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Master thesis

The long road of local renewable energy initiatives in developing solar PV-installations along national transport infrastructure in the Netherlands

Stefan de Graaff

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PREFACE (ENGLISH)

In front of you lies the final version of my master thesis. This thesis is written for the purpose of completing my master program Environmental and Infrastructure Planning at the University of Groningen. Finishing this master thesis also marks the end of my days as a student. The foundation of my interest in and my choice for spatial planning was laid by playing the computer game Sim City as a child. After completing my bachelor Spatial Planning and Design and a wonderful journey through Iceland and the United States of America, I chose to start with this master program. During these periods, my interests in transport-infrastructure and the energy transition grown significantly. The topic of my master thesis was therefore easily chosen. In November, the first stones were laid by writing a comprehensive research proposal. This resulted in a smooth begin of the thesis project as well as in a graduate internship at Witteveen+Bos. After an internship of half a year at this consulting and engineering firm, the final point has been reached: my masterthesis is finished and, consequently, my days as a student are over. I would not have been able to complete my educational programs as well as my master thesis without the explicit support of a number of persons. Therefore, I would like to expressly thank the following persons.

First of all, I would like to thank my scientific supervisor of the University of Groningen: Rozanne Spijkerboer. After submitting my research proposal, you provided me with the idea to include the interesting case A12 Maarn in my research. Consequently, you provided me with the e-mail addresses of these persons after which my research process was accelerated significantly. This has been very important for my research process in general. Also, I would like to emphasize your eagerness to provide me with useful feedback via e-mail or during our consultation moments. I have experienced these consultation moments as very pleasant and useful, also because you always clearly put much effort into providing me with feedback. This feedback made a significant contribution to the process of writing a scientific master thesis. Therefore, I would like to expressly thank you for investing your time and energy in my master thesis.

Next, I would like to thank my corporate supervisor of Witteveen+Bos: Jimme Zoete. Already during my internship application, you made me think about improving my research in such a way that it would end up in a well-structured thesis. This has continued during my internship period. Especially your input in thinking further than solely the next step has helped me a lot. By thinking about 'what project do you want to deliver?', 'what do you want to present?', and 'what should be the red-line through your thesis?' in an early stage, I was able to draw a red-line in an early stage of my research process. Also, you helped me progressing personally. We had many conversations about my future, my personality, and my future career. This helped me a lot in developing some clarities about my interests, my capabilities, and my upcoming career. Furthermore, I would like to thank you for your enthusiasm and my first introduction in the professional field of spatial planning within Witteveen+Bos. Lastly, your feedback on my concept version helped me in improving my thesis as a whole. Therefore, I want to explicitly express my appreciation for your invested time and energy in me as a person as well as in my master thesis. Thank you!

Moreover, I would like to thank the participants of my research. Your enthusiasm about the research topic and my research as a whole triggered me to conduct this research as good as possible. You were all very eager to participate in my research which resulted in the conduction of ten semi-structured interviews. Thank you for that. Last but not least, I want to thank my parents. Without you, my days as a student couldn't have been as comfortable as they were now. More important, you always supported me in achieving my educational goal: obtain a master degree.

This goal has been achieved: I complete my days as a student with obtaining a master degree about which I feel proud of myself. Now on to the next phase in my life: setting the first steps in the professional field of spatial planning.

At this point, there is nothing else left for me than wishing you great joy in reading my master thesis!

Stefan de Graaff
Groningen, 20th of September 2018

PREFACE (DUTCH)

Voor u ligt de definitieve versie van mijn masterthesis. Deze thesis is geschreven in het kader van het afronden van mijn masteropleiding Environmental and Infrastructure Planning aan de University of Groningen. Het opleveren van deze thesis betekent tevens het einde van mijn studententijd. De basis voor mijn algemene interesse in- en keuze voor planologie werd al vroeg gelegd met het spelen van het computerspel Sim City. Na het afronden van de bachelor Technische Planologie en een prachtige rondreis door IJsland en de Verenigde Staten van Amerika viel de keuze op het volgen van deze masteropleiding. Gedurende deze periodes werden mijn interesses in de transportinfrastructuur sector en de energietransitie steeds groter. De keuze voor een onderwerp voor mijn masterthesis was dan ook snel gemaakt. In november werden de eerste stenen van deze thesis gelegd met het schrijven van een uitgebreid onderzoeksvoorstel. Dit resulteerde in een soepel begin en bovendien in een afstudeerstage bij Witteveen+Bos. Na een halfjarige afstudeerperiode bij dit advies- en ingenieursbureau is het punt bereikt waarop het schrijven van deze masterthesis, en dus ook mijn studententijd, ten einde komt. Het afronden van mijn studie en het schrijven van deze masterthesis was niet gelukt zonder de support van verschillende personen die ik hiervoor nadrukkelijk wil bedanken.

Allereerst mijn begeleidster vanuit de University of Groningen: Rozanne Spijkerboer. Na het schrijven van mijn onderzoeksvoorstel kwam jij met het idee de interessante casus A12 Maarn op te pakken. Jij gaf mij de contactgegevens van de betrokken personen waardoor mijn onderzoek al vroeg in een stroomversnelling kwam. Dit is achteraf erg belangrijk voor mijn onderzoek gebleken. Ook was jij altijd bereid mij van advies te voorzien via zowel de e-mail als tijdens onze afspraken. Onze afspraken heb ik dan ook als prettig en heel nuttig ervaren, mede doordat jij duidelijk de tijd nam mijn geschreven werk van goede feedback te voorzien. Deze feedback heeft een grote bijdrage geleverd aan het schrijven van een zo goed mogelijk wetenschappelijke thesis. Daarom wil ik jou hartelijk bedanken voor de tijd en energie die jij in mijn onderzoek hebt gestoken.

Daarnaast wil ik mijn begeleider van Witteveen+Bos bedanken: Jimme Zoete. Al tijdens mijn sollicitatie voor een afstudeerstage zette jij mij aan het denken over het verbeteren van mijn onderzoek zodat het een goed gestructureerd stuk zou worden. Dit heeft zich voortgezet tijdens mijn gehele afstudeerperiode. Met name jouw input in het verder denken dan enkel de volgende stap heeft mij enorm geholpen. Door vroegtijdig uit te schrijven wat ik wilde opleveren, wat ik wilde presenteren en wat de rode lijn van mijn onderzoek moest worden, kon ik in een vroeg stadium van mijn onderzoek de rode lijn door mijn thesis trekken. Daarnaast heb jij mij op persoonlijk vlak vele stappen vooruit geholpen. Door veel gesprekken over mijn toekomst, mijn persoonlijkheid en mijn toekomstige carrière heb ik een veel beter beeld gekregen over wat ik wil, wat ik kan en wat ik in de toekomst ga doen. Ook wil ik jou bedanken voor jouw enthousiasme en het geven van een eerste aangenaam blik in de keuken van een groot ingenieurs- en adviesbureau als Witteveen+Bos. Tot slot heeft jouw feedback op mijn conceptversie mij geholpen mijn thesis als geheel een stuk sterker te maken. Ik wil jou daarom hartelijk bedanken voor de tijd en energie die jij in mij als persoon en in mijn thesis hebt gestoken.

Ook wil ik de participanten van dit onderzoek bedanken. Door jullie enthousiasme over het onderwerp en onderzoek werd ik enorm getriggerd dit onderzoek zo goed mogelijk uit te voeren. Ook waren jullie allen gelijk bereid een interview af te nemen wat mijn dataverzameling een stuk makkelijk maakte. Dank daarvoor. Tot slot wil ik mijn ouders bedanken. Zonder jullie was deze comfortabele studententijd niet mogelijk. Bovendien, en vele malen belangrijker, hebben jullie mij altijd nadrukkelijk gesteund in het bereiken van mijn educatieve doelstelling: het afronden van een masteropleiding.

Dit doel is bereikt: ik sluit mijn studententijd af met een masterdiploma op zak waarbij een gevoel van trots overheerst. Op naar de volgende fase in mijn leven, namelijk het zetten van de eerste stappen op de arbeidsmarkt.

Nu rest mij niets anders dan u veel plezier te wensen met het lezen van mijn masterthesis!

Stefan de Graaff
Groningen, 20 september 2018

ABSTRACT

Currently, there are three ongoing developments: an energy transition towards the use of renewable energy sources, an increase in the amount of local initiatives, and an integrated planning approach in the transport-infrastructure sector. Combining these three could result in a situation in which Dutch transport-infrastructure is surrounded by solar PV-installations with the involvement of a local renewable energy initiative. Despite the recognized potential, situations like these are hardly realized. This research investigates institutional barriers that currently obstruct the realization of such a situation. This qualitative research includes ten semi-structured interviews conducted in two case studies: the A12 Maarn-Maarsbergen and the InnovA58. Research is done corresponding with an institutional analysis based on the IAD-framework of Ostrom. This research identified eight grouped institutional barriers: juridical, contracting, risks, businesscase, difference in interests, priority of Rijkswaterstaat, novelty and unfamiliarity, and who does what. Additionally, this research identified several possibilities to tackle these institutional barriers. The explicit support of Rijkswaterstaat as well as the municipality is hereby of vital importance. Also, the local energy corporative could play an important role in, for example, combining multiple initiatives before coming to table with Rijkswaterstaat. This research concludes that the possibilities to develop a solar PV-installation on public sites along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative are currently limited. To link this research with planning practice, this research listed explicit recommendations for the relevant actors that could improve the possibilities to realize projects like these in future situations.

Keywords: **Energy transition, local initiatives, IAD-framework, solar PVs, integrated infrastructure planning approach.**

SUMMARY (DUTCH)

In dit onderzoek wordt gekeken naar de mogelijkheden om een zonne-installatie te realiseren op publieke gronden langs nationale transportinfrastructuur in Nederland met de betrokkenheid van een lokaal duurzaam energie-initiatief.

Relevantie, probleemstelling en onderzoeksvragen

Dit onderzoek is gebaseerd op vier relevante ontwikkelingen gerelateerd aan zowel duurzame energie als aan transportinfrastructuur planning. Ten eerste is er een energietransitie gaande waarbij het gebruik van de schadelijke fossiele brandstoffen in de ban wordt gedaan. Om aan de energievraag te kunnen blijven voldoen moet er gezocht worden naar alternatieve energiebronnen. Duurzame energiebronnen zoals het opwekken van zonne-energie kan hierbij uitkomst bieden. Ten tweede is er een significante stijging in het aantal lokale initiatieven in Nederland. Hierbij stijgt ook het aantal lokaal gerunde energiecorporaties significant: van 100 in 2014 tot meer dan 350 in 2017. Het lokaal opwekken van duurzame energie kan een belangrijke bijdrage leveren aan de energietransitie in Nederland (zie o.a. De Boer en Zuidema, 2015). Ten derde is de planningsaanpak binnen de transportinfrastructuur sector aan het veranderen. Hierbij verschuift de focus van enkel het optimaliseren van de fysieke infrastructuur naar het zoveel mogelijk waarde toevoegen aan de omgeving. Dit kan kansen bieden voor het opwekken van duurzame energie op, momenteel vaak in potentie gelimiteerde, gronden langs infrastructuur. De laatste relevante ontwikkeling is de politieke herkenning van de potentie van het integreren van duurzame energie en transportinfrastructuur. Zo wordt in een kamerbrief aan het Ministerie van Infrastructuur en Milieu (nu Infrastructuur en Waterstaat) in 2016 het gebruik van aan Rijkswaterstaat verbonden gronden voor het opwekken van duurzame energie beschreven als veelbelovende ontwikkeling. Rijkswaterstaat benadrukt deze veelbelovende ontwikkeling te herkennen en stelt dat ze haar gronden beschikbaar wilt stellen aan derden om duurzame energie op te wekken.

Deze vier ontwikkelingen tezamen zouden leiden tot een situatie waarin Nederlandse transportinfrastructuur omgeven wordt door coöperatieve zonne-energieprojecten. Als langs elke snelweg aan beide kanten dan wel het geluidsscherm of een stuk grond ter breedte van één rijstrook zou worden gereserveerd voor het opwekken van zonne-energie, wordt er genoeg energie opgewekt om 1,1 miljoen huishoudens van stroom te voorzien. Ondanks deze potentiële bijdrage aan de energietransitie en de politieke herkenning van deze potentie, zijn er in Nederland geen of nauwelijks projecten als deze gerealiseerd. Als de potentie van deze projecten zelfs op nationaal niveau erkend wordt, waarom zijn er überhaupt nog barrières die ervoor zorgen dat deze projecten momenteel niet worden gerealiseerd? Gebaseerd op deze probleemstelling is in dit onderzoek gekozen voor de volgende hoofdvraag:

Wat zijn institutionele barrières die de mogelijkheden om een zonne-installatie te realiseren op publieke gronden langs nationale transportinfrastructuur in Nederland met de betrokkenheid van een lokaal duurzaam energie-initiatief beperken en wat zijn ideeën om deze barrières te doorbreken?

Er zijn drie deelvragen opgesteld die het beantwoorden van bovenstaande hoofdvraag ondersteunen. De eerste deelvraag beantwoordt de huidige institutionele organisatie omtrent het realiseren van een zonne-installatie op publieke gronden langs nationale transportinfrastructuur in Nederland. De tweede- en derde deelvraag gaan in op de institutionele barrières die momenteel optreden. Eerst worden de huidige barrières in kaart gebracht waarna de derde deelvraag opzoek gaat naar ideeën om deze barrières te doorbreken.

Methodes

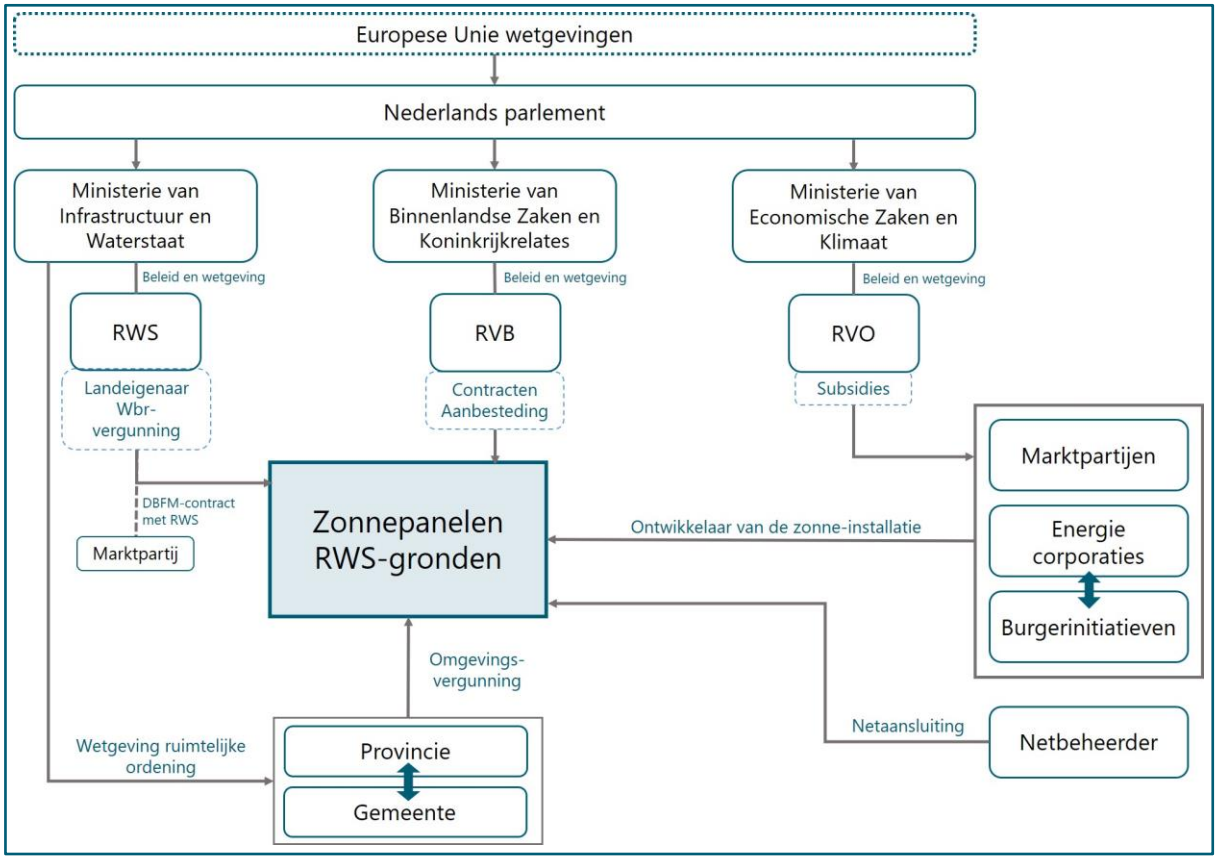
Dit kwalitatieve onderzoek heeft gebruik gemaakt van semigestructureerde interviews in twee casestudies op basis van een institutionele analyse volgens het IAD-framework van Ostrom. Deze institutionele analyse wordt gebruikt om de besluitvormingsprocessen te analyseren die plaatsvinden in een setting bestaande uit meerdere actoren. In dit geval refereert dit naar de institutionele organisatie van de transportinfrastructuur sector in Nederland. Het IAD-framework biedt bijvoorbeeld inzicht in welke factoren bepalen welke actoren de setting mogen betreden, welke posities worden ingenomen door welke actoren, welke acties hierbij horen en welke rol financiële zaken spelen. Binnen deze institutionele analyse heeft dit onderzoek gebruik gemaakt van tien semigestructureerde interviews binnen twee casestudies. Aan de ene kant is de casus A12 Maarn-

Maarsbergen, gelegen in de provincie Utrecht. Hierin is een burgerinitiatief via de gemeente naar Rijkswaterstaat toegestapt met het idee zonnepanelen te realiseren op het bestaande geluidsscherm langs de A12. Het initiatief is goed georganiseerd, zit met de juiste mensen om tafel en heeft een nadrukkelijke medewerking van de gemeente. Drie jaren en vele gesprekken verder is het idee nog steeds niet gerealiseerd. Ondanks de uitgesproken welwillendheid van Rijkswaterstaat om dit project te realiseren zijn de betrokkenen er nog niet in geslaagd dit project tot een succes te maken.

De tweede casus is de InnovA58, gelegen in de provincie Noord-Brabant. Dit is een project in ontwikkeling waarbij nadrukkelijk wordt gezocht naar mogelijkheden duurzame energie op te wekken langs de verbrede A58. Onder de noemer 'Energiecorridor' wordt op grote schaal gekeken naar potentiële locaties waarbij de betrokkenheid van derde partijen nadrukkelijk wordt gezocht. De gemeente Etten-Leur nam zelf het heft in handen door bij Rijkswaterstaat aan tafel te komen met het idee zonnepanelen te realiseren op de geluidswal in hun gemeente. Dit proces verliep tot nu toe stroef. Echter, tijdens dit onderzoek is de ontwikkeling van dit project op gang gekomen en ligt het project klaar om aanbesteed te worden.

Resultaten

De resultaten zijn beschreven aan de hand van de drie opgestelde deelvragen. Ten eerste is de huidige institutionele organisatie in kaart gebracht omtrent het realiseren van zonnepanelen op gronden langs nationale transportinfrastructuur beheerd door Rijkswaterstaat. Deze institutionele organisatie is geïllustreerd in afbeelding x.1.



Afbeelding x1: de huidige institutionele organisatie omtrent de realisatie van zonnepanelen op RWS-gronden.

Dit onderzoek heeft acht institutionele barrières geïdentificeerd. Deze factoren belemmeren de realisatie van zonne-installaties op publieke gronden langs nationale transportinfrastructuur in Nederland waar een lokaal duurzaam energie-initiatief bij betrokken is. Deze acht barrières worden hieronder beschreven.

(1) **Juridisch:** Deze barrière bestaat uit drie factoren: de bereidheid van Rijkswaterstaat om zaken te doen met een derde partij en specifiek het toestaan van zonne-installaties op geluidsschermen, de MOT-procedure ten aanzien van het verkrijgen van het recht van opstal, en het verkrijgen van de andere twee noodzakelijke

vergunningen: de omgevingsvergunning en de Wbr-vergunning. Rijkswaterstaat ziet de ontwikkeling van zonnepanelen op een geluidsscherm momenteel als ''onwenselijk'' wat de realisatie van een project als deze in beginsel niet toestaat. Daarnaast geldt een verplichte Marktconforme, Openbare en Transparante (MOT) aanbestedingsprocedure als het gaat om het in gebruik geven van staatsgronden aan derde partijen. Een lokaal duurzaam energie-initiatief moet het hierbij opnemen tegen partijen met meer financiële mogelijkheden, meer kennis en een groter bereik. Dit verkleint de kansen om het recht van opstal te krijgen aanzienlijk. Het verkrijgen van de vergunning op basis van de Wbr leidt tot problemen omdat het Rijkswaterstaat momenteel ontbreekt aan een vergunningskader waarop zonne-energieprojecten getoetst kunnen worden.

(2) **Contractvorm:** Het gebruik van een DBFM-contract kan tot problemen leiden. Een marktpartij garandeert de veiligheid en het onderhoud van het desbetreffende infrastructuurproject zoals overeengekomen in het bestaande contract met Rijkswaterstaat. Aanpassingen aan het infrastructuur project (bijv. het ophangen van zonnepanelen aan een geluidsscherm) kunnen leiden tot verhoogde risico's. Dit kan vervolgens betekenen dat de betrokken marktpartij niet bereid is de volledige aansprakelijk te blijven dragen waardoor Rijkswaterstaat gedwongen wordt het contract aan te passen. Dit kan gepaard gaan met financiële consequenties waar beide partijen niet op zitten te wachten.

(3) **Risico's:** Het realiseren van een zonne-installatie op publieke gronden langs een snelweg kan gepaard gaan met verschillende financiële risico's. Het gaat hierbij om de vraag: wie is bereid- en in staat deze risico's te dragen?

(4) **Een burgerinitiatief:** Een burgerinitiatief is afhankelijk van vrijwilligers en is daardoor vaak onderhevig aan financiële beperkingen, een gebrek aan kennis en een gelimiteerde projectomvang. Dit heeft als gevolg dat het ontwikkelen van een haalbare-, stabiele- en betrouwbare businesscase lastig is. Het ontbreekt hierbij aan het garanderen van een betrouwbare- en stabiele zakenpartner. Dit leidt tot een verlaagde bereidheid van minder belanghebbende partijen om tijd, energie en geld in het project te steken.

(5) **Verschil in belangen:** De betrokkenheid van veel belanghebbenden leidt tot een verschil in belangen. Dit heeft als gevolg dat niet elke partij dezelfde prioriteiten heeft als het gaat om de bereidheid om tijd en geld te investeren in het project.

(6) **Prioriteit van Rijkswaterstaat:** Rijkswaterstaat stelt momenteel geen prioriteit aan de integratie van lokale duurzame energie-initiatieven en de transportinfrastructuur sector. Dit komt voort uit drie factoren. Ten eerste kan gesteld worden dat Rijkswaterstaat een sterke focus op enkel het realiseren van de eigen doelstellingen hanteert. Ten tweede kan gesteld worden dat er sprake is van een interne Rijkswaterstaat cultuur. Deze cultuur focust sterk op het primaire takenpakket waarbij nieuwe ontwikkelingen in de samenleving (bijvoorbeeld de energietransitie of de opkomst van burgerinitiatieven) veelal buiten beschouwing worden gelaten. Als laatst kan gesteld worden dat Rijkswaterstaat momenteel geen duidelijkheid verschaft of zaken doen met burgers überhaupt tot hun takenpakket behoort.

(7) **Nieuwigheid:** Geen van de betrokkenheid is bekend met projecten gerelateerd aan de integratie van lokale duurzame energie-initiatieven en de transportinfrastructuur sector. Dit resulteert in onduidelijkheden hoe om te gaan met projecten als deze, een gebrek aan relevante beleidsdocumenten en een gebrek aan een vergunningskader waarop projecten als deze getoetst kunnen worden.

(8) **Wie moet wat doen?:** Momenteel is er geen sprake van een uniforme gedachte aangaande welke stakeholder welke actie moet ondernemen. Dit heeft betrekking op zowel niet-financiële als financiële zaken. Ter illustratie, aangaande financiële zaken wordt regelmatig gedacht in de trend van 'dat kan betrokkene X wel betalen, zij hebben immers genoeg financiële middelen'. Dit is echter niet altijd een gerechtvaardigde gedachte. Deze onduidelijkheden zorgen voor vertraging en kunnen leiden tot scheven verhoudingen binnen de gehele institutionele organisatie.

De derde deelvraag gaat in op ideeën hoe deze barrières doorbroken kunnen worden. Dit is schematisch weergegeven in tabel x.2 op de volgende pagina.

Barrière	Ideeën deze te doorbreken	Relevante betrokkene
Juridisch	**1 -** Nuanceer het beschouwen van zonnepanelen op geluidsschermen als 'onwenselijk'. **2 -** Land in gebruik: contract tussen het RVB en de gemeente aangaande het een-op-een gunnen van het recht van opstal. Deze kunnen vervolgens worden doorgezet aan een energiecorporatie. Gebaseerd op de casus A12 Maarn. **3 -** Overtollig gestelde grond: de reallocatie procedure waarbij overtollig gestelde gronden worden aangeboden bij de gemeente. De gemeente kan het recht van opstal krijgen en deze doorzetten aan een energiecorporatie. **4 -** Een vergunningskader opstellen aangaande de Wbr-vergunning voor zon langs infra.	1 - RWS 2 - RVB Gemeente 3 - RVB Gemeente 4 - RWS
Contract-vorm	**1 -** Het opnemen van lokale duurzame energie-initiatieven in een vroege fase van het opstellen van het contract voor het infrastructuur project. **2 -** Rijkswaterstaat kan een aanpassing initiëren in het bestaande contract met een marktpartij op basis van duidelijke afspraken over financiële gevolgen.	1 - RWS 2 - RWS Marktpartij
Risico's	**1 -** Duidelijke afspraken aangaande wie welk financiële risico kan- en gaat dragen. **2 -** De gemeente en energiecorporatie zouden financiële risico's kunnen/moeten dragen omdat Rijkswaterstaat daar momenteel niet of nauwelijks toe bereid is. Een burgerinitiatief is hier vaak niet toe in staat wat maakt dat de gemeente belangrijk is.	1 - Alle actoren 2 - Gemeente EC
Burger-initiatief	**1 -** Het combineren van meerdere burgerinitiatieven leidt tot een haalbaardere, stabielere en dus betere businesscase. Dit resulteert in meer bereidheid van Rijkswaterstaat om tijd, geld en energie te investeren in het project. **2 -** Het vergroten van de zonne-installatie resulteert in meer inkomsten en uiteindelijk tot een stabielere businesscase.	1 - Gemeente EC Burgers 2 - Burgers EC
Verschil in belangen	**1 -** Erken de bijdrage van zonne-installaties langs snelwegen aan de energietransitie **2 -** Een 'co-creator' worden waarbij waarde toevoegen aan de omgeving centraal staat. **3 -** Realisatie van projecten als deze kan resulteren in minder weerstand tegen toekomstige ruimtelijke projecten. **4 -** Positieve publiciteit aangaande de bijdrage aan de energietransitie.	1 - Alle actoren 2 - RWS 3 - RWS Marktpartij Gemeente 4 - RWS Marktpartij
Prioriteit RWS	**1 -** Het Ministerie van I&W kan RWS met opdrachten voorzien aangaande het opwekken van duurzame energie door derden op RWS-areaal. **2 -** RWS kan zich meer opstellen als participerende organisatie die de balans zoekt tussen impliciete opdrachten vanuit de maatschappij en expliciete opdrachten van I&W. **3 -** Een 'co-creator' worden waarbij waarde toevoegen aan de omgeving centraal staat.	1 - Overheid 2 - Overheid RWS 3 - RWS
Nieuwigheid	**1 -** Pilotprojecten zoals de casus A12 Maarn en de InnovA58 kunnen dienen als belangrijk leerinstrument om meer bekend te worden met projecten als deze. **2 -** Het (verder) ontwikkelen van een vergunningskader aangaande de Wbr-vergunning voor zonne-energie langs infrastructuur. **3 -** RWS, het RVB en een gemeente kunnen een draaiboek maken aangaande 'hoe om te gaan met lokale duurzame energie-initiatieven in de transportinfrastructuur sector?'	1 - Alle actoren 2 - RWS 3 - RWS
Wie doet wat?	**1 -** Open en duidelijke communicatie tussen de verschillende betrokken partijen kan bijdragen aan het verschaffen van duidelijkheid omtrent 'wie moet wat doen'? *Specifieke acties zijn uitgezet in hoofdstuk 4.3.8 en de aanbevelingen.*	Alle actoren

Tabel x.2: Ideeën om de acht institutionele barrières te doorbreken.
RWS = Rijkswaterstaat; EC= energiecorporatie

Conclusies

De conclusie van dit onderzoek geeft antwoord op de gestelde hoofdvraag:

Wat zijn institutionele barrières die de mogelijkheden om een zonne-installatie te realiseren op publieke gronden langs nationale transportinfrastructuur in Nederland met de betrokkenheid van een lokaal duurzaam energie-initiatief beperken en wat zijn ideeën om deze barrières te doorbreken?

Momenteel zijn de mogelijkheden om een zonne-installatie op publieke gronden langs nationale transportinfrastructuur in Nederland waar een lokaal duurzaam energie-initiatief bij betrokken is, **beperkt** omdat:

- Juridische verplichtingen ervoor zorgen dat het toelaten van burgers en burgerinitiatieven in de transportinfrastructuur sector niet of nauwelijks mogelijk is.
- Rijkswaterstaat haar welwillendheid en ambities niet (kan) omzet(ten) in concrete plannen en acties.
- Lokale duurzame energie-initiatieven vaak gelimiteerd zijn in omvang, financiële betrouwbaarheid en stabiliteit. Dit leidt er toe dat andere, minder belanghebbende, partijen niet gedreven worden veel tijd, geld en moeite te investeren in het project.

Deze mogelijkheden kunnen vergroot worden als:

- Gemeenten zich inzetten als belangrijke partij functionerend tussen Rijkswaterstaat en het burgerinitiatief. Hierbij kunnen zij een belangrijke rol spelen in het verkrijgen van juridische benodigdheden zoals het recht van opstal. Ook kunnen zij ondersteuning bieden op financieel gebied en kunnen zij het burgerinitiatief voorzien van opgedane kennis.
- De nationale overheid, Rijkswaterstaat en het RVB hun volledige bereidheid kenbaar maken om de integratie van lokale duurzame energie-initiatieven en de transportinfrastructuur sector mogelijk te maken. Hiermee kunnen een aantal belangrijke barrières weggenomen worden waaronder de juridische.
- Meerdere lokale duurzame energie-initiatieven gecombineerd worden voordat ze bij Rijkswaterstaat om tafel komen. Hiermee wordt het project grootschaliger, verbetert het de financiële betrouwbaarheid en wordt een grootschaligere bijdrage geleverd aan de nationale energietransitie.

Aanbevelingen

Op basis van dit onderzoek kunnen verschillende aanbevelingen worden gedaan. Deze aanbevelingen kunnen bijdragen aan het vergroten van de mogelijkheden om in de toekomst meer zonne-installaties op publieke gronden langs nationale transportinfrastructuur in Nederland te realiseren waar een lokaal duurzaam energie-initiatief bij betrokken is. Deze aanbevelingen zijn puntsgewijs uitgewerkt.

De nationale overheid moet:

- De concrete acties per schaalniveau vaststellen aangaande het bereiken van de energietransitie doelen.
- Financiële middelen toewijzen aan het uitvoeren van deze en andere acties omtrent de energietransitie.
- Rijkswaterstaat van expliciete opdrachten voorzien hun areaal in te zetten voor het opwekken van duurzame energie door derden.

Rijkswaterstaat moet:

- Duidelijkheid verschaffen over of een zonne-installatie op een geluidsscherm als wenselijk of onwenselijk wordt beschouwd.
- Een vergunningskader ontwikkelen aangaande de vergunning op basis van de Wbr voor zonne-energie langs transportinfrastructuur.
- Een draaiboek ontwikkelen aangaande ‘hoe om te gaan met lokale duurzame energie-initiatieven in de transportinfrastructuur sector?’
- Een proactieve houding aannemen waarbij bijvoorbeeld het initiatief om een bestaand contract open te breken vanuit henzelf komt. Of dit financiële consequenties heeft hangt van de gemaakte afspraken af.
- Hun bezit van overtollige gronden minimaliseren waarbij de omgeving potentiële gronden om duurzame energie op te wekken terug krijgt.

Een gemeente moet:

- Functioneren als een belangrijke tussenpartij en drijvende kracht waarmee het burgerinitiatief meer politiek gewicht krijgt.
- Ondersteuning bieden in het combineren van meerdere lokale duurzame energie-initiatieven.
- Een proactieve houding aannemen waarbij zij zelf op zoek gaan naar potentiële locaties.
- Bereid zijn enige financiële risico's te dragen.
- Proberen het recht van opstal te verkrijgen via het maken van afspraken met het RVB of de reallocatieprocedure.

Een energiecorporatie moet:

- Ondersteuning bieden in het maximaliseren van de haalbaarheid en betrouwbaarheid van de businesscase.
- Een vroegtijdige inventarisatie maken van potentiële deelnemers aan het project om de businesscase realistisch te ontwikkelen.
- Ondersteuning bieden in het combineren van meerdere lokale duurzame energie-initiatieven.
- Een stabiele zakenpartner vormen voor de gemeente.

De betrokken burgers moeten:

- Een proactieve houding aannemen waarbij hun enthousiasme en professionaliteit benadrukt wordt.
- Vroegtijdig een realistisch haalbaarheidsonderzoek uitvoeren.
- De lokale energiecorporatie en de gemeente in een vroeg stadium betrekken.

LIST OF ABBREVIATIONS

Abbreviation	Full
DBFM	Design, Build, Finance and Maintain
EAC	Economic Affairs and Climate Policy
IAD	Institutional Analysis and Development
IKR	Interior and Kingdom Relations
I&W	Infrastructure and Water Management
MOT	Public, competitive, and transparent tender
PV	Photovoltaic
RE	Renewable energy
RVB	Central Government Real Estate Agency
RVO	Netherlands Enterprise Agency
RWS	Rijkswaterstaat
TI	Transport infrastructure
Wbr	Permit based on the Public Works and Management Act

LIST OF TRANSLATIONS

English	Dutch
Central Government Real Estate Agency	Rijksvastgoedbedrijf
Concept project decision	Ontwerptracébesluit
Dutch Municipalities Association	Vereniging Nederlandse Gemeenten
Environment and Planning Act	Omgevingswet
Environmental Impact Assessment	Milieueffectrapport
Exploration phase	Verkenningsfase
Maintenance phase	Onderhoudsfase
Permit based on the Public Works and Management Act	Wet beheer Rijkswaterstaatwerken
Plan elaboration phase	Planuitwerkingsfase
Public, competitive, and transparent tender	Marktconform, openbaar en transparant aanbesteden
Right of superficies	Recht van opstal
Study and investigation phase	Onderzoeksfase
Termination rights	Noodrembepaling

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1

INTRODUCTION

This research investigates the possibilities to develop more solar PV-installations on public sites along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative. Four elements support the relevance of this research:

1 Energy: Solar energy next to national infrastructure could supply over 1 million Dutch households with electricity and could contribute to achieve an energy transition.
2 Local developments: A significant increase in local renewable energy initiatives.
3 Planning: Upcoming integrative planning approach in transport infrastructure planning.
4 Political: Although hardly realized, the national government recognizes this potential.

The remainder of this chapter will elaborate further on these elements.

