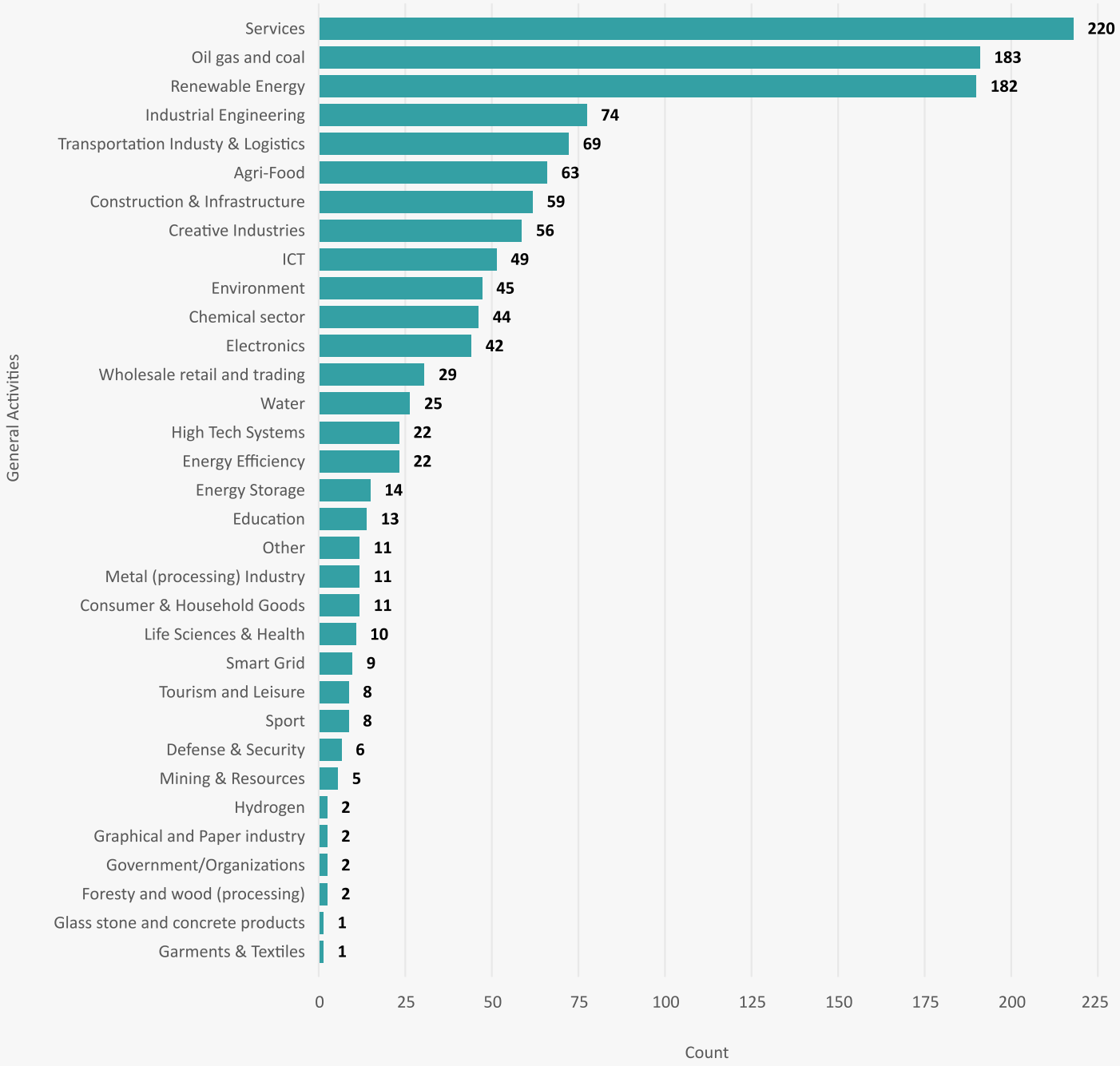

Figure 13. Distribution of 563 Companies Across 33 General Activities

Based on the 33 activities, we used cluster analysis[5] to investigate whether businesses in PZH have any groups with distinct activity profiles. The analysis revealed 12 activity clusters, that are shown in Figure 15. Organisations inside each cluster have more activities in common with each other than with organisations outside the cluster. The tighter a cluster, the more similar organisations' activity profiles are. The further apart two clusters, the more dissimilar their activities. A pie chart (see figure 16) can also help in understanding the percentage splits of energy business types in the Province of Zuid-Holland.

5 Landau, S., Leese, M., Stahl, D., & Everitt, B. S. (2011). *Cluster analysis*. John Wiley & Sons.

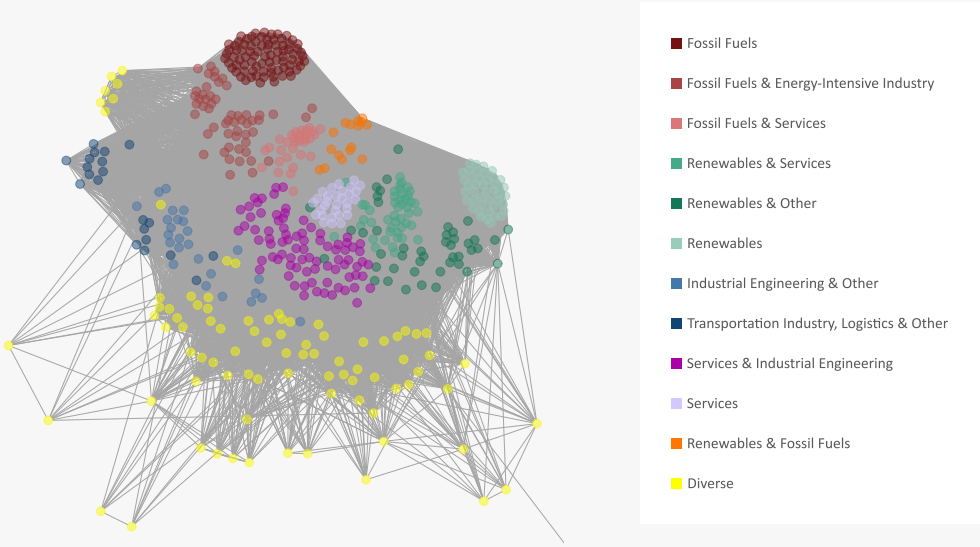

Figure 14. Activity Clusters of 562 Organisations

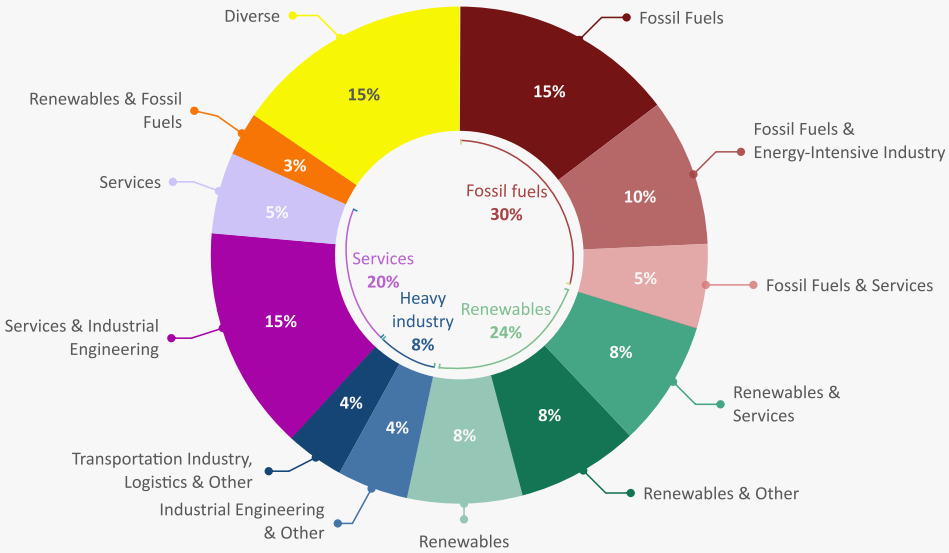

Figure 15. Percentages of Activity Clusters

Three key takeaways can be drawn from this analysis of the 562 businesses in the THBA energy dataset.

First, in numbers, renewables companies are nearly as present in the market as fossil fuel companies (24% renewables vs. 30% fossil fuels). While the fossil fuel industry still dominates the PZH energy ecosystem in terms of FTE, renewables are gaining ground in terms of the number of organisations.

Second, fossil fuels and renewables industries' activities appear to be rather separate from each other. 15% of businesses are associated exclusively with fossil fuels and 8% exclusively with renewables. Only 3% of organisations are active in both sectors (see orange nodes in the network graph above). This can be regarded as an indicator of the ongoing energy transition in PZH with conventional energy businesses slowly reorienting themselves towards renewables. This theory is also supported by the results of our interviews described in Section 7. We also expect that this number to have increased over the last 12 months since the dataset was assembled. These numbers nevertheless highlight that there are large numbers of businesses dedicated to fossil fuels, bringing the risk that they may be slow to change or invest in physical assets, networks, and personnel skills.

Third, the cluster analysis identified some interesting associations. The transportation and logistics sectors are more connected to fossil fuels, as represented by their closeness to the red-coloured nodes representing the fossil fuels organisations. On the other hand, the service sector is more associated with renewables (8.2%) than with fossil fuels (5.5%).

Implications of Economic Activity Analysis

From the 'Potential' survey plus the three points in the activity analysis above, we can suggest it may be useful for the Province to:

- **Bring the ecosystem together to collaborate and confirm actions to realise the employment opportunity in wind, solar, and storage manufacturing.**
- **Challenge large fossil fuel companies to keep up the pace of change and to integrate with the rest of the ecosystem.**
- **Encourage the transportation and logistics sectors to share information and coordinate change.**
- **Coach fossil fuel services companies to start moving towards energy transition services**

06

Key People & Organisations

The energy transition does not only require a well-balanced and integrated ecosystem. People move the ecosystem and drive innovation. Entrepreneurs, researchers, investors, and politicians create change through their activities in the market and in society.

Participants of the study were asked to name individuals considered top drivers of innovation in the Province and companies that they saw as experts and influencers. The data gathered (144 different names and 221 different organisations) is summarised below to give a list of people and organisations considered to be leaders in the Energy Transition Ecosystem.

Top 20 People

The list below shows the top 20 people cited as being key to the energy transition and innovation ecosystem in Zuid-Holland. Each one in the top 10 has a short biography, highlighting educational, government and commercial linkages. Individuals are listed in order of number of references – highest, first. New entries compared with the 2018 report are marked with a star.

01. Paulien Herder

Professor in Energy Systems Engineering & Dean of Applied Science, Delft University of Technology

Paulien Herder is professor in Engineering Systems Design in Energy and Department Head of Engineering Systems and Services. She is Director of the Delft University Energy Initiative, which brings together over 1000 FTE working in energy research. Paulien is a member of the Dutch national Topteam Energie, which is responsible for advising the national government and chairs the Taskforce EnergyTransition of Economic Board of Zuid-Holland (EBZ). Recently, she has given increasing attention to the electrification of industry (E-refinery).

02. Jan Rotmans

Professor in Sustainability Transitions, DRIFT

Jan Rotmans is Professor in Sustainable Transition at the Dutch Research Institute for Transitions in Rotterdam. Jan studied Mathematics at the University of Delft. He has published 20 books and 180 articles on climate change and the energy transition. Jan is the founder of the International Centre for Integrated assessment and Sustainable development and Urgenda. He is also one of the drivers behind the Roadmap Next Economy for the Rotterdam-Den Haag metropolitan region.

03. Allard Castelein

Chief Executive Officer, Port of Rotterdam

Allard Castelein is the Chief Executive Officer of the Port of Rotterdam. Allard previously held senior management positions at Shell and is a graduate in Medicine from the University of Rotterdam. Participants of the study cited Allard Castelein's ability to align all companies operating in the Port of Rotterdam behind the vision of becoming the most sustainable and energy efficient harbour in the world.

04. Arno Bonte

Former Vice Mayor for Sustainability, Clean Air and Energy Transition at the City of Rotterdam

As Vice Mayor for Sustainability, Clean Air and Energy Transition of the City of Rotterdam, Arno Bonte is committed to a sustainable and energy-efficient city. He is working towards an economy that runs on clean energy, arranging other ways of heating and cooking and creating more wind and solar energy. He is a member of the Taskforce EnergyTransition, EBZ.

★ NEW ENTRANT

05. Andy van den Dobbelsteen

Professor of Climate Design & Sustainability, Delft University of Technology

Andy van den Dobbelsteen is full professor of Climate Design & Sustainability at the Faculty of Architecture & the Built Environment of TUDelft. He chairs the faculty's Department of Architectural Engineering and Technology. Andy is theme leader for energy in the built environment for the Delft Energy Initiative, and Principal Investigator for the Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute). He chairs the scientific advisory board of NL Greenlabel and sits on the board of the Dutch Green Building Council.

★ NEW ENTRANT

06. Nico van Dooren

Director for New Business Development, Port of Rotterdam

Nico van Dooren is Director of Energy and Industry at the Port of Rotterdam. Nico held various senior management roles at the Port of Rotterdam and Royal Haskoning. He also is a member of the Taskforce EnergyTransition EBZ and is admired for his drive in fighting climate change.

07. Ad van Wijk

Entrepreneur & Professor Future Energy Systems, Delft University of Technology

Ad van Wijk is professor in sustainable energy at the Technical University Delft. He holds a PhD in physics from the University of Utrecht. Ad won the award of master entrepreneur in the year 2007. Ad is admired for his insightful reports, his advocacy for a green hydrogen economy, and his role in creating The Green Village in Delft.

08. Peter Palensky

Professor of Intelligent Electrical Power Grids, Delft University of Technology

Peter Palensky is full Professor for Intelligent Electrical Power Grids at TU Delft. He also serves as Scientific Director of TU Delft's PowerWeb institute, a cross-faculty think tank for integrated and intelligent energy systems, and as Principal Investigator at the Amsterdam Metropolitan Solutions (AMS) institute. Peter is internationally known for his work on modelling and simulation of future power systems, for creating cyber-physical digital twins, and for connecting leading edge research with industrial applications in the energy sector.

★ NEW ENTRANT

09. Alice Krekt

Program director, DeltaLinqs Climate Program

Alice Krekt is programme director at Deltalinqs Climate Program (DCP). She has over 20 years experience in port strategy and development. She worked, amongst others, at Port of Rotterdam and Arcadis N.V. She builds bridges between organisations and strives to connect people within strategic cooperations. As director of the Deltalinqs Climate Program (DCP), Alice initiates and leads private and public partner projects to reach the Paris Climate Agreement objectives.

10= Rene Peters

Business Director Gas Technology, TNO, Delft

Rene is responsible for technology development in the area of gas technology, including LNG, gas transport and storage, unconventional gas, exploration and biogas. He is leading the Upstream Gas Innovation Program within the Top consortia for Knowledge and Innovation – Gas, commissioned by the Ministry of Economic Affairs.
He started his career in Shell Research and moved to TNO where he had various technical and managerial positions in the area of oil and gas technology. He also acts as a chairman of the European Forum for Reciprocating Compressors and is the chairman of the EERA Shale Gas Initiative.

★ NEW ENTRANT

10= Rinke Zonneveld

Former Executive Director, Innovation Quarter, now CEO, Invest-NL

Until September 2022, Rinke Zonneveld was the General Manager of Innovation Quarter. Innovation Quarter is responsible for implementing economic development within the Province Zuid-Holland. Rinke studied Economics at the Free University of Amsterdam. Prior to his current position, Rinke held a number of senior posts in the Dutch central government. Rinke is considered a key driver of energy innovation as Innovation Quarter attracts business investment which provides investment and employment. He also manages the EnergiIQ-fund.

10= Stephan Brandligt

Former Deputy Mayor, Municipality Delft

Stephan Brandligt is Deputy Mayor for the Municipality of Delft. Stephan studied Aerospace Engineering at the University of Delft. Stephan started his career at Coopers & Lybrand (now PWC) and founded his own internet company after that. Stephan is considered a driver in energy innovation due to the many initiatives he is involved in, in Delft. He also is a member of the Energy Innovation Board ZH, representing the Metropole Region Rotterdam The Hague (MRDH). His political party GroenLinks won the recent municipal elections in Delft.

	Name	Organisation	Type
11	**Marjan van Loon**	Shell	Business
12	**Berend Potjer** ★	PZH	Government
13	**Marco van Steekelenburg**	PZH	Government
14	**Frans Timmermans** ★	European Commission	Government
15	**Jan Jaap van Os** ★	Exasun	Business
16	**Earl Goetheer** ★	TNO	Knowledge
17	**Liesbeth van Tongeren** ★	(former) Gemeente Den Haag	Government
18	**Kornelis Blok**	TU Delft	Knowledge
19	**Olindo Isabella** ★	TU Delft	Knowledge
20=	**Derk Loorbach**	DRIFT	Knowledge
20=	**Tim van der Hagen** ★	TU Delft	Knowledge

Top 30 Organisations

The table below provides an overview of the organisations which are perceived to be key in driving energy innovation in Zuid-Holland, featuring many research and Government organisations as key drivers of the energy transition.

In the first table, there is a clear prevalence of people from the Government and Knowledge sector. This makes sense: Government representatives have a central role in guiding, supporting and bringing together all the actors of the ecosystem. Likewise, universities and research agencies often explore the frontiers of technical possibility, so it is reasonable that researchers should be the main leaders in the field. There may also be a name recognition effect - there are relatively fewer

	Name	Pillar
1	**TU Delft**	Knowledge
2	**Port of Rotterdam**	Business (Not-For-Profit)
3	**TNO**	Knowledge
4	**Shell**	Business (For-Profit)
5	**PZH**	Government
6	**Innovation Quarter**	Smart Money
7	**DRIFT**	Knowledge
8	**Eneco**	Business (For-Profit)
9	**Gemeente Rotterdam**	Government
10	**Stedin**	Business (Not-For-Profit)
11	**DeltaLinqs**	Business (Not-For-Profit)
12	**Exasun**	Business (For-Profit)
13	**Gemeente Delft**	Government
14	**Gemeente Den Haag**	Government
15	**YES!Delft**	Business (Not-For-Profit)

	Name	Pillar
16	**GasUnie**	Business (Not-For-Profit)
17	**THUAS**	Knowledge
18	**Vopak**	Business (For-Profit)
19	**Zepp Solutions**	Business (For-Profit)
20	**Air Liquide**	Business (For-Profit)
21	**Deltares**	Knowledge
22	**DMEC**	Business (Not-For-Profit)
23	**Engie**	Business (For-Profit)
24	**RVO**	Government
25	**Solar Monkey**	Business (For-Profit)
26	**TKI**	Business (Not-For-Profit)
27	**Urgenda**	Knowledge
28	**Buccaneer Delft**	Business (Not-For-Profit)
29	**The Green Village**	Knowledge
30	**Siemens Energy**	Business (For-Profit)

academics and politicians than business people, so individually they are better known.

On the other hand, in the second table, covering organisations, those belonging to the Business Pillar clearly dominate. This may be because multiple individuals are being nominated from the same Energy businesses of that businesses are referenced as a whole, rather than particular individuals.

Who Refers to Whom?

The map below shows the connections between influencer organisations. Its purpose is to identify which organisations were referenced most often and by whom. TU Delft is the large box - it was by far the most referenced single organisation in the Zuid-Holland energy transition ecosystem.

In addition, it is interesting that the plot also helps us to see distinct groups referencing the top organisations. A repeated plotting of the network was used to check our conclusions. There are consistently four main groups. The 'Port of Rotterdam group' and the 'Shell group' appear to be clusters of the more traditional energy, chemical and transport companies and they reference each other within their groups, and between the two groups more often than outside. The 'TNO group' - including Stedin and Exasun - could be seen as being more 'new energy / transition.' They referenced the 'Shell group' less often and were more likely to reference the government-focused 'PZH group'.

This analysis of network connections supports the industrial activity cluster analysis in Section 5. According to who-refers-to-whom, connections seem stronger within the traditional energy and chemical industry than outside into the transitioning renewable energy sector. **The PZH could address this networking gap as a possible policy action.**

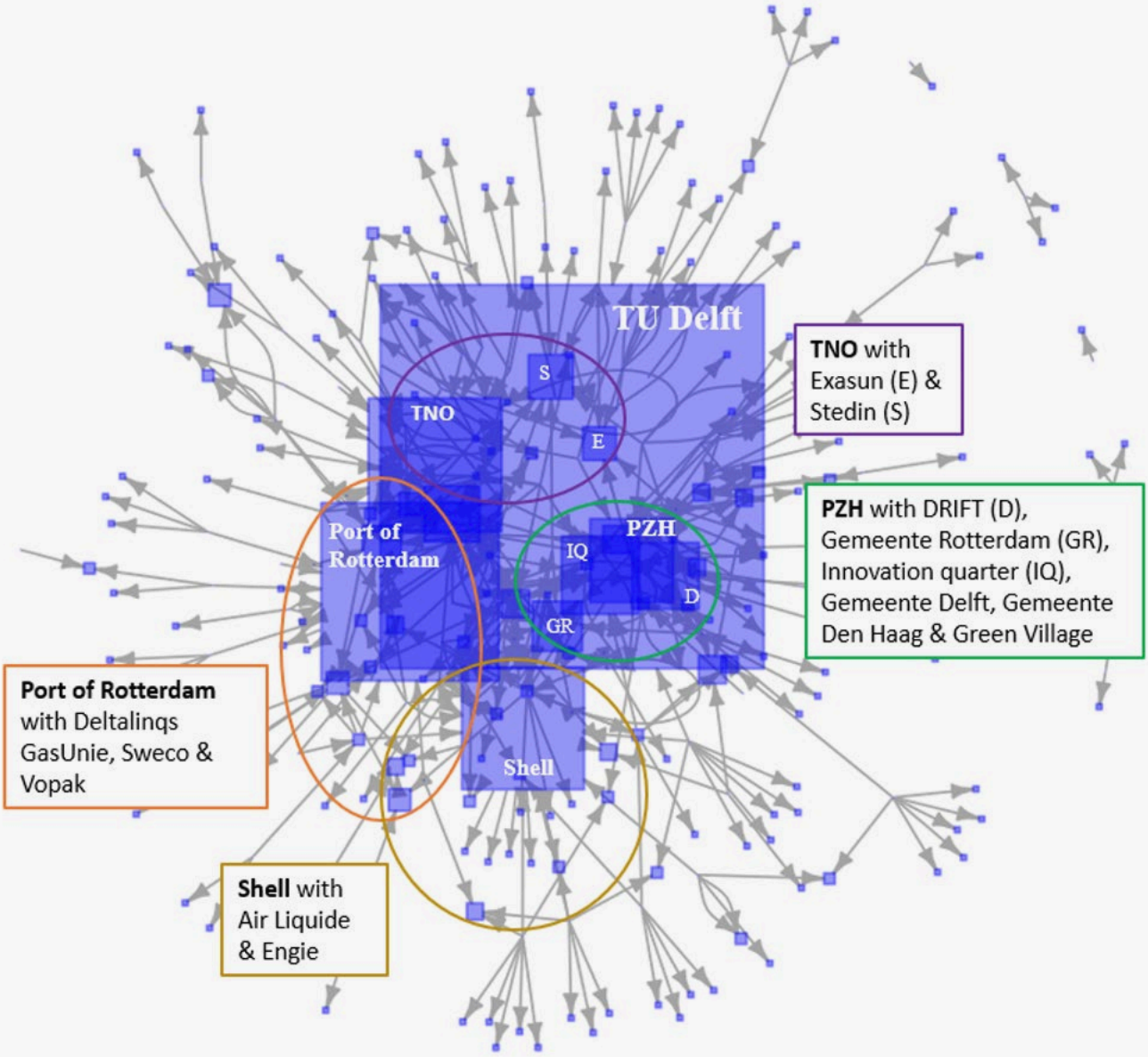

Figure 16. Network of Recommended Organisations

07

Opinions on the PZH Energy Innovation Ecosystem

In this section, we record the key opinions given during interviews, organised according to which of the four pillars of the ecosystem they reference, and we identify separately those that focus on interaction between the pillars.

Interviewees across all sectors were asked about the performance of the ecosystem in Zuid-Holland. What strengths are seen in the region? What obstacles need to be addressed? What activities offer the greatest opportunities to reduce carbon emissions globally or to increase employment in Zuid-Holland? What actions need to be taken to empower the Province? Where possible, comparisons were drawn between the 2018 report and responses received during this round of interviews.

Strengths and Obstacles

The plot below shows the categories of strengths and obstacles that interviewees mentioned (column Category), if the interviewees thought the category was rather an obstacle or a strength (column Net), and how often the categories were mentioned (right side).
The two top net strengths are

- ***The geography of the Province, particularly the city of Rotterdam and the harbour as a business hub where quick connections can be made with other parties.***
- ***Knowledge, to which Delft contributes a lot.***

Regarding the factors that were most regarded as slowing down the energy transition, the two obstacles with the most negative net score were

- ***The government, because of regulatory complexity which results in long procedures as well as outdated regulations and a lack of clear direction.***
- ***The lack of talent, in particular technicians and skilled workes below universitiy degrees.***

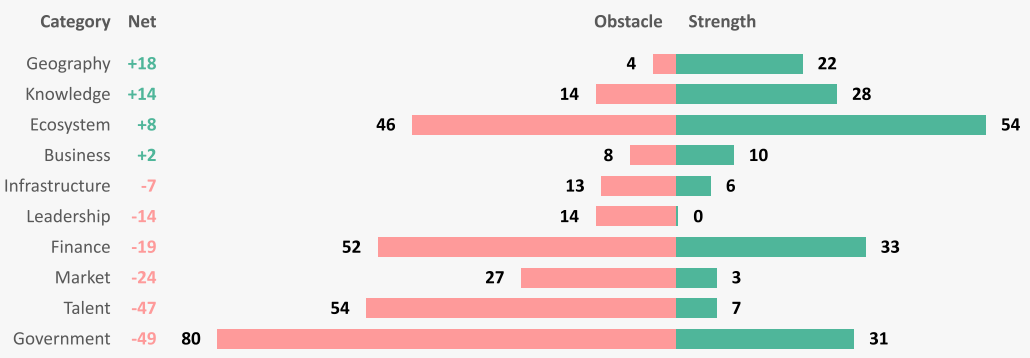

Figure 17. Strengths and Obstacles of the Energy Transition Ecosystem in the Province

Ratings of the Pillars

Participants were asked to rank on a five-point scale each pillar's effectiveness in promoting energy transition. Compared with 2018, average ratings were 6% higher, so the notable changes are that Finance is rated lower, and that ratings for Government have risen considerably.