1.1 Relevance

Windpark Krammer, a wind energy project in Zeeland in the southwest of the Netherlands, emphasizes the potential of integrating renewable energy (RE) with the transport infrastructure (TI) sector. Windpark Krammer includes the realization of 34 wind turbines and is initiated by the largest local renewable energy initiative (LREI) of the Netherlands (RvON, 2018). During a period of 25 years, citizens started their own cooperatives which now include more than 4000 citizens (Omroep Zeeland, 2017; RvON, 2018). These cooperatives developed a well-functioning collaboration with energy companies and local, regional, and even national authorities. One of these national organizations is Rijkswaterstaat (RWS) which is the executive arm of the Ministry of Infrastructure and Water Management (I&W). The wind turbines are being built on land (near sea locks and a dam) owned by RWS. Windpark Krammer is an example of integrating the generation of wind energy with the TI-sector. The Dutch parliament emphasizes the potential of a project like this in which renewable energy sources are integrated with the Dutch TI-sector (Ministry of IE, 2016). However, projects related to the integration of solar energy with the TI-sector are currently hardly realized. Why is realizing these projects important and, moreover, why is this realization currently lacking?

Energy

Energy was, is, and will become even more important for the functioning of the modern society of nowadays. The use of energy has increased over the years side by side with the population growth and the increased living standards. The use of energy increased exponentially, especially since the second half of the 20th century. This is a result of the substantial economic developments, population growth, and industrial revolutions and therefore, energy has become a crucial part for the functioning of our society (Monstadt, 2007; Steetskamp & Van Wijk, 1994; Stern & Kander, 2012; Verbong & Van Vleuten, 2004). The increased use of energy led to growing concerns about the environment and started the search for new energy sources. This is expressed in several reports of the United Nations: The *Limits to Growth* report (see Meadows et al., 1972) and the *Brundtland Report* that introduced the sustainable development concept in 1987 (WCED, 1987). These reports emphasize the importance of generating energy for the functioning of our society. However, they also highlight the importance to shift away from the use of fossil fuels towards the use of renewable energy sources.

The importance to shift away from the use of fossil fuels towards the use of renewable energy sources is based on three reasons: climate change, the exhaustion of fossil fuels, and the geopolitical relations related to supply countries (see 2.1.1). A transition from the use of fossil fuels towards the use of RE is a fundamental change in our energy system and is referred to as 'the energy transition' (De Boer & Zuidema, 2015; Loorbach, 2010; Rotmans et al., 2001; Van Kann, 2015). Nevertheless, this energy transition is not easy to achieve in our complex society (De Boer & Zuidema, 2015). The European Union has set the 20-20-20 targets in their climate policy to put pressure on its member states in achieving an energy transition (Europe Nu, 2015; European Union, 2009). The targets vary per country and the targets for the Netherlands regarding the share of RE are 14% in 2020 and 16% in 2023 (SER, 2013). This 16% share of RE will only be the beginning of a society running completely on RE sources. However, the Netherlands performs poorly when it comes down to the use of these renewables: 2.5% in 2005 and 5.9% in 2016 (CBS, 2017b). The goal of 14% RE in 2020 is thus far away. This is caused by several factors that constrain the implementation of RE sources in the Netherlands: dependency on the natural gas supplies, the NIMBY-effects, scarcity of space, a lack of solid policies budget, and the poor integration of RE with the dominant energy networks (see 2.1.3). The local level could contribute to improve the poor performances of the Netherlands regarding the energy transition (Arentsen & Bellekom, 2014).

Local developments

Local initiatives related to RE are an important element in achieving an energy transition. According to Agrawal (2010), climate adaptation is highly dependent on the local context. This is in line with Artensen & Bellekom (2014), De Boer and Zuidema (2015), STRN (2010), and Ornetzer & Rohracher (2013) who all state that it makes sense to focus on LREIs in order to achieve an energy transition. Furthermore, Monstadt (2007) stresses the importance to focus on the local scale by stating that the current centralized energy network will be increasingly supplemented by decentralised systems. Moreover, De Boer and Zuidema (2015) argue that LREIs are not only relevant to produce energy. They state that LREIs accelerate the energy transition as a whole by creating knowledge and governance capacity applicable to deal with the energy transition. The amount of LREIs in the Netherlands is increasing significantly: from about 100 in 2014 (Van der Heijden, 2014) to over 350 nowadays (HIER opgewekt, 2017). Furthermore, there are about 500 local initiatives which are not officially considered as cooperatives but highlight the potential of LREIs. These factors contribute to the potential of using LREIs in the energy transition in the Netherlands.

Planning

Empty public sites surrounding national TI can provide opportunities for the integration of RE with the TI-sector. As mentioned earlier, scarcity of space currently constrains the implementation of RE sources in the Netherlands (De Boer & Zuidema, 2015; Van Kann, 2015). The empty public sites surrounding TI offer opportunities to implement RE sources. This could result in a multifunctional outcome that provides a solution for the scarcity of space problem. This multifunctional outcome requires an integrated planning approach. The planning approach in the TI-sector is shifting from a sectoral approach towards a more integrated approach. The focus is shifting from the physical infrastructure itself towards adding value to the surrounding environment (Arts, 2007; Arts et al., 2015; 2016; Heeres et al., 2012; Hijdra et al., 2015; Roovers, 2014; RWS, 2015; Spijkerboer et al., 2015; Van Buuren & Roovers, 2015). These surrounding sites are currently often unused and limited in its potential as a result of the sound- and air pollution caused by the road nearby (Tranchick, 1986, Van der Horst, 2007). The sites along TI are especially suitable for the implementation of solar photovoltaics (PVs) which has been successfully tested in among others India (Sharma & Harinarayana, 2013), the US (Paudel & Hirsch, 2015; Volpe, 2012; Wadhawan & Pearce, 2017), the UK (Highways England, 2016; Parker, 2015) and even in the Netherlands itself (Van der Borg & Jansen, 2001). Especially the integration of generating RE on noise barrier systems offer a high potential (Nordmann & Clavadetscher, 2004; Vallati et al., 2015). RWS owns 700 kilometres of noise barriers in the Netherlands (RWS, 2018b). This confirms the potential of realizing solar PV-installations on noise barriers in the TI-sector.

Political

Although the integration of RE and the TI-sector is currently lacking, the national government has recognized its potential. In 2016, the Dutch Ministry of Infrastructure and the Environment (now Ministry of Infrastructure and Water Management) wrote a letter to the parliament in which Windpark Krammer is called a source of inspiration for the future (Ministry of IE, 2016). In this letter, the integration of RE with the TI-sector on lands owned by RWS is recognized as a promising development (Ministry of IE, 2016). Furthermore, RWS is searching

for opportunities to make their lands available for third parties regarding the generation of RE (RWS, 2017). Despite these political statements, projects related to the integration of RE with the TI-sector are currently hardly realized.

1.2 Problem description

The problem addressed in this research is the, despite its recognized potential, lacking realization of solar PV-installations on public sites surrounding national TI in the Netherlands with the involvement of a LREI. This problem is based on three promising developments and, moreover, three problems arising from these developments. There are three promising developments within the Netherlands relevant for this research:

1. The number of LREIs has risen significantly during the last couple of years (HIER opgewekt, 2017; Van der Heijden, 2014). This is promising since LREIs can play an important role in the energy transition from fossil fuels to RE sources (Agrawal, 2010; Arentsen & Bellekom, 2014; De Boer & Zuidema, 2015; Ornetzer & Rohracher, 2013; STRN, 2010).
2. The planning approach in the TI-sector is shifting from a sectoral approach towards an integrated approach in which the scope is widened from only the physical infrastructure towards adding value to the surrounding area (Arts, 2007; Arts et al., 2015; 2016; Heeres et al., 2012; Hijdra et al., 2015; Roovers et al., 2014; RWS., 2015; Spijkerboer et al., 2015; Van Buuren & Roovers, 2015).
3. The potential of integrating RE with other land-use function (e.g. TI) is widely recognized. Van Kann (2015) argues for smarter spatial planning in which energy and sustainable development are directly taken into account. Also, De Boer & Zuidema (2015) argue for an integrated energy landscape which *''help[s] sustainable energy initiatives to develop and upscale, as initiatives that are well-embedded in the existing physical and socio-economic structures are more prone to acceptance by the local society and less vulnerable for failure''* (p.8). Moreover, the Dutch government also recognises the potential of integrating TI with LREIs (Ministry of IE, 2016; PBL, 2014; SER, 2013).

Combining these developments would result in a situation in which public sites along TI are used to generate RE by using a solar PV-installation in which a LREI is involved. However, this situation is still hardly, if at all, realized in the Netherlands.

There are several problems noticeable that declare the rarely, if at all, realization of this potential situation. First, there is the general poor performance of the Netherlands regarding the implementation of RE sources (CBS, 2017a) (see 1.1). Secondly, the potential of LREIs is currently insufficiently used. According to De Boer & Zuidema (2015) and TNO (2015), the Dutch central government is still merely focused on the 'command and control' strategy instead of acting as a facilitator with focus on the local-scale. The attention for the local-scale is currently limited and, according to De Boer and Zuidema (2015), *''other than informing the local society and allowing them a say in the exact design, linkages with local interests [...] are largely ignored''* (p.5). This often results in increased local resistance while involvement of the local interests can lead to less resistance and a more successful energy transition (De Boer & Zuidema, 2015; Kemp et al., 2007; PBL, 2014). The potential of LREIs remains thus still not completely used. Finally, the integration of TI with LREIs is, despite its recognized potential, still rarely, if at all, realized in the Netherlands.

The process towards an integrated planning approach in the TI-sector is constrained by among others the historic long-lasting sectoral approach of important stakeholders such as RWS (Hijdra et al., 2015). Institutional barriers play an important role in the lacking realization of the desired situation. These barriers occur because of the involvement of many policy domains that all have their own institutional frameworks that can create an overload of (contradictory) rules (Grotenbreg & van Buuren, 2018; Negro et al., 2012). According to Grotenbreg & van Buuren (2018), there are hardly any rules regarding the integration of several different sectors into one project which results in institutional difficulties. Also, Loorbach (2010) emphasizes the need for new governance modes that reduce the lack of coordination and direction. Suzuki et al. (2016) state that *''harmonization of existing and new policies and institutions is key''* (p.4) in order to achieve an energy transition. However, this harmonization of institutional frameworks of the involved stakeholders in the process of integrating TI with LREIs is currently lacking. Therefore, this study uses an institutional analysis to investigate the underlying processes.

The problem addressed in this research is based on these developments and related problems: The public areas along TI in the Netherlands are, despite its (recognized) potential, hardly, if at all, used to generate RE by a solar PV-installation with the involvement of a LREI.

1.3 Research objectives

The aim of this research is filling up the literature gap about the intertwining of LREIs, the integrated planning approach in TI planning, and the potential of realizing solar PV-installations on sites surrounding TI. There is literature available about all three developments, but the intertwinement is currently missing. Furthermore, this research aims to improve the capacity of Dutch TI stakeholders to facilitate LREIs in developing solar PV-installations on public areas along highways since this offers many potential. These promising development could help the Dutch government to achieve the energy transition. The areas along highways are owned by RWS which is part of the Dutch government. In order to allow LREIs to develop a solar PV-installation along a highway, many institutional barriers have to be tackled. This research aims to investigate these barriers and thereby seeks to identify opportunities to tackle these barriers. This institutional analysis will be done by using the Institutional Analysis and Development-framework (IAD-framework) of Ostrom, with an addition of a dynamic component by Spijkerboer et al. (submitted). The IAD-framework is designed to analyse the decision-making processes within a multi-actor setting which is also the case in this research. Following the theory of the IAD-framework will contribute to achieve the research objectives.

These objectives will be achieved by answering the following research question:

What are institutional barriers that limit the possibilities to develop a solar PV-installation on a public site along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative, and what are opportunities to tackle these?

To answer this main research question, three sub research questions must be answered:

1. What is the current institutional organization in the Netherlands regarding the integration of renewable energy and transport infrastructure planning?
2. Which institutional barriers currently occur when developing a solar PV-installation along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative?
3. What are opportunities to increase the possibilities to successfully develop a solar PV-installation along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative?

1.4 Outline of this thesis

This thesis consist of 6 chapters of which the first chapter has been set out. Chapter 2 presents a theoretical background in which the relevant concepts related to this research are set out. These concepts are summarized in a conceptual model in which the relations and concepts are illustrated functioning as the basis of this research. Next, chapter 3 describes the research methods used in this thesis. Chapter 4 presents the gathered data and sets out the results and analysis of the conducted research methods. Based on the results, chapter 5 presents the conclusion, discussion, and recommendations of this research. The research questions presented in 1.3 are answered and the link between theory and practice will be made. Finally, a reflection on the entire process of writing a master thesis will be presented in chapter 6. After these content-related chapters, the references used in this research are listed after which this thesis concludes with relevant appendices.

2

LITERATURE AND THEORY

This chapter consists of five subchapters related to energy, local initiatives, the TI-sector, the institutional analysis, and the conceptual model. The energy subchapter emphasizes the necessity of the energy transition and the poor performances of the Netherlands. The second subchapter describes the governance approach, the developments regarding LREIs and the potential of using these LREIs in the energy transition. In the third subchapter, the shift towards an integrated planning approach in the TI-sector and the link with RE is set out. The subchapter related to the institutional analysis describes the theory related to the IAD-framework. This institutional analysis is used to analyse the decision-making processes in the multi-actor setting of the TI-sector. Finally, the conceptual model summarizes the concepts set out in the previous chapters and illustrates the core of this research.

2.1 The Energy Transition

This subchapter elaborates on the developments related to energy. First, the trends in the global energy consumption are described. Secondly, this subchapter elaborates on transition theories and the energy transition. Finally, the current situation in the Netherlands regarding the generation of RE is set out. These energy-related developments are relevant since they emphasize the importance of increasing the number of RE projects in the Netherlands.

2.1.1 Energy

Energy is an important condition for the functioning of our society. This was, is, and will become even more the case in our modern society. According to the IAEA (2009), the energy requirements of Western Europe will increase from 71 EJ in 2010 to 77 EJ in 2030 (1 EJ = 1 exajoule = 1018 Joule). The use of energy increases side by side with population growth and increasing living standards (Hughes, 2005; Weinberg & Hammond, 1972). Vice versa, energy and energy systems play a crucial role in economic growth and the performance of economies (Monstadt, 2007; Stern & Kander, 2012) and for *''the functioning of nearly all production, services and infrastructure sectors, as well as for politics, public health and even individual social practices''* (Monstadt 2007, p. 326). The importance of a reliable energy network is emphasized by Verbong & Van der Vleuten (2004) by introducing a 'vulnerability paradox': a more reliable (energy) network will lead to a bigger impact in case of a malfunctioning since the society has become increasingly dependent on the energy network. Moreover, Steetskamp & Van Wijk (1994) argue that more and more layers of our society are based upon an uninterrupted electricity supply via a reliable energy system.

Energy is often generated via the use of the traditional fossil fuel resources. In 2015, the world's total energy supply consisted of 81.4% fossil fuels and only 1.5% renewables like heat, wind, solar, (geo)thermal and tide (IEA, 2017). However, the use of fossil fuels is disputed because of three important reasons:

1. The use of fossil fuels contributes significantly to climate change related problems such as draught and smog pollution (De Roo, 1999; EPA, 2014; Höök et al., 2010; Höök & Tang, 2013; IPCC, 2007; 2012; 2014; Van Kann, 2015; Yang et al., 2011).
2. Fossil fuel reserves are limited to a finite amount and will deplete within the next 30 years (Droege, 2012; IER, 2015; Shafiee & Topal, 2008; Smil, 2010a; Sorrell et al., 2012).

3 Fossil fuels are supplied by countries such as Saudi Arabia, Russia and Iran, which causes unstable and unpredictable geopolitical relations (Correljé & Van der Linde, 2006; EC, 2015; Van Kann, 2015).

These fossil fuels related problems implicate the urgency to search for other energy sources (Antics & Sanner, 2007; De Boer & Zuidema, 2015). Spreading risks by using other energy sources such as wind and solar energy and thereby creating an 'energymix' in order to reduce the dependency on fossil fuels is already done by Scandinavian countries and can be an option for the future in the Netherlands as well (Van Kann, 2015). These RE sources have an enormous potential since they can produce many times the world's total energy demand without the negative externalities of the fossil fuel sources (Xia & Xia, 2010). Moreover, another significant advantage that favours especially wind and solar energy over fossil fuels is the possibility to combine these energy sources with different land-use functions. Housing, (transport) infrastructure or agriculture can often be combined with generating RE by placing wind turbines or solar PV panels on unused sites which are limited in their potential (see chapter 2.3.3). This integration of different land-use functions is necessary to create an energy landscape which is suitable for an energy transition (De Boer & Zuidema, 2015).

In this research, the focus will only be on solar PV-installations as RE source. With a rare exception of Windpark Krammer, the realization of wind turbines on public sites surrounding TI can be described as difficult since it is often constrained by among others location-specificity and NIMBY-effects (Cass et al., 2010; De Boer & Zuidema, 2015; Gordijn, 2003; Scheidel & Sorman, 2012; Sijmons et al., 2008; Van Kann, 2015; Walker et al., 2010). Solar energy can be harvested by using photovoltaics (PV). The production of solar PV-installations increases by an average of almost 50% each year since 2002, which indicates the enormous potential of solar PVs (Kropp, 2012, in Devabhaktuni et al., 2013). The United Nations (2018) recently published a report about the global trends in RE in which they state that the investments in solar energy are the largest of all the RE sources and increased with 18% compared to 2016. This is mainly caused by trend of declining prices of harvesting solar energy, which is also recognizable in the Netherlands (NOS, 2018; UN, 2018).

The use of solar PV-installations has some drawbacks. Harvesting energy by using solar PVs is constrained by the need for high solar intensities, high fund variables for labour (maintenance), visual intrusion and over-production storage (Tsoutsos et al., 2005; Scheidel & Sorman, 2012; Zahedi, 2011). However, these drawbacks are outweighed by the advantages of using solar PVs. The prices of solar PVs are declining, which makes this energy source accessible and realistic for a wide group of people (NOS, 2018; UN, 2018). Furthermore, solar PV-installations can easily be integrated with other land-use functions such as buildings (on roofs), TI (on left-over spaces such as noise barriers, see 2.3.3), or agriculture (greenhouse heating) (Devabhaktuni et al., 2013; Tsoutsos et al., 2005). In addition, solar PVs require little space and are not that location-specific as, for example, wind turbines (Van Kann, 2015).

2.1.2 A transition from fossil fuels to renewable energy sources

The deteriorating situation regarding the environment and the negative externalities of the use of fossil fuels implicate the urgency to shift away from the use of most of the current energy sources and search for new RE sources. The shift away from the use of fossil fuels to the use of RE sources is a fundamental change in our energy system and is referred to as the 'energy transition' (De Boer & Zuidema, 2015; Loorbach, 2010; Rotmans et al., 2001; Smil, 2010b; Van Kann, 2015). A transition in itself is a long-term process which can run for 20-25 years that takes place in our societal systems (Rotmans et al., 2001; Van der Brugge et al., 2005). A transition is about the co-evolution of cultural, economic, technological and institutional processes resulting in fundamental changes in the functioning of a societal system (Rotmans et al., 2001). Hasanov & Zuidema (2018) define transitions as *''a process of change within a society or culture (including its physical and material artifacts) that is a result of the co-evolution of various processes and developments in different domains, resulting in multi-scale structuration''* (p.86). In other words, a transition takes place on multiple scale-levels, within multiple phases, and encompasses multiple actors. The next section will elaborate further on this.

The multi-phase concept is described by among others Rotmans et al. (2001). A transition can be realized through four phases: predevelopment, take-off, breakthrough, and stabilization. This can be visualized by a s-curve (see figure 1). In between the two stable situations (pre-development and stabilization), there is a period of massive change (Van der Brugge et al., 2005). Also, there is the multi-level perspective which consists of three levels: micro-level (niches), meso-level (regimes) and the macro-level (landscape) which is illustrated in

figure 2 (Geels & Kemp, 2000; Loorbach, 2010; Van der Brugge et al., 2005). In this research, the niches can be seen as LREIs, the regime as the Dutch top-down organizations, and the landscape as the European Union. The niches are seedbeds for innovation (Artensen & Bellekom, 2014), include few stakeholders and have a low degree of arrangements and rules which are loosely structured (Geels, 2011; Ornetzer & Rohracher, 2013). These niches are *''inhabited by individual actors, technologies and local practices developing new ideas and new initiatives in 'protective spaces''* (Kemp et al., 1998 in De Boer & Zuidema, 2015, p.3). In contrast, the regimes are often based on more solid structures in centralized systems embedded in the landscapes which in turn provide the broader, fixed and slowly changing contexts and structures (De Boer & Zuidema, 2015; Kemp & Loorbach, 2006; Ornetzer & Rohracher, 2013). Interaction and mutual reinforcement between these three societal levels is necessary in order to start and accelerate a transition (De Boer & Zuidema, 2015; Hasanov & Zuidema, 2018). Consequently, *''[a] transition is the result of the interaction between changes and innovations at these different levels; slowly changing trends lead to new ways of thinking (paradigms) that lead to innovation and vice versa.''* (Kemp & Loorbach, 2006, p.108). This interaction can also result in that *''niche practices can get upscaled and become new regimes or get incorporated into existing regimes''* (Hasanov & Zuidema, 2018, p.86).

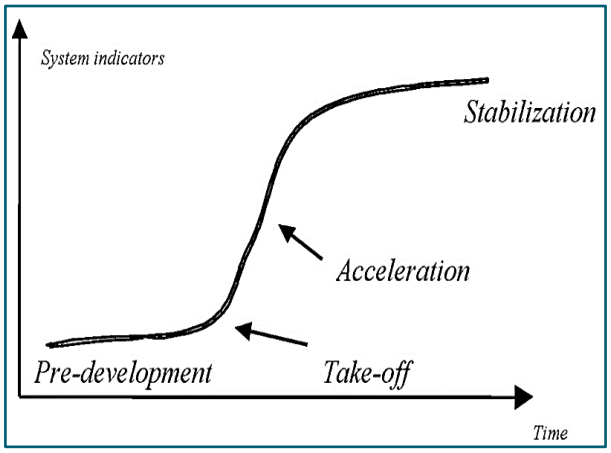

Figure 1: Multi-phase perspective (Rotmans et al., 2001)

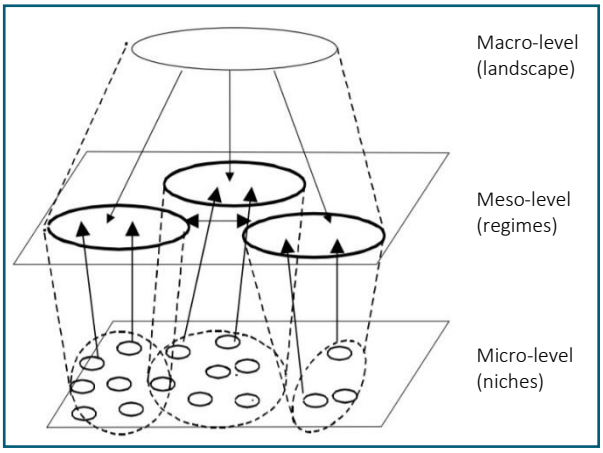

Figure 2: Multi-level perspective (Geels & Kemp, 2000)

Nevertheless, the desired energy transition is far from easy to implement. The current fossil-fuel based energy system is hard to change since it is used for several decennia, the infrastructure (pipes, energy plants, networks) is there, and there are many stakeholders involved. In other words: *''the energy system is a complex web of interrelated actors and networks, both in a physical, economic, social and institutional sense''* (De Boer & Zuidema 2015, p. 1). The habit to use fossil fuels and the present infrastructure can be grouped under historical developments which can form a constraining factor for the energy transition. This constraining historical development is often referred to as path dependency. *"In short, path dependency suggests that only a limited number of possible development paths are open at a specific moment. This is due to historical developments and present conditions"* (Rauws et al., 2014, p.147). This is in line with Byrne (2003) and Kim (2011) who state that the decisions and acts of people and institutions can be limited by certain conditions formed by historical developments. Path dependency is not necessarily negative because a narrow focus on one specific path can lead to optimization of that specific path or strategy. Path dependency can be related to institutions. Institutions are in turn characterized by rules, patterns and structures and can enable or disable the actions that people take (Alexander, 2005; 2006; González & Healey, 2005; Hodgson, 2015; Olsen, 2009; Sorensen, 2015) (see 2.4). Institutions can therefore play an important role in fostering an energy transition (Alexander, 2006).

2.1.3 The current situation in the Netherlands regarding renewable energy

The Netherlands performs poorly regarding the shift to the use of RE sources. The goal, shares and factual numbers are illustrated in table 1. The current share of 5.9% (2016) RE of the total energy consumption is rather low compared to the set goal of 14.0% in 2020. When taking the increase of 2.4% in the period from 2005 to 2016 hereby into account, one can state that the set goal of 14.0% in 2020 is far ahead and hard to achieve.

Year		2005	2015	2016	2020	2023	2050
Goal (share of RE)		-	-	-	14.0%	16.0%	95.0%
Realized share RE		2.5%	5.8%	5.9%	-	-	-
Solar Energy	Share	1.4%	4.4%	5.4%	-	-	-
	Total increase in consumption	-	39.0%		-	-	-
Wind Energy	Share	12.7%	20.9%	24.0%	-	-	-
	Total increase in consumption	-	21.0%		-	-	-

Table 1: The goal, shares and factual numbers about RE in the Netherlands (CBS, 2017a; 2017b; SER, 2013)

Combining these set goals with the transition theory as set out in 2.1.2, one could question the transition strategy of the Netherlands. Taking the numbers of both 2005 (realized share of 2.5% RE) and 2020 (goal of 14.0% RE) in account, one could argue that the goal of 95.0% share of RE in 2050 is rather ambitious and far ahead. Based on the slow progress from 2005 to 2020, one could argue that the Netherlands is still situated in the pre-development phase of the energy transition. Nonetheless, to realize a significant increase in the share of RE, the Netherlands should reach the acceleration phase as soon as possible. Therefore, one could question the ambition expressed in the set goals regarding the share of RE. In which phase are the current set goals of 2020 and 2023? Moreover, in which phase should the set goals of 2023 be in line with the transition theory? This is illustrated in figure 3. Taking the transition theory in account, one could state that the Dutch energy transition is progressing slower than it should in order to achieve the set goal of 95.0% RE in 2050.

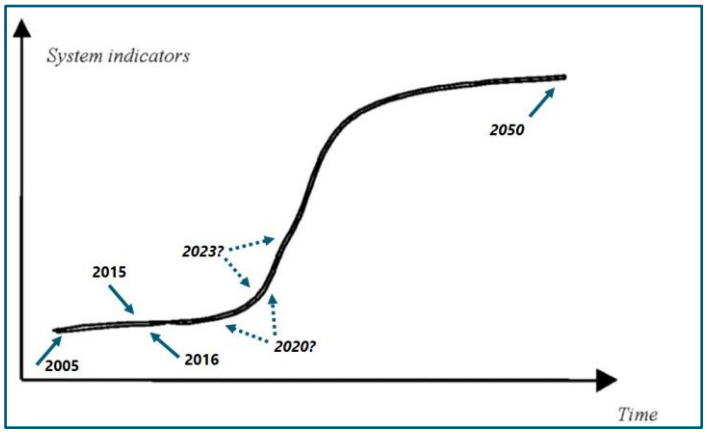

Figure 3: Transition theory - Dutch energy transition

The poor performance of the Netherlands regarding the implementation of RE sources is caused by several factors which are already briefly mentioned in the introduction in 1.1:

1 Natural gas supplies in the Netherlands constrain the shift to other energy sources because (1) the gas industry provides many economic benefits for the Dutch state, limiting full dedication of the Dutch state to search for other energy sources, and (2) the Dutch society is used to use gas instead of other energy sources (Rotmans, 2010; 2011; Verbong & Van Vleuten, 2004). However, the role of the natural gas supplies in the development of RE sources is changing, since the Dutch government has decided to stop the production of natural gas (Rijksoverheid, 2018a).

2 NIMBY-effects play a prominent role in the implementation of renewables in the Netherlands due to its densely populated character (Eurostat, 2015). This results in more resistance against the implementation of especially wind turbines because people experience the negative externalities more often (Cass et al., 2010; Walker et al., 2010). It also results in a scarcity of empty and suitable space which is in turn disadvantageous for RE sources since they need more space than traditional energy sources (De Boer & Zuidema, 2015; Smil, 2010b; Van Kann, 2015).

3 The lack of proper and solid policies and budgets regarding RE in the Netherlands constrain their developments. Generally, there are no policies running for more than four years since the Dutch government system has elections every four years. The Energy Agreement of 2013 is, however, still running and provides the Dutch government with a more solid policy regarding RE and can offer a

solution for the difficulties in integrating the dominant energy networks with the RE markets (Algemene Rekenkamer, 2015; De Boer & Zuidema, 2015; Rotmans, 2010; 2011; SER, 2013).

The Energy Agreement is published by the Dutch government – acting as the meso-level in the multi-level concept of the energy transition – and offers potential for fostering an energy transition. The Dutch government acts as initiator by managing the laws, policies and negotiations with other stakeholders (SER, 2013). They set the goal of achieving a share of 14% RE in 2020, based on the 20-20-20 targets of the European Union (acting as the macro-level) (Europe Nu, 2015a; European Union, 2009). The importance of the local level is highlighted by emphasizing the following points in the Energy Agreement (SER, 2013):

- Adapt spatial plans to fit local demands
- Simplify the permit-processes for local producers
- Improve the integration of local energy producers in the dominant energy network.

2.2 Local renewable energy initiatives

This subchapter describes the developments related to LREIs. First, the difference between government and governance is set out. This contributes to understand the decentralization process in which the local scale becomes more important. Next, the importance of the local scale is described. Finally, the link between the local scale and the energy transition is set out by describing the developments and potential related to LREIs.

2.2.1 Government and governance

There is an ongoing shift from the central government-based approach towards a system with decision-making structures that are more market-based, liberalized and decentralized (Loorbach, 2010). The term 'government' refers to *''the formal and institutional processes which operate at the level of the nation state to maintain public order and facilitate collective action''* (Stoker, 1998, p.17). Loorbach (2010) links government with a 'top-down' approach. As a result of the shift, the power of the centralized government has decreased which in turn entails a decrease in *''the extent to which social change can be effected by government policies''* (Loorbach, 2010, p. 162). The power of the central government is distributed over several governmental scale-levels which entails the involvement of more stakeholders referred to as 'governance' (Jänicke & Jörgens, 2006; Jordan, 2008; Loorbach, 2010). According to Loorbach (2010), governance is characterized by heterogeneity of the society, diversity, and a decreased influence of the central government. Jordan et al. (2005) and Stoker (1998) emphasize the governance approach and argue that a governance approach includes multiple scale-levels in which the focus is not on authority-based governing forces, but rather on self-organization. This is in line with Alexander (2005) who adds that *''governance addresses all the sectors and actors involved in the process of regulation, coordination and control that enable or constrain the behaviour and actions of members in a society''* (p. 218). The shift from a government approach towards a governance approach entails a necessary change in patterns, structures, rules, and practices. These processes are closely linked to institutions. Studying institutions and conducting an institutional analysis can make a contribution to understand the underlying processes that declare the shift from government to governance. This is elaborated further in section 2.4.

An important notion is that the government approach is not replaced by the governance approach, but that it functions more complementary. Jänicke & Jörgens (2006) refers to it as a 'hybrid mixture' in which the central government remains important operating as a 'back-up' and 'stick behind the door' in case of a malfunctioning of the decentralized approach. This is in line with Zuidema (2016) who adds that the central government ensures a robust foundation for a decentralized approach. Additionally, De Roo (2003) argues that a governance approach is more suitable than a government approach in dealing with complex situations. Furthermore, he distinguishes a 'technical rationale' (government) and a 'communicative rationale' (governance). The technical rational approach fits best in 'simple' issues in which few stakeholders are involved and central guidance is beneficial (De Roo, 2003; Zuidema, 2016). The communicative rational approach fits best in solving complex issues with a high degree of uncertainty and in which many stakeholders are involved. Central guidance is in the case of realizing LREIs along TI not beneficial since there are many sectoral and fragmented interests due to the many stakeholders (De Roo, 2003; De Vries et al., 2017; Spijkerboer et al., 2017). These complex issues need an integrative approach in which all the interests are included by actively interact and participate. To deal with the complexity, a tailor-made solution is necessary. This can be achieved

by applying a decentralized approach by which multi-scale participation and collaboration are enabled (De Roo, 2003; Zuidema, 2016). Again, according to Zuidema (2016), it is important to create a hybrid mixture in which the decentralization enables *''localities to develop their own course of action, but within the frames of references and stimuli provided by central policy imperatives''* (p. 48). Participation and collaboration on the local scale is linked to bottom-up initiatives which is described in the following section.

2.2.2 The importance of the local scale

It makes sense to use a bottom-up approach when dealing with complex issues (De Roo, 2003; Zuidema, 2016). A bottom-up approach takes place on the micro-level (niches) of the multi-level approach of among others Geels & Kemp (2000) and Loorbach (2010). The bottom-up initiatives within the niches include few stakeholders and have a low degree of (restricting) arrangements and rules which are loosely structured (Geels, 2011; Ornetzer & Rohracher, 2013). Bottom-up initiatives, or local initiatives, generally have several advantages. First, innovation often occurs within the niches-level since experimenting is possible on this scale-level (Arentsen & Bellekom, 2014; De Boer & Zuidema, 2015; Lutsey & Sperling, 2008; Seyfang & Longhurst, 2013; Seyfang & Smith, 2007). In case of a successful experiment which also fits within the general vision of the higher scales, it is ready to scale-up by interacting with higher scales such as municipalities (between niche and regime) (Geels & Kemp, 2000; Loorbach, 2010). Secondly, a bottom-up approach is often more efficient than a top-down approach since local actors are triggered by the emerged competition (Lemos & Agrawal, 2006). Lemos & Agrawal (2006) also argue that a bottom-up approach brings the affected people closer to the decision-making process which in turn can result in less societal resistances for the project (De Boer & Zuidema, 2015). Finally, decision-makers are supplemented with important context-specific knowledge from the locals when adopting a bottom-up approach (Lemos & Agrawal, 2006; Lutsey & Sperling, 2008). This context-specific knowledge is essential in a decentralized approach dealing with complex issues (Jänicke & Jörgens, 2006).

Local initiatives are closely linked to the concept of self-organization. Hasanov & Zuidema (2018) argue that *''self-organization is associated with informal or semi-formal practices that concern different forms of collective action, social activism related to proactive civic engagement and eventually, build coalitions with local institutions''* (p.86) (institutions in this case in terms of 'organizations', see 2.4). The processes of self-organization are essential in understanding the interactions within the niches as well as the interactions and innovation opportunities between the niche and regime level (Hasanov & Zuidema, 2018). Moreover, *''self-organization plays a role in the institutional interplay between various local initiatives and local governance structures, which is also explicitly the case in debates on energy transitions''* (Hasanov & Zuidema, 2018, p.85). This link between local initiatives and the energy transition is described in the following section.