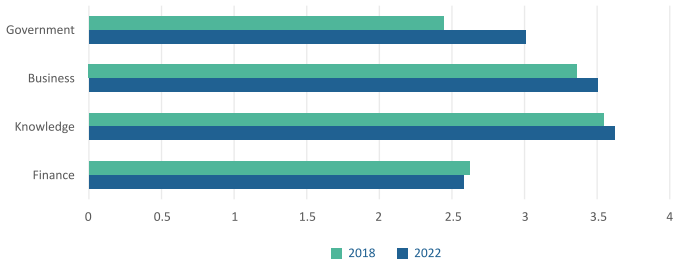

Figure 18. Interviewee Ratings of Each Pillar, 2018 vs. 2022

Pillar-Level Comments

This section looks at comments on each pillar in turn, and then asks whether a fifth pillar would be useful as part of the Province's planning going forward.

Government Pillar

In 2022, the Government pillar ratings for promoting the energy transition in Zuid-Holland showed the biggest improvement versus 2018. The Government was still in third place, though. as many respondents wanted the Government to do more with its key role in the ecosystem - a key role that is shown in Section 6, where people in Government are frequently referenced as top influencers.

The importance of Government action is shown most obviously in the #1 category requested - **Clear Direction**. A major hurdle to Government providing Clear Direction appears to be the contrast between the brevity of election cycles (4-5 years), the long-term returns from many investments (5-50 years), and the even longer time-horizon needed to plan for the climate crisis (10-200 years). These conflicting cycles may be preventing strong long-term planning for energy transition in the Provincie Zuid-Holland, the Netherlands, and perhaps more widely. Below are some interviewee requests for the government to set a Clear Direction.

> **The government isn't communicating a clear vision on the future economy and the future structure of the country. They need to take a lead and must take an integrated approach.**
>
> Arij van Berkel, Lux Researching

> **A short-term of leadership in government leads to a long-term confusion in vision.**
>
> Director digitalization for a digital service provider

> **Political delays continue to be an issue - the 4 year election cycle only allows for quick wins, whereas the energy planning cycle is 30-50 years long and our plans look 10 years forward.**
>
> Manager at an energy network company

Case study
The Dutch Marine Energy Centre (DMEC)

Number of NL FTEs: **10.6**
Number of PZH Energy FTEs: **10.6**
Number of PZH Energy Transition FTEs: **10.6**
Location: **The Hague**
Pillar: **Interaction and partly business (Not-for-Profit)**

The Dutch Marine Energy Centre (DMEC) is a non-profit organisation that acts as an accelerator for marine energy solutions. They emphasise the untapped potential of the oceans as a source of renewable energy and focus on the interaction interface involved in marine energy markets. To realise their vision of harnessing this energy source, they work with companies, government bodies, and other relevant stakeholders in and outside of the Netherlands to drive innovation, improve access to capital and markets, and influence policies related to the marine energy market. They are involved with start-ups and larger companies that harness tidal, wave, salinity gradient, and ocean thermal energy, as well as floating solar and floating wind energy. They founded the Marine Energy Community, which consists of technology developers, universities, and companies to find solutions to various problems they are facing. Interviewee Britta Schaffmeister is the CEO of DMEC, and focuses on the direction of the marine energy ecosystem, and what can be done to support it.

Key takeaways

1. The ecosystem should not constrain its thinking to the provincial level.

2. Policy-makers should facilitate the implementation of new technologies.

3. The Province should stimulate the training of mechanics and technicians to accommodate the energy transition.

Key Quote

'If you want a thriving ecosystem you need to have a long-term vision' (Governments should take the responsibility and allocate funds for innovations)

The Government is likely to be a key player in at least 3 more of the top 7 actions requested: Strengthen Network Connections, Collaborative Decision Making, and Information Sharing. This suggests a possible course of action: to increase its engagement with the business community, to support relatively low-cost key institutions that can enhance network connections, and to address citizen perceptions around the energy transition. The argument is that some rather unspectacular long-term investments require coordinated change - and this can be made easier by increasing awareness through engagement with the industry on one side, and citizen engagement via distributed, locally-driven sustainable action in communities.

The Dutch Marine Energy Centre, recently launched in Scheveningen, in the Gemeente Den Haag, is an example of an institution that Government bodies can encourage in order to strengthen network connections, collaborative decision making and information sharing.

When asked about opinions concerning current government regulations, many individuals focused on the Government **improving regulatory speed**: putting enough resources in so that permitting, enforcement, or reviewing energy projects can be done quickly. One interviewee reported needing twice as long to get permissions for a new wind farm as actually to build it.

Additionally, Provincie Zuid-Holland was asked to improve and facilitate open lines of communication between the Government and external organisations. This will provide much needed **regulatory clarity** to individuals across all pillars that are attempting to plan their future. Existing regulations may also be too burdensome for novel technologies and should be reviewed to make sure they do not overreach.

Finally, **integration** and **alignment** were key concerns: current and future regulations need to better consider vertical integration and alignment from the EU level all the way down to city councils. Interviewees suggested that each level of government should be aware of, but not overreach, its role. The Province should, for example, collaborate 'above' and 'below' for consistent national, province, and city guidance, and should coordinate with peers to achieve scale. In both cases, the clear unifying aim should be to make the sustainable energy transition as fast, easy, and flexible as possible.

On Regulatory Speed and Clarity:

> **Permit processes are incredibly slow and are causing delays. Local councils don't have the capacity and can't keep up with the demand. Councils extend the review period of every [building] permit request we have submitted.**
>
> Founder sustainable architect bureau

> **Existing regulation seems to be the hurdle for innovation. New technology doesn't always fit into regulations designed for existing technology**
>
> Kornelis Blok, Delft Energy Initiative

Many were frustrated with **Government subsidies** that were either insufficiently sized, too specific to be accessible, or non-existent altogether. While the recent expansion of the Sustainable Energy Transition Subsidy Scheme (SDE++) from €5B to €13B is welcomed, applications for funding open after the publishing date of this report, so its impact on the ecosystem cannot be interpreted at this time. The Government could also do more to incentivise private financing in the energy transition, perhaps with favourable tax schemes for measurable transition impact.

On Government Subsidies:

> **The government needs to focus on interventions with the biggest impact, where do you get the biggest 'bang for your buck'. Be smart about making interventions that make a significant difference. For example - the proposed subsidies and regulations around heat exchangers for households have a massive impact but with limited impact per euro spent compared to other possible scenarios.**
>
> Liesbeth Tuininga-Mulwijk, Vanadis Power

> **Investments for start-ups are sometimes available, but scale-ups face a lack of support from both private investors and government subsidies**
>
> Astrid Madsen, Independent Consultant

> **Because there are so many opportunities in the market, as a commercial bank, the lack of clarity from the government makes it hard for us to commit funds. We don't have a clear choice of what the winners are going to be, which makes it harder to move forward, and as long as that is the case, there will be slow progress and reluctance to invest**
>
> Dirk Jan van Swaay, ING

Finance Pillar

he Finance Pillar deals with access to 'Smart Money' for startups and scaleups, with funding sources including Banks,vs Private Equity Funds, Public Funding organisations, and Funding advisors. Interestingly, although Finance received the lowest ratings in the 2022 interviews, there were relatively few comments about specific issues.

For the smallest companies in particular, the perception was that **start-up funding was reasonably available**, or not the key constraint. A few even questioned whether there was even too much support: for example, long-term support for start-ups that did not progress.

The finance issue perceived was more about a **lack of available capital for scale-ups**. Interviewees broadly agreed that there was an issue with getting funding for large scale proofs of concept, and scaling technically-proven concepts to commercial success. Moving all the way from bench-scale demonstrations to a profitable full-fledged operation requires several stages of

Case study
ING

Number of FTEs: **15,000**
Number of Energy FTEs in Zuid-Holland: **100**
Location: **Headquarters in Amsterdam, many locations in Zuid-Holland**
Pillar: **Finance**

ING provides commercial funds and makes investments via its Sustainable and Corporate Investments teams so that companies can transition to sustainable business models. Simultaneously, it works on Public-Private Partnerships (PPPs) at the provincial, national and European level to make value chains more sustainable and align a company's energy objectives with regulations, controls, and certification. Interviewee Dirk-Jan van Swaay, Director of Energy Transition and Public-Private Partnerships (PPPs) explained that while ING still has legacy clients in the fossil industry, it does not accept any new clients from that industry. In recent years, the bank has been steering its portfolio more towards the energy transition and the goal of the Paris Agreement to limit global warming to 1.5 degrees Celsius. For example, ING has been investing in green energy technologies, wind and solar in particular.

"[W]e have targets for each and every sector - to find ways to help the clients reduce their emissions in that sector. Everybody has to do it and it is a topic in every discussion. [I]t is on everybody's mind in every meeting. We have full programmes running, with the targets that we can measure to drill down and roll up. We rate all the things in the existing portfolio, and produce a lot of reports on how it works."

"In our Zero Emissions Foundation, we made commitments to one another to not to buy more carbon based vehicles from 2025: all the public transport operators, public transport authorities, banks, advisors, and original equipment managers, …all the decision makers in one place."

Key takeaways

1. "No-one dares take the big decisions alone"; difficult decisions must be made, such as whether to invest in nuclear energy, whether to stop aviation if green fuels are not used. Such decisions need to be made in a public-private partnership, so that laws and legislation can be aligned with the decisions made, and different actors can collaborate to find a solution. However, "It will take guts and leadership and collaboration to get through that process.

2. Importance of energy efficiency in the energy

transition: "More than €30bn of our national government's €300bn budget is spent on energy, yet our energy efficiency is currently less than 10%"

3. Establishment of a good financial model or method could help make investment decisions, similar to the central government's Multi-Actor-Impact-System for its governance decisions.

Key Quote

"We need to look at total energy consumption and move from point solutions to fundamental changes in how we generate and use energy. … It is also one that needs to be a public / private initiative. To deal with all the laws and rights, you have to work together on finding a solution. It will take guts and leadership to get through that process."

transition in business capability, financing, scale and interconnectedness to suppliers and customers. While NL impact investors exist, and are prepared to prioritise green returns - Pymwymic, for example - all investors were influenced by considerations of speed of returns on investment. The perception was that **finance prefers asset-light investments** such as energy management software, rather than some of the capital intensive solutions or distributed ownership solutions that energy transition demands: distributed power supply, new grid connections, long-term investments in solar and wind plants.

Challenge of capital for **distributed assets and fragmented gains**. Financiers tend to prefer assets that can be managed centrally with clear responsibility. The less exciting 'ugly duckling' sustainability actions also require attention. Province in the Netherlands have targets to get hundreds of thousands of homes off natural gas infrastructure and to improve overall domestic energy efficiency. That requires financial solutions to fund boring but highly impactful solutions like consumption reduction, home insulation and electrification. This challenge has not yet been solved - and so presents a financing opportunity.

Some participants in the study mentioned the role played by **foreign investment**, as they had to go outside of national borders to access capital. Several complained that Dutch banks and venture capital firms appeared to be risk-averse. Some cited a lack of reliable local investors and capital, some pointed to a lack of information for validating risks and business cases, some highlighted a lack of business planning skills. While caution in investment in 2020-2022 might have been a prudent response to an overinflated market and the COVID crisis, local entrepreneurs expressed pain that foreign investment was stepping in to fill the gap, and that some Dutch entrepreneurs had had to accept investments on unattractive terms or with unattractive conditions.

On Access to Finance:

> **Access to capital could be better. We need Dutch investors to fund something other than super safe investments and to take some risk to avoid the market being taken over by foreign investors.**
>
> Founder sustainable energy firm

> **There are some subsidies for scale-ups, but they are never going to be sufficient to cover the costs of capital expansion.**
>
> Regional president tank storage

> **Funding to overcome the valley of death - the space between the bench-scale testing and the practical application of the technology - is lacking**
>
> Director energy transition large consultancy company

Where are the opportunities to invest in the Provincie Zuid-Holland Energy ecosystem? We asked our interviewees where they would invest. The only constraint was that they could not recommend a company in which they had an interest. The results are below - perhaps this list includes the next big success from Zuid-Holland!

Pick a winner:

If you had €1.000.000 to allocate to any energy transition company or sector in the Zuid-Holland, who would it be?

Agriculture
- **Bbbls**
- Dutch Medical Food
- **MEZT**
- **Physee**

Batteries and Storage
- **AquaBattery**
- **Battolyser Systems**
- ELEO
- **FLASC**
- Greener
- iWell
- **Skoon Energy**

Biofuels and AltFuels
- **GIDARA Energy**
- **Neste**
- **Zero Emission Fuels**

Carbon Capture Utilisation and Storage
- Carbyon
- Climeworks
- Perpetual Next
- SCW Systems

Community Building
- **Innovation Dock**
- Raad voor Interim Management
- **WijkEnergieWerkt**
- **Yes!Delft**

Digitalization
- **2Tokens**
- **Blockbax**
- **Gradyent**
- **GreenAtlas.earth**
- Madaster

Energy Companies - Solar
- Circular Plastics Alliance
- **Exasun**
- **Oceans of Energy**
- **Pholtaire**
- **PV Works**
- **Rable**
- **Solar Monkey**
- Solarge

Energy Companies - Wind
- **[Ampyx Energy]**
- **KitePower**
- Teraform (Solar/Wind)

Energy Companies - Other
- **Bluespring Energy (Offshore Renewables)**
- Moltex (Nuclear)

Heat
- **Eteck**
- HeatTransformers
- **Magneto**
- Sprinkler Energy (Heat Exchange)

Hydrogen
- BayoTech
- **Hydron Energy**
- **Zepp Solutions**

Materials
- **Delft IMP**
- **VS Particle**

Transportation
- **Flying Fish Maritime Innovation**
- **Hardt Hyperloop**
- Lightyear
- **Rocsys**
- **Venturi Aviation**

Unclassified
- **75inQ (Gender Equality)**
- **Carble (Coffee Footprint)**
- DC Systems (Electrification)
- **Loop Biotech (Bio-coffins)**

Regular: not PZH based
Bold: PZH based

Figure 19. Pick a winner - Who interviewees would invest in

Knowledge Pillar

The Knowledge pillar was rated highest by our respondents in terms of its contribution to energy transition. Provincie Zuid-Holland has three of the top Dutch universities along with leading hogeschools and colleges of applied science. In aggregate, approximately 40,000 students per year graduate from undergraduate, masters, and PhD programmes from Leiden University, Delft University of Technology, Erasmus University Rotterdam, and The Hague University of Applied Sciences. In addition, specialist research programmes exist in multiple focused areas connected with energy transition, providing a base of expertise, and attracting foreign talent to study, research, live, and eventually stay and work. With such strength, it is easy to assume that organisations have plenty of choice when searching for future employees.

As many organisations address future sustainability and energy transition targets, one item repeatedly arose: **access to talent**. Regardless of organisation size or purpose, people were concerned that there simply is not enough manpower to deliver the scale of work needed to deliver the energy transition. The problem of talent can be divided into three sub-groups - research-level STEM [science, technology, engineering, and mathematics] graduate-STEM talent, and technicians.

Few respondents highlighted a lack of research-level STEM talent - it was seen generally as a strength that should be increased and leveraged. Some respondents saw issues arising with insufficient graduate STEM talent - in absolute student numbers, and in international section of graduates returning home, reducing the amount of available talent. Many respondent mentioned that companies were struggling and would continue to struggle because of a **lack of trained installers**, technicians and mechanics to carry out hands-on physical work such as installation.

How can this be addressed? Respondents highlighted a general need to make work in the energy transition more attractive to young people across education levels and geographical locations. Even more importantly, making young talent want to participate in the energy transition within the Netherlands will be critical to its success. These issues pertaining to talent should be tackled in the short-term to address immediate staffing issues (some respondents suggested easing visa rules for qualified technicians or researchers) as well as in the long-term via **training redesign, training payments or subsidies** to increase the flow of good technical talent from the Dutch educational system.

The Knowledge pillar also expressed concern about the **need for more testing sites** and piloting spaces (a concern expressed by the Business pillar too). Lack of physical space and limited piloting programs are seen as a constraint by both these sectors, with a risk of restricting knowledge production and failure to convert ideas into solutions.

Case study
Delft Energy Initiative (DEI)

Number of NL FTEs: **1,000**
Number of PZH Energy FTEs: **1,000**
Number of PZH Energy Transition FTEs: **1,000**
Location: **Delft**
Pillar: **Knowledge, Universities and initiatives**

DEI Initiative is the umbrella organisation for energy research at TU Delft, providing a gateway to its energy research, education, and innovation. Students, scientists, businesses, and governments can utilise the DEI community as 'a catalyst for collaboration and discussion'. DEI hopes to actively contribute to energy innovation and ensure that society continues to prioritise a sustainable energy supply. The DEI is split into four energy institutes: the Wind Energy Institute, the Urban Energy Institute, the PowerWeb Institute, and the e-Refinery Institute.

DEI is a valuable component in Zuid-Holland energy innovation ecosystem, and its initiatives cover "virtually every aspect" of the energy transition. Kornelis Blok, its Chairman says: "I want you to have the impression of how diverse the future energy transition is; we're working on it all here at TU Delft."

TU Delft aims to have a CO2 neutral campus by 2030 by using a variety of different energy sources and technologies, as well as by reducing energy consumption in buildings.

Key takeaways

1. Key focus areas for the transition are 'the 3D's'; Decrease energy and material use, Digitalisation, Decarbonisation.
2. Current outdated regulations are seen as the greatest hurdle to energy transition.
3. Electrification is key: electrify as many sectors and technologies as rapidly as possible.
4. Future hydrogen sectors include heavy transport, shipping, aviation, and feedstocks.

Key Quote

You ain't seen nothing yet…in the coming 10 years, we need to do so much more. It will remain hard work for companies, the Province, and for us. We need speed, human capital, and regulation. The years of planning need to be shorter. So much more needs to happen, and we're just at the beginning.

On testing spaces:

> **[We need] spatial planning to make more space available for producing energy (e.g. nuclear on the Maasvlaakte, Rotterdam, or solar in large spaces), and for testing solutions in fieldlabs.**
>
> Ras Lalma, YES!Delft

> **Think differently about energy transition. Most stakeholders are thinking from where we are now, but we need to think from scratch about how it could be. If we want to reach radically different goals, we need to start again, do it properly - including circularity and efficiency, including nitrogen considerations.**
>
> Transition Programme Director, Business

> **The low-hanging fruit is not yet being consumed. Heat pumps can reduce amount of energy needed tremendously. Efficiency is extremely important… Green fuels? Only in aviation because there is no other option. Hydrogen only for extremely high temperature industrial applications.**
>
> Manager, Large Energy User

> **Finally, the importance of a system-wide view was emphasised for knowledge researchers, as well as for government policy-makers to remember: to think 'from scratch' to 'focus on efficiency', to 'capture the low hanging fruit'.**

> **[The regulators could] draw a line on a piece of the sea for testing innovations. If they would do that, we could do a lot with it.**
>
> Kirsten Ruiter, Buccaneer

Quotes to support need for Talent:

> **We must support the talent market and empower young people to become informed and passionate about the energy transition.**
>
> Jeroen Roeloffzen, Over Morgen

> **A major bottleneck is that there are lots of students studying at university, but the biggest gap is trained and qualified technicians and installers who can work with new technologies.**
>
> Founder sustainable architect bureau

> **We have to go out to find and develop talent. If we had been doing a better job at this than years ago, we would have had many more trained people and fewer vacancies. We need mechanics, operators, trained engineers, high-end researchers - more people to run our business.**
>
> Maurice van Bourgonje, Croda

> **We have elaborate sustainability plans, but simply don't have the manpower capacity to execute it.**
>
> Stephan Brandligt, Gemeente Delft

Business Pillar

The Business pillar was rated second highest by our respondents in terms of its contribution to energy transition and innovation. The Business pillar also contributed two-thirds of all the interviewees, but even the 103 Business pillar interviewees are only a part of the very large energy business community in Zuid-Holland, many focused on achieving a more sustainable future. Participants highlighted the positive features of the breadth and quality of the Business pillar:

- Strong SME manufacturing base
- Deep industrial capabilities
- World-leading expertise in engineering, bioscience, chemicals and hydrocarbons
- Concentrated geographical proximity
- Interlinked industrial systems
- Port of Rotterdam

The clustering of companies within Zuid-Holland is seen as a prime driver of success. There are great strengths identified in the capability, talent, and interlinked industrial systems, especially around the Port of Rotterdam. However, these strengths could become weaknesses when transition is needed:

- There are relatively few really large established businesses and very many small start-ups
- Relations between large and small are sometimes ineffective.
- Need to coordinate the whole ecosystem to make plans for change
- Existing collaboration and interaction efforts appear mixed.

So what needed to be improved?

- Overcoming the embedded interests of the owners of large infrastructure items that may block access or overshadow the urgency of the energy transition.
- Improving ecosystem players' awareness of each other's capabilities and activities
- Supporting start-ups including by
    - Adding business skills to their strong technical skills
    - Helping find launch customers for products ready for testing
    - Validating information on product impact

Interviewees recommended the development of awareness campaigns, training networks, and capacity development programs for tech founders to help guide start-ups through this process and lead novel

technology to a wider audience. Interviewees suggested that large companies and governments should be encouraged to be the first customer, and to share learning and data from 'supported launches' to help the market as a whole to learn and develop. Businesses could then also work more effectively with other pillars:

- To change outdated regulations that might be a barrier to innovation
- To find funds in a risk-averse market
- To communicate technical solutions in a publicly available marketplace of ideas

Comments on Large Companies - a key part of the business pillar

In Section 4, we noted the importance of large companies, and asked what can be done to encourage them to move faster towards transition. Here, in Section 7, there are some useful strengths, obstacles and recommendations for how the ecosystem deals with large companies.

Some interviewees said that existing large companies are part of the problem: too big, too slow to change. Issues mentioned included undue political influence, regulatory capture and blocking access to key infrastructure. For example, on defining the right path for the future, one interviewee said:

> **[T]he government is including the industry sectors in finding energy solutions - they end up finding what the industry wants, not what the best energy system is for the Netherlands. We should limit the say of the industry when writing legislation and subsidies.**

On the other hand, some large companies described their strong commitment to energy transition, arguing that all or substantial parts of their workforce were now working on energy transition:

> **It is part of everything we do.**

Others described working practices that always now include energy transition:

> **Every meeting has it on the agenda.**

It is also clear that large companies are seen as having a reservoir of highly competent engineers and project managers who could be a globally unparalleled resource if re-oriented to deliver energy transition. How the Province could engage with large companies to leverage their strengths, while supporting the growth of the small companies is the specific focus of section 8.4: "Converting insights to actions."

Case study
Watertaxi

Number of NL FTEs: **15**
Number of PZH Energy FTEs: **1**
Number of PZH Energy Transition FTEs: **1**
Location: **Rotterdam**
Pillar: **Business**

The Rotterdam Watertaxi company provides transport over water to over 700,000 passengers annually. The company had identified hydrogen as a potential fuel source 7 years ago, and developed a hybrid prototype with support from the EU and the Provincie Zuid-Holland. The prototype helped identify the components needing improvement: battery systems and drive train, for example. Now the company has bid for and won a City of Rotterdam tender for a 15 year licence to run water taxis in Rotterdam, on the condition that their ship fleet will have zero emissions by 2030, which, says co-owner Daan van der Have, they plan to achieve beforehand. The company is not simply replacing the diesel fuel with electric. It has re-thought how its service integrates with the rest of the transport system. For example, across, not up and down the river: zero emissions is one thing, but efficiency is also important. So we changed … from large, low frequency, long-distance diesel ships … to high frequency smaller ships on 2km distances. We avoided any routes that could be serviced by land transport - which is 10x more efficient on rolling wheels than frictional water. The physics is important! Short, slower routes can be served by battery powered ships; faster ships and longer routes will need a denser energy carrier, and for that, hydrogen seems to be the only sustainable answer. Rotterdam Watertaxi is therefore working with the Port of Rotterdam to test hydrogen bunkering in the port and prove the case for hydrogen in sustainable shipping.

Key takeaways

1. Difficulties for small companies to access finance: “It’s the big companies with the big programmes that get cash… it’s not possible to develop something radically new on a small budget…. Because of this, there are huge possibilities for innovation that are not happening.”

2. Focusing on the energy transition on its own is not enough. Improving energy efficiency is key.

3. Importance of cooperation between different stakeholders for learning and to help solutions emerge in situations where they require scale to succeed.

Key Quote

You have to cooperate. We were invited by DeltaLinqs to do a presentation on our Hydrogen project in Oct 2021 and that resulted in a quarterly meeting with all these people to talk about progress. So a very small project like ours generated big cooperation...Yes, some…were competitors with each other. That works ok - they all have the same problems. They have to build ships for 30 years, and they have to get it right...So they really need to cooperate. They need the help of DeltaLinqs, the Dutch government and the port of Rotterdam, and they won't get that help individually."