2.2.3 Local renewable energy initiatives

Bottom-up initiatives in the RE sector can function as a driving force in the energy transition (Arentsen & Bellekom, 2014; Monstadt, 2007; Ornetzer & Rohracher; Seyfang & Smith, 2007; STRN, 2010). Energy generation occurs traditionally on the meso-level. However, LREIs acting on the micro-level provide opportunities to generate RE more locally and can thereby actively contribute to the energy transition (Arentsen & Bellekom, 2014; Monstadt, 2007; Ornetzer & Rohracher; STRN, 2010). The opportunity for a shift in the energy production from central to local is recognized by Monstadt (2003 in Monstadt, 2007) who argues that *''the existing centralized supply structure is gradually being supplemented by decentralized systems of heat and power generation, network supply and energy storage''* (p. 327). Also, Lemos & Agrawal (2006) argue that *"a collaborative style in siting renewable energy (...) will probably be more effective than top-down planning"* (p. 63). This is mainly because an energy transition involves many actors and stakeholders (TNO, 2015) which indicate the possibilities for a collaborative approach on the local level (De Roo, 2003). Furthermore, the value of LREIs is emphasized by De Boer & Zuidema (2015) who argue that *''these local community driven initiatives are now not just relevant for producing Megawatts, they also create knowledge, institutional networks, and, more generally, a governance capacity to act with regards to a future pursuit of sustainable energy''* (p.6).

Local initiatives can be referred to as grassroots initiatives (Hasanov & Zuidema, 2018). Seyfang and Smits (2007) emphasize the value of grassroots initiatives and argue that *''grassroots innovation can deliver sustainability benefits where top–down measures struggle. This is because community action utilises contextualised knowledge and implies a better 'fit' of solution. Grassroots groups have experience and knowledge*

about what works in their localities, and what matters to people. They can be well placed to present sustainability issues in ways more meaningful, personal and directly relevant [and] (…) they can engage and reinforce behavioural change.'' (pp. 593-594). These context-specific characteristics of grassroots initiatives are in line with the more general reasons why LREIs emerge which is set out next.

There are several reasons for the emergence of LREIs: (1) the growing common feeling of 'doing things ourselves' and 'doing things collectively' by which consumers become producers (Artensen & Bellkom, 2014; Hasanov & Zuidema, 2018; Van der Schoor & Scholtens, 2014). (2) Technological innovations enabled small-scale (renewable) energy production (Van der Schoor & Scholtens, 2014). (3) People have concerns about the environmental conditions and decide to do something by themselves (Arentsen & Bellekom, 2014; Walker, 2008). (4) Citizens are dissatisfied about- and have distrust in the government and the current large-scale energy providers (Arentsen & Bellekom, 2014; Hasanov & Zuidema, 2018). (5) Communities – emerged from the feelings of doing things ourselves – desire to become autonomous and strengthen the identity of the community (Arentsen & Bellekom, 2014; Walker, 2008). And finally, (6) economic reasons such as dissatisfaction about energy prices, creating (local) jobs and creating profit for individuals or regions are driving forces behind the emergence of LREIs (Arentsen & Bellekom, 2014; Walker, 2008).

Municipalities can play an important role regarding the success or failure of a LREI (Van der Schoor & Scholtens, 2015; Yildriz et al., 2015). Municipalities function on the edge of the niche and regime level and can therefore act as a facilitator in the upscaling of a LREI emerged on the niche-level. They can also act as an inspirator by undertake small-scale actions themselves such as the implementation of solar PV-installations on municipal buildings or promoting RE by being as energy neutral as possible (e.g. green cars) (Van der Schoor & Scholtens, 2015). Moreover, municipalities can provide the LREIs with specific knowledge and financial support which can be of vital importance in the success or failure of such an initiative (Van der Schoor & Scholtens, 2015). Besides the influence of the municipality, the development of LREIs is characterized by several success factors as well as by several constraining factors. These success and constraining factors can in turn be divided into internal and external influences. This is illustrated in table 2.

	Success factor	Constraining factor
Internal	- Team commitment - Shared/clear vision - Concrete goals - Ability to finance	- Required maintenance after construction - High financial risks - Unsure economic viability - High upfront investments needed - Required knowledge and skills
External	- Multi-scale relations - Multi-scale support - Ability to obtain the required permits	- Obtaining permits is a difficult process - Difficult to enter the energy markets

Table 2: Success and constraining factors of local renewable energy initiatives. Based on Hain et al. (2005), Seyfang et al. (2013), Van der Schoor & Scholtens (2014) and Walker (2008)

The realization of local initiatives related to RE involves many stakeholders operating on multiple scale levels. As stated in 2.2.1, the national level is important in acting as a robust foundation for the decentralized approach in which participation is enabled. Also, the lower governmental organizations such as the municipality are of vital importance even as the local initiatives and involved residents. An institutional analysis could help to understand the multi-actor and multi-scale processes that declare the functioning of the relevant actors on the multiple scale-levels related to the realization of LREI projects. The institutional analysis used in this research is set out in 2.4.

2.3 The transport infrastructure sector

This subchapter elaborates on the developments regarding the integrative turn in the TI-sector in the Netherlands. This integrated planning approach is relevant since the focus on the surrounding environment could contribute to integrate LREIs with the TI. Furthermore, the potential of integrating RE with TI is set out which emphasizes the relevance of this research. Next, the organization related to the TI-sector in the Netherlands is set out. In this, the relevant actors, documents, and strategies are introduced which illustrates the relevant developments in the Dutch TI-sector.

2.3.1 Integrating transport infrastructure with the surrounding area

The planning approach in the TI-sector is shifting from a sectoral to an integrated approach (Arts, 2007; Arts et al., 2015; 2016; Heeres et al., 2012; Geerlings et al., 2012; Roovers, 2014; Spijkerboer et al., 2015; Van Buuren & Roovers, 2015). This is caused by (1) a major renewal challenge of the physical infrastructure in the Netherlands (Arts et al., 2015; 2016; Linden et al., 2004), (2) an increasing complexity of our society causing more involvement and interactions of actors and interests (Geerlings et al., 2012), (3) a scarcity of space which asks for a more multi-functional planning approach (see 2.3.3) (Heeres et al., 2012), and (4) the fact that TI is crossing geographical, administrative and social borders which results in the involvement of many actors and institutions which different interests (Hijdra et al., 2015). This integrated planning approach emphasizes the integration of multiple land-use functions by which the focus is shifting from the physical infrastructure itself towards the whole surrounding area (Arts et al., 2015; 2016; Geerlings et al., 2012; Van Buuren & Roovers, 2015). Heeres et al. (2012) confirm this by argue that *"such planning approaches imply that the development and redevelopment of road infrastructure projects is accompanied by the development of the area as a whole, including assessment of all interests involved in the decision-making process"* (p.149). By integrating several land-use functions and take the surrounding area explicitly into account, the infrastructure planning approach is now about adding value to the whole area instead of only renewing/developing the physical infrastructure (Arts et al., 2016; Heeres et al., 2016; Hijdra et al., 2015; Van Buuren & Roovers, 2015). The integration of the physical infrastructure with the surrounding area is visualized in figure 4.

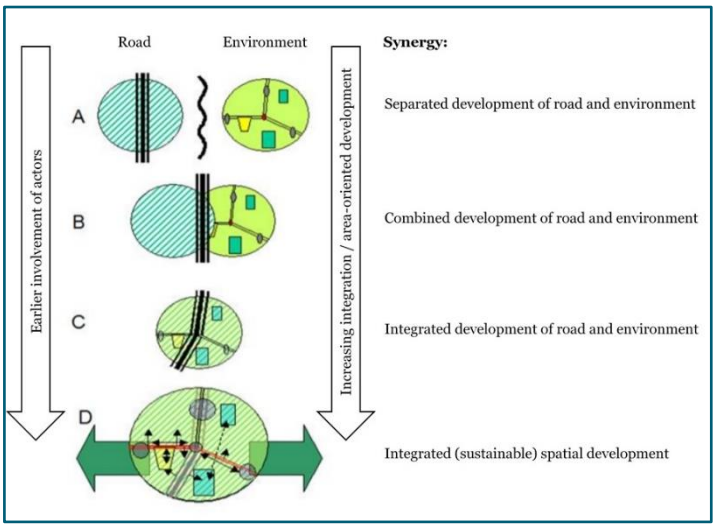

Figure 4: Development towards an integrated approach (Arts, 2007; Arts et al., 2015)

2.3.2 The situation in the Netherlands regarding transport infrastructure planning

The most important stakeholder in the Dutch TI-sector is RWS. RWS manages the major national TI-projects which are addressed in this study. They are subject to the direct supervision of the Ministry of I&W of which they are the executive arm. RWS have set the goal to reduce their energy consumption with 20% in 2020 and become energy-neutral in 2030 (RWS, 2015; 2018a). The basis of their functioning and main goals are among others guaranteeing reliability, accessibility, and safety of their networks (Wagner & van Gelder, 2014).

A form of an integrated approach in the TI-sector is the use of so-called DBFM-contract (Design, Build, Finance, Maintain). These contracts are used in the Netherlands by RWS when dealing with (large) TI-projects. DBFM-contracts are characterized by integration since multiple different disciplines are integrated in one contract between RWS and one other party (Eversdijk & Korsten, 2009; RWS, 2018a; Verweij, 2015). A DBFM-contract is characterized by a strict and clear task-description, a risk and responsibility outsourcing and a long-term duration of 20-30 years which entails a low degree of flexibility (Eversdijk & Korsten, 2009; RWS, 2018a; Verweij, 2015). The phases of a DBFM-contract are in line with the different phases of the MIRT-programme (overview of the projected spatial planning projects and programmes) of the Ministry of I&W which serves as the most important policy document in the TI-sector (Ministry of I&W, 2016; Rijksoverheid, 2018c). Based on the DBFM-contract and the MIRT-programme, five phases in the planning process of developing TI in the Netherlands can be distinguished. These phases are distinguished by different tipping points regarding the

decisions made during the process of developing TI in the Netherlands. This research investigates projects in the plan elaboration and maintenance phase (see 3.2.2). The different phases are visualized in figure 5.

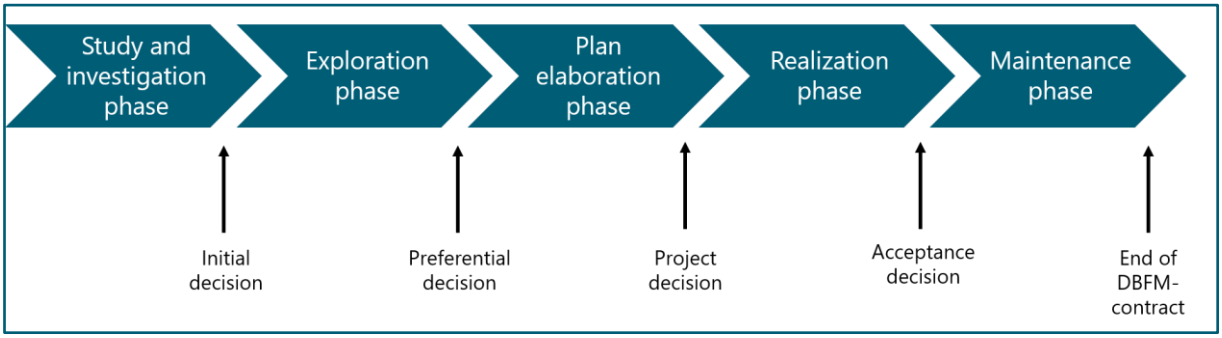

Figure 5: Phases in the planning process of developing transport infrastructure in the Netherlands (Ministry of I&W, 2016; Rijksoverheid, 2018a).

RWS operates corresponding to a strategy focussed on prestation management. This is done by agreements made between the Ministry of I&W and RWS in style of a service-level-agreement (SLA) (Rijksoverheid, 2016). Within a SLA, the focus is merely on the objective in which the process to achieve this objective is of less importance. This is in line with the 'new public management' (NPM) paradigm emphasized by Stoker (2006). The NPM paradigm implies that a national government should act more like a market party in which the focus is on efficiency and effectiveness. Here, the role of the national government is limited to establish frameworks that guide lower governmental organizations (Stoker, 2006).

In order to understand future developments regarding spatial planning in the Netherlands, it is relevant to elaborate on the latest developments in the Dutch law regarding spatial planning. An important noticeable amendment in the Dutch law is the implementation of the Environment and Planning act (Dutch: Omgevingswet) which will take effect in 2021 (Rijksoverheid, 2018b; RWS, 2018a). This act aims to integrate different (sectoral) policies and laws to simplify and fasten the implementation of, for example, energy and TI-projects in the Netherlands (Rijksoverheid, 2018c; Van den Broek, 2015). Moreover, this act contributes to the ongoing decentralization and deregulation in the Netherlands by focussing more on the local scale (Rijksoverheid, 2018b; RWS, 2018c). The act aims for more time- and space-specific measures which implicates the importance of context-specific measures of national actors (e.g. RWS) and more local actors such as municipalities and citizens through citizen participation (De Roo, 2001; RWS, 2018c; Zuidema, 2011). This can provide opportunities for the development of LREIs in the Netherlands.

The implementation of the Environment and Planning act as well as the Dutch TI-sector in general involves many stakeholders. These stakeholders (e.g. national government, RWS, municipality, and residents) are operating on multiple scales and all have different interests regarding the outcome of spatial planning projects. In order to understand the decision-making processes in this multi-actor setting, an institutional analysis can provide opportunities. This is elaborated in 2.4.

2.3.3 Transport infrastructure and renewable energy

The integrated approach in the TI-sector can provide opportunities for the development of RE resources. Heeres et al. (2012) argue that this integrated planning approach is needed because of an *"increasing scarcity of space, especially in small and crowded locations, such as in parts of the Netherlands. This demands innovative combinations of functions to ensure balanced spatial development and to avoid conflicting interests"* (p.149). This indicates the necessity to use the available land as efficient as possible. Scarcity of space also forms one of the constraining factors for the general implementation of RE (see 2.1) (De Boer & Zuidema, 2015; Smil, 2010b; Van Kann, 2015). Moreover, the areas along TI are often empty and unused, which provides opportunities for the realization of a solar PV-installation. Taking these factors into account, the integrated planning approach in the infrastructure sector can offer a solution for the scarcity of space problem related to the realization of RE resources.

The areas along TI are often empty and unused due to their limited potential in land-use functions caused by the proximity of the polluting highways resulting in sound- and air pollution (Trancick, 1986; Van der Horst,

2007). However, these areas provide significant opportunities for the development of solar PV-installations. This has been successfully tested in several countries like India (Sharma & Harinarayana, 2013), the US (Paudel & Hirsch, 2015; Volpe, 2012; Wadhawan & Pearce, 2017), the Netherlands (Van der Borg & Jansen, 2001) and the UK (Highways England, 2016; Parker, 2015). Especially the integration of generating RE on noise barrier systems offer a high potential (Nordmann & Clavadetscher, 2004; Vallati et al., 2015). Furthermore, the left-over spaces along TI provide significant opportunities for the realization of solar PVs because (1) the land is often owned by a governmental party which can fasten the necessary procedures, (2) highways located close to industrial or residential areas offer opportunities since those locations often need many electricity which then can be generated nearby, and (3) solar PV systems are easily accessible via the physical road itself which can ease the maintenance and implementation procedures (Nordmann & Clavadetscher, 2004; Vallati et al., 2015). Therefore, the realization of solar PV-installations on public sites along Dutch TI can provide the national government with opportunities regarding the energy transition. To understand the processes that declare the whether or not realization of such projects, an institutional analysis could help. The next section elaborates further on this institutional analysis.

2.4 Institutions and the IAD-framework

This subchapter explains the IAD-framework used in this research to analyse the decision-making processes in the multi-actor setting of the integration of RE with the TI-sector. This chapter will first define the term 'institution', followed by an introduction of the IAD-framework. Finally, the IAD-framework is applied to this study.

2.4.1 What are institutions and by what are they characterized?

Institutions are characterized by rules, patterns, structures, practices and interactions (Alexander, 2005; 2006; González & Healey, 2005; Hodgson, 2015; Olsen, 2009; Sorensen, 2015), and can be defined *as ''the framework of norms, rules, and practices which structure action in social contexts''* (González & Healey, 2005, p.2058). Institutions are not only able to enable human actions, but are often associated with constraining human actions. This is emphasized by North (1990) who defines institutions as *"the rules of the game in a society, or, more formally, [...] the humanly devised constraints that shape human interaction"* (p.3). McGinnis (2011) combines both approaches and defines institutions as *''human-constructed constraints or opportunities within which individual choices take place and which shape the consequences of their choices''* (p.170). Institutions are often divided into formal and informal rules (Buitelaar et al., 2007; González & Healey, 2005; Kingston & Caballero, 2009). Formal rules are written down in the form of laws, regulations and contracts, while informal rules are norms, attitudes and codes of conduct (González & Healey, 2005; Koppejan & Groenewegen, 2005; North, 1990). Institutions can thus be seen as formal and informal 'rules of the game' that contextualize spatial planning and decision-making. Studying institutions can help to understand the here and now, but is also helpful to investigate the dichotomy between continuity and change (Crabbé & Leroy, 2008; Koppejan & Groenewegen, 2005).

Institutions are characterized by a dichotomy between the significant intention to change structures and routines on the one hand, and a robustness and resistance to change on the other hand (Koppejan & Groenewegen, 2005). The intention to change institutions is funded in the potential role of institutional change in fostering societal change (Olsen, 2009) and the fact that institutional change *''shapes the way society evolves through time''* (North, 1990, p.3). Institutions do change within their own specific contexts, but this change often occurs incrementally and without any large modifications (Koppejan & Groenewegen, 2005; North, 1990). Kim (2011) argues that institutions are created by human actions and can therefore also be deconstructed. Alexander (2005) and Buitelaar et al. (2007) agree with this and argue that institutional deconstruction, and thus institutional change, can occur naturally as well as intentionally. Koppejan and Groenewegen (2005) describe several reasons why institutional (re)design can be of vital importance in changing systems in different sectors regarding the improvements in efficiency and effectiveness and the integration and interaction of multiple systems. Also, institutions are closely related to sustainable development since institutions can both activate or constrain sustainable developments (Alexander, 2006). Furthermore, institutional change is necessary in tackling institutional barriers that constrain the implementation of, for example, RE projects (Alexander, 2006; Kim, 2011; Olsen, 2009).

However, despite the (potential) importance, changing institutions is a difficult process. Institutions are characterized by stability, predictability and robustness and are often described as 'resistance to change' (Koppejan & Groenewegen, 2005). Institutional change is difficult because (1) institutions are associated with different interests which are located within different 'action arenas' which are not equally accessible for all relevant stakeholders (Ostrom, 1990, in Koppejan & Groenewegen, 2005; Koppejan & Groenewegen, 2005), and (2) institutions often emerge out of incremental, informal processes developed within a specific context over a longer timeframe which are hard to change since they are ''*embodied in customs, traditions, and codes of conduct*'' (North, 1990, p.6). In other words, institutional change is constrained by context-specific processes developed over time. This can be referred to as 'path-dependency'. The term path-dependency is used to describe the phenomena that choices made in the past (e.g. policies, regulations and institutions) constrain the possibilities for future developments (Buitelaar et al., 2007; Greener, 2005; Hall & Taylor, 1996; North, 1990; Sorensen, 2015).

Contemporary choices and developments are thus based upon patterns developed over time. Once an organization has decided to adopt a certain path, there is a significant amount of effort needed to change this path and its patterns in order to respond to new (societal) developments (Hall & Taylor, 1996). An example of path-dependency is the sectoral approach of RWS in the TI-sector in the Netherlands (Heeres et al., 2012). Within the TI-sector, RWS adopted a strong sectoral approach for over sixty years with a narrow and 'line-oriented focus'. A significant advantage of such a strong sectoral approach is the optimisation of that one specific strategy. However, a drawback is that the shift towards a more integrated approach is constrained by the current path which has been used for decades (Heeres et al., 2012). In order to understand these (fixed) patterns and structures and search for possibilities to foster institutional change, an institutional analysis can offer a solution. Crabbé and Leroy (2008) argue that an essential part of such an institutional analysis is ''*the question of what the typical features of a certain institutional context are and how they affect specific policy processes and policy products. The essence of an institutional evaluation is to know whether that institutional context is suitable and adequately equipped for the type of policy one intends to pursue*'' (p. 20). The next section will elaborate further on the institutional analysis used in this research.

2.4.2 Introducing the IAD-framework

In order to gain more insight in the institutional context and the action arenas in which institutions are located, this research applies the IAD framework of Ostrom (2005; 2010; 2011). The IAD-framework is especially suitable to analyse the decision-making processes within a multi-actor setting. According to Hijdra et al. (2015), the IAD-framework distinguishes itself from other institutional analyses by addressing the importance of external rules and their influence on the internal 'action arena'. This action arena (or action situation) refers to the ''*the social space where participants with diverse preferences interact, exchange goods and services, solve problems, dominate one another, or fight*'' (Ostrom, 2005, p.14). Collective decision-making processes take place within these action arenas and can be better understood by applying the IAD-framework (Hijdra et al., 2015; Ostrom, 2005). The IAD-framework is visualized in figure 6.

The external rules that influence the internal action arena are referred to as 'the rules of the game', and are described by seven types of rules that structure the action situation (see figure 6) (Ostrom, 2005; 2010; 2011):

1. **Boundary rules:** relate to how actors can enter or leave certain positions
2. **Position rules:** relate to actors holding certain positions
3. **Choice rules:** relate to which actions are associated with which positions
4. **Scope rules:** relate to the (desired) outcomes that could be affected
5. **Aggregation rules:** relate to how actors make decisions and to the action-outcome linkages
6. **Information rules:** relate to the information flows and channels between actors
7. **Payoff rules:** relate to the distribution of costs and benefits to actors in positions

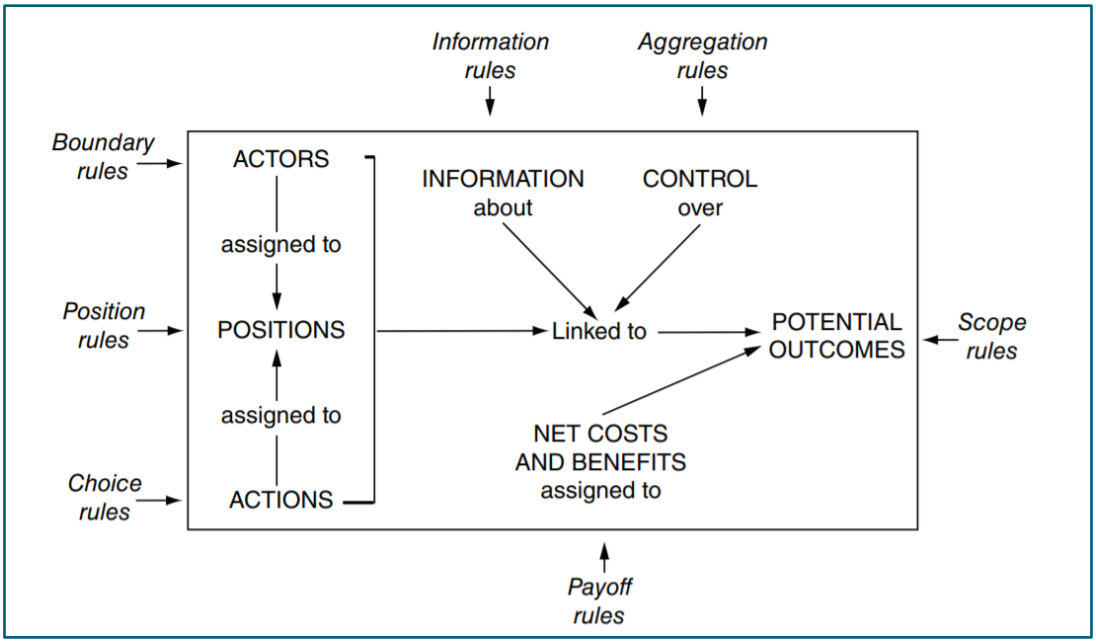

Figure 6: External 'rules of the game' directly influencing the elements of the internal action arena (Ostrom 2005)

Ostrom and Basurto (2011) summarize the different types of rules from the actors' perspective by stating that *''actors in positions choosing among actions at particular stages of a decision process in light of their control over a choice node, the information they have, the outcomes that are likely, and the benefits and costs they perceive for these outcomes''* (p.323). This indicates that no component of the rules acts independently, but is affected by other components (Ostrom, 2005). Table 3 schematically visualizes the operationalization of the IAD-framework. The explanation of the operationalization of the IAD-framework is done with reference to this table and the use of the example of the boundary rule. This example is chosen because the boundary rule determines which actors can enter or leave the internal action arena which is of vital importance in this research. The other rules are operationalized in the same way. The first column describes the variables that are connected to the different rules of the game. These variables cover the meaning of the specific rules. In terms of the example of the boundary rule, which refers to the possibilities of actors enter or leave certain positions in the internal action area, the variable 'actors' covers the meaning of this rule in a proper way. The third column in table 3 describes the action verbs that refer to the specific rule and by that contribute to the link between theory and practice. The boundary rule can in this case be linked to the action verb 'enter or leave' since this is what the rule is all about. The fifth column describes the default conditions added by Ostrom and Basurto (2011). These conditions refer to the situation in which no rules exist. This in turn would mean that the internal action arena can be influenced without any constraints. In the example of the boundary rule, this would mean that anyone can enter the internal action arena without any constraints. The sixth and final column describes the 'play of the game' added by Spijkerboer et al. (submitted). The next section elaborates on the play of the game component.

A drawback of the IAD-framework is the rather static view on institutions (Schmidt, 2010; Spijkerboer et al., submitted). The IAD-framework is in line with the understanding of institutions as described in section 2.4.1 (in terms of path-dependency, robustness and difficulties to foster change) which can be referred to as a tool focussed on stability instead of change (Schmidt, 2008; 2010). Schmidt (2010) argues that the IAD-framework is therefore *''better at explaining continuity than change''* (p.2). This research demands a more dynamic view on institutions especially since institutional barriers often occur between continuity and change (Spijkerboer et al., submitted). This is confirmed by Ostrom and Bassurto (2011) who emphasize the importance of *''analytical tools for analysing dynamic situations – particular institutional* change'' (p.317). In order to make the IAD-framework more dynamically and capable of studying the mechanisms triggering institutional change, Spijkerboer et al. (submitted) add the 'play of the game'. This play of the game includes the ideas, interpretations and reflections of the actors involved in the action situation and the rules of the game. These ideas are visualized in table 3 (column 6). In terms of the example of the boundary rule, the play of the game includes ideas about which actors should be involved and how and when.

Variables	Rules	Action verb	Rules of the game based on Ostrom (2005)	Default conditions (Ostrom and Basurto, 2011, p.324)	Play of the game (Spijkerboer et al., submited, pp. 5,6)
Actors	Boundary rules	Enter or leave	Who enters/leaves positions and how?	Anyone can enter	Ideas regarding the actors that should be involved, how and when.
Positions	Position rules	Be	What are the positions and what do they want?	No formal positions exist	Ideas regarding the roles actors should uptake and how roles relate to each other.
Actions	Choice rules	Do	What actors in certain positions may, must or must not do under specific conditions or at certain points?	Each player can take any physically possible action	Ideas regarding responsibilities that actors should have and opportunities they perceive.
Outcomes	Scope rules	Occur	Which outcomes may, must, or must not occur?	Each player can affect any state of the world that is physically possible	Ideas regarding outcomes and targets that should be pursued.
Decision-making (control)	Aggregation rules	Jointly affect	How do actors jointly affect decisions regarding proposed actions and activities and how?	Players act independently [...]	Ideas regarding (criteria for) coordination of decision-making among actors.
Information	Information rules	Send or receive	What information is to be send and received by which actors, at what moment, and using which channels?	Each player can communicate any information via any channel available to the player	Ideas regarding information that should be shared between actors and how learning should occur.
Costs and benefits	Payoff rules	Pay or receive	What costs and benefits have to be payed or received by actors?	Any player can obtain any outcome that the player can physically obtain and defend.	Ideas regarding the distribution of costs and benefits among actors.

Table 3: Schematical approach for studying the different components of the IAD-framework

According to Spijkerboer et al. (submitted), the play of the game adds the dynamic factor to the IAD-framework by adding *''actor's ideas, interpretations and deliberations regarding how rules should be reframed, ignored or abolished''* (p. 5). This dynamic addition is essential for this research since institutional barriers often appear to occur on the edge of continuity and change. In other words, some institutional frameworks only focus on continuity (e.g. sectoral planning in the TI-sector) while the integration of, for example, multiple land use functions (RE and TI) requires a certain degree institutional change. This dynamic 'play of the game' component added to the IAD-framework can offer a solution in discover, analyse, and tackle the institutional barriers that occur in developing a solar PV-installation on a public site along TI in the Netherlands with the involvement of a LREI.

The original IAD-framework (figure 6) is solely based on the rules of the game. These rules of the game are in figure 6 visualized with a single arrow from the outside to the inside. This one-way interaction is in line with the rather static view focused on explaining continuity instead of possibilities for change. The play of the game component focusses more on change by adding a dynamic component. This dynamic component is not corresponding with the one-way interaction (single arrow) between the rules of the game and the internal action arena as visualized in figure 6. Therefore, Spijkerboer et al. (submitted) developed an adjusted version of the IAD-framework which focusses more on change instead of only explaining continuity. This is done by replacing the single arrows by double-headed arrows to emphasize the dynamic component added by the play of the game addition to the IAD-framework. This framework is depicted in figure 7. For example, the choice rules determine the actions taken by the different actors in certain positions. These choice rules are fixed, which means that, in case of solely applicate the rule of the game component, the actions that the certain actors may, must or must not do under the specific circumstances are also fixed. When adding the play of the game component, these actions can be influenced and consequently adapt to the changing circumstances which decreases the fixed status of those actions.

The important opportunity to change the possible actions of actors in certain position can increase the possibility of external actors to enter the internal action arena. The application of the IAD-framework to this research is set out further in the methodology chapter (see subchapter 3.2.3).

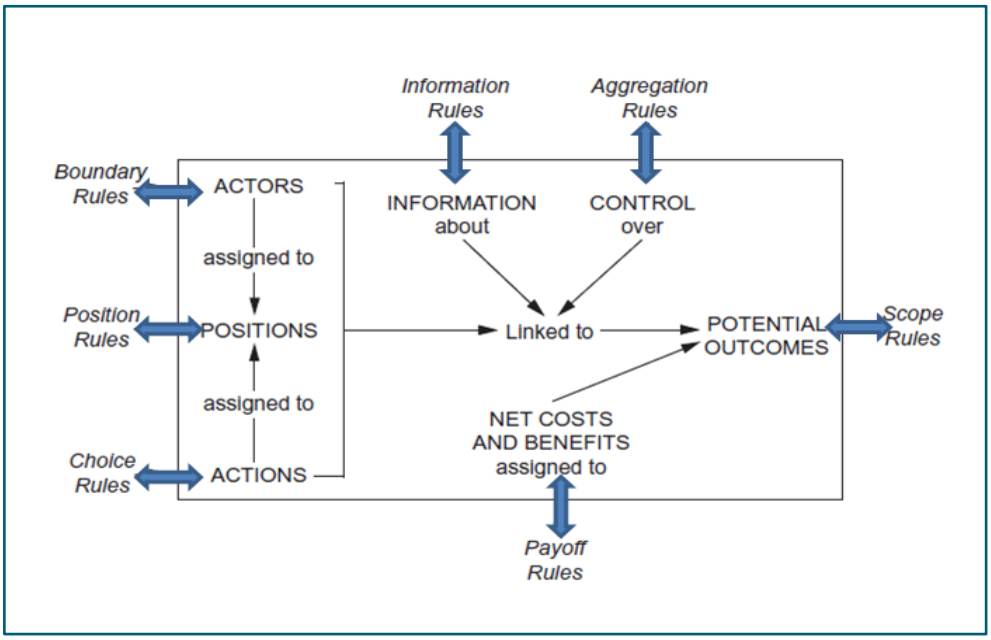

Figure 7: The IAD-framework with the 'play of the game' component (Spijkerboer et al., submitted)

2.5 Conceptual model

The conceptual model used in this research is based on the theoretical background as set out in 2.1-2.4. This model is illustrated in figure 8. The upper three squares delineated with a dotted line illustrate the relevance on which this research is based: the integrative approach in the TI-sector, the increase in the amount of citizen initiatives and the challenges related to the energy transition. As a result of the increasing amount of citizen initiatives as well as the challenges related to the energy transition, there is an increasing amount of LREIs. These local initiatives make a contribution to the energy transition. As set out in subchapter 2.3, the public sites along TI in the Netherlands provide opportunities to generate RE. To use this opportunity, an integration between LREIs and the TI-sector is necessary. The TI-sector is operating as the internal action arena which is corresponding with the IAD-framework presented in subchapter 2.4. However, this integration is currently obstructed by several institutional barriers. Based on the previous described theories, one could expect several institutional barriers such as the use of a DBFM-contract, the SLA-management of RWS, and the necessity to obtain multiple permits. One of the research objectives is identifying more institutional barriers to supplement the list of barriers. Consequently, and based on the play of the game component and the conducted semi-structured interviews, this research aims to investigate opportunities to tackle these institutional barriers.

These and other institutional barriers will be investigated by using the IAD-framework, illustrated with the red box. The current institutional barriers will be identified by applying the rules of the game (red box) after which the play of the game (green box) component will help identifying opportunities to dismiss these barriers. As a result, the box with current barriers according to theory will be supplemented by barriers identified in practice which is illustrated in chapter 5 of this research. Also, this research aims to investigate opportunities to tackle these institutional barriers which is set out in subchapter 4.3 and chapter 5. The next chapter will elaborate further on the research methods applied in this research.

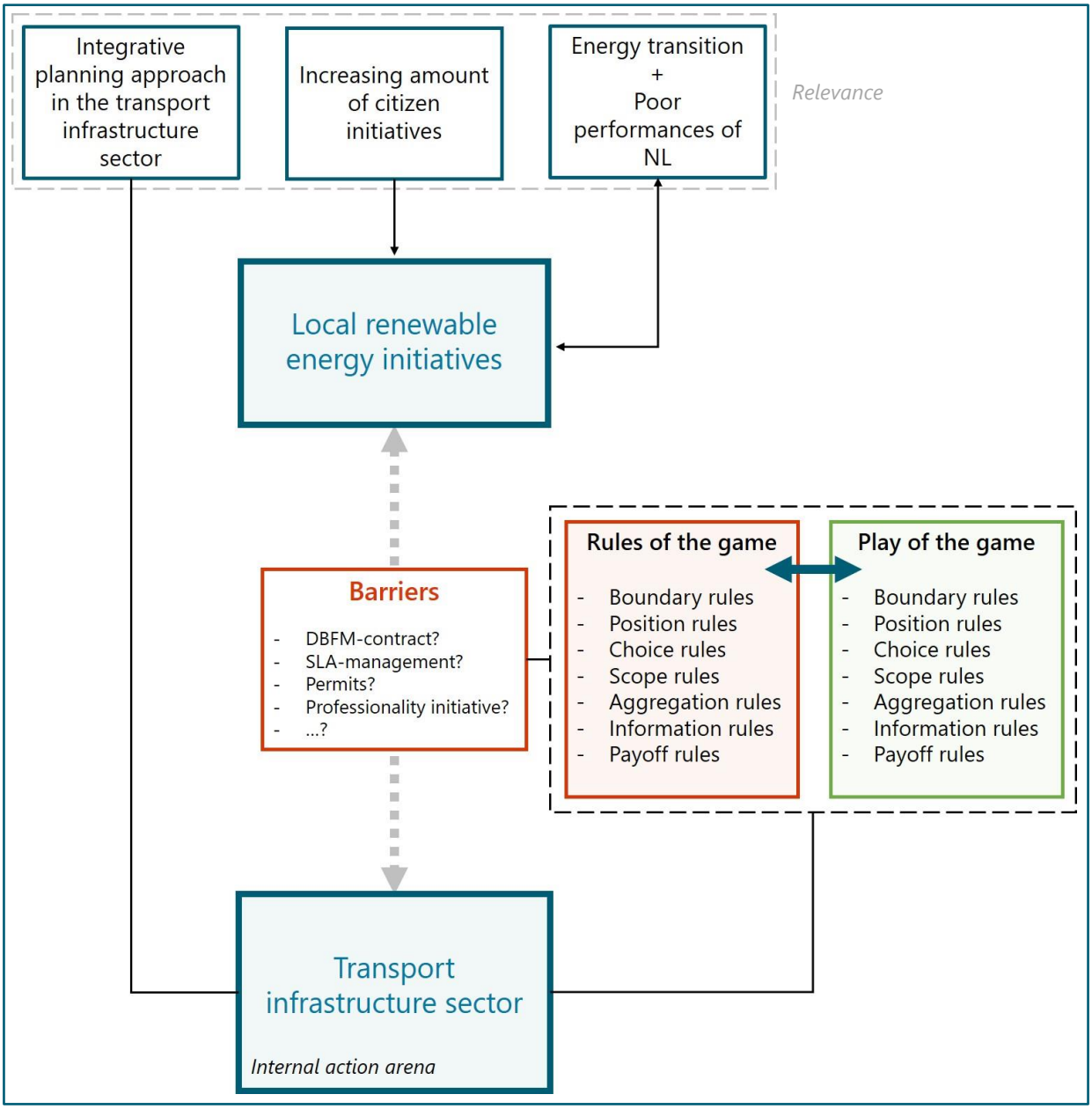

Figure 8: Conceptual model

3

METHODOLOGY

This chapter describes the research methods used in this research. This is done to assure the validity and transparency of this research. First, qualitative research is introduced. This functions as a basis for remaining sections. Next, the research design is set out. Here, the research strategy, the case study method, and the application of the IAD-framework is described. This contributes to clarify the research in general and especially the processes before the data collection begun. The third subchapter describes the data collection methods. Here, the interview methods are explained in a transparent manner. This results in an open explanation of the data collection process. Next, the data analysis process is described to guarantee the validity of the data analysis process. Moreover, it contributes to the validation of the process from gathered data to conclusions. This chapter ends with a description of the used case studies. These context-specific information contributes to the understanding of the next chapters in which the case studies are worked out.