A Fifth Pillar?

Many interviewees commented on the importance of pillars working together and of system thinking. For example, banks may only be willing to provide funds if businesses have clarity of direction from the government. Entrepreneurs cannot install new energy systems without talent trained in knowledge

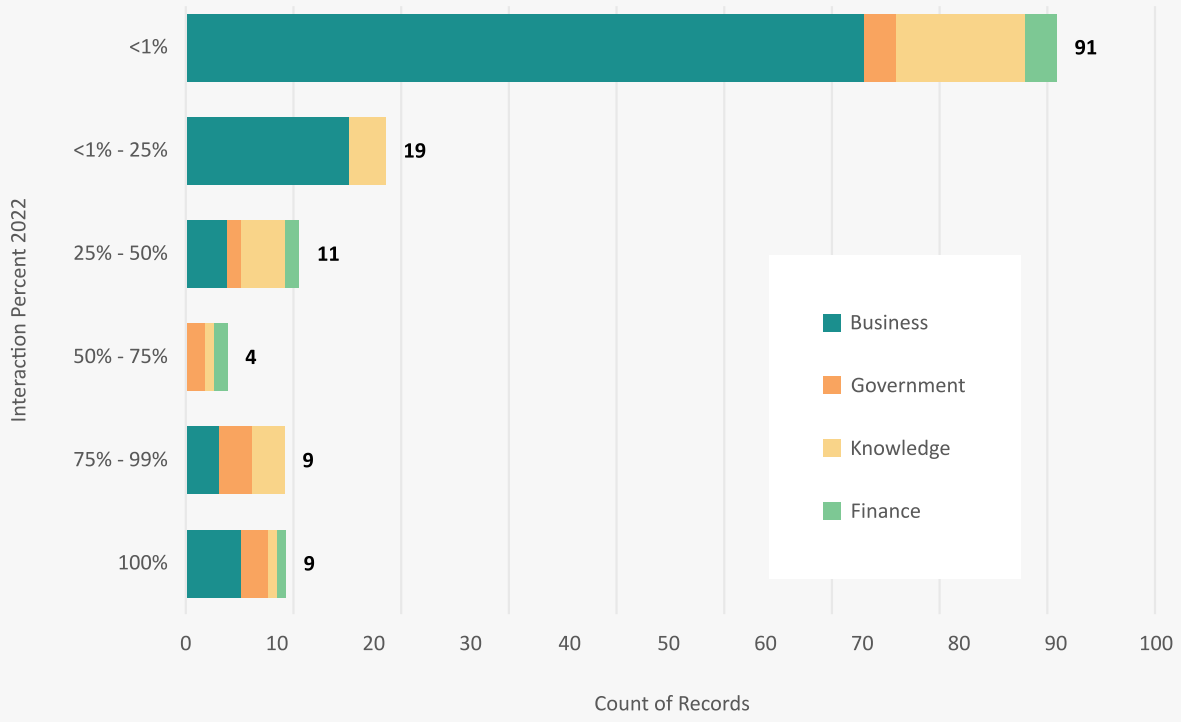

Figure 20. Distribution of Interaction Funding per Pillar

institutions. Some interviewees suggested targeting interaction organisations as a pillar to help the Provincie Zuid-Holland drive towards the energy transition.

How important is Interaction between Pillars?

In 2022, interviewees were asked how much of their funding was intended to support interaction between pillars - as opposed to delivering products or services. Figure 20 shows how many organisations saw themselves as being mostly funded for interaction: 9 interviewees out of 152 said that all their funding was for supporting interaction, while 91 said that none of their revenue came from supporting interaction. Figure 21 shows that people working for Government organisations tended to report that a high percentage of their people had 'interaction' roles: approximately 66% of their staff. Likewise, weighted for organisation size, Finance interviewees reported 16% of their headcount working in interaction roles. Knowledge institutions reported 10%. Business interviewees reported less than 1%.

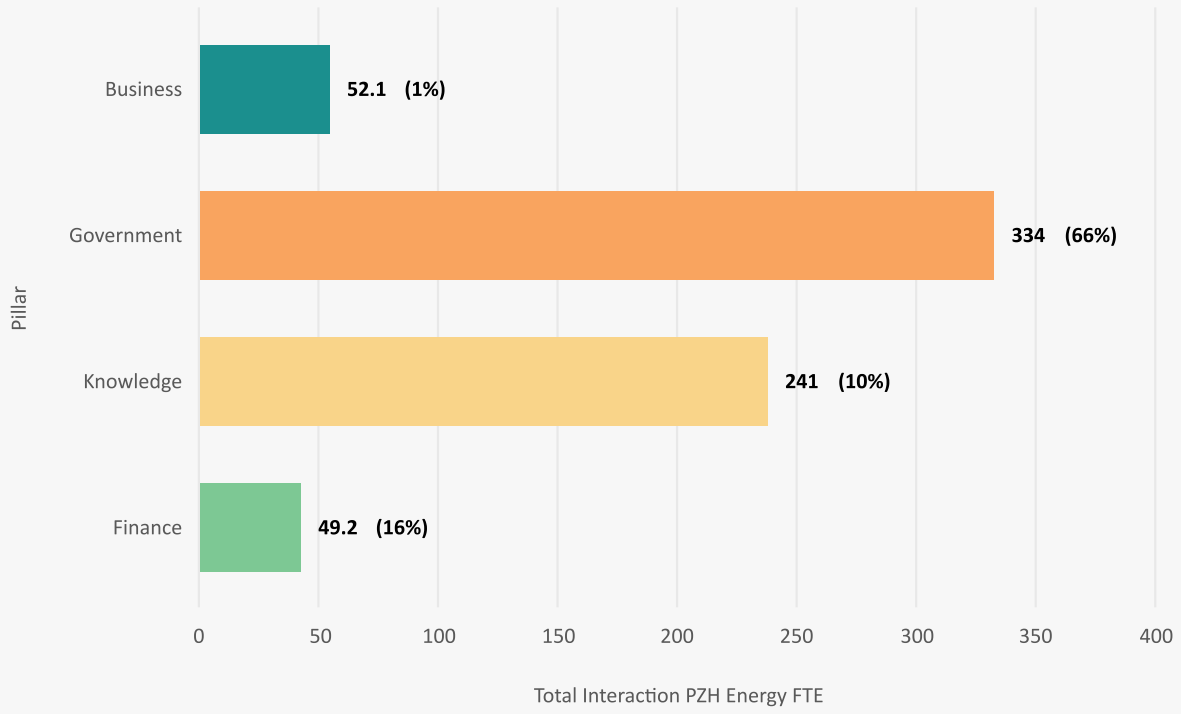

Figure 21. Total Interaction PZH Energy FTE by Pillar

On Interaction as 5th pillar:

> **Framework wise, there are a lot of different parties in the ecosystem, linked like a chain. Even the weakest link is going to make the difference between success and failure.**
>
> Jeroen Roeloffzen, Over Morgen

> **The province doesn't understand that there needs to be more interaction between skills and knowledge across sectors and fields.**
>
> Anouk Creusen, 75inQ

> **There is not enough focus on human behaviour, social impact and adaptation, setting up more connectivity events can increase the social support for organisations/people.**
>
> Marcel Vroom, Ambergy

> **Here is a need and a desire to collaborate between sectors but in reality it is challenging to make de-risking happen (e.g. finding investors that are willing to fund an innovative technology collaboration between a university and a company).**
>
> Liesbeth Tuininga-Mulwijk, Vanadis Power

> **There is funding from Europe, almost a billion euros and the Government is now looking for projects. How do they get attention for applications for these projects? RVO has a newsletter on subsidy programs, but I don't see any correspondence on energy in the Province. The government should be more active in communicating the opportunities for start-ups.**
>
> Executive at biomass energy producer

There are sound economic reasons for the Province to support interaction. Interaction can help encourage There are sound economic reasons for the Province to support interaction – as collaboration can address scale issues, can help increase Information Sharing, and can help coordinate Joint Actions. These economic reasons are discussed in Section 8.2. The Provincie already reports that it allocates nearly 50% of its time to supporting interaction. It makes sense for the PZH to continue this and potentially to increase its coordination with other institutions - such as the city councils - which have similar aims. Interaction is vital and should be encouraged.

Should the Province treat Citizen Initiatives as a 5th Pillar?

Citizens' Initiatives might merit more attention within the pillars. Citizens' Initiatives in energy are usually not-for-profit organisations, in a distinct geographical area, owned and/or run by the consumers. They are compatible with the EU's 2022 **Energy Communities initiative**, which encourages legal entities that make it "easier for citizens, together with other market players, to team up and jointly invest in energy assets."

Case study
Coöperatie Deltawind

Number of NL FTEs: **14**
Number of PZH Energy FTE: **4**
Number of PZH Energy Transition FTE: **4**
Location: **Oude-Tonge**
Pillar: **Business (Not-for-Profit)**

Deltawind is a (not for Profit) citizen-led initiative which shifts the control of energy production to local communities. Participants in the cooperative collectively own and control the means of energy production and sell this energy to corporations and companies. They are currently developing a floating solar park and hydrogen (H2GEO).

Key takeaways

1. For-profit companies will only focus on sustainable practices if it is profitable, which is a huge hindrance to the energy transition.
2. Small cooperatives struggle greatly with access to funding.
3. Governments should place citizen energy initiatives on equal footing with companies to increase citizens' autonomy over the energy production.

Key Quote

"There is a lot of both, technical and political interest, … but we need more action and less chit chat"

See also

- H2GO
- Energy communities (europa.eu)

Organisations of this kind were included in the research as Business (Not-for-Profit). Treating them as a separate pillar could help focus on policies that specifically encourage them rather than the Business (For-Profit) group. For example, these could include allowing certain legal and governance structures, offering tenders or specific subsidies. Not-for-Profit business groups can encourage joint creation of innovative transition solutions, and citizens' support for local implementation. These groups could be foundations, neighbourhood energy initiatives offering free services (such as 'Duurzaam Duinnord', or 'Energy Party'), more formal energy cooperatives owned by local citizens (such as Cooperatie Deltawind) or even large-scale businesses such as Stedin.

There are sound economic reasons for supporting local and not-for-profit business sectors. Citizens' Initiatives can potentially access local information and creativity, and may help to coordinate people to enable change. They need transparency and good regulation to avoid capture by personal interests. It makes sense for the

PZH to balance change efforts via the big four pillars with some change efforts aimed specifically to support a healthy local, not-for-profit business sector.

In conclusion, while interaction is not a pillar itself, interviewees definitely supported the Province encouraging interaction. In addition, the Province has an opportunity in distinguishing Citizens' Initiatives more strongly from conventional for-profit businesses. Citizens' Initiatives, being between Government institutions and Businesses, may provide a benchmark for comparing delivery by the other two. Citizens' Initiatives can be relevant for mobilising action to support the energy transition through local information, creativity and consent and can be addressed by distinct government sector policies. As such, we would recommend future work to consider a 5 pillar approach, in which Citizens' Initiatives (including Not-For-Profit Businesses) fill an important role between Businesses and Government. The model for a possible 2026 report might therefore look something like this:

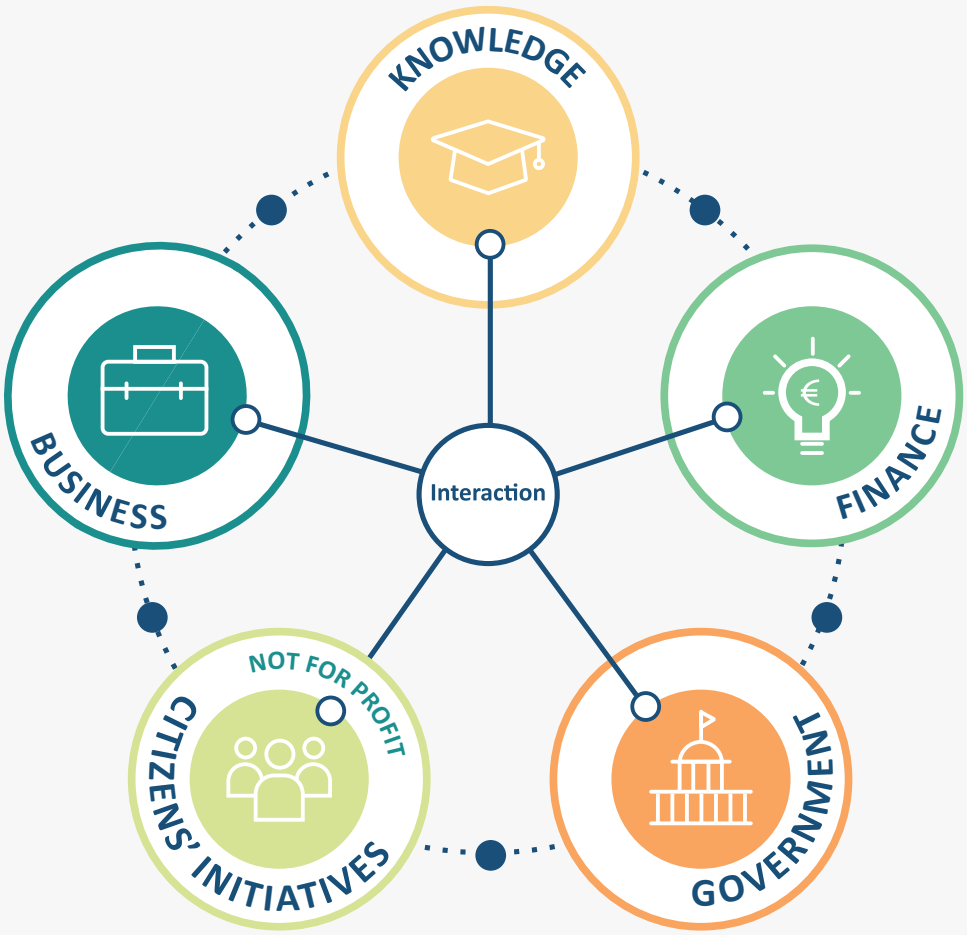

Figure 22. Potential Adjustment to the 4 Pillar Model

08

Interviewee Recommended Actions for the PZH Energy Ecosystem

Section 8 sets out interviewees' recommendations, and how we suggest the Province of Zuid-Holland converts them into action.