3.1 Introduction and qualitative research

This research uses qualitative research methods to achieve the research objectives and answer the research questions. The goal of this research (see 1.3) determines the methods used to achieve this goal (Flyvbjerg, 2001). This qualitative research entails a detailed study of two case studies both situated in different phases of the planning process in the TI-sector: the case A12 Maarn-Maarsbergen and the case InnovA58 (see 3.2.2 and 3.5). This section will elaborate further on the characteristics of qualitative research.

3.1.1 Qualitative research

This research is based on qualitative data which is gathered by using qualitative research methods. This is the most appropriate research method for gathering in-depth data about experiences and opinions of people which in turn explains certain actions or decisions (Hennink et al., 2011). Qualitative research methods are used to explore subjective meanings and values and emphasize *''quality, depth, richness and understanding''* (Clifford et al., 2010, p.9). Moreover, this method is useful in understanding decision-making processes, including the values and norms that structure these processes (Hennink et al., 2011). Qualitative research is a form of intensive research design in which *''the emphasis is on describing a single case study, or small number of case studies, with the maximum amount of detail''* (Clifford et al., 2010, p.3).

According to Reulink and Lindeman (2005), qualitative research is especially suitable for studying a complex problem or situation. They argue that qualitative research is an appropriate research method for studies that focus not merely on describing phenomena or changes, but for studies that focus in particular on fostering these changes. These applications are corresponding with the research objective of this research: study, and identify opportunities to tackle, the institutional barriers that occur when solar PV-installations are integrated with national TI in the Netherlands with the involvement of a LREI. Qualitative data contributes to the accuracy of the analysis of the decision-making processes, opinions, and actions of stakeholders in this action arena and helps explaining the underlying structures of these processes. Furthermore, the opinions and ideas of the stakeholders are essential in identifying possibilities to tackle the identified barriers. Qualitative data is particularly applicable for gathering this subjective data. The next section will elaborate further on the research design of this study.

3.2 Research design

This section presents the research design of this study. First, the research strategy is set out in a stepwise fashion. Next, the case study method is described and this section ends with the application of the IAD-framework to this research.

3.2.1 Research strategy

Based on the research questions used in this study, a literature research has been done to build a theoretical foundation for the qualitative research. This theoretical basis functioned as a basis for the conducted open-ended- and semi-structured interviews and contains literature and theory about the energy transition, transition theory, (the potential of) local (RE) initiatives, the integrated planning approach in the TI-sector, and theory about the IAD-framework used in this study. Based on this theoretical background and three open-ended interviews, a first inventory of possible barriers has been made, acting as a supporting back-up throughout the following steps. Next, based on the theory of the IAD-framework, the open-ended interviews, and the inventory of possible barriers, ten semi-structured interviews were conducted with relevant stakeholders acting in the two case studies. Consequently, the institutional barriers occurring in both case studies were listed after which, again based on the semi-structured interviews in both case studies, opportunities to tackle these barriers were explored. This process is stepwise illustrated in figure 9. The following sections will elaborate further on the case study method used in this research.

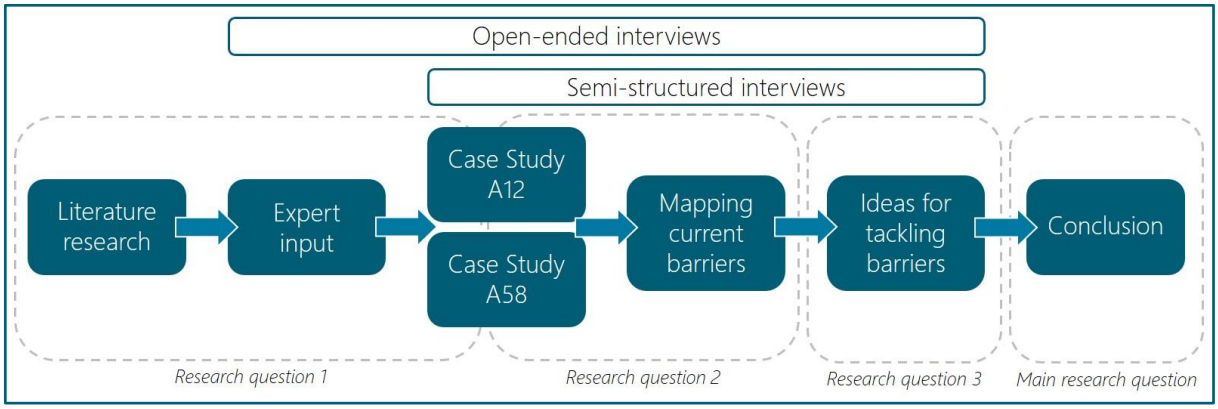

Figure 9: Stepwise structure of this research

3.2.2 Case study method

This research used a case study method to gather qualitative data. Yin (2014) defines a case study as *''an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident''* (p.13). Case studies are used to explain a specific phenomenon or situation as detailed as possible (Flick, 2015; Rice, 2010). Case studies are especially appropriate to answer 'why?' and 'how' questions (Blumberg et al., 2011; Yin, 2014), because *''such questions deal with operational links needing to be traced over time, rather than mere frequencies or incidence''* (Yin, 2014, p.6). The essence of a case study method is investigating the underlying processes of one or more decision(s) in answering the 'why?', 'how' and 'for what' questions (Schramm, 1971 in Yin, 2014). Although case studies provide hardly or not at all opportunities for generalization, the results of a case study can provide insights in theoretical concepts that reach beyond the specific case of the study (Hennink et al., 2011; O'Leary, 2004; Yin, 2014). In this perspective, generalization is, to a certain extent, possible since the results can be applied to other, comparable, contexts. This can in turn result in further research, which implicates the contribution of this research to the scientific literature basis and spatial planning practice.

The case study method is an appropriate method for this study since it contributes to the possibilities to analyse the underlying processes that declare the current difficulties in integrating LREIs with the Dutch TI-sector. The case study method contributes to the understanding of the context and processes of both LREIs as well as the context of the TI-sector (Morris & Wood, 1991; O'Leary, 2004; Saunders et al., 2008). This study conducts two case studies introduced in subchapter 3.5. According to Blumberg et al. (2011) and Yin (2014), the use of multiple case studies is more appealing since their results are considered more robust. Blumberg et al. (2011) argue, however, that the selection of multiple case studies should be a well-considered decision.

This research studies two case studies: the A12 Maarn-Maarsbergen and the InnovA58. As mentioned earlier, projects related to solar PV-installations on public sites surrounding TI with the involvement of a LREI are hardly realized in the Netherlands. This results in a small amount of applicable and appropriate cases to study. Both the A12 Maarn-Maarsbergen and the InnovA58 are well-applicable to this research and its narrow scope. Both cases are pilot-projects which emphasizes the unfamiliarity with cases like these. This unfamiliarity could entail a less solid pattern of structures, actions, and processes which can offer opportunities for the investigation of opportunities to tackle the listed institutional barriers. Moreover, the case studies used in this research are selected based on possibilities to analyse possible differences or supplementations between the institutional barriers occurring in different phases in the planning process of the TI-sector (see figure 10). The possibilities to integrate LREIs with the TI-sector could, for example, differ significantly per phase in this process. For example, the involvement of a LREI in an early phase of a project (e.g. InnovA58) could differ significantly from the procedure of the involvement of a LREI in a phase in which the physical infrastructure is already constructed for years and the focus is only on maintaining its current functions (e.g. A12 Maarn-Maarsbergen). Since both case studies in this research relate to different phases, the distinguishing of multiple phases will contribute to the validity of the results of this research. Also, studying two case studies both situated in different phases of the planning process in the TI-sector results in a broadened data collection and, in general, in more data about projects relevant for this research.

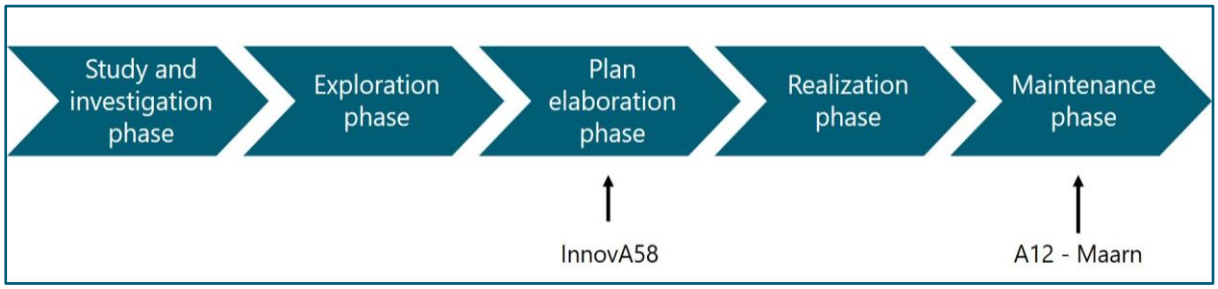

Figure 10: Phases of the planning process in the TI- sector linked to the case studies (Ministry of I&W, 2016; Rijksoverheid, 2018)

Based on these arguments, one could state that the studied case studies are chosen based on a well-considered decision. Figure 10 presents the distinguished phases in the planning process of the TI-sector used in this research as shown in 2.3.1, supplemented by the case studies linked to the specific planning phase on which they relate to. The detailed description of the case studies is set out in section 3.5, and the next section will elaborate on the application of the IAD-framework.

3.2.3 The application of the IAD-framework

This section describes the application of the IAD-framework in this research. This section elaborates on subchapter 2.4.2 in which the theory of the IAD-framework is set out. The IAD-framework is in this research especially used in the data collection process by conducting multiple interviews in line with the IAD-framework theory and consequently acting as a guideline in the systematically analysis of the decision-making processes within a multi-actor setting in which an internal action arena (the TI-sector) is triggered by external conditions (involvement of a LREI). The IAD-framework was ideally suitable to systematically analyse these processes after which the current barriers and opportunities to tackle these barriers were investigated (Hijdra et al., 2015; Ostrom, 2005). To illustrate this, an example of the boundary rule (enter/leave positions) can offer clarity. The boundary rule can in this research provide insights in the processes that determine the possibilities of a LREI to enter the internal action arena of the TI-sector. The next sections will elaborate further on the operationalization of the IAD-framework by building on section 2.4.2 and table 3.

Hijdra et al. (2015) operationalized the IAD-framework in their institutional analysis within RWS regarding the redevelopment of waterways in the Netherlands. In their application, they distinguished multiple phases in the planning process of these waterways acting as different action arenas (see appendix I for the table). Subsequently, they convert the different rules of the game to questions applicable for the institutional context of the action arenas of RWS. This research builds on this application of the IAD-framework to planning practice done by Hijdra et al. (2015). The distinguished phases used in this research are based on the phases of the DBFM-contract and the MIRT-programme as described in section 2.3.2 (Ministry of I&W, 2016; Rijksoverheid, 2018c). Since this research uses two case studies both situated in one phase of the planning process of the TI-sector, this application is only made for these two phases. This is set out in table 4.

Arena	Plan elaboration phase | InnovA58	Maintenance phase | A12 Maarn-Maarsbergen
Boundary rules	How actors enter/leave the plan elaboration arena. E.g. governmental bodies, market parties, local stakeholders	How actors enter/leave maintenance arenas. E.g. contract managers, local stakeholders
Position rules	What do these actors want or need? How many have similar wishes?	What do these actors want or need? How many have similar wishes?
Choice rules	What plan elaboration actions do they take? Analyses, designs, finances	What maintenance actions do they take? Is there space for additions?
Scope rules	What is the result about? Concrete plan making	What is the result about? E.g. only maintenance, or space for other additions?
Aggregation rules	How are decisions made? Who decides which project will be realized?	How are decisions made? Only contractor or influence of client possible?
Information rules	What information is, or must be shared among actors?	What information is, or must be shared among actors?
Pay-off rules	How are benefits and costs distributed to actors in positions?	How are benefits and costs distributed to actors in positions?

Table 4: Link between the IAD-framework and the planning phases in the TI-sector

The questions set out in table 4 are in line with the IAD-framework applied to the relevant phases in the planning process of the TI-sector and function as a guideline throughout this research and, especially, during the data collection phase. The questions of the semi-structured interviews are based on the different rules of the game and the questions set out in table 4. During the analysis, the rules of the game and the play of the game provided support in systematically ordering the identified barriers and the identified opportunities to tackle these barriers. For example, the barriers related to finances were corresponding to the payoff rule of the IAD-framework, which in turn provided insights in the importance of the several institutional barriers. The application of the IAD-framework contributed to the relevance and level of detail of gathered qualitative data and in turn eased the analysis process. The filled in table referring to the rules of the game applied to this research is presented in appendix V. The play of the game component is presented in chapter 4.3 and the recommendations in chapter 5.4. The next sections will elaborate further on the used interview methods in this research.

3.3 Data collection

This chapter presents the methods used in the data collection process of this research. First the two interview methods are set out, followed by the selection of the participants of these interviews. This section ends with a description of ethical aspects.

3.3.1 Open-ended interview method

As shown in figure 9, this study used an open-ended interview method (or informal discussion method) with relevant experts. Reulink and Lindeman (2005) confirm the value of such a method and Blumberg et al. (2011) argue that this qualitative research method is often used in case studies since *''the key informants provide valuable insights into the case's issues and can also point the case researcher towards other sources of evidence, such as relevant documents, archival surveys, or an existing internal survey or study''* (p. 378). This definition covers the application of this method in this research in a proper way. The open-ended interview method was applied in the form of an informal discussion with relevant experts. These conversations are held with people working at different organizations which provided the researcher with useful insights from multiple perspectives. The open-ended interviews are conducted via face-to-face and e-mail. The face-to-face method provided the researcher with relevant information and context-specific knowledge on which the first inventory of possible barriers is built. Subsequently, the overview with expected barriers has been showed to the participants at the end of the semi-structured interviews in order to either confirm or deny an expected barrier. This method is in line with the second objective of an interview method: searching for confirmation of insights and information the researcher already holds (Blumberg et al., 2011) (see 3.3.2).

Moreover, the open-ended interviews provided the researcher with information about relevant actors on which the selection of participants was built (see 3.3.3). The open-ended interviews are also conducted via e-mail conversations. These conversations are held to gather more information about specific themes and the provision of multiple (internal) documents. Table 5 lists an overview of the participants of the open-ended interviews conducted face-to-face.

Number of participants	Date	Organization(s)	Function (shortened)	Related to case study
2	06-02-2018	Rijkswaterstaat	Senior advisors	A12
2	13-03-2018	Rijkswaterstaat	Senior advisors	A12
2	20-03-2018	Rijkswaterstaat Witteveen+Bos	Spatial planning advisors	InnovA58

Table 5: List with conducted open-ended interviews

3.3.2 Semi-structured interview method

Conducting (semi-structured) interviews is a crucial part of many case studies (Blumberg, 2011; Yin, 2014). This study used the semi-structured interview method which can be defined as *''a verbal interchange where one person, the interviewer, attempts to elicit information from another person by asking questions. Although the interviewer prepares a list of predetermined questions, semi-structured interviews unfold in a conversational manner offering participants the chance to explore issues they feel are important''* (Clifford et al., 2010, p.103). The semi-structured interviews conducted in this research provided essential insights in the factors that determine the complex processes in which multiple actors and interests are involved (Barribal and While, 1994; Longhurst, 2010). This is applicable for gathering insights in the processes related to the possibilities to integrate LREIs with the TI-sector.

Semi-structured interviews are an appropriate (qualitative) research method to gather knowledge about perceptions, opinions and experiences of actors (Dunn, 2010; Hay, 2010) which can in turn contribute to the search for barriers and opportunities to tackle these barriers in the integration of LREIs with TI. According to Blumberg et al. (2011), a semi-structured interview contains of two important objectives: (1) gathering information about the perspective of the informant on the issue, and (2) searching for confirmation of insights and information the researcher already holds. The second objective is connected to the open-ended interview method which is described in section 3.3.1. The semi-structured interviews are conducted based on an interview guide functioning as a guideline throughout the interview. These interview guides are made for every single interview in order to ensure the complete applicability for that specific person and organization. The interview guides all consist of questions related to the relevance of this research, to the rules of the game of the IAD-framework, and the play of the game of the IAD-framework. An example of an interview guide is attached in appendix II. The conducted semi-structured interviews are listed in table 6 in the next section in which also the selection of these participants is set out.

3.3.3 Selection of the participants

The participants of both interview methods were sampled by using the 'snowballing' method. The term 'snowballing' can be referred to as a method in which the researcher asks *''initial participants to nominate other potential participants who ten nominate further participants''* (O'Leary, 2017, p. 383). Snowballing can be used for researches of which the population is not easily identifiable (O'Leary, 2004). In this way, contacts from the university as well as from the internship (Witteveen+Bos) were used to get in contact with relevant actors for this research. Subsequently, these contacts were used to get in contact with other relevant actors after which, using the snowballing method, many relevant actors were contacted. For example, the supervisor(s) of the university provided the e-mail addresses of a person within RWS. This person was in turn willing to first participate in an explorative open-ended interview followed by a detailed semi-structured interview. Subsequently, this person provided the researcher with the e-mail addresses of other relevant actors within this project which led to interviews and e-mail conversations with multiple important actors.

Table 6 lists the ten participants of the semi-structured interviews conducted for this research. The interviews are conducted with people of both case studies, working at multiple organizations, and acting on multiple scale-levels. Three semi-structured relate to the InnovA58 case study and seven semi-structured interviews

relate to the A12 Maarn-Maarsbergen case study. This unequal ratio is based on the complexity of both case studies (see 3.5 for a detailed description). On the one hand, the InnovA58 is situated in the plan elaboration phase of the planning process in the TI-sector and is currently exploring possibilities to involve LREIs. This implies the hardly or not at all concrete involvement of a citizen initiative which causes a limited number of different actors and stakeholders. On the other hand, the A12 Maarn-Maarsbergen is already facing the situation in which a LREI came to table with organizations such as RWS and the local municipality with the idea to develop a solar PV-installation along the A12. This implies the involvement of more different actors with many different interests. This in turn contributes to the complexity of this case study. Based on this, the well-considered decision for the unequal ratio regarding the number of interviews has been made.

Participant	Date	Organization	Function	Case
Participant 1	24-04-2018	Rijkswaterstaat	Senior advisor	A12
Participant 2	15-05-2018	Initiator	Citizen of Maarn	A12
Participant 3	17-05-2018	Rijkswaterstaat	Senior advisor	A12
Participant 4	22-05-2018	Municipality Utrechtse Heuvelrug	Policy advisor	A12
Participant 5	31-05-2018	Rijkswaterstaat	Manager real estate portfolio	A12
Participant 6	04-06-2018	Heuvelrug Energie	Advisor	A12
Participant 7	04-06-2018	Witteveen+Bos / Rijkswaterstaat	Leader innovation	InnovA58
Participant 8	07-06-2018	Poort van Bunnik	Manager	A12
Participant 9	15-06-2018	Rijkswaterstaat	Project manager and senior advisor	InnovA58
Participant 10	05-07-2018	Municipality Etten-Leur	Policy advisor	InnovA58

Table 6: List with conducted semi-structured interviews

3.3.4 Ethics

Ethical aspects are important in doing scientific research (Hay, 2010; Valentine, 2005; Zhang, 2017). The researcher asked permission to use the collected information gathered by the conducted interview and guaranteed anonymity, which are both usual and useful aspects in scientific research (Hay, 2010; Hennink et al., 2011) and especially in case study research (Yin, 2014). Before an interview, the participant was asked to read and sign a consent form that allowed the researcher to record the interview (see appendix III). All the participants were informed beforehand about the connection between the researcher and Witteveen+Bos. This could result in less openness of the participants in answering the questions asked during the interviews. Nevertheless, this research has been done independently of any of the relevant actors in both case studies. With this, the researcher guarantees the objectivity of this research.

The researcher is aware that this research topic is about a sensitive issue at both RWS as well as the initiators of the LREI in the case A12 Maarn-Maarsbergen. To prevent any conflicts between the multiple actors or the researcher, the independence of the researcher emphasized several times. Also, the researcher is aware of some sensitive issues regarding the positions and actions of multiple actors in this setting which also indicates the importance of the careful handling with the gathered data. As a result, the collected data is processed anonymously in order to guarantee the hardly or not at all negative impacts of this research. However, some of the actors involved in the case studies are possibly able to track other participants based on their organization and function. This is possible since all the organizations are in contact with each other causing familiarity of organizations and associated persons. The filled-in consent forms regarding the permission to record the conducted semi-structured interviews are kept private during this research. The consent forms as well as the interview recordings will be destroyed after publishing this thesis in order to prevent any negative incidents.

Moreover, the representativeness of this research should be taken into account because of the use of case studies. The use of a case study limits the possibilities of generalization as already stated in section 3.2.2. Since the answers, opinions and views of one participant are not automatically applicable for the entire organization, more in-depth interviews are necessary to make a valid analysis applicable for organization as a whole.

3.4 Data-analysis

This section presents the data-analysis process of this research. First the interview and coding processes are set out. Next, the structures of the results chapter are underpinned followed by the link between the gathered data and the analysis.

3.4.1 From interviews to data

This research started with conducting three open-ended interviews as described in 3.3.1. These interviews are not recorded but schematically written out to end up with a schematic overview of the most important elements of the three conducted interviews. These interviews provided the researcher with data that gave handhold during the remaining research steps. Also, this data has been used to write subchapters 4.1 and 4.2. Next, this research conducted ten semi-structured interviews (see 3.3). These interviews function as the basis for the data collection of this research. The first step of the data analysis was recording all the semi-structured interviews. This is done to collect as much information as possible from the conducted interviews. Consequently, the recordings were transcribed to a clean read transcript which resulted in ten reader-friendly texts. This is done to ease the analysing process without adjusting the content of the conversation. After transcribing the interviews, this research coded the interviews twice.

First, the interviews were coded based on codes referring to the IAD-framework. This resulted in a code book consisting of fourteen codes referring to both the seven rules of the game as well as to the seven plays of the game. However, this coding method limited the data analysis procedures necessary to answer the research questions. The data ordered in line with the IAD-framework resulted in many overlap between the different identified barriers which in turn resulted in a limited distinction between the different barriers. Since the research questions indicate the search for concrete institutional barriers, this research conducted another coding process. The second coding process has been done with codes corresponding with the expected and identified codes based on theory, the open-ended interviews, and the semi-structured interviews. This resulted in a code book consisting of 25, both implicit and explicit, codes (see appendix IV). These codes refer to the eight barriers, eight identified opportunities to tackle these barriers, and general topics as climate neutrality, who does what, and the process of the initiative at the case A12 Maarn-Maarsbergen. The juridical barrier has been divided into three codes: doing business with a third party, the MOT-procedure, and permits. This has been done because of the size of the juridical barrier and the necessity to keep an overview of the three different parts of this juridical barrier. This division has also been used to structure chapter 4. The transcripts are coded by using Atlas.ti software. After finishing the coding process, Atlas.ti provided the researcher with a report per code which eased the structuring of the results chapter. The next section will elaborate further on the process from data to analysis.

3.4.2 From data to analysis and conclusion

The chapter in which the results are set out (chapter 4) is structured in line with the sub research questions. This has been done to ensure the capability to answer these questions in the concluding chapter and, consequently, to answer the main research question. The reports provided by the Atlas.ti software gave handhold during the process from data to analysis. Subchapter 4.1 was written based on the theoretical background and the data and analysis of the open-ended interviews as well as of the semi-structured interviews. Next, subchapter 4.2 elaborates on the current institutional barriers corresponding to the eight code reports provided by the Atlas.ti software. Both the open-ended interviews and the semi-structured interviews are used to write this subchapter. Consequently, the same strategy has been used to set out the identified opportunities to tackle these barriers in subchapter 4.3. This subchapter is solely based on the conducted semi-structured interviews.

Based on the results, one can state that some barriers are more constraining than others. This can be stated based on both the frequency participants discussed barriers and the identified opportunities to tackle barriers. For example, every participant discussed and agrees on the juridical barrier and, additionally, tackling the juridical barrier seems hard to achieve because of the constraining legislations, involvement of many stakeholders, and the complete eagerness to tackle the barrier. In contrast, the contracting method was discussed less. Also, some participants denied the constraining power of this barrier. The results presented in subchapters 4.2 and 4.3 provide the input for the conclusion of this research. Structuring chapter 4 in line with

the order of the sub research questions helped presenting the conclusion in a clear and structured way. The conclusions are presented in relation to theory and literature to link theory to planning practice. Here, the similarities and differences between the relevant theory and literature and the planning practice are identified. Based on this information, the applicability to both theory and practice is described. The applicability to planning practice is further emphasized by formulating multiple practical recommendations for the stakeholders involved in the action arena. These recommendations are based on subchapter 4.3 and highlight the contribution of this research to planning practice.

3.5 The case studies

O'Leary (2004) describes a case as *''a particular instance or entity that can be defined by identifiable boundaries''* (p.115). This subchapter will set out the used case studies in this study: the A12 between Maarn and Maarsbergen and the project InnovA58. These descriptions are based on policy documents and a first inventory based on the open-ended interviews.

3.5.1 The A12 Maarn-Maarsbergen

The first case study used in this study contains a situation located on the A12 between Maarn and Maarsbergen. The highway A12 is the oldest highway of the Netherlands and has a length of 137 kilometres. The road connects The Hague via Gouda, Utrecht and Arnhem with the Ruhr area in Germany (RWS, 2018h). The road has been widened in 2012, after which a noise barrier has been realized on both sides of the A12. The noise barrier located in Maarn contains a sloping upper part which offers a high potential for producing solar energy by using a solar PV-installation (see figure 12 in figure 11). This part of the noise barrier is highlighted in the map (figure 11) and has a length of about 1.3 kilometres. The case study investigates the situation in which a LREI contacted, via several other parties, RWS with the idea to realize a solar PV-installation on the south side of the noise barrier (on the sloping upper part) along the A12 between Maarn and Maarsbergen. This is visualized in the combination of the figures 11 and 12.

Figure 11: The location of the noise barrier along the A12 between Maarn and Maarsbergen.
Figure 12: The noise barrier along the A12 in Maarn

The A12 is in the maintenance phase of the planning process of an infrastructure project in the Netherlands (see 3.2.2). It is part of a DBFM-contract between RWS and the Poort van Bunnik (consisting of multiple parties such as the BAM) which runs until 2032. The maintenance phase started with the acceptance decision after the realization phase, and ends with the end of the current DBFM-contract. The noise barrier is property of RWS which makes it a property of the Dutch state. The maintenance tasks are outsourced to the Poort van Bunnik and possible lease contracts are managed by the Central Government Real Estate Company (Rijksvastgoedbedrijf – RVB). The project is currently functioning as a pilot-project for RWS. This implies that this case is used in an experimental way to test opportunities and exceptions made to, normally, mandatory

procedures. Table 7 shows the involved actors and their main interests/role in this case. The precise role of every single actor will be described in chapter 4.

Actor	Main interest/role
Rijkswaterstaat	Land owner and managing safety, accessibility,
Central Government Real Estate Company (RVB)	Contract holder for state-owned land
Municipality Utrechtse Heuvelrug	Licenser, facilitator, intermediary
Heuvelrug Energie	Intermediary and knowledge about solar parks
Poort van Bunnik	Maintain road- and noise barrier functions
Initiator(s)	Realize a solar PV-installation on noise barrier along the A12 at Maarn

Table 7: The involved actors and their roles in the case study A12

3.5.2 The project InnovA58

The second case study used in this research contains the project InnovA58. The A58 is located in the South of the Netherlands in the province of North-Brabant. This project is about the redevelopment of the A58 in order to improve the general traffic flows and solve the current traffic jam problems. The current situation causes the biggest and 'most expensive' traffic jam of the Netherlands (SmartwayZNL, 2018). This problematic situation will be addressed by widening the road from 2 to 3 lanes on two routes of the A58: from junction Sint-Annabosch to junction Galder and from the cities Eindhoven to Tilburg (see map in figure 13).

The InnovA58 is a special project due to four important characteristics: (1) the integrative approach of innovations during the different phases of the project, (2) the cooperation and knowledge sharing between other projects, (3) involvement of the surrounding (citizens, interest groups, local stakeholders) is already allowed in an early stage, and (4) the energy-neutral goals and the general sustainable character of the project (RWS, 2018e; SmartwayZNL, 2018).

The terms 'smart', 'innovation' and 'sustainable' are central concepts in this project. RWS aims to redevelop the A58 together with knowledge partners, other governmental bodies, market parties, and citizens in such a way that it will become a smart, sustainable and future-proof highway (SmartwayZNL, 2018). The energy-ambitions are bundled into the general goal of creating an 'Energy corridor' which refers to the ambition of realizing RE sources along the new A58 (RWS, 2018g). This includes solar, wind and thermal energy. The Energy Corridor is funded in a cooperation between RWS, market parties and lower governmental bodies and is in line with the energy policies of these organizations. The project team is investigating possibilities to involve citizens in realizing RE projects such as solar PV-parks on noise barriers along the A58. An example is municipality Etten-Leur who came to table with RWS with the idea to develop a solar PV-installation on a noise barrier. In case RWS gives permission to do so, the municipality will in turn involve a local initiative or energy cooperative to realize the project.

The InnovA58 project is currently in the plan elaboration phase of the planning process of TI in the Netherlands (see 3.2.2). The next milestone will be the concept project decision (in Dutch: Ontwerptracébesluit) and the final Environmental Impact Assessment (RWS, 2018f). This implies that the preferential decision is further elaborated to a concept project design which is now ready for publication after which involved or interested people are free to react on the design (RWS, 2018d; RWS, 2018f). The plan elaboration phase ends with a definitive project decision after which no adjustments or further involvement is allowed, which is scheduled for 2020 (RWS, 2018f).

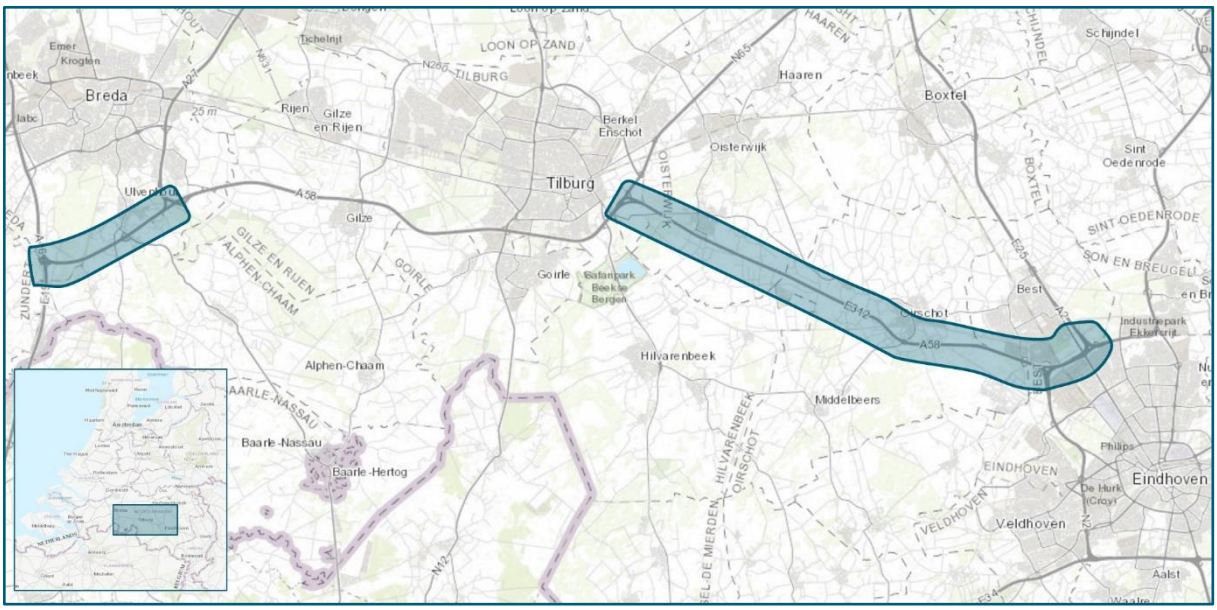

Figure 13: The locations of the project InnovA58 in the province of North-Brabant (NL).

4

RESULTS AND ANALYSIS

This chapter describes the results of this research and consists of three subchapters. These subchapters are corresponding with the research questions of this research. First, the results related to the current action situation are presented. This is relevant since this functions as the basis of understanding the context and practice of the studied institutional situation. Next, the current identified institutional barriers are set out. The final subchapter presents the identified opportunities to tackle the institutional barriers. The references for the results based on the gained data by the conducted semi-structured interviews are indicated with P. (1-10) followed by an abbreviation of the organization the participants work at. More information about the participants is set out in table 8.

Participant	Organization	Abbreviation	Function
Participant 1	Rijkswaterstaat	RWS	Senior advisor
Participant 2	Initiator	Initiator	Citizen of Maarn and initiator project
Participant 3	Rijkswaterstaat	RWS	Senior advisor and project manager
Participant 4	Municipality Utrechtse Heuvelrug	Mun. UH	Policy advisor
Participant 5	Rijkswaterstaat	RWS	Manager real estate portfolio
Participant 6	Heuvelrug Energie	HE	Advisor
Participant 7	Witteveen+Bos / Rijkswaterstaat	W+B / RWS	Leader innovation theme Energy
Participant 8	Poort van Bunnik	PvB	Manager
Participant 9	Rijkswaterstaat	RWS	Project manager and senior advisor
Participant 10	Municipality Etten-Leur	Mun. E-L	Policy advisor

Table 8: The participants of the semi-structured interviews numbered 1-10.

4.1 The current action situation

This subchapter describes the current action situation for developing a solar PV-installation on RWS lands. This description is based on the collected data of this research, information from the documents of Spijkerboer et al. (submitted), De Vries et al. (2017), and websites of the Dutch central government. The current action situation is visualized in figure 14. This operates as a general impression of the situation in the Netherlands regarding the realization of solar PV-installations on RWS lands. This figure can be applied to a certain extent to future comparable situations in the Netherlands. However, since the case study research method is not completely suitable for generalizations (see 3.2.2), the action situation also depends on the contexts of the specific project. The description of the action situation is based on the 'position' and 'choice' rules of the IAD-framework. The position rules describe the positions held by actors while the choice rules describe the actions that these actors may, must or must not do at certain points in the case of realizing a solar PV-installation along TI in the Netherlands (see 2.4 and Appendix V). The Dutch parliament functions according to legislations set by European Union. An example of this are the 20-20-20 targets referring to the shift towards the use of RE sources (Europe Nu, 2015; European Union, 2009). The Dutch parliament consists of multiple Ministries of which the Ministry of Infrastructure and Water Management (I&W), the Ministry of the Interior and Kingdom Relations (IKR) and the Ministry of Economic Affairs and Climate Policy (EAC) are relevant for this research. These Ministries provide their executive organizations with assignments and legislations.

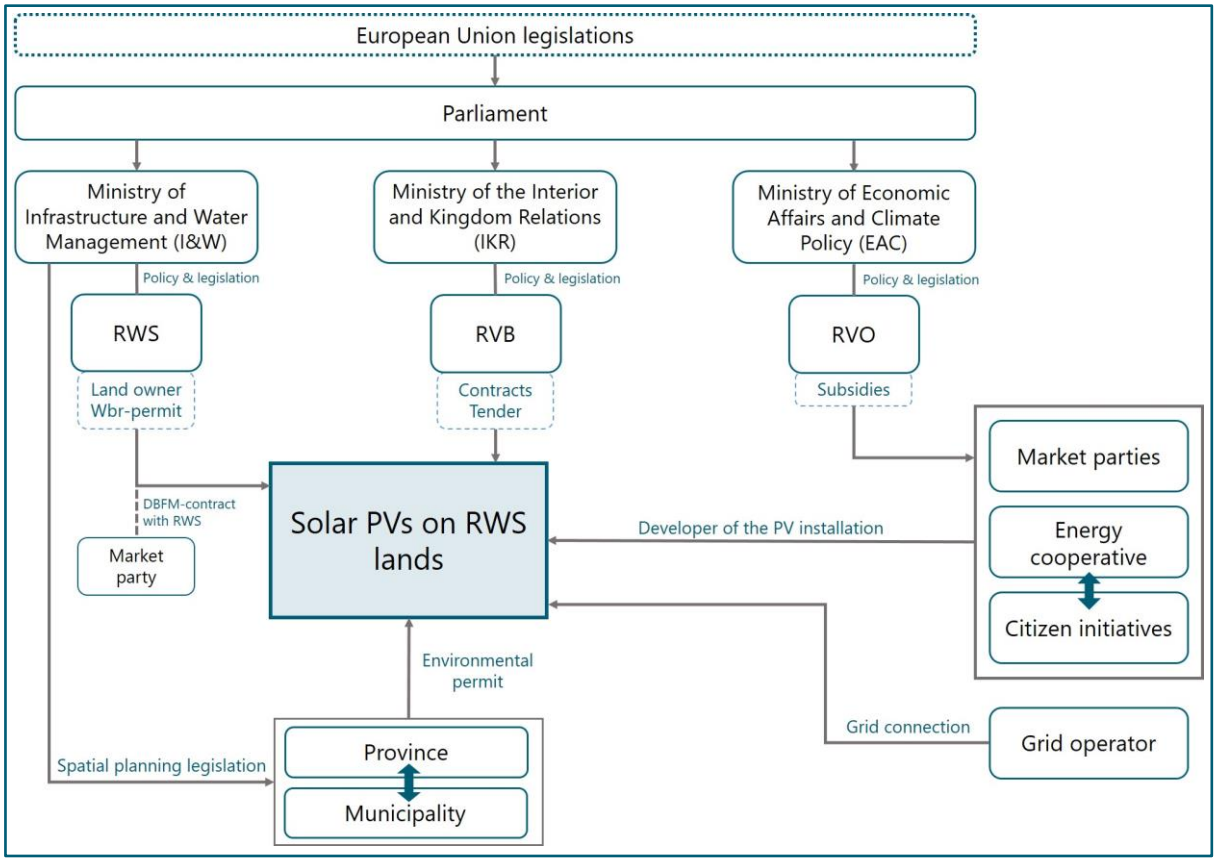

Figure 14: The current action situation for realizing solar PV installations on RWS lands. Based on Spijkerboer et al. (submitted) and De Vries et al. (2017).

RWS (RWS) is the executive organization of the Ministry of I&W and responsible for the management, safety, accessibility, and mobility of national TI in the Netherlands. They receive assignments and budget for these assignments from the Ministry of I&W which causes a narrow focus on their prime goals (P. 1,3,5,7,9 - RWS). RWS is the licensing authority for the permit based on the Public Works Management Act (Dutch: Wet beheer Rijkswaterstaatwerken). Moreover, RWS owns many lands surrounding their infrastructure that provide significant opportunities for producing RE (Ministry of IE, 2016). These lands can be used to produce RE for their own purposes (energy neutral in 2030) or to produce RE by third parties. Since RWS is not allowed to act as an energy producer competing with energy companies (RWS, 2015; P. 1,3,5,7,9 - RWS), producing energy for their own purposes means that they are only *''the owner of the associated guarantees of origin''* (Ministry of IE, 2016, p.3). This implies that there is always a third party involved when it comes down to the generation of RE on RWS lands. This third party can be either a market party, single citizens or a cooperative of citizens (see right side of figure 14) that should be in possession of multiple necessary permits before they can generate, for example, solar energy on land owned by RWS (see 4.2.2). RWS is using DBFM contracts in large TI-projects. DBFM contracts ensure that a market party remains responsible for the maintenance of the infrastructure projects, corresponding to the duration of the long-term contract. Therefore, the involved market party plays an important role in case RWS or a third party requests for adjustments in the infrastructure project (P. 8 - PvB).

The RVB manages the contract related businesses regarding state-owned land such as areas along national TI owned by RWS (P. 1,5,9 - RWS). The RVB is therefore also the organization that initiates the public tender process in case of surplus lands or requests from third parties such as a local initiative of a market party functioning as the potential developers of the solar PV-installation. In case of a public tender process, every single interested party can make a bid to acquire the rights of superficies for the specific land parts granted by the RVB. The party with the highest bid wins the tender process and gains the rights to develop the solar PV-installation, regardless of their underlying intentions (P. 1,5,7,10 - RWS, W+B/RWS, Mun. E-L).

The municipality and province are functioning conform the spatial planning legislations set by the Ministry of I&W. Depending on the size of the project, either the municipality (smaller projects) or the province (larger projects) is the licensing authority for the environmental permit (P. 1,4,6 - RWS, Mun. UH, HE). This permit is given in case the project does not conflict with the existing zoning plan of the area and the project does not have any (substantial) negative consequences for the area and the people living around. The municipality is representing citizens via the public way which makes that they are close to citizens. Therefore, municipalities could play an important facilitating role in these situations (P. 1,4,10 - RWS, Mun. UH, Mun. E-L).

Potential developers are, together with the grid operators and the involved market party via the DBFM-contract, the non-governmental parties. They are situated on the right in figure 14. A potential developer can be a market party, a citizen initiative, or an energy cooperative. A citizen initiative can function individually, but has also opportunities to get overarched by an energy cooperative. This energy cooperative consists of multiple (smaller) citizen initiatives which makes them a bigger organization, which could in turn increase their influences in the action situation (P. 1,9 - RWS). The grid operator is responsible for the grid connection of the project. Agreements between the developer and the (local) grid operator are therefore necessary.

Potential developers may apply for subsidies (e.g. the SDE subsidy) at the Netherlands Enterprise Organization (RVO) which is part of the Ministry of Economic Affairs and Climate Policy. Depending on the size and other specific project characteristics, a subsidy can be granted. Also, the RVO is the authority responsible for the regulation Reduced Rate or, in other words, the Postcoderoosregeling (PCR-regulation). The PCR-regulation is a regulation that ensures that citizens involved in a project in which a solar PV-installation is realized on lands that is not their own, are provided with a financial compensation in line with the energy tax. This financial compensation is 12 eurocent per kWh. This is half of the compensation rate one will receive when the panels are on your private roof (24 eurocent per kWh). The PCR-regulation for a project currently runs for 15 years (P. 6 - HE).

4.2 Which institutional barriers occur?

This section describes eight institutional barriers that occur in the situation of realizing a solar PV-installation on public sites along national TI in the Netherlands with the involvement of a LREI. This section is linked to the 'rules of the game' part of the IAD-framework (see figure 6). The data presented in this section functions as the basis for answering the second sub research question of this research.

4.2.1 Introduction and overview

The barriers that occur are based upon both the open-ended interviews as well as on the semi-structured interviews of the two cases studied in this research. The barriers that occur in each of the case studies are visualized in figure 15. Most of the barriers play a role in both studied case studies. Therefore, this chapter does not differentiate the barriers into the two case studies. According to all the participants, the combination of a solar PV-installation, TI and, especially, local initiatives is quite new which causes that both case studies are facing the same barriers. The references for the results in this section are solely made to the participants of the semi-structured interviews. In the next subsections, the barriers are set out in detail.

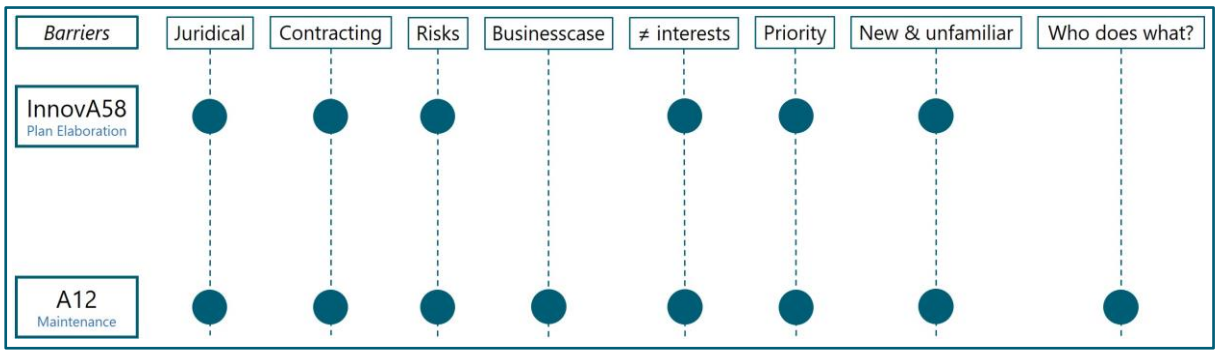

Figure 15: Overview of the identified institutional barriers

4.2.2 Barrier 1 - Juridical

This subsection describes the constraining factors relating to juridical aspects. First, the willingness and ability of actors in the TI-sector to do business with a third party is set out. Next, the public tender process is described followed by a description of necessary permits. The section ends with a link between the barrier and the rules of the game of the IAD-framework.

Doing business with a third party

An important condition is the possibility for a third party to obtain the right of superficies of the lands along the national TI in the Netherlands. Without these rights, a third party has no possibility to develop a solar PV-installation on these state-owned areas. However, RWS does, in principle, no business with a third party unless their RE initiative meets several, very specific, conditions that enable the granting of the rights of superficies. These conditions are that (1) based on realistic expectations and the MIRT-programme, no adjustments will be made to the current infrastructure project within the next 15-20 years, (2) RWS can include an option for termination rights and (3) the lands are tendered via a competitive, public, and transparent procedure (MOT-procedure) (P. 1,3,5 - RWS). Despite these comprehensive conditions, RWS still holds a cautious position regarding granting business rights to a third party.

> *''The reason for this cautious position is the uncertainty. We think in long-terms and we should be able to, in case this becomes necessary at a certain point in time, remove the noise barrier or whatever''* (P. 9 - RWS).

In other words, the cautious position held by RWS is caused by the risks involved in doing business with third parties (P. 1,3,5,9 - RWS). One of these risks is that RWS is not able to foresee 15-20 years ahead of prospect, because the MIRT-programme only takes the upcoming 12 years into account (P. 5 - RWS). Other risks are the possibilities that a relevant policy or legislation changes, and the complexity of the necessary agreements between the many involved actors (P. 1,5,9 - RWS). The cautious position held by RWS is highlighted by a recent addition to the Real Estate Strategy of RWS itself. This addition builds on the first condition (no adjustments necessary in the next 15-20 years) set by RWS whether or not grant business rights to a third party. This strategy states that granting right of superficies (In Dutch: recht van opstal) to a third party to develop a solar PV-installation on noise barriers is considered as *''undesirable''* (P. 1,2,3,6 - RWS, Initiator, HE). Although this addition is not yet fixed, it highlights the cautious position held by RWS. In case this addition to the Real Estate Strategy becomes fixed, the possibilities of a LREI to develop a solar PV-installation along TI in the Netherlands are (almost) gone. The latter indicates the importance of this barrier. The other parts of the juridical barrier are set out in the next subsections.

MOT-procedure

The MOT-procedure (Dutch: Marktconform, Openbaar en Transparant aanbesteden) is the mandatory competitive, public and transparent tender process that the RVB must start in line with the third condition set by RWS regarding whether or not grant the right of superficies to a third party (P. 1,3,4,5,7,10 - RWS, Mun. UH, W+B/RWS, Mun. E-L). The idea to develop a solar PV-installation along TI can arise both from a local initiative and the municipality. In case the idea originates from a local initiative, the municipality is often an intermediary who transfers the idea to RWS and by that giving the idea more value and political weight (P. 4,7 - Mun. UH, W+B/RWS). In case RWS is willing and able to grant the business rights of the specific lands to a third party (a first estimation for meeting the conditions is made), the RVB is, in line with EU-legislations, obliged to start the MOT-procedure. This MOT-procedure implies that every single interested party can apply to realize the idea developed by the promotors of the idea: the local initiative or the local municipality. The party with the highest bid wins the tender process and gains the right of superficies for the specific lands. According to the participants, this results in uncertainty for the initiators whether they can actually realize 'their' project since they are often financially limited which in turn reduces their chances to win the tender process. This process is visualized in figure 16.

In other words, the mandatory MOT-procedure functions as a barrier for local initiatives since it reduces their chances to actually realize the initiative they have (P. 1,3,4,5,7,10 - RWS, Mun. UH, W+B/RWS, Mun. E-L). As a result of this procedure, *''the idea can end up everywhere''* (P. 4 - Mun. UH). For example, if *''a Chinese developer wants to realize it, it will be no problem at all for Rijkswaterstaat and the RVB''* (P. 7 - W+B/RWS). This is

problematic since *''this actually means that we are trying to create a project about which we don't have any control over in the future''* (P. 10 - Mun. E-L).

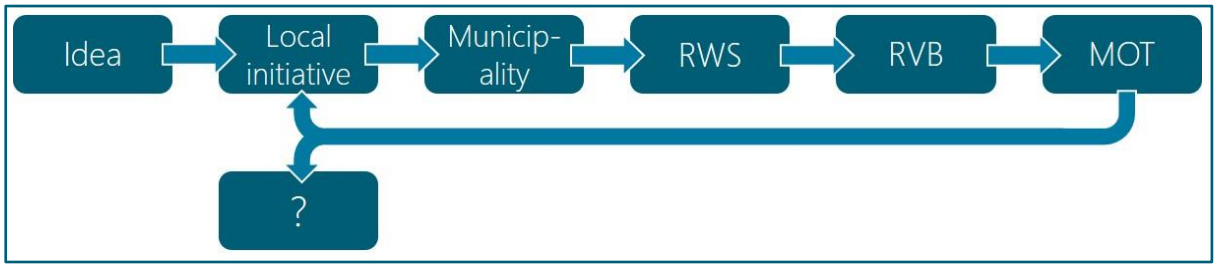

Figure 16: The stepwise process and consequence of the MOT-procedure

The mandatory MOT-procedure leads to disunity between both the different stakeholders as well as within RWS. Participant 5 (RWS) raises questions about the necessity of the MOT-procedure for local projects as small as the case A12 Maarn-Maarsbergen. He emphasizes the significant reduction of the chances of a local initiative to realize 'their' project by obliging the MOT-procedure and, additionally, states that *''at the moment a well-organized citizen initiative did the exploration and all, do we then still have to come up with that procedure? That is quite discrepant and cause a clear field of tension''* (P. 5 - RWS). However, the MOT-procedure is currently still a mandatory process regardless the size of the project and is based on the openness in government and the principle that everyone must have equal chances to realize a, for example, solar PV-installation on that specific land (P. 1,3,5,7,10 - RWS, W+B/RWS, Mun. E-L). So *''it is not about the principle, but about the practicality''* (P. 5 - RWS).

Permits

According to the participants, a local initiative must obtain three necessary permits before they are allowed to realize a solar PV-installation on lands along national TI in the Netherlands:

1. A permit based on the Public Works Management Act (Wbr), granted by RWS
2. An Environmental Permit, granted by the municipality
3. The right of superficies for the specific land, granted by the RVB

1 The Wbr-permit is a permit based on the Public Works Management Act. This permit is granted by RWS and the procedure takes about half a year (P. 1,2,3,4,7,10 - RWS, Initiator, Mun. UH, W+B/RWS, Mun. E-L). This Wbr-permit is given if the project does not cause any conflict with the main interest of RWS: guaranteeing accessibility and safety on their networks (P. 1,3,5,10 - RWS). This includes tests regarding possible reflection, distraction, damage, and other technical aspects. And in case the project *''does not conflict with the Wbr, and the request can be united with the public interests, this permit will be granted''* (P. 3 - RWS). However, a framework regarding solar PV-installations on state-owned lands on which the licensing authority can base its decision to whether or not grant the Wbr-permit is currently missing (P. 3,7 - RWS, W+B/RWS).

> *''For example, there is no framework on which licensing authorities can test for a permit regarding solar energy on state-owned lands [...] [with] requirements regarding safety, reflection, landscape plans, lease, cables and pipes, traffic safety, obstacle-free zone, maintenance, flora and fauna, sound effects, drainage and so on...''* (P. 7 - W+B/RWS).

2 The Environmental Permit is granted, in these cases, by the municipality (P. 1,2,4 - RWS, Initiator, Mun. UH). The Environmental Permit is granted in case the project does not (or barely) conflict with the existing zoning plan, the negative consequences to the surrounding area are acceptable, and the project does hardly or not at all lead to any resistance from the people around (P. 4 - Mun. UH). A LREI applies for the Environmental Permit after they have reached agreements with RWS and the RVB about the right of superficies because there is no need for an Environmental Permit if the right of superficies cannot be obtained (P. 2,4 - Initiator, Mun. UH). According to participant 2 (Initiator), the Environmental Permit will not lead to any problems because *''everyone will think 'wow!', and reflection is excluded and I cannot imagine that people are opposed to the project''*. Participant 1 (RWS) partially agrees with this but also makes a critical remark by stating that

''there will be many people who like the idea because they are participants, but there are possibly also people who find it less attractive. They will think the panels will cause reflection in their gardens, amplify the sound effects, or simply don't like solar panels…'' (P. 1 - RWS).

According to the licensing authority in the case A12 Maarn-Maarsbergen (P. 4 (Mun. UH), the Environmental Permit will most likely not lead to any problems. The municipality did a quick scan to make an inventory of the situation in which they found, except a small adjustment in the zoning plan, no problems at all.

3 The right of superficies is granted by the RVB (P. 1,3,4,5,7,10 - RWS, Mun. UH, W+B/RWS, Mun. E-L) and is closely related to the MOT-procedure described in section 4.2.2. The RVB only grants rights of superficies in case the initiative meets the comprehensive conditions mentioned in the first subsection of 4.2.2. The right of superficies for the specific land is granted to the party that makes the highest bid in the MOT-procedure. As already stated earlier, this MOT-procedure can reduce the chances of success for a LREI which causes that obtaining the right of superficies functions as a barrier in cases like these.

Link to rules of the game

The juridical barrier is linked to two rules of the game: the *boundary* rules and the *choice* rules. The boundary rules are applicable since the juridical factors cause difficulties in the possibilities for a third party to enter the action arena. This is done by, for example, the willingness to do business with third parties, the comprehensive conditions set by RWS regarding granting the rights of superficies and the mandatory MOT-procedure. The choice rules are applicable since they specify what actors must, may or must not do at certain moments which is closely linked to the obligations regarding the granting of permits. For example, the obligation to start a MOT-procedure is legally defined which implicates that the RVB has, currently, no choice whether or not start a MOT-procedure.

4.2.3 Barrier 2 - Contracting

The contracting barrier refers to the use of a DBFM-contract in the TI-sector in the Netherlands as also described in section 2.3.2. The DBFM-contract is a long-term contract between RWS and a market party in which RWS outsources the design, build, finance and maintenance parts of an infrastructure project to a market party, based on multiple agreements made in an early stage of the specific project. This includes that the involved market party is responsible for maintaining the current functions of the road in line with the agreements made in the contract. *''That market party did investments and is challenged to use proper materials that last for 20 years in order to prevent any surprises and financial costs''* (P. 1 - RWS). This is confirmed by stating that

''The management and maintenance are included in the DBFM-contract which is linked to a financial compensation. Initiatives which could affect this maintenance and are also not manageable by the contractor, will affect its incomes about which he will not be happy. The only thing he wants is to have complete control over 'his' project which he can predict beforehand. That's the businesscase. Citizen initiatives that cause uncertainties makes it therefore very difficult.'' (P. 9 - RWS).

In other words, current DBFM-contracts are based on maintaining the projects' current functions without any adjustments. As a consequence, any adjustments to the road, the noise barriers or other functions are not included in the contract. This can constrain the possibilities to integrate LREI and solar PV-installations with existing TI-projects in which a DBFM-contract is used.

''The use of a DBFM-contract is nice in a low-dynamic area in which you know that the road will just be there for the next 20-30 without any reasons to make adjustments that infrastructure project but in a high-dynamic area such as in the middle of the country…'' (P. 1 - RWS).

In case of any adjustments to the original infrastructure project by, for example, adding private solar PVs to the public noise barriers, the existing DBFM-contract should be adjusted since the made agreements are not completely applicable anymore. According to participants 1 and 10 (RWS), this is accompanied by several problems and is adjusting a DBFM-contract a difficult process for which one party has to pay for. Although adjustments in DBFM-contract are possible (P. 8 - PvB), there is currently unclarity about who should take the

initiative to adjust the contract and who could, and is willing to, pay for this (P. 1,8,10 - RWS, PvB). Especially the (limited) size of the project at the A12 Maarn-Maarsbergen causes that actors wonder whether it makes sense to break such a long-term contract for such a small project (P. 1,4,9 - RWS, Mun. UH).

Link to rules of the game

The contracting barrier is related to the *payoff* rule of the IAD-framework. Contracting is about financial agreements regarding the TI-project, the distribution of costs and benefits and agreements about who pays for what, which is strongly linked to the payoff rules.

4.2.4 Barrier 3 - Risks

There are multiple risks and uncertainties involved in case a third party would develop a solar PV-installation on state-owned lands on, for example, a noise barrier. There are multiple risks that cause that having complete certainty about the course of the TI-project is difficult which in turn cause less willingness to invest time and money in projects like these (P. 1,5,6,8,9 - RWS, HE, PvB). This is about, for example, the financial risks regarding the possibility that the initiator or energy cooperative goes bankrupt and about the reliability of a LREI in itself. Also technical risks such as the possibility that a noise barrier can collapse as a result of the attachment of solar PVs, the possibility that a panel can fall off and end up on the road (which seems unrealistic in the case of the A12 Maarn-Maarsbergen since the solar PV-installation would be realized at the backside of the barrier), and the possibility that the solar PVs amplify the sound effects, wind effects and reflection can cause difficulties. Moreover, uncertainties cause several risks that must be carried by one of the actors. This could be a possible unexpected change in the legislation regarding noise barriers or a necessary adjustment to the infrastructure project (P. 1,4,5,6,8,9 - RWS, Mun. UH, HE, PvB).

A central question regarding the risk management in a situation in which a LREI wants to develop a solar PV-installation on state-owned land along national TI in the Netherlands is: who is able and willing to carry these risks? This causes several difficulties that makes that the risks management currently functions as a major constraining factor in these cases. In case of the use of a DBFM-contract, the involved market party is risk carrier for the duration of the contract (see 4.2.3). This results in a situation in which the market party made an inventory of risks in an early stage of the process which functions as a basis for the guarantee of risks carrier during the long-term contract between them and RWS. However, as already described earlier, the attachment of a solar PV-installation on a noise barrier can lead to multiple risks which are not included in the risks inventory of the market party. The market party is therefore not *''a supporter of a situation in which a third party touches our assets''* (P. 8 - PvB). In such a situation, they adopt a position in which they state that *''we will shift the responsibilities back to Rijkswaterstaat since we don't want to be the main risk carrier anymore''* (P. 8 - PvB).

Nonetheless, simply shifting the responsibilities back to RWS is easier said than done. For example, the willingness of RWS to carry (some of the) financial risks should not be taken for granted. *''Rijkswaterstaat is stating rightly that we don't want to be responsible for any damage since 'you have attached the solar PVs on our noise barrier yourself'''* (P. 5 - RWS). Moreover, *''we should carry all the risks and the Dutch state should get the costs. That is of course not going to happen. Why should we sponsor many different citizen initiatives to take away all the financial risks in a contract?''* (P. 9 - RWS). Besides the willingness, RWS is not allowed to carry financial risks in cases like these. Since RWS is part of the Dutch state, is it not allowed to be a guarantor because then *''it will be a kind of improper state support''* (P. 5 - RWS). In case of an unexpected change of legislation or a necessary adjustment of the TI-project, RWS can activate the termination rights to remove the solar PV-installation from the noise barrier. This involves a financial compensation to the initiators and the question is whether RWS is willing to take this risk or not (P. 1,5,9 - RWS). Furthermore, RWS has no financial resources to carry these risks since it is not in line with their main objectives for which they receive money from the Ministry of I&W (see 4.2.5 and 4.2.6) (P. 5 - RWS).

Despite the good will of the LREI or energy cooperative, their financial resources are often limited compared to the financial resources of the other actors. This causes that they are not able to carry (large) financial risks and that there is always a possibility that the local cooperative goes bankrupt (P. 1,4,6,8 - RWS, Mun. UH, HE, PvB). The next section will elaborate further on possible difficulties regarding the involvement of a citizen initiative.

The main question remains: who carries which risks? Some actors are willing but not able, some actors are able and not willing, and most of the actors shift responsibilities and financial risks to another party.

> *''You should make long-term appointments with short-term citizens. A road will remain for one hundred years while a citizen initiative will never run for one hundred years. How are you going to do that?!''* (P. 9 - RWS).

Link to rules of the game

The barrier regarding who carries which risks is linked to two rules of the game: *scope* rules and *payoff* rules. Scope rules are about which outcomes may, must or must not occur. Especially the 'must not occur' relates strongly to this barrier since a risk such as 'a solar PV panel can fall of the noise barrier and end up on the road' must not occur. The payoff rules relate to the willingness and ability to carry financial risks. Which actor is willing and able carry the financial consequences in case a solar PV panel causes an accident because it falls down or simply distracts a road user? Furthermore, which actor should pay for the financial consequences in case the noise barrier must be removed unexpectedly according to a change in legislation or a necessary adjustment to the road itself? This distribution of costs can be assigned to the payoff rules of the IAD-framework.

4.2.5 Barrier 4 - The businesscase

The involvement of a LREI or energy cooperative can on the one hand be seen as positive and on the other hand as negative. A positive aspect is that citizens get the opportunity to develop a solar PV-installation on other lands than their own since they are not always able to put solar PV panels on, for example, their own roof. Also, it stimulates the local economy and you it provides opportunities generate RE on the same place as it will be consumed (P. 1,2,4 - RWS, Initiator, Mun. UH). To be successful, a LREI must in any case be professional, enthusiastic and persevere since these characteristics can contribute to the organization of the initiative itself (P. 1,2 - RWS, Initiator). However, the involvement of a LREI on state-owned lands can also involve some drawbacks such as financial limitations, a lack of relevant knowledge and a limited project size. These drawbacks are currently not all necessarily applicable on the case A12 Maarn-Maarsbergen or the InnovA58, but can cause difficulties in a later stage of these cases or in comparable future projects.

A LREI is often limited in their knowledge- and financial capacity. Citizen initiatives are often running on volunteers which can cause difficulties in their financial- and knowledge capacities (P. 1,2,10 - RWS, Initiator, Mun. E-L). *''That is something people often forget: all the other actors get paid for their invested time and efforts while we as a group are doing this purely on a voluntary basis''* (P. 2 - Initiator). However, *''it is often serious business, so this plays a role of course. […] now we only have citizens with good will and therefore it is all getting a bit more difficult.''* (P. 10 - Mun. E-L). Moreover, LREIs are depending on financial flows from their (future) customers and have usually no money on hand which can cause financial limitations. They have to pay a certain amount of money to the RVB to lease the state-owned lands, and are probably not eligible for a direct subsidy from the municipality (P. 4 - Mun. UH). Also the use of the PCR-regulation (see 4.1) does not make a proper contribution to the feasibility of the businesscase of the initiative. Since the PCR-regulation provide the customers with only 12 eurocent per kWh instead of 24 eurocent per kWh (because the panels are on other lands than your own properties) and the initiative can use the PCR-regulation for only 15 years, the financial attractiveness is reduced significantly. *''For the cooperative, it will take ten years to recoup the costs. Then you have only five years to enjoy your solar PVs and then it's done. This makes that this construction is much less attractive than doing it on your own roof''* (P. 6 - HE). These factors cause that the businesscase of a LREI is in potential subject to financial limitations.

Yet, the opinions regarding the businesscase in the case A12 Maarn-Maarsbergen are divided. According to the initiator (P. 2), the businesscase of their initiative is complete and will not cause any problems: *''I am sure that we can sell our 500 to 700 panels within three weeks […] since people in Maarn are openminded about our project. […] I wish I had to worry about the feasibility of our businesscase''* (P. 2 - Initiator). However, other relevant actors clearly have their doubts regarding the feasibility of the businesscase of the initiative (P. 1,3,6,8 - RWS, HE, PvB). These doubts can in turn cause less willingness to invest time and money in projects like these since *''Rijkswaterstaat will not invest in a project if the cooperative does not have their businesscase in order''* (P. 3 - RWS). This limited feasibility is, besides the financial limitations as described earlier, also caused

by the limited size of this (and most likely also other) initiative(s) (P. 1,4,6,8,9 - RWS, Mun. UH, HE, PvB). This limited size is strongly related to the financial limitations of a LREI and vice versa. A small amount of solar PV panels on a noise barrier results in both less financial incomes for the initiative but also less willingness of the other stakeholders to invest time and money in the project. This is in turn caused by less financial reliability of the initiative and a limited amount of potential generated energy, both resulting in less priority and willingness from the stakeholders in the action arena (P. 1,3,4,8,9 - RWS, Mun. UH, PvB).

RWS is not eager to invest much time and money in many different small-sized projects such as the initiative at the A12 at Maarn (P. 1,2,4,8,9 - RWS, Initiator, PvB). *''Rijkswaterstaat probably prefers to realize large projects, however, this is not a large project in terms of the amount of solar PV panels''* (P. 4 - Mun. UH). This is also recognized by the initiator who states that *''the official walks away and will probably think: whatever. It is such a small project, I have other important things to do. Priority is thus a thing, I think''* (P. 2 - Initiator). The lack of priority (see 4.2.7) is caused by the small amount of potential generated energy that does not make a direct significant contribution to the energy transition (P. 1,9 - RWS), and by the loss of control since *''it should not be a sum of many different citizen initiatives where we [Rijkswaterstaat] have to try to get everything coordinated''* (P. 9 - RWS). The circle is completed by the difficulties of the local initiative to improve their businesscase caused by a lack of knowledge (P. 1,2,10 - RWS, Initiator, Mun. E-L) and the difficulties to increase their project size. This is illustrated by the initiator who states that *''Rijkswaterstaat told me that my project was too small followed by the question why I don't do it [realize solar PVs red.] along the whole A12?! I would really like to do so, but we are only with three volunteers so let's do this first. That is already hard enough.''* (P2 - Initiator).

Link to rules of the game

The businesscase of the initiative can be linked to the *payoff* rules of the IAD-framework. The financial flows cause the whether or not feasibility of the businesscase and the willingness of stakeholders in the internal action arena to whether or not invest their time and money in the project. All the involved actors are depending on these financial flows since it in the end determines the success of the initiative as a whole.

4.2.6 Barrier 5 - Difference in interests

The success of realizing a solar PV-installation along a Dutch highway with the involvement of a LREI is constrained by a difference in interests between the many involved actors. The involvement of many different actors is already a barrier in itself since this does not benefit the process in general (P. 2,5,9 - Initiator, RWS). According to all the participants, the energy transition, in which the Netherlands is currently still searching for (more) opportunities to generate RE, functions as an overarching interest between all the involved actors (see 4.3.6). However, *''on the highest level of abstraction, everyone says: we are in an energy transition and we have to do something with that. However, as it becomes more concrete, the differences in interests comes into play. On that highest level, everyone says 'yes, yes, yes', but when push comes to shove, it becomes suddenly all too difficult.''* (P. 1 - RWS). Despite similarities in interests between for example the citizen initiative(s), the energy cooperation and the municipality (see 4.3.6), there is a difference in interests between the (other) involved actors. This is set out in the following subsection.

The interest of a LREI in this case is rather simple: realize a solar PV-installation along national TI in the Netherlands. As described earlier, these areas are possessed by RWS that has other main interests than the LREI has. The main interests of RWS are guaranteeing safety and accessibility of their networks within the TI-sector (P. 1,3,5,7,9 - RWS, W+B/RWS). Allowing a LREI to realize a solar PV-installation on their lands is not in line with their main interests which cause that their priority is currently not on facilitating these initiatives as good as possible (see 4.2.7). Furthermore, *''the interest of Rijkswaterstaat is not to satisfy every single citizen but just to guarantee the overall mobility in an efficient way''* (P. 9 - RWS). RWS also has some internal differences in interests which is set out in section 4.2.7.

Also, the interests of the involved market party differs significantly from the interests of the LREI. As also described earlier, their interest is maintaining the current function of the road, the noise barrier, and other assets in line with the (long-term) contract with RWS (P. 8 - PvB). This is conflicting with realizing a solar PV-installation on a noise barrier, since this is not in line with their agreements and inventories on which they based their financial inventory in an early stage of the infrastructure project. This results in that *''I have no*

interest in this since my risks regarding complying the agreements made with Rijkswaterstaat are increasing. For me, it is an accumulation of possible costs and risks which makes that, however it is not necessarily a barrier, I currently do not see the usefulness of investing money in this'' (P. 8 - PvB).

These conflicts in interests between the side of the LREI on the one hand versus the stakeholders within the internal action arena of the TI on the other hand currently limit the chances of success of projects like these. Actors such as RWS are powerful players in the situation since they are, for example, owning the lands surrounding national TI in the Netherlands. Consequently, their lack of interests in these cases can cause problems regarding the willingness to facilitate and invest time and money in these projects. This is identifiable in both the case A12 Maarn-Maarsbergen and the case InnovA58. For instance, in the case A12 Maarn-Maarsbergen, the initiators are asking for a construction calculation to exclude the first technical barriers. The initiative to do this must come from RWS and it must in turn be executed by the involved market party (P. 1,2,8 - RWS, Initiator, PvB). However, these actors do not have a main interest in the project, cause that their willingness to do this is currently lacking. The lacking initiative from RWS is also identifiable at the InnovA58 in which *''the municipality takes all the initiative while Rijkswaterstaat is leaning back. […] In fact, Rijkswaterstaat can do this by themselves but we are currently investing time and money in it while we are also doing Rijkswaterstaat a favor''* (P. 10 - Mun. E-L). Therefore, the difference in interests between the involved actors do not benefit the process of realizing solar PV-installations along national TI in the Netherlands.