This section first lays out the recommended actions to improve the energy transition and seeks to identify broad themes in what interviewees requested. Second, it identifies economic principles underlying requested actions and discusses the issue of organisational size. Third, it highlights potential actions for each Pillar. Finally, it offers an action toolkit to support future decision making that aligns with underlying principles, with three examples of how it can be applied.

Who Recommended What?

This section covers (i) 23 categories of actions recommended by interviewees, (ii) 6 action groups for the categories, and (iii) any tendencies in what kind of interviewees wanted what kinds of actions.

The research recorded over 290 quotes on recommended actions. In many cases, interviewees emphasised urgency, for example:

> **We are in an emergency situation: we are already under water**
>
> Managing Director, solar energy solutions company

> **Governments, at all levels, should take the lead to enable (and where needed, force) the energy transition at a much higher pace. … They should act now.... Yesterday!**
>
> Managing Director, solar energy solutions company

Urgency is not enough, however – we need clarity and direction. With so many requested actions from so many different Ecosystem players, categories and numbers help bring clarity.

Categories of Recommended Actions

People's recommendations were coded by researchers into categories. The 23 categories that resulted are listed below, with the number of references each received. The most popular are listed first, with example quotes to give a sense of what they include.

Category of action	Total cited	Example quote
Clear Direction	27	"When companies (or households) can anticipate what is coming, they can make decisions. Unpredictability makes it very hard." - Founder, Storage company “They should appoint an ambassador…a Minister of Energy Transition…” - Founder, Energy architect company "If you want a thriving ecosystem you need to have a long-term vision." - Leader, think-tank
Strengthen Network Connections	23	“The Netherlands is one big ecosystem. It’s good to have local ecosystems, but … the ecosystem for hydrogen needs to be strengthened across these regional borders.” - C-Suite, Energy company “[The Government could] tap into business organisations, organise seminars for businesses on sustainability, and networking businesses together for sustainable practices” - Manager, Agrisolutions company
Lifecycle Stage Support	19	“A lot of effort is being put into energy transition, but it is hard to build up a business in this sector due to lack of financing options. ... The Province should invest more money in start-ups, scale-ups and initiatives (neighbourhood etc), then pass the company onto investors.” - MD, Solar company
Regulatory Speed	19	“Cut the red tape! Regulations are too complex, too time-consuming; permits are extremely slow. It all needs to be more simple. People can object too easily … . The central government is slow to update regulation." - Manager, Government pillar
	17	…Collaborative Decision Making
	17	…Incentivise Non-carbon Solutions
	17	…Information Sharing
	14	…Support Talent Creation
	13	…Community Building

Category of action	Total cited	Example quote
	13	…Support Research
	13	…Whole System Panning
	12	…Identify key customers
	12	…Smarter funding
	11	…Collaborative roll-out
	10	…Improve spatial planning
	10	…Regulatory flexibility
	9	…Grid Investments
	8	…Maximise learning
	7	…Regulatory clarity
	6	…Regulatory collaboration
	6	…Overall support for investment
	6	…Support pilots
	6	…More testing grounds

Groups of Categorised Actions

To get a better idea of the broader picture of the actions recommended, researchers grouped the individual action categories into 6 action groups (see Figure 24). For example, the overall group 'Bold vision for ecosystem' brought together the three categories 'Clear Direction', 'Whole System Planning' and 'Identify Key Customers'.

Tendencies to Recommend Particular Actions?

In this section, we look at any tendencies by type of interviewees to recommend types of actions. We look at three interviewee characteristics: (i) the city in which their organisation is based, (ii) the size of their organisation, and (iii) to which pillar they belong.

Based on the City

We focused on the three cities with which most of the interviewees were associated: Rotterdam (41), The Hague (35), and Delft (27) - which account for two thirds of all interviewees. We analysed which of the 23 action categories was mentioned most often by each city, and any action category that a city showed it was more likely to reference.

The results show that Rotterdam and The Hague were

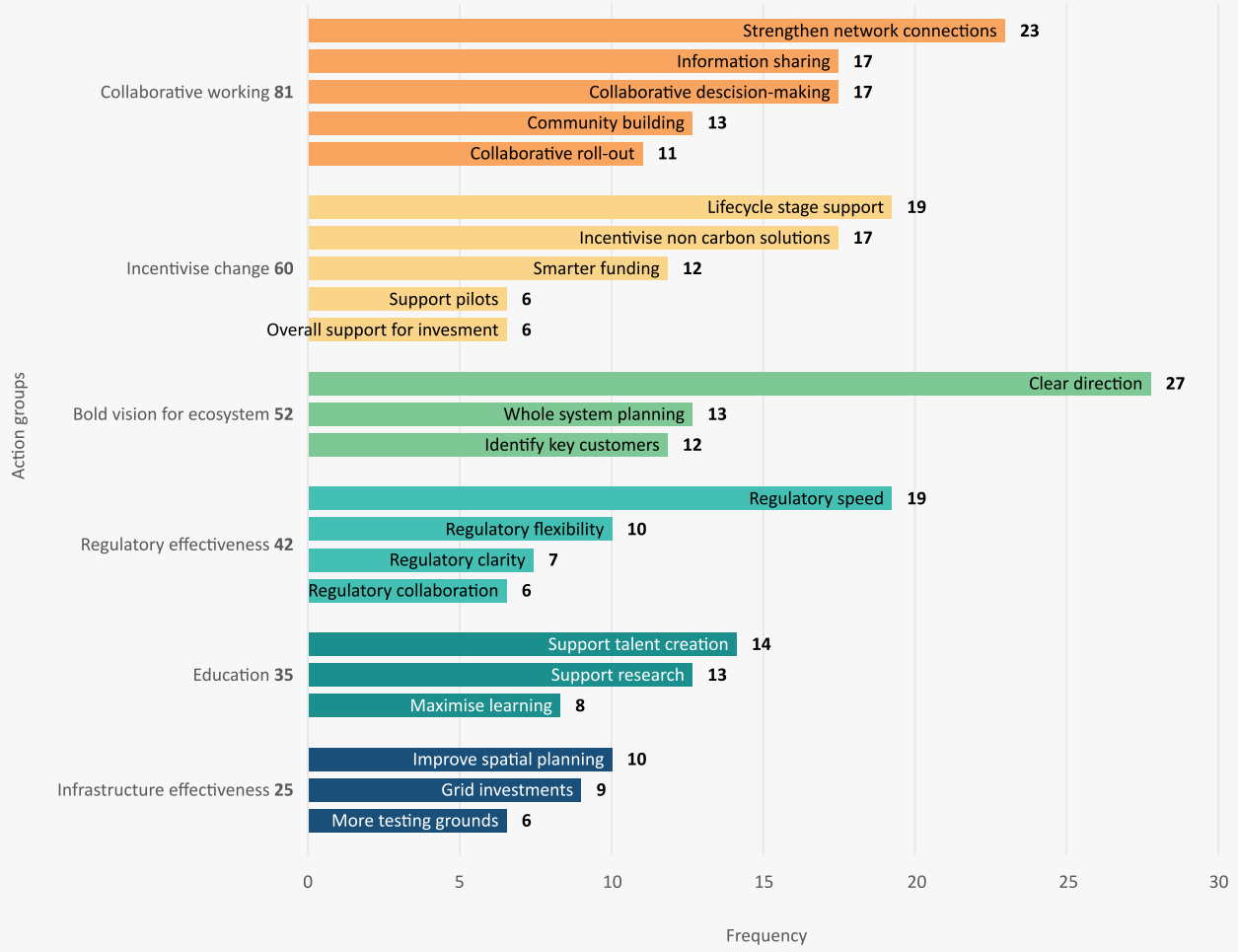

Figure 23. Action Groups and Associated Action Categories

aligned in both seeking stronger network connections, while Delft sought a clear direction for the ecosystem. Rotterdam was more likely than the others to reference 'Collaborative Roll-out', The Hague referenced 'Support Pilots' and university-dominated Delft mentioned 'Maximise Learning' most often.

Based on the Size

In regards to the size of the interviewees' organisations[6], the results showed that some action categories ranked highly by micro and small organisations were not mentioned at all by medium and large organisations, pointing to some pronounced differences between organisations of different capacities. Briefly, micro organisations were especially interested in finding testing grounds, and getting key customers. Once customers had grown a little, they became strongly interested in regulatory speed. And knowing a Clear Direction was important at both ends of the size range!

6 Interviewees' organisations were classified in four groups based on OECD size classifications: https://data.oecd.org/entrepreneur/enterprises-by-business-size.html

	Rotterdam	The Hague	Delft
Most frequently referenced action category	1. Strengthen Network Connections 2. Regulatory speed 3. Clear Direction & Collaborative decision-making	1. Strengthen Network Connections 2. Incentivise non-carbon solutions 3. Clear Direction	1. Clear Direction 2. Collaborative decision-making & Support research & Regulatory speed
Greater relative interest: This city was more interested than average in...	Collaborative Roll-out	Support Pilots	Maximise Learning

Based on the Pillar

Finally, the Business and Knowledge pillars have a cluster of similar interests around strengthening connections, sharing information and building a community. Meanwhile getting a Clear Direction again was a high priority for Government (appearing in 20% of all Government pillar recommendations) and for Business interviewees (10% of Business pillar recommendations).

	Micro (0-10)	Small (>10-25)	Medium (>25-250)	Large (>250)
Most frequently referenced action category	Clear Direction	Regulatory Speed	Regulatory Speed, Clear Direction, Grid Investments	
Greater relative interest: This size was more interested than average in…	Identify key customers, More testing grounds	Regulatory Clarity	Collaborative Roll-out	Regulatory Speed, Clear Direction, Grid Investments

Underlying Economic Issues

Behind each requested category of action, we seek to identify the underlying economic issues to answer the question 'if this is a problem, why hasn't society or the market resolved it already?'

Six main economic issues emerge from our analysis. Two are system issues, driven by the physical characteristics of energy supply and the nature of the political system.

	Business	Knowledge	Government	Finance
Most frequently referenced action category	Strengthen network connections	Information sharing	Clear Direction	Collaborative roll-out, Support talent creation, Lifecycle stage support
Greater relative interest: This Pillar was more interested than average in...	Clear Direction, Regulatory Speed	Community building, Support research Lifecycle stage support		

Case study
Aquabattery

Number of NL FTEs: **15**
Number of PZH Energy Transition FTEs: **15**
Number of PZH Energy FTEs: **15**
Location: **Leiderdorp**
Pillar: **Business, Innovative start-ups (scale-ups)**

AquaBattery is a technology provider of sustainable batteries that store renewable energy in saltwater. The energy transition is the start-up's top priority, with the digital and circular transitions ranking second and third. They created their prototype in 2016, and plan to sell products commercially from 2023.

CEO and founder Jiajun Cen describes AquaBattery's purpose as being to revolutionise the energy storage market by developing the world's most sustainable, affordable, and scalable battery. Their ambition is to offer a battery with the lowest CO2 footprint per kWh stored, the lowest cost for 24+ hours of storage, while using local resources (e.g. water, table salt, and reservoirs).

Key takeaways

1. **Expertise to scale-up**: "Many young deep-tech founders don't have much commercial background and they are learning how to scale a business on the job. Having access to experienced and certified scale-up coaches would be useful to grow our business and get the technology faster to the market."

2. **Investments**: It is challenging to fund the development of hardware innovations for the energy transition, such as a sustainable battery, because they are associated with high risks, late revenues, and high development costs. Governmental institutions should spot high potential startups, provide funding and subsidy schemes, and coach the team to become investment-ready. Examples: train management teams about how to raise funding and scale their business, raise aware of public funding, connect to private investors.

3. **Identify early adopters**: Innovative SMEs could greatly benefit from policies that facilitate finding early adopters and support the uptake of new technologies in the energy system.