Link to rules of the game

The difference in interests barrier can be linked to the *position* rule of the IAD-framework. The position rules are about the positions held by actors and especially about what these actors want. This is well in line with the different interests of the actors in the action arena of integrating LREIs with the TI-sector.

4.2.7 Barrier 6 - Priority of Rijkswaterstaat

RWS is an important player in the action arena since they can either allow or constrain the integration of a LREI with the TI-sector. An important condition in this is the willingness to invest time and money in this integration process which should come from a certain degree of priority. However, the priority of RWS to invest time and money in this is currently lacking. *''Look at what this citizen has done so far! How can it that he has such a drive to do this, and additionally, why do we not have this drive?!''* (Quote senior advisor RWS by P. 2 - Initiator). This lacking drive is due to three factors closely related to each other. First, RWS adopts, to a certain degree, a sectoral focus in which their priority is solely on their own objectives. Secondly, one can speak of an internal culture within RWS that is not accustomed to do things outside their main package of tasks. And finally, RWS has not yet clear whether they want to do business with citizens at all. These causal factors are set out next.

The sectoral focus on the primary objectives of RWS is caused by the small-scoped assignments they are provided with by the Ministry of I&W. RWS is controlled in a top-down fashion in which the focus is solely on performances and achieving mobility-related goals (P. 1 - RWS). As a result, generating energy on their lands is not a primary goal of RWS which in turn results in an absence of financial resources to do something with the developments regarding the generation of RE on these state-owned lands (P. 1,3,5,7,9 - RWS, W+B/RWS). The lack of concrete objectives regarding the generation of RE on RWS lands is, according to participant 9 (RWS), remarkable. The Dutch parliament has, in line with the Paris Agreements and European climate policies, established policies regarding the minimum amount of generated RE, however, their own task is currently not defined. Since RWS is a large landowner in the Netherlands, one would expect that the Ministry of I&W would provide RWS with concrete assignments regarding the generation of RE on their lands that are in line with the decentralized spatial policies in the Netherlands (P. 9 - RWS). Despite a letter to the parliament (Ministry of IE, 2016) in which these ambitions are made clear, the integration of generating RE (by third parties) and the TI-sector is still lacking (P. 1,9 - RWS). As a result, project managers of RWS currently focus only on *''realizing a project, and everything that makes this complicated is preferred to be kept off''* (P. 9 - RWS). Regarding the generation of RE by a third party, this results in that RWS adopts the position in which they state that *''these small initiatives ask for much effort of people, but do not make a significant contribution to achieving the overarching goal [the energy transition red.]. They do contribute to achieving the goal of the municipality, but not to the goal of Rijkswaterstaat''* (P. 1 - RWS).

Within RWS, one can speak of an internal culture that consists of two different views. On the one hand, there is a group of people that has a strong focus on the primary objectives while on the other hand, there is a group of people that wants to take the environmental aspects on board with an eye for citizen initiatives regarding the generation of RE (P. 1,3,9 - RWS). This results in a lack of priority of the organization as a whole to put effort into integrating LREI with the TI-sector in the Netherlands. This culture is based on policies and norms and values set in the past. However, the current norms and values are not able to deal with the complicated energy transition challenge (P. 9 - RWS). *''These norms and values are based on a solidified past. This is how we did it, that went well so we stick to these way of working. These norms function in turn as the basis to do a next project. Therefore, renewal is always hard to achieve since you have to break through these norms which is very difficult. That involves risks and that is something nobody is waiting for''* (P. 9 - RWS).

Within this internal culture, it is also a habit to buy a certain amount of lands surrounding an infrastructure project. However, this is, with an eye on the energy transition, not in line with the ambitions regarding the generation of RE by third parties on lands surrounding these infrastructure projects. *''In case of a roundabout, this is of course inoperative space, but along a highway, one can question himself: why do we still have these lands anyway?!''* (P. 9 - RWS). Recognizing superfluous of these lands could increase the chances for an initiative such as in the case A12 Maarn-Maarsbergen. *''As long as we possess so many unnecessary lands that offer potential for energy while we still give them a monofunctional function, one will not get any further''* (P. 9 - RWS). This is elaborated further in 4.3.1.

A third factor that causes a lack or priority is a result of the first two factors: *''do we [Rijkswaterstaat red.] want to do something with citizen initiatives at all?''* (P. 9 - RWS). This is a result of that RWS is not used to come one on one to table with citizens since they are in principle far more distanced from citizens than, for example, a municipality (P. 1 - RWS). Moreover, *''as Rijkswaterstaat, you must invest a lot of time for a little bit of energy. Partly because it is new, partly because the process just takes time. So the question is: it that what you want?''* (P. 3 - RWS). Participant 9 (RWS) adopts a critical attitude regarding this question by stating that *''I am not a supporter of linking multiple citizen initiatives to projects at all. I am more a supporter of: think about how to large-scale generate renewable energy and in turn provide this to the citizens.''* Yet, it is also stated that RWS is emphatically willing to take actions regarding the upcoming trend in LREI and by that adding value to the society instead of only focussing on their primary goals within the TI-sector (P. 1,3,4,7 - RWS, Mun. UH, W+B/RWS). The internal willingness at RWS to integrate these developments is thus currently not something everyone agrees with. And in case there is a will, does RWS actually know how to deal with LREIs? This is set out in 4.2.8.

Based on these causal factors, the priority of RWS to take actions regarding the integration of LREIs with the TI-sector in the Netherlands is currently lacking. In addition to the latter, this integration process is new and unfamiliar for all the involved stakeholders which requires time, money and thus priority to discover how to deal with it. The next section will elaborate further on this.

Link to rules of the game

The priority of RWS can best be associated with the *position* rules of the IAD-framework. The position rules are about the positions held by actors and especially about what these actors want. The position held by RWS determines whether or not having priority on putting effort in LREIs.

4.2.8 Barrier 7 - New and unfamiliar

Speaking in general terms, the situation in which a LREI is integrated with the TI-sector is rather new. Every involved actor is forced to face new and unfamiliar challenges that can cause problems or unclarities (P. 1,3,4,5,7,9 - RWS, Mun. UH, W+B/RWS). Facing these challenges takes time (P. 3,7,9 - RWS, W+B/RWS) and effort since *''everyone starts prancing at the smallest changes''* (P. 1 - RWS) which is a result of the internal sectoral culture within RWS (see 4.2.7). But what exactly is currently missing?

First of all, the actors within the action arena are unfamiliar with both citizen initiatives and generating renewable energy let alone the integration of these with the TI-sector. This causes that a script that describes how to deal with LREIs in the TI is currently missing (P. 1,2,3,7,9 - RWS, Initiator, W+B/RWS). In case of a request from a third party to attach solar PV panels on a noise barrier, *''you will end up in a difficult situation:*

you are going to attach private solar panels on public assets. How are you going do to that? [...] In fact, we are not used to do that and we generally don't do that anyways'' (P. 9 - RWS).

Secondly, a framework on which a licensing authority can judge whether or not grant a Wbr-permit is currently missing (see 4.2.2) (P. 3,7,9 - RWS, W+B/RWS). RWS *''is, in terms of permit conditions, very capable in dealing with familiar situations but energy on noise barriers is yet quite unfamiliar''* (P. 3 - RWS). Especially the conditions to grant a permit to allow the generation of solar energy on state-owned lands are currently missing (P. 7 - W+B/RWS). *''That is all quite new [...] and we are currently developing this framework based on reference projects''* (P. 7 - W+B/RWS).

Furthermore, general insights in how to deal with the integration of LREIs with TI regarding the current contracting methods and juridical aspects are missing (P. 3,4,7,9 - RWS, Mun. UH, W+B/RWS). *''Because the whole situation is quite new, these juridical things are currently not yet worked out''* (P. 7 - W+B/RWS). According to participants 3,5 and 7 (RWS, W+B/RWS), the policies and scripts to improve the integration of LREIs with the TI-sector are currently in development. This would contribute to answering the 'how' questions in future scenario's in case the willingness of the actors is there. Next to the current difficulties regarding the 'how' questions are difficulties regarding the 'who' question. This is set out in the next section.

Link to rules of the game

This barrier can be linked to two rules of the game: *choice* rules and *information* rules. The choice rules determine the actions that may be done by certain actors in certain positions, however, these actions are currently not completely clear. The information rules are linked to the available information about the integration process and the degree of sharing this information with the other involved actors.

4.2.9 Barrier 8 - Who does what?

A final barrier is about unclarities regarding responsibilities and taking initiative or in other words: who does what? In case of the A12 Maarn-Maarsbergen, actors shift responsibilities to other actors which indicate that nobody actually knows (or wants to know) what they actually should do. This can, for example, refer to adjusting the current DBFM-contract. According to participant 2 (Initiator), RWS is able to pay for several actions regarding, for example, the adjustments in the DBFM-contract or a construction calculation since *''these amounts of money are negligible for such a big organization.''* However, other actors state that RWS will not pay for any of these actions at all (P. 3,9 - RWS) since *''it is an initiative from a third party. The fact that we are prepared and investing money to sort out certain things is already enough. But we are surely not going to pay for any researches or cables or something like that. Why not? Because we do not have a concrete objective for that. That's why I do not see the direct reason why we should invest money in this''* (P. 3 - RWS). This is again linked to the sectoral internal focus by which RWS is currently operating (see 4.2.7).

There is, for example, also unclarity about the financial aspects regarding the construction calculation that should be executed to ensure the technical reliability of the noise barrier. RWS should provide the involved market party (in this case the Poort van Bunnik) with an assignment to execute the construction calculation (P. 2,4,6,8 - Initiator, Mun. UH, HE, PvB). However, the market party must in turn provide a consultancy firm with the assignment to do the construction calculation which involves external costs (P. 6,8 - HE, PvB). According to participant 6 (HE), this would cost around €300,- *''which could in principle be carried by all the involved actors.''* However, the costs of the construction calculation will approximately be around the €2000,- (P. 2,8 - Initiator, PvB). But who should pay for this? According to participant 2 (Initiator), RWS should pay for this while participant 8 (PvB) states that, besides RWS, the initiators of the project should also make a contribution to this payment. However, as already said earlier, RWS states that they will not pay for any researches at all (P. 3,9 - RWS). Also, the market party will not pay for these costs since *''we don't have any interests at all.''* (P. 8 - PvB). In other words, a lot of unclarity about a relative small part in the overarching process.

According to participant 9 (RWS), even the highest level of abstraction (the national level), is facing unclarity about which actions they should take. As mentioned earlier, participant 9 (RWS) states that the Dutch state should make their ambitions concrete instead of the current undefined objectives. This could be done by setting concrete targets and define the processes to achieve these targets. However, this is in conflict with the

decentralization and the future implementation of the Environment and Planning act in which the responsibilities are shifted to the local and regional levels (P. 5 - RWS). Unclarity about even the actions that should be taken by the highest level of public authority in the Netherlands is not beneficial in improving the opportunities to integrate LREIs with the TI-sector.

In other words, most of the actors are shifting responsibilities to take certain action to other actors. Some actors are thinking too simple about actions that could 'easily' be taken by other actors while these actors do not want to take these actions. Section 4.3 will elaborate further on the opportunities to improve this integration.

Link to the rules of the game

The *choice* and *information* rules can be linked to the barrier 'who does what?'. The choice rules determine the actions that may be done by the actors about which is currently a lot of unclarity. The information rules are especially linked to the unclarity between the different actors about who should do what. This could imply a limited share of information about relevant businesses such as who should pay what.

4.2.10 Recap of the identified institutional barriers

The previous sections describe eight institutional barriers that currently constrain the integration of LREIs with the TI-sector in the Netherlands. These barriers, their short description, and their link to the rules of the game are set out in table 9.

Barrier	Description	Rules of the game	Link to the rules of the game
Juridical	The juridical barrier consists of three parts related to difficulties in: granting rights of superficies to a third party, granting permits, and the mandatory public tender process.	Boundary- and choice rules	Boundary: A lack in willingness to do business with third parties, the comprehensive conditions regarding the rights of superficies and the mandatory MOT-procedure constrain the possibilities to enter the internal action arena. Choice: The actors are obliged to do these actions.
Contracting	The use of a DBFM-contract does (currently) not allow much flexibility to make adjustments to the existing infrastructure project.	Payoff rules	Contracting is about financial agreements and the distribution of costs and benefits.
Risks	Safety, technical and financial risks. Who is able and willing to carry which risks?	Payoff- and scope rules	Payoff: Who is able and willing to carry the financial consequences in case a risk becomes reality? Scope: The risks refer to outcomes that must not occur. For example, a solar panel must not fall of the noise barrier.
Business-case	The businesscase, professionality, and size of the local initiative can determine the chances of realization.	Payoff rules	The financial aspects determine the feasibility of the businesscase and in turn determine the willingness of e.g. RWS to put effort into the project.
≠ Interests	There are many stakeholders involved, all with different interests and priorities.	Position rules	The interests of the actors are in line with the positions they held.
Priority RWS	Refers to the priority of RWS to invest time and money in projects like these. Closely related to an existing internal sectoral culture within RWS.	Position rules	The position held by RWS determines the whether or not having priority on businesses related to LREIs.

New & unfamiliar	None of the involved stakeholders knows (fully) how to deal with projects like these. There is a lack of policies, criteria and knowledge about dealing with projects like these.	Choice- and information rules	Choice: The actions that may be done by certain actors in their positions are currently unclear since the situation is new and unfamiliar for the involved actors. Information: Available information about how to deal with this situation and the degree of sharing this information with the other involved actors.
Who does what?	There is unclarity about which stakeholder should do what.	Choice- and information rules	Choice: Which actor should do what actions according to their positions? Information: Unclarity regarding the information about who should do what, who should pay for what, and who should initiate what.

Table 9: The institutional barriers

4.3 Are there opportunities to tackle these institutional barriers?

This section describes the opportunities to tackle the investigated institutional barriers described in section 4.2. This section is related to the play of the game component of the IAD-framework as described in 2.4.2. An important notion is that these opportunities are (mainly) context-specific. This indicates the limited possibilities to make a generalization applicable to other comparable projects in the Netherlands. Furthermore, it is necessary to emphasize the pilot-project character of the case A12 Maarn-Maarsbergen. These case uses opportunities currently applied in an experimental way and sometimes based on exception made to, normally, mandatory processes. This causes that promising opportunities used in this case are not one-on-one applicable to other cases. This section is structured corresponding with the eight barriers as presented in section 4.2.

4.3.1 Opportunities for barrier 1 - Juridical

This section is divided into three parts corresponding with the structure presented in 4.2.2: doing business with a third party, the MOT-procedure, and the permits.

Doing business with a third party

As already mentioned in 4.2.2, RWS has made an exception on their statement to do, in principle, no business with third parties. RWS has set comprehensive conditions that must be met by the LREI before the citizens can obtain the rights of superficies (see 4.2.2). However, their recent statement added to their Real Estate Strategy implies that this exception is no longer an opportunity. This addition is not fixed yet, so only time will tell how this (possible) clinching process will end. In case RWS confirms the position in which they experience the realization of a solar PV-installation by a third party their noise barriers as undesirable, citizen initiatives and energy cooperatives could unite themselves to start a national lobby to convince the national government to allow initiatives like this (P. 6 - HE). The municipalities can also play an important role in the latter by using the Dutch Municipalities Association (Dutch: Vereniging Nederlandse Gemeenten - VNG) to lobby for more opportunities regarding the possibilities for a LREI to realize projects on state-owned lands in their municipality. The drive to take actions regarding LREIs in the TI-sector could also be derived of the side of the national government. If the Dutch parliament states that this integration is a desirable one, the Ministry of I&W will provide RWS with objectives and assignments to achieve this desirable situation which will increase the integration process which is elaborated upon in 4.3.6 and 4.3.8 (P. 1,5,9 - RWS).

The initiative to give function the superfluous lands along Dutch highways could also come from RWS itself (P. 1,7,9 - RWS, W+B/RWS). However, a crucial condition in this is nuancing their statements regarding the undesirableness regarding initiatives like these. In case they do so, they can offer the lands or assets to other either public or private organizations. Subsequently, these organizations can use these lands via a lease construction which is juridical possible (P. 9 - RWS). However, according to participant 3 (RWS), this is not how it works in practice since, *''we are not involving initiatives from third parties. In fact, we expect a third party to come to us''*. Another possibility is labelling specific lands as surplus lands and offer the rights of superficies

first to other public organizations before starting the MOT-procedure. Since RWS has so many lands in the Netherlands, they could think about selling lands that provide opportunities to generate RE that are currently unused and, as far as they can predict, stay unused for the next 15 years (P. 9 - RWS). *"I own lands and if you are interested to use these lands you can submit a price offer. We could in turn make these lands available by using a kind of lease construction"* (P. 9 - RWS).

Both constructions would ease the possibilities for a LREI to do business with RWS and obtain the rights of superficies for the lands. The construction for the MOT-procedure is set out in de next subsection.

MOT-procedure

There are multiple opportunities regarding the MOT-procedure barrier. First, it is important to mention the significant difference between two matter of usages in state-owned lands or assets such as a noise barrier. On the one hand, there are lands in use. For example, a road functions to enable cars to drive from A to B and a noise barrier functions to minimize the sound amplifications resulting from those cars. On the other hand, there are unused lands that can be labelled as surplus lands. These surplus lands offer possibilities to reassign the lands by giving it a new function. There is a significant difference between these two matter of usages of state-owned lands along highways regarding the procedures in doing business with third parties to generate RE. The situation regarding the lands in function is described in the next section while the situation regarding the surplus lands is described in the section after that.

1 In case a LREI develops the idea to realize a solar PV-installation on a noise barrier along a highway (asset in use), there is an opportunity that the necessary rights of superficies of this specific lands can be granted one-on-one to the local municipality instead of starting a MOT-procedure [1] (P. 1,2,3,4,6 - RWS, Initiator, Mun. UH, HE). This construction implies that the RVB enters into a contractual relationship with the local municipality about the direct granting of the rights of superficies of the noise barrier without starting a, normally mandatory, MOT-procedure. This contractual relationship is based on agreements made between these actors. Subsequently, the municipality will enter into a contractual relationship with the local energy cooperative that is able to set up the project in line with the PCR-regulation (see 4.1) (P. 1,2,4,6 - RWS, Initiator, Mun. UH, HE). Next, the existing energy cooperative will operate the project by itself or, as is the plan at the case A12 Maarn-Maarsbergen, will set up a new energy cooperative specifically related to the project (P. 6 - HE). In other words, *"the first intentional agreements and the discussions about possible future contracts are between the municipality and Heuvelrug Energy and we will pass it in turn on to the new cooperative"* (P. 6 - HE). This construction is illustrated in figure 17. The municipality and local energy cooperative are thus currently functioning as necessary intermediate parties. In this case, the risks (*"that are of course not that big"* (P. 4 - Mun. UH)) are carried by the municipality since they have *"the right of superficies, and those risks will partly be passed on to the cooperative that will realize the solar PV panels"* (P. 6 - HE). Both the municipality Utrechtse Heuvelrug and Heuvelrug Energy are very willing to adopt this position, which is clearly a crucial condition in this construction.

Again, this construction is based on context-specific agreements made between the involved actors. This context-specificity is confirmed by the absence of this opportunity at the case InnovA58. Here, the RVB has confirmed that using this way of tackling the MOT-procedure barrier is currently not possible since they are obliged to start the MOT-procedure for these lands with an explicit function (P. 10 - Mun. E-L).

Figure 17: The possible construction to avoid the mandatory MOT-procedure

2 The second situation refers to the case in which a land has been labelled as surplus lands. This is not the case at the A12 Maarn-Maarsbergen or the InnovA58, but can provide opportunities in future projects in

[1] This opportunity refers to the case A12 Maarn-Maarsbergen in which this construction is tested based on a pilot-project character. In 2016, the municipality Utrechtse Heuvelrug has come to an agreement with the RVB regarding the direct granting of the rights of superficies to the municipality instead of starting the MOT-procedure to increase the opportunities of the citizen initiative.

case RWS starts to push off their surplus lands (see previous section and 4.2.7) to provide other parties with opportunities to reassign the function of these lands. This process is legally defined as the reallocation procedure. In this procedure, a municipality (or other governmental organization) can adopt a preferential position regarding the granting of rights of superficies to avoid the mandatory MOT-procedure. ''*The RVB must sell these lands. They ask around at other departments or governmental organizations with the question 'this lands will be sold, raise your finger in case you are interested and have a destination for this'. It is emphatically about a policy objective. So the municipality has a preferential position in case they can make clear that it is about a policy objective*'' (P. 5 - RWS and confirmed by P. 1 - RWS). As in the situation of lands with an explicit function, the role of the municipality is an important one. This confirms the importance of the willingness of the municipality to invest time and money in projects like these.

In case (1) and (2) do not belong to one of the possibilities, the MOT-procedure will be started by the RVB. In this case, there are two possibilities for the LREI to obtain the right of superficies. They will obtain the rights of superficies via the MOT-procedure in case they either submit the highest bid or are the only interested party (P. 1,10 - RWS, Mun. E-L). In case the specific LREI is the only interested party, the project will most likely be small-sized that the feasibility of the businesscase becomes hard to achieve (see 4.2.5). The possibilities to win the MOT-procedure by submitting the highest bid could be increased by increasing the size of the project by, for example, combining multiple initiatives (see 4.3.4) (P. 9,10 - RWS, Mun. E-L).

Also, the MOT-procedure for small-sized LREIs like these is not undisputed. According to participants 1,2,4,5 (RWS, Initiator, Mun. UH), one can question the obligation to start a public process for a (small-sized) LREI. ''*Such a MOT-procedure for small-size projects is actually not in line with the government as they want now*'' (P. 5 - RWS). According to participant 2 (Initiator), their project consists of less solar PV panels than the set minimum by the RVB to start a MOT-procedure, however, this limit of minima have not yet been drawn (P. 1,4 - RWS, Mun. UH). In case either RWS or one of the relevant Ministries (see 4.1) sets clear that initiatives like these should be allowed more, the legal defined conditions regarding the MOT-procedure could be adjusted. The successes of local renewable initiatives are thus dependent on the willingness of the national government. Therefore, the willingness of the national government is vital.

Permits

As already set out in 4.2.2, there are three necessary permits that should be obtained by the LREI before they can realize their RE initiative: the Environmental Permit, the rights of superficies, and the Wbr-permit. The Environmental Permit will, in general, not lead to any problems. In case of the A12, the municipality has made a quick scan of the situation after which they confirmed that granting this permit will not lead to any problems (P. 2, 4 - Initiator, Mun. UH). Obtaining the rights of superficies for the specific lands is highly dependent on the developments regarding the willingness to do business with third parties and the MOT-procedure, both described in the previous subsections. Furthermore, the Wbr-permit will, in principle, be granted in case the project does not conflict with the Wbr-conditions and is in line with the public interests (P. 3 - RWS). However, this permit is currently hard to obtain since the framework on which the licensing authorities can base their choice whether or not grant the Wbr-permit for solar PV-installations along TI is currently missing (see 4.2.2 and 4.2.8) (P. 3,7,9 - RWS, W+B/RWS). To eliminate the problems regarding obtaining the Wbr-permit, RWS should continue with developing this framework (P. 7 - W+B/RWS). Similar to the previous subsections, the rights of superficies are currently causing the main problems and currently only time can tell how this process will develop further.

4.3.2 Opportunities for barrier 2 - Contracting

There are three possibilities that could contribute to minimizing the constraining effect of the use of a DBFM-contract. First, and not applicable to the investigated case studies, one could include the generation of solar energy in in the contract in an early stage. For example, the client (RWS) could set requirements regarding the generation of RE along the TI-project and could, in case they are willing to do so, require the involvement of a LREI (P. 7 - W+B/RWS). Secondly, the existing contract could be adjusted or, thirdly, a new (smaller) side-contract could be prepared. In both cases, the initiative should come from RWS (P. 1,2,3,7 - RWS, Initiator, W+B/RWS). Therefore, the eagerness of RWS take actions regarding LREIs in the TI-sector is, again, of vital importance. ''*Those solar PVs will be realised on that noise barrier in case Rijkswaterstaat would really like to have solar PVs on it. It's that easy*'' (P. 8 - PvB).

If RWS would like to adjust the existing contract, this could have financial impacts for one of the involved actors. According to participant 8 (PvB), *''adjusting the contract could have a financial impact, however, this does not have to be so. […] That depends on the agreements made with Rijkswaterstaat.''* In other words, the existence of a DBFM-contract does not necessarily constrain the possibilities to make any adjustments to the current infrastructure project. However, it highly depends on if *''the market party is willing to change its existing contract and if Rijkswaterstaat internally wants to adjust the existing contract with the Poort van Bunnik''* (P. 3 - RWS). According to participant 8 (PvB), adjusting the contract is not necessarily a problem since it is just about making clear agreements between them and RWS in which *''Rijkswaterstaat should take the lead''* (P. 8 - PvB). In case there are still financial impacts, which seems unavoidable since nothing is for free in this world, especially with the involvement of a cots-driven market party, it is unclear which party is willing and able to pay these financial impacts. Since RWS has, currently, no budget for initiatives like these, they are most likely not willing to invest much money so then *''you transfer those costs to a significant extent to the initiators''* (P. 1 - RWS). The limited possibilities that RWS will carry (all of) the financial impacts is also mentioned in 4.2.4 and is confirmed by the following:

> *''In that case, we will carry all the risks and the State should carry all the costs which is, of course, not going to happen. […] And certainly not for every single citizen initiative, so then put those panels down somewhere else. As State, you are not going to carry those risks, especially not for a single citizen or a small group of citizens.''* (P. 9 - RWS)

To sum up, the existence of a DBFM-contract does not necessarily constrain the possibilities to integrate LREIs with the TI-sector. Making clear agreements between RWS, the market party and the LREI would contribute to minimize these negative effect. However, most likely there are some costs linked to adjusting the existing contract. It is currently still unclear which actor is able and willing to carry these costs. Agreements between the involved actors and further research to adjusting DBFM-contracts could offer clarity in this.

4.3.3 Opportunities for barrier 3 - Risks

Just as described in 4.3.2, making clear agreements between RWS, the municipality, and the market party contribute to minimize the constraining effects of the risks management barrier (P. 2,4,6,8 - Initiator, Mun. UH, HE, PvB). These agreements should include who is willing and able to carry which risks, in which the willingness of all relevant actors to engage in the dialogue is a crucial condition. Although some actors are very reluctant regarding the possible impacts of the risks, there are also actors who nuance the possible impact of the predicted risks. The impacts of the possible technical barriers (e.g. the carrying capacity of the noise barrier) are, most likely, negligible because *''at Rijkswaterstaat, things are being built for eternity so one ounce less or more does not matter''* (P.1 - RWS).

Also, regarding the financial impacts, some actors are less reluctant than others. In case of the A12 Maarn-Maarsbergen, the municipality states that *''those are amounts in which the municipality does not see any risks since those are small amounts of money for a municipality''* (P. 4 - Mun. UH). Also the possibility that the energy cooperative goes bankrupt is not a risks that the municipality sees as a major problem. *''In case Heuvelrug Energy goes bankrupt, the solar PV panels that are still on that noise barrier and are still generating renewable energy will become property of the municipality. That is thus all coverable''* (P. 4 - Mun. UH). In other words, *''it can be solved, but it is super complicated''* (P. 9 - RWS). The main question regarding the carrying of risks remains: who is willing and able to carry these financial risks?

As already mentioned earlier, RWS is not willing to carry large financial risks. RWS is, however, the party that should take the initiative in starting the dialogue between the involved actors and making agreements between the market party and themselves (P. 2,4,6,8 - Initiator, Mun. UH, HE, PvB). For example, there are financial consequences involved in case a noise barrier would collapse as a result of an attached solar PV-installation. A citizen initiative or energy cooperative is not able to carry the responsibility for these financial risks. This makes that agreements between RWS and the involved market party about the possible financial consequences are the only way to deal with these risks and costs (P. 2,4,6 - Initiator, Mun. UH, HE). The willingness of RWS and the market party are, again, crucial in this. Especially the willingness of RWS to carry the financial risks is essential since the involved market party is, initial, not willing to carry these because of their minimal interests in projects like these (P. 8 - PvB).

''In case an external party is attaching solar PV panels on our noise barrier, we will shift the responsibilities back to Rijkswaterstaat. That is, in principle, not a barrier [...] but part of the dialogue between us and Rijkswaterstaat. Obviously, in case you are talking about (carrying) risks, there is a financial consequence involved. Who will pay this? Initially, the Poort van Bunnik not. That is thus part of the adjusting agreements with Rijkswaterstaat'' (P. 8 - PvB).

The capacities of a citizen initiative to carry financial risks are not that much because of their financial limitations (see 4.2.5). This is why the citizen initiative would involve an energy cooperative or set up a new one. The future consumers of that energy cooperative are, only partly, risk carrier since they have invested money in the project and in case of any malfunctions, they will be financially affected (P. 6 - HE). However, the energy cooperative is also not able to carry large financial risks because of their financial limitations (P. 2,6 - Initiator, HE). This is why the municipality will be an important player in the action arena. Together with the (new) energy cooperative, they would be one of the main risk carriers in projects like these. The municipality will have some obligations by obtaining the rights of superficies which can in turn be transferred to the involved energy cooperative (P. 6 - HE).

In case of the A12 Maarn-Maarsbergen, the municipality is willing to adopt the position of risk carrier which results in a minimalization of the constraining effect of the risks management barrier (P. 4 - Mun. UH). Also in the case InnovA58, the municipality states that they are willing to, to a certain degree, carry some of the financial risks (P. 10 - Mun. E-L). However, both the municipality as well as the energy cooperative are not capable to carry the major financial risks. To take away the barrier regarding these risks, it comes down to the willingness of RWS to make clear agreements about these risks (P. 2,4,6 - Initiator, Mun. UH, HE). In other words, it comes down to the explicit eagerness of the municipality and RWS (P. 2,6,8 - Initiator, HE, PvB).

A factor that could play an important role regarding the willingness to carry some financial risks is the overarching interest regarding a sustainable living environment (see 4.3.5).

''Working towards a sustainable living environment is not possible in a cost neutral way. Therefore, you must invest money anyway to work towards a more sustainable living environment. That goes for Rijkswaterstaat, but also for a municipality and, in my opinion, also for a private party like the BAM'' (P. 1 - RWS).

To sum up, the barrier regarding risk management can only be tackled in case RWS and the local municipality are explicitly willing to carry some of these risks. It comes down to making clear agreements about who should carry which risks and the willingness to vouch for the financial consequences in case something happens. Also the actual impacts of some of the risks is clarified yet. This makes that communication between the relevant actors becomes of vital importance to make projects like these a success.

4.3.4 Opportunities for barrier 4 - The businesscase

The key opportunity for the barrier regarding the businesscase of the LREI is combining multiple initiatives. This will improve the general feasibility of the businesscase, the financial reliability, and the willingness of especially RWS to answer the requests from the society regarding the generation of solar energy on their lands. This could all contribute to the chances of success of initiatives like these (P. 1,2,4,6,8,9 - RWS, Initiator, Mun. UH, HE, PvB). An energy cooperative could play an important role in making combinations of multiple LREIs since they possess knowledge about citizen initiatives, making a business case, and the fitting of solar panels in the landscape (P. 6 - HE). Additionally, an energy cooperative offers stability and reliability regarding the dialogue with the municipality. Figure 18 illustrates the process of combining multiple initiatives, involve an energy cooperative, involve the municipality and then come to table with RWS.

''In case the construction [regarding the MOT-procedure] becomes reality, they [Mun. UH red.] will have major responsibilities which they will not accept for a single citizen. They know our cooperative for eight years now and we are involved in their energy policies and businesses like that. This makes that we are a more reliable and stable partner than a single citizen'' (P. 6 - HE).

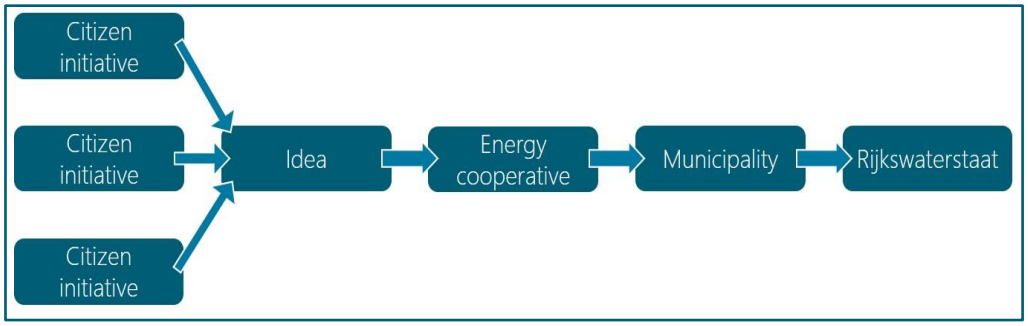

Figure 18: A promising process to improve the chances of a local renewable energy initiative

Furthermore, the financial feasibility of the businesscase could be improved by increasing the size of the solar PV-installation by, for example, increasing the used length of the noise barrier (P. 1,8 - RWS, PvB). Although the initiator is aware of this opportunity to improve his businesscase, he is also aware of his limited capacity in terms of people involved in his project (P. 2 - Initiator). This makes that 'simply' increase the size of the project is hard to achieve. Again, combining multiple initiatives would offer opportunities here. Besides the mentioned opportunities that arise from combining multiple initiatives, the professionality of the citizen initiative itself remains of vital importance (P. 1,2 - RWS, Initiator). The project team should, for example, not lack in enthusiasm, perseverance, and willingness to invest spare time. Moreover, coming to table with the right persons is a crucial condition. In case of the A12 Maarn-Maarsbergen, the LREI succeeded in coming to table with the right people (P. 2 - Initiator) while in case of the InnovA58, this process is currently not easy (P. 10 - Mun. E-L).

4.3.5 Opportunities for barrier 5 - Difference in interests

As already stated in 4.2.6, there are both similarities and differences in interests of the involved actors. The interests at the side of the LREI are rather simple: the initiators (and future customers) want to realize solar PV panels on the noise barrier in Maarn since he has no possibilities to put a solar PV-installation on his own roof[2] (P. 2 - Initiator). This corresponds with the involved energy cooperative (and the municipality) since an energy cooperative is searching for opportunities to generate as much solar energy as possible and, moreover, is functioning as an intermediary to help individual citizens in realizing (large) solar PV-installations on lands not in their own possession (P. 4, 6 - Mun. UH, HE). Currently, these interests differ from the interests of the actors in the TI-sector. Nevertheless, there are some factors that could contribute to getting the interests of the actors in the TI-sector more in line with the interests of the initiators of the project to bring the realization of projects like these one step closer. This is elaborated further in the next sections.

First of all, generating solar energy along national TI would contribute to achieve the set goals regarding the energy transition in line with the EU-targets P. 1,3,4,9,10 - RWS, Mun. UH, Mun. E-L). Actors as RWS, the RVB, and municipalities have goals regarding climate neutrality and *''these projects contribute to achieve this goal''* (P. 10 - Mun. E-L). Additionally, *''with the lands we possess, we could do both the society in general as well as the process to get the Netherlands climate neutral a favour''* (P. 9 -RWS). This corresponds with the second factor which is especially applicable for RWS: becoming a co-creator that adds value to the environment instead of only to the infrastructure project (P. 1,3,7,9 - RWS, W+B/RWS). As a public servant, it should become the standard to add value to the environment instead of the current narrow scope on the infrastructure projects (P. 7 - W+B/RWS).

Thirdly, investing time and money in LREIs could contribute to reduce resistance to infrastructure related projects (P. 1,3,4,6 - RWS, Mun. UH, HE). *''Some people would like something in return for negative effects of a road and through projects like these, so we can gain some support''* (P. 3 - RWS). Finally, some actors refer to the positive exposure for actors as the involved market party regarding the contribution to the energy transition (P. 1,2 - RWS, Initiator). However, the involved market party at the case A12 Maarn-Maarsbergen (Poort van Bunnik) is not convinced of the contribution of the solar PV project to the positive exposure of the Poort van Bunnik (P. 8 - PvB). Therefore, the contribution of small solar PV-projects like this to a positive

[2] The interest of the initiator is solely based on the case A12 Maarn-Maarsbergen since there is not a concrete initiator at the case InnovA58.

exposure for a large market party is not undisputed. A factor that could play a role in convincing the market party to invest their time and money in a project is early involvement. In case of the A12 Maarn-Maarsbergen, the market party was involved after 2 years of consultation between RWS, the municipality, and the initiators while the market party is certainly an important player in the action arena (P. 2,6,8 - Initiator, HE, PvB). Despite this, the involved market party is emphasizing their willingness to put effort into the project (P. 8 - PvB).

To sum up, getting the different interests of the involve actors in line is not about gaining money, but more about raising awareness about immaterial factors. This is in contrast to the barrier related to risk management in which the focus is solely on financial-related factors. The actors could, or should, make a contribution to the energy transition, become a co-creator, and creating support. If the actors would recognize these immaterial contributions, they are probably more eager to carry financial risks.

4.3.6 Opportunities for barrier 6 - Priority of Rijkswaterstaat

RWS is an important actor in the action arena since they can either allow or obstruct the initiatives from the society. However, their priority to invest time and money in projects as the case of the A12 Maarn-Maarsbergen is currently lacking. As also mentioned in 4.3.5, the Dutch government should act more like a participating government to cope better with the increasing influences of citizens (P. 3 - RWS). According to participant 1 (RWS), the government is now functioning in line with a top-down approach by providing lower governmental organizations with explicit assignments in a hierarchical way. However, the lower governmental organizations (such as RWS) should operate more in line with a bottom-up approach in which they gain implicit assignments from the society which they, in turn, balance with the explicit assignments provided by the national government (P. 1 - RWS). The push-factor of the national government to RWS to act as a participative governmental organization is an important condition in this (P. 1,3,9 - RWS). The national government is setting the first steps by implementing the Environmental and Planning Act that forces organizations as RWS to act more as a participative organization (P. 1,3 - RWS). *''The resolving power for the challenge we are facing could not only come from above [the national government], but also from below [the society]''* (P. 1 - RWS). Moreover, the Ministry of I&W (see 4.1) should provide RWS with explicit assignments, and thus budget, in which they state that specific state-owned lands should be used for generating RE by third parties (P. 1,3 - RWS).

Within RWS, there is an upcoming awareness to increase their knowledge and actions related to generating RE and the trend in citizen initiatives (P. 1,3,7 - RWS, W+B/RWS). *''People are cautiously saying that we prefer to focus solely on the infrastructure objectives but that we also recognize that there is more to the world than only infrastructure and we want to make a contribution to that. This makes that you have to allow other things on your assets to make them multifunctional''* (P. 1 - RWS). Therefore, especially for the influencing project managers, it should become the standard to think as a co-creator that adds as much value as possible to the environment instead of the current project-based way of working within RWS (P. 7 - W+B/RWS). Adopting this co-creator position could result in the situation in which RWS is minimizing their land possessions to provide the society with opportunities to generate RE without the current complicated procedures (P. 9 - RWS). Next, *''we [RWS] have to use our lands as useful as possible and only then, we will get one step further''* (P. 9 - RWS).

Furthermore, the energy transition, the Environmental and Planning Act and the increasing influence of citizens force RWS to act more like a public servant instead of only an infrastructure producer (P. 1,3 - RWS). RWS could think more from the outside to the inside instead of the current other way around. This because the use of the infrastructure networks is not determined only by the amount of asphalt, but by the usage of citizens, degree of urbanization, and the developments of the other transport modes (P. 1 - RWS). In other words, the national government should provide RWS with explicit assignments while RWS should bring in implicit assignments via a bottom-up approach with adopting a co-creator position.

> *''I should in any case achieve my own objectives, but as a public servant I really want to add as much value to the environment as possible''* (P. 7 - W+B/RWS).

4.3.7 Opportunities for barrier 7 - New and unfamiliar

The involvement of LREIs in the TI-sector is new and unfamiliar for all the involved parties (P. 1,4,6,7,8,9 - RWS, Mun. UH, HE, W+B/RWS, PvB). Both the case A12 Maarn-Maarsbergen and the InnovA58 are projects with a pilot-project character. These pilot-projects function as a useful learning tool for the relevant actors to get more familiar with dealing with LREIs in the TI-sector (P. 1,4,6,79 - RWS, Mun. UH, HE, W+B/RWS). These pilot-projects could function as a frame of reference in developing a licensing framework for solar energy in the TI-sector as well as for developing new policies and scripts that help to deal with future comparable projects (P. 1,7 - RWS, W+B/RWS). Also, RWS is, besides the licensing framework, currently developing a guide that functions as an instrument to ease the process to either refuse or allow requests from society regarding the generation of RE on their lands (P. 1 - RWS). This instrument was initially meant to refuse the many requests RWS receives since *''there are so many people that come to us and this costs time and money while it yields too little''* (P. 1 - RWS). However, RWS is recognizing the potential of LREIs. RWS is aware of the absence of possibilities to enable these initiatives which results in that *''the instrument is slowly evolving in an instrument meant to enter more into dialogue with the environment and to get, as Rijkswaterstaat, more proactive in the environment''* (P. 1 - RWS). This confirms the willingness of RWS to put effort into involving LREIs which is of vital importance to increase the opportunities of initiatives like these. Also, the municipalities in the investigated cases are clearly emphasizing their willingness put effort into getting familiar with initiatives like these in order to increase the chances of realization (P. 4,10 - Mun. UH, Mun. E-L).

> *''This is new for us and we have to take a different role as municipality, but we are willing to stick our necks out for this, so let's do this.''* (P. 4 - Mun. UH)

4.3.8 Opportunities for barrier 8 - Who could do what?

This last subsection of chapter 4 functions as a synopsis of the other sections. This section builds on the opportunities described earlier. Moreover, it reverses the question 'who does what?' in 'who could do what?' to make a contribution to dismiss the current unclarities regarding which actor could take which actions. Currently, most of the involved actors shift responsibilities to other actors which cause unclarities and mixed feelings to other actors which is, obviously, not beneficial for the course of the project. The general opportunity is to create clarity about which actor could, or even should, take which action by a clear, open and honest way of communication between the relevant actors. Moreover, organizations as RWS or a municipality could take the lead in assigning actions to the right actors. Therefore, the actions that could, or should, be taken by the relevant actors are set out in this subchapter. This section is structured in line with the operational level of the actors, starting with the initiators and ending with the national government. Furthermore, this subchapter functions as a basis for the recommendations subchapter in subchapter 5.4.

The citizens involved in the project

The most important action for the citizens involved in projects like these is taking initiative and drive other actors to put effort into 'their' project (P. 1,2,6 - RWS, Initiator, HE). Additionally, citizens could start with a feasibility research. Here they could make an early inventory of 'what do we need', estimate their chances of realization regarding finances, technical aspects, and look for opportunities to involve the municipality and local energy cooperative (P. 2 - Initiator). After developing a business plan -possibly with help from other organizations- the initiative could make itself known to RWS (P. 7 - W+B/RWS). An important factor in this is coming to table with the right people of the relevant organizations. In case the consultations between the relevant organizations have been started, the initiative could act as an intermediary by organizing consultation moments and bringing the various actors together. (P. 2 - Initiator). The drive and enthusiasm of the citizens will be of vital importance to raise enthusiasm among the other actors.

The local energy cooperative

The local energy cooperative is an important player at the side of the citizen initiative. They are able to provide the citizen initiative with knowledge about setting up a business case regarding solar energy. Moreover, based on their network and experience, an energy cooperative could make an early inventory of possible participants which will contribute to make the business plan as reliable as possible (P. 6 - HE). The local energy cooperative also functions as a more stable and reliable business partner for the municipality compared to a couple of citizens. This can be stated since an energy cooperative is often operating more as a professional organization

with employees while a citizen initiative is running on volunteers. This stability could in turn contribute to the willingness of the municipality to put effort into the specific project (P. 4,6 - Mun. UH, HE). In case the project is operationalized by a new energy cooperative, the existing local energy cooperative is able to help setting up this new energy cooperative. An energy cooperative could do this by itself, or they could inform a larger organization as Greenchoice (P. 6 - HE). Furthermore, an energy cooperative could provide support in combining multiple initiatives by deploying their knowledge, contacts, and networks.

The municipality

A municipality is an important intermediary between the citizens and RWS. The municipality could take a leading role in bringing initiatives like these to a success by eliminating as much barriers as possible (P. 4,7,10 - Mun. UH, W+B/RWS, Mun. E-L). The municipality is the representative organization of the citizens which makes that they are closer to citizens than RWS is. They could give the LREI more value and political weight which could benefit the willingness of RWS to put effort into the initiative (P. 1,4,9 - RWS, Mun. UH). Just like the energy cooperative, the municipality is able to provide support in combining multiple initiatives by using their network and knowledge (P. 4 - Mun. UH). They have gathered relevant knowledge by their experience in developing other solar energy projects, while their network emerges automatically from their long-lasting existence in the region (P. 4 - Mun. UH). Moreover, a municipality could take the initiative to realize projects like these by suggesting possible locations suitable for the generation of RE. For example, in case of the InnovA58, the municipality Etten-Leur took the initiative by suggesting the noise barrier as a potential location to generate RE based on their developed energy strategy (P. 10 - Mun. E-L). In case a municipality acts as initiator, the project has political value from the beginning which could increase the chances of success. Besides these mentioned actions, the municipality is also the organization that should organize the environmental processes regarding the granting of the Environmental Permit (P. 1,4 - RWS, Mun. UH). To sum up, one could state that the municipality is a crucial player in the action arena. Without their explicit support, the realization of the project will be hard to achieve.

The market party

The actions that could be taken by the involved market party are less explicit than the actions of the other organizations. This is because their interests are minimal since there are only limited opportunities regarding generating financial flows. Also, they are subject to assignments provided by RWS since they are involved via a DBFM-contract[3]. Although their minimal interests, the cooperation of the market party is important in, for example, executing a construction calculation to exclude technical risks such as a collapsing noise barrier (P. 1,2,6,8 - RWS, Initiator, HE, PvB). Other possible actions should be based on agreements made between the market party and RWS.

The Rijksvastgoedbedrijf

The RVB is responsible for the MOT-procedure and the granting of the rights of superficies for the state-owned lands along Dutch TI. However, the obligation to start a MOT-procedure regardless the size of a solar energy project is questionable (P.1 - RWS). This could result in a future change to their action list.

Rijkswaterstaat

RWS is an important actor in the action arena since they can either deny or allow LREIs to develop a solar PV-installation on lands along national TI in the Netherlands. Therefore, RWS should determine whether or not putting effort in citizen initiatives regarding the realization of solar PV-installations on their lands. If RWS decides to allow these initiatives, they require self-reflection in order to specify further actions. The latter will increase the chances of realization of projects like these. These actions are only possible in case RWS is able to allocate budget to deal with these projects (P. 1,3,5 - RWS). As already mentioned earlier, RWS should continue to develop a licensing framework related to the Wbr-permit and a guide that describes how to deal with citizen initiatives and solar energy in the TI-sector (P. 1,3,7 - RWS, W+B/RWS). Moreover, RWS should initiate adjustments in an existing contract or initiate the inclusion of projects like these in a new contract (P. 7 - W+B/RWS). Regarding the construction calculation in case of the A12 Maarn-Maarsbergen, RWS should provide the Poort van Bunnik with an assignment to execute this (P. 2,6,8 - RWS).

[3] A market party can also be involved via another way, however, this statement is made based on the investigated case study A12 Maarn-Maarsbergen in which the market party is involved via a DBFM-contract with RWS.

Also, RWS could adopt a proactive position regarding the inventory of possible locations (P. 1,7 - RWS, W+B/RWS). RWS could, for example, gather ideas from citizens in the exploration phase of the infrastructure project and, subsequently, include these ideas in their project (P. 7 - W+B/RWS). Additionally, RWS could adopt a proactive position regarding the minimalization of the lands they possess (P. 9 - RWS). *''We should minimize our land possession so that the environment can get the maximum back. We subtract space from the environment to give it a monofunctional use. […] We should give those lands back to the environment. And if we can use our lands as useful as possible, we will get a step further''* (P. 9 - RWS).

The InnovA58 project functions as an important example for RWS regarding the proactive position they could adopt in the future. On the one hand, the InnovA58 is meeting own objectives while on the other hand, the project is adding as much value as possible to the environment (P. 7,9 - RWS, W+B/RWS). RWS took the initiative in starting the dialogue with the multiple municipalities surrounding the A58. These municipalities, as well as the province of North-Brabant, have their energy neutrality objectives and they were searching for opportunities to meet these objectives. Subsequently, *''I asked for opportunities to start a joint initiative in which the A58 functions as the red line. That resulted in the Energy Corridor''* (P. 9 - RWS). Within the Energy Corridor, RWS is searching for opportunities to include LREIs which will, for the citizens, ease the process to get involved. This process emphasizes the potential of a proactive position of RWS. In a proactive role, RWS could act as a driving force regarding the generation of RE along national TI in the Netherlands. Again, the willingness to adopt this position is of vital importance.

The national government

The national government could take multiple actions related to increase the possibilities of realizing solar PV-installations on public lands along national TI with the involvement of a LREI. They could assess budget for projects like these and, subsequently, provide RWS with assignments (and budget) to allow and help initiatives like these (P. 1,5,9 - RWS). Dutch Ministries can formulate an assignment in which is stated that *''these state-owned lands must be made suitable for the generation of renewable energy by third parties''* (P. 5 - RWS). The first step could have been made by the Dutch state to assess budget for RE projects like these. Currently, there is not enough money available to achieve the climate neutrality objectives which results in problems and limited possibilities to allow RE requests from the society.

Furthermore, the national government could develop a framework with concrete actions regarding the set goals related to becoming climate neutral (P.9 - RWS). This framework with concrete actions to achieve the set objectives is currently missing since *''setting concrete objectives afterwards is easy since this involves less risks. That's a trick in developing policies. However, you are now running into that because you want to get more concrete''* (P. 9 - RWS). Therefore, the Dutch national government should, in case they want to put effort into LREIs, specify their goals and provide other governmental organizations such as RWS with concrete assignments (P. 1,5,9 - RWS).

4.3.9 Recap of the opportunities

The previous subchapters are summarized in table 10 below in which the opportunities for each of the identified barriers are set out shortly. The opportunities are linked to the relevant actors that are responsible for taking these actions in practice.

Barrier	Opportunity	Relevant actor(s)
Juridical	1 - Allow third parties to develop a solar PV-installation on RWS lands by nuancing the 'undesirable' statements.	RWS
	2 - Lands in use: A contractual relationship between the RVB and municipality regarding the one-on-one granting of the rights of superficies which in turn increases the opportunities for a local renewable energy initiative to obtain these rights.	RVB Municipality
	3 - Surplus lands: The reallocation procedure: labelling state-owned lands as surplus lands and grant the rights of superficies to the municipality. This in turn	RVB Municipality

	increases the opportunities for a local renewable energy initiative to obtain these rights. 4 - Developing a licensing framework that eases the procedure to whether or not grant the Wbr-permit.	 RWS
Contracting	1 - Include local renewable initiatives in the contract in an early stage. 2 - Rijkswaterstaat could initiate an adjustment in the existing contract with the involved market party based on explicit agreements.	RWS RWS Market party
Risks	1 - Agreements between the relevant actors about who is able and willing to carry (large) financial risks. 2 - The municipality and energy cooperative could carry (some) financial risks since, currently, Rijkswaterstaat is not willing to do so and the local renewable energy initiative is not able to do so.	All actors Municipality EC
Business-case	1 - Combine multiple initiatives to improve the feasibility of the businesscase and the reliability of the local renewable energy initiative. 2 - Increase the size of the solar PV-installation.	Municipality EC Initiators EC
≠ Interests	1 - Recognize the contribution to the energy transition. 2 - Become a co-creator that adds value to the environment. 3 - Reduce resistance to future TI-projects. 4 - Positive exposure regarding the contribution to the energy transition.	All actors RWS RWS Market party Municipality RWS Market party
Priority RWS	1 - The Dutch national government could provide RWS with explicit assignments regarding local renewable energy initiatives. 2 - Rijkswaterstaat could act, in line with the Environmental and Planning Act, more like a participative organization that balances explicit assignments with implicit assignments from the society. 3 - Rijkswaterstaat could adopt a co-creator position in which adding value to the environment becomes the standard.	Dutch State Dutch State RWS RWS
New & unfamiliar	1 - Pilot-projects such as the case A12 Maarn-Maarsbergen and the InnovA58 could function as a learning tool to get more familiar with projects like these. 2 - Rijkswaterstaat could (continue with) develop(ing) a licensing framework for solar energy along transport infrastructure to ease the whether or not granting of the Wbr-permit 3 - Rijkswaterstaat could develop a guide that functions as a script in 'how to deal with local renewable energy initiatives in the transport infrastructure sector?'	All actors RWS RWS
Who does what?	1 - Clear and open communication between the relevant actors could contribute to create clarity about which actors should take which actions. *Specific actions are set out in 4.3.8 and in the recommendations subchapter.*	All actors

Table 10: Opportunities per barrier linked to the relevant actors

5

CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

This chapter presents the conclusion, discussion, and recommendations of this research. The conclusion is based on the results set out in chapter 4 and provides an answer to the main research question: What are institutional barriers that limit the possibilities to develop a solar PV-installation on a public site along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative, and what are opportunities to tackle these? Answering this main research question is done by answering the three sub research questions presented in subchapter 1.3. The answers to this sub research questions are directly linked to the theory as set out in chapter 2. Consequently, the whether or not existing link between theory and practice is investigated. The discussion will elaborate further on this by updating the conceptual model with the results of this research. Finally, this chapter presents recommendations for planning practice.

5.1 Conclusions

This subchapter will first present the main conclusions of this research. Next, the sub research questions will be answered.

5.1.1 Main conclusions

The possibilities to integrate LREIs with the TI-sector are:

currently **limited** since,

- juridical legislations currently minimize the possibilities to involve citizens in the TI-sector.
- RWS does not, or is not able to, convert their ideas and ambitions into executable plans.
- LREIs are (often) too limited in size, financial reliability, and stability to drive other less interested actors to put much effort into their project.

possibly arising if,

- the national government, RWS, and the RVB emphasize their full eagerness to put effort into the integration of LREIs and the TI-sector since this could result in dismissing multiple important barriers.
- municipalities operate as an intermediary between RWS and the citizens. By adopting this position, they can play an important role in obtaining juridical necessities such as the right of superficies. Moreover, they can provide support in both financial as knowledge terms.
- multiple initiatives would be combined before coming to table with RWS by which they can emphasize their significant contribution to the objectives of the Dutch energy transition.

The remainder of this subchapter will underpin these conclusions by answering the sub and main research questions.

5.1.2 Answering the sub research questions in relation to theory and literature

This section presents the answers to the sub research questions of this research as presented in subchapter 1.3. The three sections that elaborate on answering the sub research questions will also discuss the relationship between the answers and the used theory and literature as set out in chapter 2. The answers of these research questions function as the basis for answering the main research question.

What is the current institutional organization in the Netherlands regarding the integration of renewable energy and transport infrastructure planning?

The answer to this sub research questions is visually summarized in figure 14 in subchapter 4.1. The Dutch parliament, consisting of multiple Ministries, operates according to legislations set by the European Union. In turn, the Ministries provide their executive organizations with assignments and sufficient budget to solely achieve these objectives. RWS is the executive organization of the Ministry of I&W, the RVB is part of the Ministry of IKR, and the RVO is part of the Ministry of EAC. RWS is responsible for the management, safety, accessibility and mobility of the national TI in the Netherlands. They own the lands surrounding this network and are the licensing authority for the necessary Wbr-permit. The RVB manages the contract-related businesses such as sales or leases regarding these state-owned lands, is responsible for the MOT-procedure, and is the licensing authority of the right of superficies. The RVO manages the subsidies such as the PCR-regulation that enables solar energy developers to get a discount of 12 eurocent per kWh on their energy tax. Moreover, the municipality (or province in case of a larger project) operates in line with the spatial planning legislations set by the Ministry of I&W and is the licensing authority for the Environmental permit. They act as the representative organization of the citizens and are often in close contact with the local energy cooperative.

This identified multi-level organization is in line with transition theory that indicates that the energy transition takes places on multiple levels (landscape, regime, niche), within multiple phases (predevelopment, take-off, breakthrough, and stabilization) and encompasses multiple actors (Geels & Kemp, 2000; Hasanov & Zuidema, 2018; Loorbach, 2010; Rotmans et al., 2001; Van der Brugge et al., 2005). The EU functions as the landscape level by providing the lower scale-levels with contexts and objectives, the national government as the regime level based on solid structures, and the citizens as the niche level in which new ideas are generated.

The lands surrounding national TI can be used to generate RE for RWS own purposes or to generate RE by third parties. According to European legislations, governmental parties are not allowed to act as an energy producer competing with energy companies. Therefore, a third party must be involved to generate RE for other purposes than solely RWS-purposes. Non-governmental parties are holding the position of potential developer of the solar PV-installation. This could be a market party, a single initiative, or an energy cooperative. A citizen initiative can either function on its own or can be overarched by an energy cooperative. To develop a solar PV-installation on state-owned lands such as the sites surrounding a highway, a LREI must obtain three permits: the Wbr-permit, the Environmental permit, and the right of superficies. According to the Dutch Energy Agreement, the procedures to obtain these necessary permits will be simplified to increase the possibilities of the local level to make a contribution to the energy transition (SER, 2013). These ambitions are, however, not corresponding with current practice. This is elaborated further in the section that answers the second sub research question.

Within the Dutch TI-sector, there is often a market party involved via the use of a DBFM-contract. In case of a DBFM-contract, the market party is responsible for the maintenance of the infrastructure project corresponding to the duration of the long-term contract. Finally, a grid operator is involved since they carry responsibility for the grid connection of the solar energy project to the regional energy network. One can state that the realization of a solar PV-installation on RWS lands involves many stakeholders. As set out in subchapter 2.2, there is a shift towards a governance approach in which decentralization, participation, and collaboration are enabled on multiple scale-levels (De Roo, 2003; Loorbach, 2010; Zuidema, 2016). This governance approach is applicable to situations characterized by the involvement of many stakeholders and, consequently, many sectoral and fragmented interests (De Roo, 2003; De Vries et al., 2017; Spijkerboer et al., 2017; Zuidema, 2016). According to Lemos and Agrawal (2006), a collaborative style in siting RE offers more potential than a central guidance style. The application of a governance approach would offer opportunities to deal with these many stakeholders and their different interests.

Which institutional barriers currently occur when developing a solar PV-installation along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative?

This research identified eight (grouped) institutional barriers that constrain the realization of solar PV-installations along national TI in the Netherlands (see figure 19). The institutional barriers are applicable to many of the involved actors in both case studies and cause that there are currently no or hardly any private solar PV-installations developed on public sites surrounding TI in the Netherlands. The identified institutional barriers are explained and set out in table 9 in subchapter 4.2.10. Based on table 9, figure 19 schematically presents the identified barriers. Next, the eight identified institutional barriers are set out in line with the order from left to right as presented in figure 19:

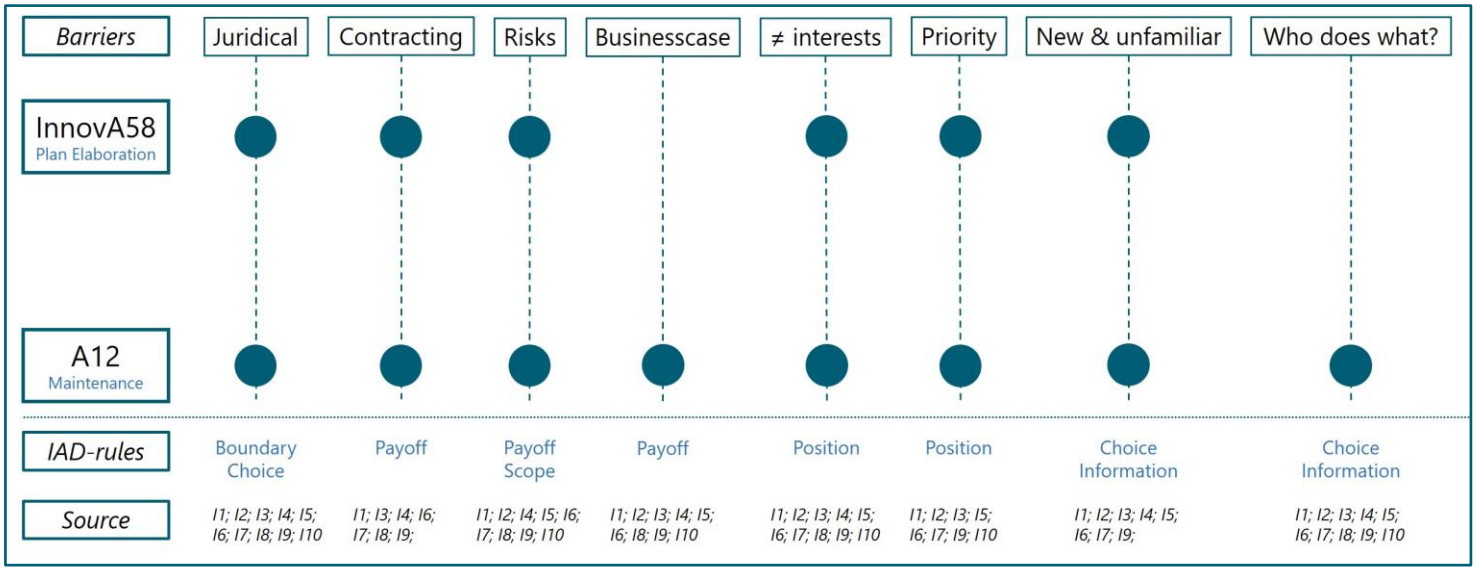

Figure 19: Identified institutional barriers, their IAD-rules and sources

(1) Based on the results presented in chapter 4, the juridical barrier can be identified as most influencing regarding the opportunities to integrate a LREI with the TI-sector. This juridical barrier consists of (1) the willingness of RWS to do business with a third party and more specifically allow the realization of solar panels on noise barriers in general, (2) the MOT-procedure, and (3) the necessary permits. Both the results of this research and the literature describe the difficulties to obtain necessary permits (Hain et al., 2005; Seyfang et al., 2013; Van der Schoor & Scholtens, 2014; Walker, 2008). However, the difficulties for a LREI to get involved in the TI-sector and obtain the necessary permits are conflicting with the ambitions expressed in the Dutch Energy Agreement. Here, the SER (2013) highlights the ambitions to simplify the permit procedures and increase the possibilities to integrate local energy producers with the regional and national energy network. This simplification hardly recognizable in current planning practice. This is highlighted by the missing licensing framework for the Wbr-permit, the comprehensive difficulties in obtaining the right of superficies for the specific lands, and the statements in the Real Estate Strategy in which solar PV-installations on noise barriers is referred to as 'undesirable'. The latter constrains the integration of LREIs with the TI-sector in such a way that one can state that the possibilities are minimized.

(2) The contracting barrier refers to the use of DBFM-contracts in the Dutch TI sector. These long-term contracts cause a difference in interests between the involved market party and the other actors. Furthermore, the results show that DBFM-contracts are currently not easily adjustable which causes that realizing a solar PV-installation on public sites surrounding an existing infrastructure project is a difficult process. This corresponds with the literature. According to Eversdijk and Korsten (2009), RWS (2018a), and Verweij (2015), the use of a DBFM-contract is characterized by a low degree of flexibility. This is among others caused by the strict and clear task description and the long-term duration of 20-30 years.

(3) The risks barrier refers to the management of safety, technical, and financial risks that occur when realizing a solar PV-installation on a noise barrier within an existing infrastructure project. The central question related to this risk management is: who is able and, possibly even more important, who is willing to carry which risks?

Both the results of this research and the literature show the financial limitations of a LREI. Literature refers to the high financial risks, the unsure economic viability, and the high upfront investments needed for a LREI (Hain et al., 2005; Seyfang et al., 2013; Van der Schoor & Scholtens, 2014; Walker, 2008). In the case study A12 Maarn-Maarsbergen, the financial risks cause a limited eagerness of especially RWS to invest time and money in the project. Corresponding with the literature, the LREI is in this case not able to carry the financial risks. Consequently, either RWS or the municipality is forced to take some of the responsibilities regarding the financial risks. Both organizations are not eager to do so, which results in this barrier.

(4) A citizen initiative, often running on volunteers, is regularly subject to financial limitations, a lack of relevant knowledge, and a limited project size. This causes difficulties in developing a reliable and feasible businesscase. Consequently, other stakeholders such as RWS are less eager to invest time and money. This is caused by a disability to guarantee a sufficient degree of stability which in turn involves more risks for RWS. These results are properly corresponding with literature. Besides the financial limitations, literature describes multi-scale relations and multi-scale support as an important external success factor (Hain et al., 2005; Seyfang et al., 2013; Van der Schoor & Scholtens, 2014; Walker, 2008). The importance of the (financial) support of, in this case, RWS is hereby confirmed.

(5) The barrier regarding the difference in interests is caused by the involvement of many actors who all have different interests and priorities. These differences cause that not every actor has the same priority regarding the eagerness to put as much effort as needed to realize the project. The results show that RWS is mainly focussed on their main objectives related to the accessibility and safety of their infrastructure networks. The involved market party is, corresponding with their contract with RWS, also focussed on their own objectives. This is in line with the literature that refers to DBFM-contracts as a strict and clear task-description and a low degree of flexibility (Eversdijk & Korsten, 2009; RWS, 2018a; Verweij, 2015). The interests of these important stakeholders in the TI-sector are not in line with the RE objectives of local initiatives which results in this institutional barrier.

(6) The sixth barrier refers to the priority of RWS to invest time and money in the integration of LREIs and the TI-sector. Currently, three mutual dependent factors cause this lacking priority. First, RWS adopts a sectoral focus with a narrow focus on achieving solely their own objectives. Secondly, one can speak of an internal culture within RWS that is not familiar with doing things outside their main package of tasks. And thirdly, RWS has not yet clarified whether or not they want to do business with citizens at all. These RWS-characteristics are corresponding with the literature related to institutions. Literature characterizes institutions by rules, structures, practices, patterns, and interactions (Alexander, 2005; 2006; González & Healey, 2005; Hodgson, 2015; Olsen, 2009; Sorensen, 2015). Moreover, literature indicates the difficulties in changing current structures and patterns referring to path dependency. (Byrne, 2003; Kim, 2011; Rauws et al., 2014). This is applicable to RWS in planning practice since the results show the internal difficulties in changing the current structures and practices. Furthermore, within RWS is a group of people that would like to shift the RWS-focus from a sectoral towards a more integrated approach. However, there is also a powerful group of people that remain solely focussed on the prime objectives of RWS. This dichotomy is also corresponding with the theory related to institutions. Literature describes the dichotomy between the intention to change structures and routines on the one hand, and a robust resistance to change on the other hand (Koppejan & Groenewegen, 2005).

(7) None of the involved actors is familiar with the development of a solar PV-installation on a public site along national TI in the Netherlands with the involvement of a LREI. This causes unclarities about how to deal with projects like these. There is currently a lack of policies that provide guidelines to actors to help dealing with projects like these. Moreover, there is not yet a framework on which licensing authorities can base their choice whether or not grant a permit. The current lack of solid policies, guidelines, and permit frameworks related to the implementation of RE is striking. Literature confirms the limiting consequences of a lack of solid policies related to RE (De Boer & Zuidema, 2015; Rotmans, 2010; 2011). Moreover, the Energy Agreement of 2013 describes the ambitions to simplify the permit-processes for local producers and improve the integration RE with the dominant energy network (SER, 2013). The results of the investigated case studies are conflicting with these ambitions which makes that planning practice differs significantly from the relevant literature.

Finally, **(8)** there is unclarity about which actors should take which actions. For example, regarding the financial aspects, actors easily shift responsibilities to other actors with the thought of 'they are probably eager and able to pay for this' which is not always a justified thought. These unclarities hold up a smooth course of the developments and can result in dissatisfactions among the actors.

What are opportunities to increase the possibilities to successfully develop a solar PV-installation along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative?

In addition to the identification of the eight barriers set out in the previous paragraph, this research also investigated whether or not there are opportunities to take away these barriers. These opportunities are set out schematically in table 10 in subchapter 4.3 in which the opportunities are described in more detail. For most of the identified institutional barriers, the process to take away the barrier is often highly dependent on the eagerness of the relevant actors to do so. RWS could play an important role in increasing the possibilities for a LREI to develop a solar PV-installation on RWS-lands. Since RWS owns and manages the public lands surrounding Dutch TI, they can either allow or constrain the development of projects like these. Also, the municipality could play an important role by acting as an intermediary between RWS, an energy cooperative and the citizens. This is corresponding with the literature in which the importance of the municipalities is emphasized. According to Van der Schoor & Scholtens (2015) and Yildriz et al. (2015), municipalities operate on the edge of the niche (LREI) and regime level (RWS and the national government) by which they can act as an facilitator in upscaling the LREI. Furthermore, they can provide LREIs with relevant knowledge and financial support which can be of vital importance for the success of a LREI. Moreover, a municipality can play an important role in taking away parts of the juridical barrier. This is set out in the next section.

There are promising opportunities to take away some of the juridical constraining factors. For example, there are two options to avoid the mandatory MOT-procedure that currently disables the LREI to (easily) obtain the right of superficies for the specific lands. First, and applicable for lands in use, there are possibilities for agreements between the RVB and the municipality regarding an one-on-one granting of the right of superficies for the specific lands. Secondly, and applicable for surplus lands, there is a legally defined reallocation procedure. The right of superficies of state-owned lands labelled as surplus are first offered to other governmental parties before the public tender process (MOT-procedure) will be started. In both cases, the right of superficies can be transferred from the municipality to an energy cooperative or LREI. These constructions provide opportunities to take away the juridical barriers.

Opportunities to take away the other barriers are detailed set out in subchapter 4.3 and table 10. In short, the reliability of the businesscase could be improved by combining multiple initiatives before coming to table with RWS. The contracting and risks barrier could (partially) be taken away by making clear agreements by an open communication between all the involved actors. Regarding the differences in interests, overarching drivers could be the contribution to the energy transition, reducing resistance to future (infrastructure) projects, and a positive exposure for the organization as a whole. The unclarities regarding the actions that should be taken by the different actors could be dismissed by clear and open communication between the involved actors.

The priority of RWS could be increased via several actions. First, the national government could provide RWS with explicit assignments to include LREIs in infrastructure projects. Secondly, RWS could balance these explicit assignments with implicit assignments that they gather via a more participative attitude which corresponds with the implementation of the Environment and Planning act in 2021 (Rijksoverheid, 2018b; RWS, 2018c). Finally, RWS could adopt a co-creator position in which adding value to the environment becomes the standard way of working. Both investigated case studies are referred to as pilot-projects. These pilot-projects contribute to dismiss the difficulties regarding the unfamiliarity and novelty in dealing with projects like these. Pilot-projects could function as a learning-tool to get more familiar with projects like these.