Key Quote

"I believe technologies to solve most, if not all, problems of the energy transition already exist. The problem is that the bulk of the innovations are not known to end-users and

decision makers. Because they require large investments to develop and industrialise, they too often do not get financed. In addition, start-ups have a challenging time attracting talent to grow their operations. Instruments which tackle these challenges need to be rolled out in order to accelerate the energy transition."

Three are market issues, relating to how markets function to bring supply and demand together. The last is administration - about how regulators set up and run an energy ecosystem.

System Issues

1. **Large minimum economic scale**: The physical characteristics of power supply mean that in several cases - such as pipeline networks or new power production technologies - significant investments are needed before technologies reach minimum efficient scale[7]. Finance is hard to obtain for large-scale pre-revenue initiatives, which especially affects the ability to move from pilot or 'start-up' stage to 'scale-up'.
   - *Potential Remedy*: mission-based policies[8], directional leadership, coordinating market players around joint solutions. Option to coordinate with larger groups (e.g. at **sub-EU**, EU or larger global bodies).
   - *Risks*: market collusion, regulatory capture, inefficiency of public bodies
   - *Mitigation*: transparency in process, auditing and ongoing management
2. **Short time horizons**: Public bodies must make some decisions about unspectacular investments that have long-term positive externalities (home insulation, system balancing projects, training) but short-term costs. Elsewhere, a commentator said "the cheapest & greenest energy is the energy you don't use… call it 'negawatts' of energy."[9] But a short-term electoral cycle risks politicians offering more spectacular projects with hi-vis photo opportunities. The consequence may be under-investment in long-term projects that would be valuable for society.
   - *Potential Remedy*: identifying time horizon issues and putting decisions on them above the immediate short-term political debate. Potentially creating 'legacy' bodies staffed by people who commit to leaving regular politics. Aim should be principle-led long-term decisions, with regular reporting of progress. Expert advice, transparently communicated, with clear

7 See e.g. Carlton, D., & Perloff, J. (2015). Modern Industrial Organization, Global Edition, 4/E. *Higher education, 4.*

8 Mazzucato, M. (2021). Mission economy: *A moonshot guide to changing capitalism*. Penguin UK.

9 UK Renewable Energy Association 2022; see also Lovins, A. B. (1990). The negawatt revolution. *Across the board, 27*(9), 18-23.

cost-benefit analysis[10]. Option to use citizen councils (see Joint Action Challenges, point 5 below).

- *Risks*: cost, political capture, lack of experts or SME stakeholders.
- *Mitigation*: transparency in process.

Market Issues

3. **Information gaps**: causing market failure, as the market is not well-informed about the potential of some technologies or suppliers. Can be lack of information, lack of standards, or a lack of simplified standards. As a result, consumers do not buy, businesses do not supply, and investors do not invest in solutions or services that would be economically and technically effective[11].
   - *Potential Remedy*: public standard setting & audits; public subsidy for private provision of information platforms; public encouragement to leverage broader networks or events to inform purchasers about available market opportunities.
   - *Risks*: lack of technical expertise in identifying relevant information gaps; possible bias in information provided; costs of organising networks.
   - *Mitigation*: importing external expertise into government discussion; transparency around process; cost-benefit analysis of ongoing management

4. **Access to Public Goods**: Some key public goods (such as a heating network, gas, or electricity grid) do exist but regulation does not incentivise access. As a result, access is restricted, meaning that development does not happen and potential gains are not created.
   - *Potential Remedy*: public good management methods - default to transparency in cost and administration; regulated return on assets; use the case for public ownership as an alternative in order to focus private owners' attention
   - *Risks*: perception of process capture
   - *Mitigation*: transparency in process

5. **Joint action challenges**: The need for system thinking and coordination. Decision makers across multiple points in the energy system have limited incentives to think about the full implications of actions across the system. The system has limited experience in thinking in this way. Decision makers therefore (1) do not take a full view of all the costs and benefits, and (2) struggle to organise large independent groups to agree joint plans and to take action together[12]. Frustration with 'poldering' sometimes makes people call for more simple decision making: "…a smart market for energy needs pricing for peaks …the whole industry to agree how it will work. I would get everyone together in a room and bangs heads until we reach an agreement on how we are going to do this."
   - *Potential Remedy*: Government 'banging heads

10 See e.g. *Boston, J. (2017). Safeguarding the future: Governing in an uncertain world* (Vol. 52). Bridget Williams Books.

11 Stiglitz, J. (1998). The private uses of public interests: Incentives and institutions. *Journal of Economic Perspectives, 12*(2), 3-22.

12 Similar topics are sometimes called 'coordination games', 'collective action problems', 'social dilemmas' etc. See Ford, A. (2016). *Can We Improve the Science of Solving Global Coordination Problems? Anders Sandberg.* Science Technology & the Future.

Case study
Technolution

Number of NL FTEs: **250**
Number of PZH Energy FTEs: **50**
Number of PZH Energy Transition FTEs: **50**
Location: **Gouda**
Pillar: **Business (and Knowledge)**

Technolution works on integrating software and hardware solutions for the energy sector, amongst others. Business Unit Director Wilbert Prinssen describes their aim as being to innovate energy distribution – including working on smart sensors for energy grids and open platforms for grid and energy management. Furthermore, they claim to be a market leader for digital twins of electricity grids in the Netherlands. The digital transition is the company's top priority, followed closely by the energy transition. While recognising the challenges of coordination, Prinssen has praise for people's sense of Purpose in the ecosystem: "People working in the ecosystem feel a strong responsibility to society, to 'keep the lights on'"

Key takeaways

1. **Need for a shared vision**: The lack of a shared view on key challenges and on what the future of the energy sector will look like is hindering individual players to act in the transition to net-zero by 2050.

2. **Infrastructure as a constraint**: "There are hundreds of thousands of electricity cables underground. That's not something you can change overnight." Therefore: increase efforts on energy saving and smarter energy management.

3. **Realism**: Focus less on "shiny" and utopian visions of the future than on investing in many measures in parallel. 'Not all investments will pay off, but that is better than waiting.' Encourage a more active and experimental attitude, so stakeholders can work together towards a shared, realistic vision.

Key Quote

"I believe technologies to solve most, if not all, problems of the energy transition already exist. The problem is that the bulk of the innovations are not known to end-users and decision makers. Because they require large investments to develop and industrialise, they too often do not get financed. In addition, start-ups have a challenging time attracting talent to grow their operations. Instruments which tackle these challenges need to be rolled out in order to accelerate the energy transition."

together'; Coordination devices for decision making; 'Citizens' Assembly' (Ireland) with random members advised by experts; Cross-party assembly (Norway) with key players e.g. suppliers, regulators and customer groups. Or a combination of the above. Ideally top-down decision making would be avoided, with a preference for a publicly understood process.

- *Risks*: cost, delay, perception of process capture
- *Mitigation*: transparency in process

Administrative Issues

6. **Regulatory effectiveness**: meaning a need to regulate energy systems more accurately (to include externalities, and to adapt as technology advances), more quickly (in implementation, e.g. of permitting) and more clearly (e.g. via enforcement). [13]Businesses report that there is uncertainty in investment markets due to non-standard contracting and insufficient access to finance for energy businesses.In both cases, lack of clarity causes businesses and investors to hesitate.
   - *Potential Remedy:* create missing markets; identify markets needing regulation; expert regulation and periodically review the effectiveness of regulation, cutting red tape / reducing complexity by comparison with other countries' systems.
   - *Risks*: cost, regulatory capture by industry, technocratic regulation
   - *Mitigation*: transparency in process, learning from comparable markets, induce competition in administrative bodies

Recommendations per Pillar

Having identified some common economic issues, we can now see the top recommendations for each pillar more clearly, roughly sorted with quickest time to impact first.

The table below shows recommendations, sorted approximately, showing initiatives with quickest time to impact first.

13 Shleifer, A. (2010). Efficient regulation. In *Regulation vs. litigation: Perspectives from economics and law* (pp. 27-43). University of Chicago Press.

		System		Market		Regulation	
Pillar	Type of Intervention	Minimum economic scale	Overcome short-time horizons	Information gaps	Access to Public Goods	Joint action challenges	Regulatory effectiveness
Government	Faster pace of change - through faster permitting; faster updating regulations or laws for current needs; aligning with other regulators.						✓
	Help with clear leadership. e.g. help set overall aims, support networks, appoint ambassadors, track progress, recognise success					✓	
	Ensure access to grids and networks - establish channels to highlight where innovations are being blocked.				✓		
	Commission key infrastructure - especially, sites for testing pilot and roll-out solutions, access to equipment required for them.		✓				
	Create markets to produce and sell gains - if there are standards, if carbon emissions can be measured, and only if standards are effectively enforced.			✓			✓
Finance	Get more start-ups through scale-up and on to roll-out - help start-ups make their business case with training in business planning skills		✓	✓			
	Address investment scale challenge: explicitly connect larger funds or build coalitions of smaller funds as secondary backers for large investments.	✓					
	Address fragmented ownership of gains via discussion with regulators and government.					✓	
Knowledge	Prepare more people to work in technician roles - improve installer training courses; seek subsidies for training; publicise courses.		✓	✓			
	Prepare scientists / researchers by connecting to businesses, building standard infrastructure, building business skills		✓				
Business	Build networks across pillars, coordinate change within business community. Default to transparency to avoid risks of collusion	✓				✓	
	Prepare to transition more effectively (by mission-based working, purpose statements, encouragement for creativity, internal working practices, aims and rewards)			✓			

Converting insights to Province-level actions

Let's use large companies in the Business pillar as an example due to their large impact on the ecosystem's transition - what can the Province do to accelerate large companies' energy transition? How can the Province help convert their talent, motivation and potential impact on the transition into reality?

First, the Province can monitor the scale of the issue - checking periodically any evolution in the current situation, where large companies account for the majority of the FTE in Energy Transition. A thriving Energy Transition Ecosystem should see the number of companies involved in energy transition rising, and the percentage of FTE accounted for by the large companies dropping. Next, for immediate impact, the Provincie Zuid-Holland can engage with its large companies to encourage them to move more effectively towards the energy future. Even before changing any regulations, the Provincie Zuid-Holland can prompt change by asking large companies:

1. How do you embed energy transition into:
   - publicly stated aims and internal target setting?
   - job descriptions and pay & rewards?
   - working practices (such as including transition as a topic in meeting agendas)?

2. How do you connect to the energy transition ecosystem:
   - by knowledge sharing with ecosystem partners (such as InnovationQuarter's **energie-en-klimaat programme**)?
   - by linking with smaller players?
   - by coordinating with knowledge sector players - e.g. hogeschools and universities - to build interest in transition training?
   - by engaging with the ecosystem, e.g., being a launch partner-customer?

3. The Province can also cooperate with other Provinces and cities to:
   - Encourage regulators to create a market for change - for example, by helping outsiders to see reliable annual reporting on FTE allocated to transition activities
   - Support transparency e.g. by giving whistle-blower protection in case of green-washing?
   - Align across Provinces and cities on ways to encourage large company – small company collaboration.

Depending on the answers and progress shown, the Province can choose how to push further for change.

09

Conclusions

This report has answered two key questions:

1. **How have the activities and number of Energy FTEs in the energy ecosystem changed?**

2. **How can the Province best help the ecosystem meet the transition challenges and take advantage of transition opportunities?**

In answer, the Hague Tech researchers have documented:

- Zuid-Holland energy ecosystem's scale, energy sources and activities and the changes since 2018
- Future potential for energy transition vs. current energy activities
- Key people and organisations leading the change
- Effectiveness of existing ecosystem pillars
- The actions recommended for improving the ecosystem

The Hague Tech also aimed to increase connections in the ecosystem and to enable easier decision making going forward.

The Nature and Scale of the Zuid-Holland Energy Ecosystem

What are the organisations in the Zuid-Holland energy ecosystem, and how many of them are involved in what kinds of energy innovation?

In 2022, we interviewed 135 organisations, which employed at least 22,000 Energy FTE in the PZH energy ecosystem. We estimated that the 135 organisations allocate at least 7,650 FTE in Zuid-Holland to energy transition activities. The energy transition ecosystem mapped in 2022 is therefore substantially larger than the 4,300 Energy innovation FTE mapped in 2018.

The energy transition ecosystem mapped in 2022 is substantially larger than the 4,300 Energy innovation FTE mapped out in 2018. In 2022, we estimate that at least 7,650 Energy Transition FTE in Zuid-Holland are allocated to energy transition activities.

Activities with Greatest Impact on Carbon Dioxide Emissions & Employment

Respondents most often suggested - for both carbon reduction and employment growth:

- wind power manufacturing
- solar manufacturing and
- energy storage

There was some separation between companies with fossil energy and renewable energy activities, implying that a substantial hard core is not yet crossing over to take advantage of renewables opportunities. Support for awareness and networking may encourage companies to switch across to renewables opportunities. Support for awareness and networking may encourage companies to switch across to renewables opportunities. Wider opportunities for carbon reduction - e.g. re-thinking energy losses, energy usage and sustainable materials - should also be encouraged.