To sum up, there are opportunities to improve the process of integrating LREIs with the TI-sector. An important condition in improving this process is the eagerness of the national government, RWS, the RVB, and the local municipality to support these projects. Moreover, the involved actors should get more familiar with projects like these by realizing the current pilot-projects and, consequently, apply the learned lessons to

new cases. It still remains of vital importance that RWS nuances their statements regarding the 'undesirableness' of solar PV-installations on noise barriers by which the eagerness of RWS is to put effort into the integration process is, again, emphasized.

5.2 Answering the main research question

In this section, the main research question of this research will be answered. This answer is based on the results as presented in chapter 4 and the answers of the sub research questions as presented in subchapter 5.1.

What are institutional barriers that limit the possibilities to develop a solar PV-installation on a public site along national transport infrastructure in the Netherlands with the involvement of a local renewable energy initiative, and what are opportunities to tackle these?

The possibilities to develop a solar PV-installation on a public site along national TI in the Netherlands with the involvement of a LREI **are currently limited**. These limited possibilities are mainly caused by the lack of explicit eagerness and possibilities of, especially, RWS to put effort into projects like these. The highly constraining juridical barriers are associated with RWS and the RVB and could only be taken away with the explicit cooperation of RWS, the RVB, and the national government. This explicit cooperation is currently lacking which is emphasized by the recent addition to RWS its Real Estate Strategy in which solar PV-installations on noise barrier is referred to as 'undesirable'. This is conflicting with several RWS-participants in this research who emphasize the willingness of RWS to put effort into integrating LREIs with the TI by, for example, realize a solar PV-installation on a noise barrier. Therefore, the lacking eagerness of RWS could only be improved by addressing a higher level of abstraction within RWS or addressing the Ministry of I&W under which RWS operates. In case RWS employees get assigned by the higher levels of abstraction to include LREIs in the scope, the eagerness to do so will increase significantly. Also, dismissing other institutional barriers could contribute to increase the eagerness of RWS and higher levels of abstraction to allow initiatives like these.

Therefore, this research also investigates opportunities to dismiss some of the other current institutional barriers. Again, these opportunities are highly dependent on the eagerness of the involved actors to take the necessary actions. This can be emphasized by the agreements made in the case A12 Maarn-Maarsbergen regarding the one-on-one granting of the right of superficies from the RVB to the municipality to avoid the, currently constraining, mandatory MOT-procedure. Also, agreements about adjusting an existing DBFM-contract and carrying financial risks, as well as adopting a co-creator position in which adding value to the environment becomes the standard, are highly dependent on the eagerness of the relevant actors to do so. This eagerness could, for example, be increased by enlarging the reliability, feasibility, and thus stability of the businesscase of the LREI. The cooperation of the local municipality can be considered as an important condition in taking away multiple barriers. They could, for example, play an important role in avoid the MOT-procedure and obtain the right of superficies, carry (financial) risks, combine multiple initiatives, and offer a more stable business partnership between the citizens and RWS. In other words, without the explicit support of the local municipality, the integration of LREIs with the TI-sector is doomed to fail.

To conclude: the possibilities to develop a solar PV-installation on a public site along national TI in the Netherlands with the involvement of a LREI are currently limited. The involved stakeholders recognize the potential of this integration, however, they are not able to, or not eager to, convert their statements and ambitions into actions that contribute to dismiss the current institutional barriers. The case A12 Maarn-Maarsbergen shows that, despite the significant eagerness of RWS, the municipality, the energy cooperative, and the initiators, realizing a project like this is currently rather difficult.

5.3 Discussion

This subchapter links theory to practice by comparing the literature and theory presented in chapter 2 to the results presented in chapter 4. Consequently, the conceptual model is updated with the investigated institutional barriers.

5.3.1 Linking theory to practice

The conceptual model in subchapter 2.5 presents possible barriers that constrain the integration of LREIs with the TI-sector. These barriers are solely based on the theory presented in subchapters 2.1-2.3. The identified theoretical barriers are all identified in practice. Figure 20 illustrates the expected barriers as well as the identified barriers in practice. According to theory, DBFM-contracts are characterized by a low degree of flexibility (Eversdijk & Korsten, 2009; RWS, 2018a; Verweij, 2015). This is corresponding to practice since the results show that adjusting an existing DBFM-contract by, for example, realizing a solar PV-installation on a noise barrier, is associated with difficulties and unclarities. Also, the barrier regarding the SLA-management of RWS is identified in practice (Rijksoverheid, 2016; Stoker, 2006). This strong focus on prestation management is referred to as 'priority of RWS'. This priority is currently lacking which results in a low degree of eagerness to put effort into this integration process. Also, obtaining permits is a difficult process in practice since the LREI must meet complicated conditions before they can obtain, for example, the right of superficies of the state-owned lands. Finally, the professionality of the LREI can obstruct the integration process in practice and is referred to as 'businesscase'. The results show that stakeholders such as RWS or a municipality are less eager to invest time and money in a project in case the LREI is characterized by a low degree of professionality. The other identified barriers are not indicated by the current literature. Therefore, one can state that this research contributes to the current theories about citizen initiatives, the energy transition, and the integrative approach in the TI-sector. This research especially nuances the potential of the integration of LREIs and the TI because, despite the recognized potential, the integration process is currently hardly, if at all, possible.

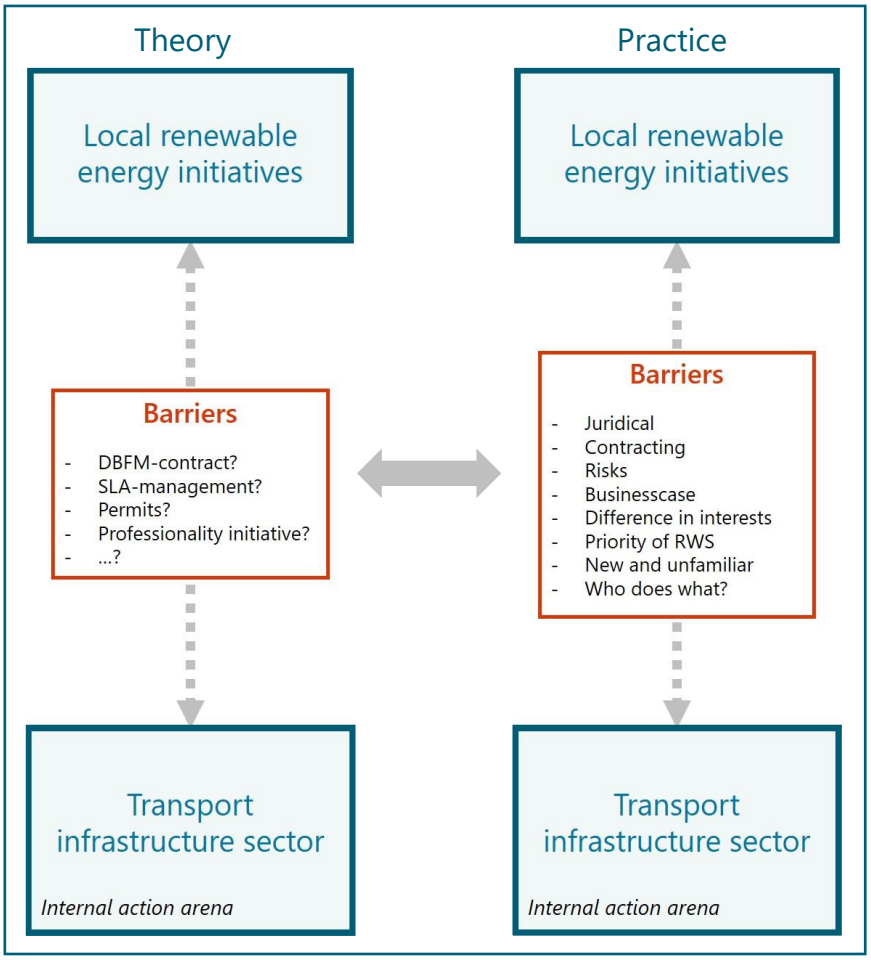

Figure 20: The theoretical barriers versus the barriers identified in practice

5.3.2 Applicability to theory and practice

This research contributes to the scientific collection of literature related to the implementation of RE, the integrated approach in the TI-sector and, especially, to the integration of both RE and TI. Existing theory and literature emphasize the potential of both LREIs and the development of a solar PV-installation on, for

example, a noise barrier along a public highway. Literature related to the integration of these promising developments is currently missing. This research makes the first step in filling up this literature gap.

This research is applicable to planning practice since the results could contribute to increase the possibilities for a LREI to develop a solar PV-installation on public lands surrounding Dutch TI. This research investigates and lists the current institutional organization which could improve the familiarity with projects like the investigated case studies. This research shows an overview of the current barriers which could provide stakeholders in future comparable situations with handhold during the development of the project. Moreover, the listed opportunities to take away the institutional barriers could contribute to the success of future comparable projects. Also, the opportunities could provide the stakeholders in de investigated case studies with a handhold in de process to bring their project to success. Furthermore, the studied pilot-projects and the results of this research could provide stakeholders in future projects with clarity beforehand regarding the 'do's and don'ts' in developing a solar PV-installation on public lands surrounding TI with the involvement of a LREI.

5.3.3 Limitations

This research faces multiple limitations. As also described in subchapter 3.2.2, a case study method provides limited possibilities for generalization (Hennink et al., 2011; O'Leary, 2004; Yin, 2014). This limited generalization is possibly also applicable to this research since the two investigated case studies are both associated with context-specific agreements, exceptions, and innovations based on the pilot-based character of the cases. These context-specificities can limit the representativeness of this research since the opportunities applied in these cases are not automatically applicable to other cases. Moreover, the participants of the conducted interviews are selectively chosen based on their connection with the specific project or the organization they work at. These persons were all eager to participate in this research which can imply that the participants of this research are all supporting the integrating LREIs with the TI-sector. This results in that the statements of the involved actors are not necessarily applicable to their organization as a whole. Since this research is limited by time and size, there are no possibilities to dismiss this limitation by conduct multiple interviews per organization. Also, the municipalities involved in this research were very eager to put effort into the cases. In case this research studies another case in which the municipality was less eager to put effort into the case, the results were probably different than the results as they are now.

Furthermore, several participants indicated the political sensitivity of this research topic. This was especially associated with the case A12 Maarn-Maarsbergen in which some participants indicate their frustrations about the lack of initiative from other stakeholders, the time that it takes to get one step further, and the lack of communication of important developments. This political sensitivity can result in more cautiousness regarding the sharing of -possibly political sensitive- information with the researcher. Also, this research is prone to changes in legislations, a replacement of persons holding certain positions, and developments in other energy-related fields. For example, in case the Real Estate Strategy in which solar PV-installations on noise barriers developed by third parties is referred to as 'undesirable' becomes fixed, the possibilities to realize such an installation are immediately minimized. Another example that confirms the prone to changing circumstances is a replacement of an alderman who is either highly supporting or highly opposing projects like these. Finally, the developments regarding the shift away from using the natural gas supplies in the Netherlands can accelerate the integration process significantly.

5.4 Recommendations

This subchapter builds on subchapter 4.8 in which the question 'who could do what?' is set out in detail. The recommendations of this research emphasize the significant contribution of this research to planning practice. These recommendations are only applicable in case the involved actors do all recognize the potential of realizing a solar PV-installation on public sites (e.g. a noise barrier) along Dutch national infrastructure and are eager to invest time and money in projects like the case A12 Maarn-Maarsbergen and the case InnovA58. Besides the concrete actions per main stakeholder, this subsection also provides a checklist for RWS. This checklist provides a guideline in case they come to table with LREIs in future situations.

5.4.1 Which actors should take which actions?

The national government should:

- Define the concrete actions per scale-level regarding achieving the energy transition objectives.
- Asses budget to achieve the renewable energy objectives.
- Provide other governmental organizations such as RWS with explicit assignments to make the lands surrounding Dutch transport infrastructure suitable for the generation of renewable energy by third parties.

Rijkswaterstaat should:

- Clarify whether they desire third parties to develop a solar PV-installation on their lands or not.
- Develop a framework on which the licensing authority can base the decision whether or not grant a Wbr-permit.
- Develop a guide that answers the *'how to deal with local renewable energy initiatives in the transport infrastructure sector?'* question.
- Adopt a proactive position in which they take the initiative make agreements about adjusting an existing contract.
- Minimize their surplus lands and provide the environment with potential locations to generate renewable energy.

A municipality should:

- Act as an intermediary and driving force by giving the citizen initiative more political weight.
- Support with combining multiple citizen initiatives before coming to table with RWS.
- Adopt a proactive position in which they search for potential locations by themselves.
- Carry (some) financial risks.
- Try to obtain the right of superficies from the RVB by making agreements or using the reallocation procedure.

An energy cooperative should:

- Provide support in maximizing the feasibility and reliability of the businesscase of the project.
- Make an early inventory of potential participants to realistically develop the businesscase.
- Support with combining multiple citizen initiatives before coming to table with RWS.
- Offer a stable business partner for the municipality.

The citizens involved in the project should:

- Adopt a proactive position in which their enthusiasm and professionality is emphasized.
- Execute a feasibility research in an early stage.
- Involve the local energy cooperative and municipality in an early stage of the project.

5.4.2 Checklist for Rijkswaterstaat in case citizens are the initiators

In case (a collective of) citizens requests RWS to develop a solar PV-installation on their lands, RWS could use the checklist presented in figure 21. This could provide guidance and smoothen the process to realize this project. This checklist is mainly based on the gathered data from the case A12 Maarn-Maarsbergen. The checklist is structured corresponding to the time that RWS must invest to collect the answers to the questions. In case the answer on one of the questions is a 'no', the chances of success of the project are small. For example, in case of a 'no' on a question in an early phase, RWS does not have to invest time and money in the remaining questions. In case of the A12 Maarn-Maarsbergen, RWS is still questioning the financial reliability of the businesscase of the LREI. In case the businesscase seems too unreliable in the end, RWS wasted much time and money over the years. This could be prevented by first checking whether or not the businesscase is reliable enough before investing much time and money in the project. After the answers on question five, the consultations between all the involved stakeholders should start. In that case, they can discuss the risks together which will provide all the stakeholders with more clarity and stability in an early phase. Next, the involved stakeholders should invest time and money in obtaining the necessary permits. This is a process that requires much time and, possibly, money. Consequently, it is necessary that all the risks and

unclarities related to the first eight questions are answered and excluded first. The next steps are developing the project.

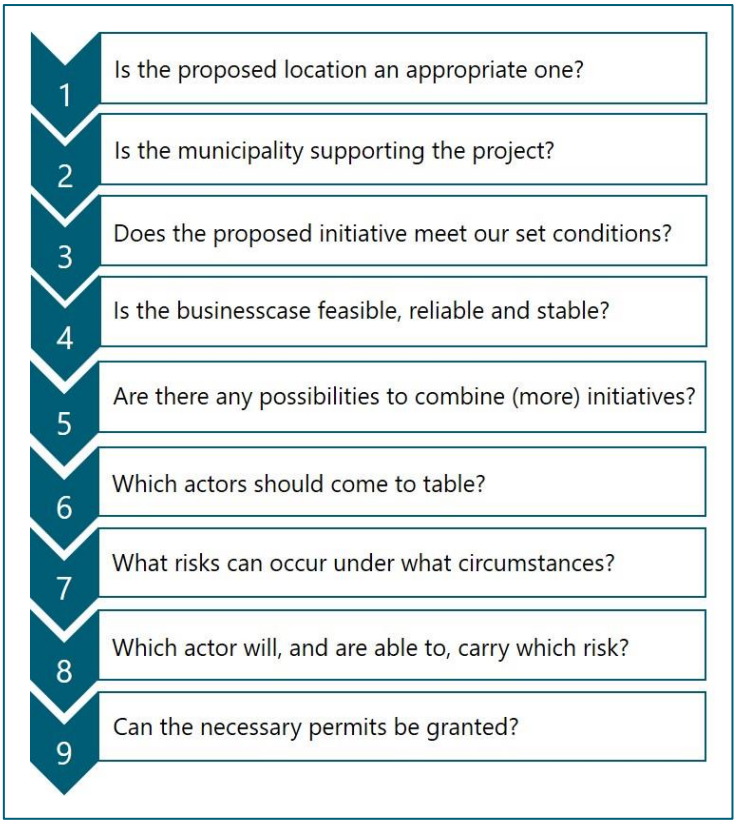

Figure 21: Checklist for Rijkswaterstaat in case citizens are the initiators

5.4.3 Suggestions for further research

This research provides several suggestions for further research. First, this research provides a suggestion for further research in the possibilities to adjust the legislations related to the mandatory MOT-procedure. Currently, there are suggestions through the grapevine to set a minimum in terms of the amount of solar panels for which the MOT-procedure becomes mandatory. This would ease the procedure for citizens to obtain the right of superficies for the proposed location. Secondly, this research provides a suggestion for further research within the RWS-organization regarding the clarification whether RWS is eager to allow the realization of solar PV-installations on noise barriers or not. Thirdly, this research provides a suggestion to enlarge the scientific literature basis related to LREIs, the potential role of large governmental organizations in the energy transition, and the integration of RE with TI in general. The latter could build on existing, but rather outdated, literature that emphasizes the potential of realizing solar PV-installations on noise barriers. Another suggestion for further research conducting a similar research for sites surrounding rail infrastructure in the Netherlands. These sites also provide opportunities to generate renewable energy and are, moreover, owned by governmental parties. It would be interesting to compare these two situations. Finally, this research provides a suggestion for further research in searching for locations in the Netherlands suitable for the generation of solar energy by realizing a solar PV-installation on public sites along TI. This would contribute to map the potential of integrating LREIs with the Dutch TI-sector.

6

REFLECTION

Reflecting on the chosen research methods and strategy

This research used several research methods that provided me with a comprehensive data collection. This data was gathered by conducting three open-ended interviews followed by ten semi-structured interviews divided over the two case studies. By using these qualitative research methods, I was able to gather in-depth data related to the case studies. The gathered data provided me with sufficient opportunities to answer the research questions. The participants of the interviews were all eager to participate and were, mostly, enthusiastic about the research topic. The sequence of the research methods has been the right since the data from the open-ended interviews provided handhold during the semi-structured interviews. Moreover, by studying two different case studies situated in different planning phases in the TI-sector in the Netherlands, the validity of the answers of the research questions has been strengthened. Nonetheless, the application of the IAD-framework could be better. During the analysis process, I observed the limited possibilities to apply the IAD-framework to this research regarding the analysis process. Other researches that applied the IAD-framework structured the results chapter corresponding with the rules of the game. However, this seems not the right way of structuring this research. This can be stated since several identified barriers are corresponding to multiple rules of the game. This would result in a limited overview of what institutional barriers actually occur in practice. Since the research questions are about identifying these institutional barriers in practice, I was enforced to structure the results chapter in a different way. After conducting the entire research and writing the conclusion, I can state that this was the right decision.

Successes

The research proposal of this research was very comprehensive. This resulted in an easy start of this research and, possibly, in the nomination for an internship at Witteveen+Bos. The pleasant, professional, and stimulating working environment within Witteveen+Bos functioned as an important motivation to put much effort into this thesis. The contacts of the internship at Witteveen+Bos and of the university provided me with e-mail addresses of multiple relevant persons. This eased the process of getting in contact with the right people in an early stage of the research. Consequently, these conversations contributed to narrow the scope of this research in an early stage which eases the search for relevant literature. As a result, the search for relevant literature was a relatively easy process, also with help from literature provided in courses during the master program and literature used in other theses. Additionally, thinking about 'what will you deliver at the end of your thesis?' in an early stage of writing this thesis helped me in thinking more on the long-term. Also, setting a structure before writing a new section helped in writing a thesis with a, hopefully, clear red-line.

Lessons learned

The process from the theory of the IAD-framework to the data collection process was difficult. Applying such a theoretic and abstract model to practice was something I struggled with. Also, the process from data to analysis was something to improve in the future. The process in structuring the results chapter was a complex process due to the limited applicability of the IAD-framework. This resulted the necessity to code the transcripts twice which took a lot of time. Moreover, postponing less interesting parts of doing research (e.g. transcribing) was something I faced. Postponing these parts led to a situation in which a complete week was filled in with transcribing which was not that motivating.

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APPENDICES

APPENDIX : TABLE HIJDRA ET AL. (2015)

Arena	Agenda setting/ policy making	Programming	Project Planning	Project preparation and implementation
Boundary rules	How actors enter/leave agenda/setting policy making arenas. E.g. politicians, lobbyists, government officials	How actors enter/leave programming arenas. E.g. politicians, lobbyists, government officials	How actors enter/leave project planning arenas. E.g. project members, permitting officials, project partners	How actors enter/leave project preparation/ implementation arenas. E.g. contracting team, construction team, and local stakeholders.
Position rules	What do these actors want or need? How many have similar wishes?	What do these actors want or need? How many have similar wishes?	What do these actors want or need? How many have similar wishes?	What do these actors want or need? How many have similar wishes?
Choice rules	What policy actions do they take?	What programming actions to they take?	What planning actions do they take? Permitting process and intergovernmental agreements play a role in this phase.	What preparation/ implementation actions do they take? Design and contracting are important elements
Scope rules	What is the result about? E.g. policy acts, guidelines	What is the result about? E.g. programming sequence.	What is the result about? E.g. Environmental Impact Statement, intergovernmental agreements	What is the result about? E.g. technical design, construction contract, agreements with local stakeholders.
Aggregation rules	How are decisions made? (voting/ consensus/ruling/ negotiating)	How are decisions made?	How are decisions made? This determines options for negotiating/trading for value.	How are decisions made? This determines options for negotiating/trading for value.
Information rules	What information is, or must be shared among actors?	What information is, or must be shared among actors?	What information is, or must be shared among actors? In this phase this determines the perception of transaction cost for value opportunities.	What information is, or must be shared among actors? In this phase this determines the perception of transaction cost for value opportunities.
Pay-off rules	How are benefits and costs distributed to actors in positions?	How are benefits and costs distributed to actors in positions?	How are benefits and costs distributed to actors in positions? (determines incentives to seize opportunities)	How are benefits and costs distributed to actors in positions? (determines incentives to seize opportunities)

Hijdra et al. (2015).

II APPENDIX : AN EXAMPLE OF AN INTERVIEW GUIDE

INLEIDING [KORT]

1. Bij welke organisatie bent u werkzaam en wat is uw functie?
2. Wat is uw rol binnen de onderwerpen 'duurzame energie' en/of 'burgerinitiatieven'?
3. Wat is uw rol binnen het project InnovA58?

ALGEMENE VRAGEN AANGAANDE HET PROJECT INNOVA58 [KORT]

Het grootste deel van de benodigde informatie is verkregen via de website van het project.

1. Welke partijen zijn momenteel betrokken bij het project InnovA58?
2. Op welke wijze worden deze partijen betrokken?
3. In welke fase speelt dit zich af?

VRAGEN AANGAANDE HET BETREKKEN VAN BURGERINITIATIEVEN

Deze vragen hebben betrekking op het proces aangaande het wel/niet betrekken van lokale duurzame energie-initiatieven in het project InnovA58.

1. In hoeverre is het mogelijk burgerinitiatieven te betrekken bij het project InnovA58 om de potentiële locaties voor zonne-energie te benutten?
2. Hoe kan dit proces verlopen en welke factoren spelen hierbij een belangrijke rol?
3. Waarom wil het project InnovA58 zonne-energie opwekken en waarom zou het hiervoor burgerinitiatieven willen gebruiken? *[belang + factoren]*
4. Wat zou de rol van de *infrastructuur stakeholders/ Witteveen+Bos* kunnen zijn als het gaat om het betrekken van deze burgerinitiatieven? (*Afwachten/faciliteren/initiëren*).
5. Wat zou de rol van de verschillende overheidspartijen hierin kunnen zijn?
6. Wie of wat (organisatie) bepaalt of er burgerinitiatieven worden betrokken om duurzame energie op te wekken binnen dit project?
7. Welke acties moeten worden ondernomen/worden al ondernomen om burgerinitiatieven/burgers te betrekken voor het opwekken van zonne-energie?
8. Hoe vindt de communicatie momenteel plaats en welke rol speelt dit?
    a. *(Interviewer is op de hoogte van InnovA58 in beeld)*
9. Welke rol spelen financiële zaken in dit project en het wel/niet betrekken van burgerinitiatieven voor het opwekken van duurzame energie?

VRAGEN AANGAANDE BARRIÈRES EN MOGELIJKHEDEN DEZE TE DOORBREKEN

Deze vragen hebben betrekking op mogelijke barrières die optreden bij het betrekken en realiseren van burgerinitiatieven aangaande het opwekken van zonne-energie langs de A58.

1. Wat zijn volgens u de grootste barrières die optreden bij het betrekken van burgerinitiatieven aangaande het opwekken van zonne-energie op de potentiële locaties langs de A58?
2. En wat kunnen volgens u de grootste barrières zijn die optreden bij het daadwerkelijk realiseren van deze initiatieven?
    a. Hoe ontstaan deze barrières?
3. Heeft u ideeën hoe deze barrières doorbroken kunnen worden? Wat is hiervoor nodig?
4. Zijn deze ideeën realistisch aangaande financiën, beleid en de verschillende belangen?
5. Wat zou er volgens u veranderd moeten (en kunnen) worden zodat burgerinitiatieven in de toekomst met succes zonnepanelen kunnen realiseren langs snelwegen in Nederland?

HET DOORNEMEN VAN VOORAF OPGESTELDE BARRIÈRES

Vooraf zijn, op basis van eerdere gesprekken, literatuur en andere documenten een aantal mogelijke barrières opgesteld die betrekking kunnen hebben op het betrekken en realiseren van burgerinitiatieven aangaande het opwekken van zonne-energie langs nationale infrastructuur in Nederland.

1. Bent u het eens met deze barrières?
2. Heeft u aanvullingen?
3. Per barrière: wat zou een mogelijkheid zijn deze te doorbreken?
4. Zijn er dingen niet besproken die wel degelijk van belang zijn voor mijn onderzoek?

Wat zou volgens u per se moeten terugkomen in dit onderzoek?
Wat zou u graag als mogelijke uitkomst zien wat kan dienen als een concreet advies?

- *Het in kaart brengen van de huidige barrières*
- *Kaart/figuur met de verschillende barrières per fase en hoe deze wel/niet doorbroken kunnen worden.*
- *Een kaart met mogelijke locaties voor zonne-energie als leidraad voor vervolgonderzoek*

Heeft u nog tips voor mij?

Dank!

III APPENDIX : CONSENT FORM

Toestemmingsformulier interview

Een onderzoek naar de mogelijkheden meer zonneparken te realiseren langs nationale infrastructuur in Nederland met de betrokkenheid van een burgerinitiatief

Het onderzoek

Het doel van dit onderzoek is het in kaart brengen- en tackelen van de barrières die ontstaan bij realiseren van zonneparken -geïnitieerd door burgers- langs nationale infrastructuur in Nederland. Dit onderzoek is de afstudeeropdracht van Stefan de Graaff voor de master Environmental and Infrastructure Planning aan de Rijksuniversiteit Groningen. Dit onderzoek wordt begeleid door

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Wat wordt er van u gevraagd?

U hoeft zich niet voor te bereiden op het gesprek, in dit interview is er interesse naar uw werkervaring binnen uw organisatie en uw betrokkenheid bij het onderwerp wat bestudeerd wordt in dit onderzoek. Het gesprek zal ongeveer één tot anderhalf uur duren. U kunt tijdens het gesprek altijd aangeven als u wilt stoppen of even pauze wilt nemen. Ook kunt u aangeven wanneer u een vraag niet wilt beantwoorden.

Wat gebeurt er met uw gegevens?

- Het gesprek mag worden opgenomen: JA / NEE

  Als het gesprek wordt opgenomen zal deze met zorg bewaard worden en opgeslagen in een beschermde omgeving. Alleen de onderzoeker zelf en zijn begeleiders kunnen toegang hebben tot het gesprek.

- Wanneer u dit wilt zal er voor uw naam een pseudoniem worden gebruikt in dit onderzoek. Verder zullen andere persoonlijke en project gegevens vertrouwelijk worden verwerkt. Dit houdt in dat mensen die buiten het onderzoek staan geen toegang krijgen tot deze gegevens.

- De resultaten zullen worden verwerkt in de vorm van een masterscriptie, waarvan de resultaten ook worden gepresenteerd tijdens de Graduate Research Day van de faculteit Ruimtelijke Wetenschappen op 28 juni 2018. Dit zal gebeuren door middel van een presentatie aan medestudenten, professoren en andere belangstellenden.

Toestemming

Bij deze verklaar ik dat ik op de hoogte ben gesteld van:

1. Het doel van het onderzoek;
2. Wat er van mij verwacht wordt tijdens en na het gesprek;
3. En wat er met mijn gegevens gebeurt.

Datum: _____ Handtekening deelnemer: _____

Datum: _____ Handtekening onderzoeker: _____

Als u verdere vragen en opmerkingen heeft, aarzel dan niet om contact op te nemen met:

Stefan de Graaff Email: s.a.de.graaff@student.rug.nl Telefoonnummer: ----------

IV APPENDIX : LIST OF CODES

General codes

Climate neutrality
How to involve local initiatives?
Main interests of the stakeholders
The long road of the initiative in the case A12 - Maarn
Who does what in the current situation?

Identifying the current barriers

B1 - Juridical Business rights to a third party
B2 - Juridical MOT
B3 - Juridical Permits
B4 - Contracting
B5 - Risks (safety and financial)
B6 - Difference in interests
B7 - New and unfamiliar
B8 - RWS culture + priority
B9 - Businesscase + professionality initiative
B10 - Who does what?

Identifying opportunities to tackle the current institutional barriers

TB1 - Juridical Business rights to a third party
TB2 - Juridical MOT
TB3 - Juridical Permits
TB4 - Contracting
TB5 - Risks (safety and financial)
TB6 - Difference in interests
TB7 - New and unfamiliar
TB8 - RWS culture + priority
TB9 - Businesscase + professionality initiative
TB10 - Who does what?

V APPENDIX : TABLE - RESULTS RULES OF THE GAME

Boundary rules: how actors can enter or leave positions	
B1:	Project and location: The project development and project location determines which actors are involved (e.g. regional department of RWS, municipality, grid operator, advisory bureaus, market parties).
B2:	Legal: Some parties are involved based on legal obligations (e.g. the RVB).
B3:	Competition: Developers (advisory bureaus for the line infrastructure as well as possible solar energy projects) enter the arena based on a compulsory public tender process.
B4:	Policy: Policy strategies determine the possibilities to involve third parties in the arena (e.g. local renewable energy initiative, market parties).
Position rules: which actor holds what position	

P1:	Legislators:
	• EU: Draft policies and goals regarding energy producers and RE goals.
	• Parliament:
	  ○ Ministry of I&W: legislator for e.g. spatial planning and infrastructure
	  ○ Ministry of IKR: legislator for e.g. the RVB
	  ○ Ministry of EAC: legislator for e.g. finances, energy ambitions and climate policies.

P2:	Executive organization: RWS is the executive organization of the Ministry of I&W. RWS is responsible for managing the Dutch infrastructure networks and guarantee safety, accessibility, and reliability.
P3:	Licensing authorities: • RWS is the licensing authority for the Wbr-permit • Municipality or province is the licensing authority for the Environmental permit. • The RVB is the licensing authority for the right of superficies.
P4:	Contract manager: The RVB manages the contracts of state-owned lands.
P5:	Infrastructure maintenance: In case of a DBFM-contract, an involved market party is responsible for maintaining the infrastructure project corresponding to the long-term contract with RWS.
P6:	Developer: A market party, energy cooperative, or citizen initiative is a potential developer of a solar PV-installation on public sites along Dutch national TI.
P7:	Grid operator: Responsible for the grid connection of the local project to the regional energy network.
Choice rules: what actions must, may, or must not be taken by actors in certain positions at certain points.	
C1:	Draft policies and goals: The EU may draft policies and set goals regarding the minimum share of RE per country.
C2:	Draft policies and regulations: The Ministries may draft policies and regulations regarding spatial planning, the realization of RE and Infrastructure, or the integration of both.

C3:	Provide locations: RWS may label their unused lands as surplus lands to provide third parties with opportunities to realize RE sources.
C4:	Draft policies: RWS may draft policies related to 'how to deal with third parties and RE in the TI-sector?'
C5:	Develop permit conditions: RWS may develop a licensing framework related to the Wbr-permit.
C6:	Initiate a project: A potential developer may contact RWS with an idea to realize a RE-project on RWS-lands.
C7:	Organize the tender: The RVB must organize the MOT-procedure before the right of superficies can be granted.
C8:	Submit bid: Potential developers may submit a bid in the auction procedure.
C9:	Develop permit conditions: A municipality or province may develop the conditions related to the Environmental permit.
C10:	Apply for permits: After obtaining the right of superficies via the MOT-procedure, a developer may apply for the Wbr-permit and the Environmental permit.
C11:	Apply for subsidies: The developer may apply for a subsidy with the RVO.
C12:	Gird connection: Either RWS or the developer may contact the grid operator.

Scope rules: Which outcomes may, must, or must not occur?

S1:	National RE goals: The Dutch parliament has to achieve the goal of 14% RE in 2020 and 16% RE in 2023.
S2:	RWS RE goals: RWS has set the target of energy neutrality in 2030.
S3:	Regional RE goals: The municipalities must achieve the set goals regarding climate neutrality. For example, the Municipality UH must be energy neutral in 2035.
S4:	Infrastructure expansion: Solar PV-installations must not be realized on lands that are possibly used for expansion of the current infrastructure project in the upcoming 15 years.
S5:	Safety and distraction: A solar PV-installation must not cause safety problems on the infrastructure networks or cause distraction by light reflections.
S6:	Maintenance: The solar PV-installation must be accessible for maintaining the solar PVs.

Aggregation rules: How do actors jointly affect decisions regarding proposed actions and activities and how?

A1:	Policy decision: RWS or the Ministry of I&W may decide whether they are eager to involve third parties in the TI-sector related to the generation of RE on their lands or not.
A2:	Permit decision: RWS must decide whether or not grant the Wbr-permit and the municipality or province must decide whether or not grant the Environmental permit.
A3:	Subsidy decision: The Ministry of EAC must decide whether or not appoint a subsidy to a developer.

A4:	Termination rights: RWS includes a 'termination rights' option in the contract with the developer that allows RWS to end the project immediately.
A5:	Contract decision: In case of the use of a DBFM-contract, RWS and the involved market party must decide whether or not they are eager to adjust their existing contract.
Information rules: What information is to be send and received by which actors	
I1:	Publish (surplus) potential lands: RWS may publish the locations of the lands labelled as surplus lands to provide a municipality with an opportunity to obtain the right of superficies for that specific land.
I2:	Publish locations: The RVB must publish the locations for which a MOT-procedure is started.
I3:	Consultations case A12 Maarn-Maarsbergen: In case of the A12 Maarn-Maarsbergen, there are consultations between the involved actors on a regular basis.
Payoff rules: What costs and benefits have to be payed or received by actors?	
F1:	RWS funding: RWS is funded by the Ministry of I&W. The funds are intended for infrastructure-related purposes and are not intended for secondary tasks.
F2:	Lease: A potential developer must pay a certain amount of money to RWS corresponding to the contract with the RVB.
F3:	Highest bid: The developer that submits the highest bid in the MOT-procedure obtains the right of superficies for that specific land.
F4:	Subsidies: The developer may receive subsidy from the RVO.
F5:	Businesscase: The developer must develop a feasible and reliable businesscase for their project. The municipality of local energy cooperative could provide support in this.
F6:	DBFM-contract: The market party gets paid for maintaining the infrastructure project corresponding to the long-term contract with RWS. Any adjustments in the infrastructure project could lead to financial consequences.