Universities and government employees were most often identified in the 'Top 20 People' list; Businesses were most often identified in the 'Top 30 Organisations' list to lead this transition.

Actions Recommended & Support Required

295 actions recommended were gathered into 23 action categories, with the top 4 being: setting a clear direction, strengthening network connections, supporting businesses especially at the stage of scaling up, and increasing regulatorys speed.

The action categories were grouped by pillar - for example, for government, the recommendations were:

- Faster, more accurate regulation
- Clear leadership - to overcome joint action challenges
- Ensure access to grids and networks - where public goods are in private hands
- Commission key infrastructure - to overcome short time horizons
- Create markets for improvement - where there are information gaps

For other pillars, the recommendations with the potential for greatest impact seemed to be:

- Training and support to deliver a larger number of trained installers
- A review of ways to support transition through the scale-up stage
- Increased use of purpose to support coordination between businesses, and clear leadership inside them - to deal with joint action challenges.

We suggest that the Province tests future requests for actions against these proposed economic principles to ensure that each action aligns with its long-term principles.

Wider Benefits

The study is also intended to have additional benefits of

- increasing the awareness that players in the ecosystem have of each other, potentially to help coordinate action

We anticipate that the Province will use the industry players identified and the data gathered on their priorities to link people and organizations to one another, to provide information online and to co-ordinate groups around their priorities for change.

Researchers' Recommendations

We recommend going forward that the Province of Zuid-Holland:

- Sets clear overriding aims, such as 'to reduce energy consumption by 25%; to reduce energy losses by 50%;
- Supports industry players in coordinating change, encourages information sharing and mutual support, but sets ever-more ambitious aims for the rate of progress;
- Tracks the growth and evolution of the Energy Transition sector to ensure it delivers transition and creates jobs;
- Invests in a few key public goods: including education at the technician level and key

infrastructure such as testing grounds;

- Encourages pricing for gains and costs and removes obstacles to allow markets to form; and
- Simplifies regulation by aligning vertically at the city, province, national and EU level.

Provincie Zuid-Holland is uniquely well-placed to coordinate multiple top-class cities and the national government and help its innovation and transtion sector sector grow into a world-leading hub of expertise in research and delivery.

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Further details, data and all downloadable materials are available from the Provincie Zuid-Holland website: **zuid-holland.nl**

Attachment 1

List of Organisations and Energy Transition FTE Estimates

Sub-department FTE are shown in addition to parent department FTE to give a sense of scale. Duplicate FTE are not double counted in the final report totals.

Legend:

*	Not Interviewed this year
Bold	PZH based

No.	Organisation	Pillar	2018 PZH Energy Innovation FTEs (est.)	2022 PZH Energy Transition FTE (est.)
1	**Stedin**	Business - Not for Profit	25	1625
2	**Delft Energy Initiative**	Knowledge	1000	1000
3	**Shell**	Business	20	700
4	**TNO**	Knowledge	560	300
5	Equans (formerly Engie)	Business	75	500
6	Nuon Nederland (now Vattenfall)	Business	500	*
7	**Eneco**	Business	450	450
8	**Siemens Energy**	Business	400	450
9	Alliander	Business - Not for Profit	27	375
10	Universiteit Utrecht	Knowledge	250	*
11	**TU Delft Department of Electrical Sustainable Energy**	Knowledge	*	225
12	ING	Finance	50	200
13	**Joulz**	Business	*	190
14	**ABB**	Business	*	164.4
15	**BP**	Business	2	120
16	**Leiden University**	Knowledge	50	100
17	**SIF Group**	Business	*	90
18	**BAM**	Business	75	*
19	**Gemeente Den Haag**	Government	55	60
20	**Provincie Zuid-Holland**	Government	60	50
21	**Air Products**	Business	*	55
22	**RVO Zuid-Holland**	Finance	52	*
23	**Erasmus University Rotterdam**	Knowledge	*	50
24	**TU Delft Energy Systems Group**	Knowledge	*	50
25	**Vopak**	Business	*	50
26	**Technolution**	Business	50	50
27	**GasUnie**	Business - Not for Profit	21	50
28	**Hoogheemraadschap van Rijnland**	Government	50	*
29	**Innovation Quarter**	Finance	12.5	48
30	**Gemeente Rotterdam**	Government	48	*
31	**HyCC**	Business	*	45
32	**Sweco**	Business	*	45
33	**TU Delft ESP Lab photovoltaics**	Knowledge	*	40
34	**Oceans of Energy**	Business	*	38
35	Energie Beheer Nederland b.v.	Business - Not for Profit	38	5
36	**Rebel Group**	Business	*	35
37	**BNG**	Finance	32	*
38	**Battolyser Systems**	Business	*	30
39	**VSPARTICLE**	Business	*	30
40	**Zero Emission Fuels**	Business	21.5	30
41	**ASN Bank**	Finance	30	*
42	**Woonbron**	Business - Not for Profit	30	*
43	**Port of Rotterdam**	Business - Not for Profit	28	23
44	**AeroDelft**	Business	*	25

No.	Organisation	Pillar	2018 PZH Energy Innovation FTEs (est.)	2022 PZH Energy Transition FTE (est.)
45	**Ørsted**	Business	*	25
46	**HVC**	Business	25	*
47	**LUMC**	Knowledge	*	20
48	**De Haagse Hogeschool**	Knowledge	10	20
49	**CIC Rotterdam**	Business	20	*
50	NIA	Finance	20	*
51	**Solar Monkey**	Business	*	19
52	**LeydenJar Technologies**	Business	*	17
53	**AquaBattery**	Business	*	15
54	**BAM infra regio West**	Business	*	15
55	**Darel**	Business	*	15
56	**Delft IMP**	Business	*	15
57	**Ecorys**	Business	*	15
58	**Topsector Energie**	Government	13.5	1
59	**Croda**	Business	*	13
60	**Hitma**	Business	*	13
61	**Fokker Papendrecht**	Business	13	*
62	**DSM Delft Permit**	Business	12.5	10
63	**Deltalinqs**	Business - Not for Profit	6	12
64	**DMEC**	Business - Not for Profit	*	10.6
65	**Ekinetix**	Business	*	10
66	**Energy Research Institute - RSM**	Knowledge	*	10
67	**Hogeschool Rotterdam**	Knowledge	*	10
68	**Involtum**	Business	*	10
69	**Heineken**	Business	10	5.5
70	**Duurzaam Den Haag**	Business	10	*
71	**Gemeente Zoetermeer**	Government	10	*
72	**ROC Mondriaan**	Knowledge	10	*
73	**TWTG**	Business	*	9.9
74	**Flying Fish Tech**	Business	*	9
75	**Gemeente Delft**	Government	4	9
76	**SimGas**	Business	9	*
77	**EAZ WIND**	Business	*	8
78	**Mocean Forecast**	Business	*	8
79	**Supersola**	Business	*	8
80	**Vestia**	Business - Not for Profit	*	8
81	**Centre for Sustainability**	Knowledge	8	*
82	**Gemeente Dordrecht**	Government	8	*
83	NVDE / De Duurzame Energie Koepel	Business	8	*
84	**DRIFT**	Knowledge	7.5	7.5
85	**The Green Village**	Knowledge	7.5	7
86	**Future Proof Shipping**	Business	*	7
87	**Karbonik**	Business	*	7
88	**VNCI**	Business - Not for Profit	*	7
89	**Yes!Delft**	Finance	*	7

No.	Organisation	Pillar	2018 PZH Energy Innovation FTEs (est.)	2022 PZH Energy Transition FTE (est.)
90	**Duiker Combustion Engineers**	Business	*	6.6
91	**Netherlands Measurement Institute (NMI)**	Business	*	6
92	**Over Morgen**	Business	*	6
93	**Platform Zero**	Business	*	6
94	**PortXL**	Government	*	6
95	**World Startup Factory**	Finance	*	6
96	**Duijvestijn Tomaten**	Business	2	6
97	**CE Delft**	Knowledge	6	3
98	**De Bouwagenda**	Business	6	*
99	**RES Rotterdam Den Haag**	Government	*	5.5
100	**Uniper Zuid-Holland**	Business	5.5	*
101	**Fieldlab Industrial Electrification (FLIE)**	Business	*	5.3
102	**BBBLS Energy Saving greenhouses**	Business	*	5
103	**Deerns**	Business	*	5
104	**H2O Systems Holland BV**	Business	*	5
105	**Neptune Energy/Nougat**	Business	*	5
106	**SmartPort**	Business	1.8	5
107	**Buccaneer Delft**	Business - Not for Profit	5	3
108	**DAGO**	Business	5	*
109	**Gemeente Westland**	Government	5	*
110	**Hoogheemraadschap van Delfland**	Government	5	*
111	**Koole Terminals Rotterdam**	Business	5	*
112	**Warmtebedrijf Rotterdam**	Business	5	*
113	**Gemeente Goeree-Overflakkee**	Government	4.5	*
114	**Ammerlaan**	Business	*	4
115	**Coöperatie Deltawind**	Business - Not for Profit	*	4
116	**SOLHO**	Business	*	4
117	**The Hague Centre for Strategic Studies**	Knowledge	*	4
118	Lux Research Inc	Knowledge	4	4
119	**Accenda**	Business	*	3.5
120	**Stitching DOEN**	Finance	3.4	*
121	**nflux**	Business	*	3
122	**Rotterdam The Hague Innovation Airport**	Business - Not for Profit	*	3
123	**StoredEnergy BV**	Business	*	3
124	**TechLeap.nl**	Knowledge	*	3
125	**Unified international**	Knowledge	*	3
126	**Efficiator**	Business	3	*
127	**Waterschap Schieland & Krimpenerwaard**	Government	3	*
128	Nationaal Groenfonds	Finance	2.5	*
129	**75inQ**	Business - Not for Profit	*	2
130	**Ballast Nedam Development**	Business	*	2
131	**Bluespring**	Business	*	2
132	**Breytner**	Business	*	2
133	**Dutch Wave Power**	Business	*	2
134	**Holland Houtland**	Business	*	2

No.	Organisation	Pillar	2018 PZH Energy Innovation FTEs (est.)	2022 PZH Energy Transition FTE (est.)
135	**Pholtaire**	Business	*	2
136	**Rockstart**	Finance	*	2
137	**Spatialise**	Business	*	2
138	**SustainableIndustryLab.nl**	Knowledge	*	2
139	**Waste4me**	Business	*	2
140	**WPF**	Business - Not for Profit	*	2
141	**ODE Decentraal**	Business	2	*
142	**Warmte Koude Zuid-Holland**	Government	2	*
143	**Windvogel**	Business - Not for Profit	2	*
144	**Birds.ai**	Business	*	1.75
145	**Navus Ventures**	Finance	1.75	*
146	**Greenport West-Holland**	Business	1.6	*
147	**Coalitie HOT**	Business	1.5	*
148	**TU Delft Urban Energy Institute**	Knowledge	*	1.3
149	**Ideas from Europe - Sustainable Scaleup Foundation**	Government	*	1.25
150	**Nettenergy**	Business	*	1.2
151	**Ambergy Industrial**	Business	*	1
152	**EF Solar**	Business	*	1
153	**Erasmus Centre for Data Analytics - Rotterdam School of Management**	Knowledge	*	1
154	**FPP Management B.V.**	Business	*	1
155	**Green Sea guard**	Business	*	1
156	**Ifund**	Finance	*	1
157	**KVE Composites**	Business	*	1
158	**Rentmeester Architecten**	Business	*	1
159	**Rotterdam Watertaxi Company**	Business	*	1
160	**Technology Park Ypenburg**	Business	*	1
161	**The Coatinc Company**	Business	*	1
162	**The Hague Tech**	Business	*	1
163	**Vanadis Power**	Business	*	1
164	**Wederic**	Finance	*	1
165	**Werkgevers Drechtsteden**	Government	*	1
166	**Independent Consultant**	Government	*	1
167	**Fonds 1818**	Finance	1	*
168	**Freelance Onderzoeker**	Knowledge	1	*
169	**Clean Tech Delta**	Business	0.9	*
170	**Platform Geothermie**	Knowledge	0.8	*
171	**MRDH**	Government	0.5	*
172	**Business Anacritics**	Finance	*	0.25
173	**Mannovation**	Business	*	0.1
174	**Corbion**	Business	*	0
175	**Cottonwood Technology Fund**	Finance	*	0
176	**Greencast.io**	Knowledge	*	0
177	**IbisPower - PowerNest**	Business	*	0
178	**SET Ventures**	Finance	*	0
179	**Wavemakers United**	Knowledge	*	0

Notes:

- If not directly provided by an organisation, 2022 Energy Transition FTE were estimated by researchers utilising interviewee estimates, industry knowledge, public information, and comparable organisations.
- A few organisations show 0 Energy Transition FTE in this table. These organisations may have indicated that they work in traditional energy sources or do not have dedicated FTE located in PZH performing transition work.