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vertrouwelijk

## **Samenwerkingsovereenkomst EWP-UDG**

Green Deal ultradiepe geothermie (C-217)

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## Begrippen en afkortingen

Annex	een annex bij deze overeenkomst.
BTW	belasting over de toegevoegde waarde (of: omzetbelasting).
EBN	EBN B.V.
EWP	exploratiewerkprogramma.
EWP-UDG	exploratiewerkprogramma voor ultradiepe geothermie.
Garantieregeling	de garantieregeling 'Risico's dekken voor aardwarmte (RNES Aardwarmte)' van de Minister van Economische Zaken en Klimaat en de Minister van Landbouw, Natuur en Voedselkwaliteit.
Green Deal	Green Deal ultradiepe geothermie (C-217) van 19 juni 2017 (vindplaats: <a href="http://www.greendeals.nl">www.greendeals.nl</a> ).
Kamerbrief	de brief van 19 juni 2017 van de minister van Economische Zaken en Klimaat aan de Voorzitter van de Tweede Kamer over Groene economische groei in Nederland (vindplaats: TK 2016-2017, 33 043, nr. 72).
Mijnraad	de Mijnraad als bedoeld in artikel 105 van de Mijnbouwwet.
NGO	niet-gouvernementele organisatie.
SCAN-programma	nationaal programma Seismische Campagne Aardwarmte Nederland voor de exploratie van geothermische energie in gebieden met een lage geologische en geofysische informatiedichtheid in Nederland.
SDE+	de subsidieregeling 'Stimulering Duurzame Energieproductie' van de Minister van Economische Zaken en Klimaat.
SodM	Staatstoezicht op de Mijnen, de toezichthouder als bedoeld in artikel 126 van de Mijnbouwwet.
Stuurgroep	de stuurgroep als bedoeld in artikel 12 van de Green Deal.
TCBb	de Technische Commissie Bodembeweging als bedoeld in artikel 114 van de Mijnbouwwet.
TNO	Nederlandse organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO.
UDG werkomgeving	de digitale werkomgeving waarop Partijen met elkaar informatie en documenten delen.
uitvoeringscommissie	de commissie als bedoeld in artikel 7.1 van deze overeenkomst.
werkgroep	een werkgroep als bedoeld in artikel 6.1 van deze overeenkomst.
workshop	een workshop als bedoeld in artikel 6.6 van deze overeenkomst.

## Partijen

1. EBN B.V., gevestigd te Utrecht, hierbij vertegenwoordigd door de heer J.W. van Hoogstraten en mevrouw E.A. Rosendaal, hierna te noemen: EBN;
2. Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO, publiekrechtelijke rechtspersoon op basis van artikel 3 van de TNO-wet, hierbij vertegenwoordigd door haar Raad van Bestuur, hierna te noemen: TNO;
3. De consortiumpartijen 'project UDG Leeuwarden' als genoemd in Annex 1, onderdeel b, hierbij vertegenwoordigd door FrieslandCampina Nederland B.V. en hierna samen te noemen: Consortium UDG Leeuwarden;
4. De consortiumpartijen 'project GOUD' als genoemd in Annex 1, onderdeel c, hierbij vertegenwoordigd door Stichting Economic Board Utrecht en hierna samen te noemen: Consortium GOUD;
5. De consortiumpartijen 'project Renkum' als genoemd in Annex 1, onderdeel d, hierbij vertegenwoordigd door Tellus Renkum B.V. en hierna samen te noemen: Consortium Renkum;
6. De consortiumpartijen 'project Geothermie Oost Brabant' als genoemd in Annex 1, onderdeel e, hierbij vertegenwoordigd door Geothermie Brabant B.V. en hierna samen te noemen: Consortium Geothermie Oost Brabant;
7. De consortiumpartijen 'project UDG Schiedam' als genoemd in Annex 1, onderdeel f, hierbij vertegenwoordigd door Huisman Equipment B.V. en hierna samen te noemen: Consortium UDG Schiedam;
8. De consortiumpartijen 'project UDG Haven Rotterdam' als genoemd in Annex 1, onderdeel g, hierbij vertegenwoordigd door Havenbedrijf Rotterdam N.V. en hierna samen te noemen: Consortium UDG Haven Rotterdam;

Ieder van de Partijen 3 tot en met 8 hierna ook te noemen: een Consortium, of gezamenlijk: de Consortia. Ieder van EBN, TNO of een Consortium hierna ook te noemen: Partij, of gezamenlijk: Partijen.

## Overwegingen

- Partijen zijn, met de Minister van Economische Zaken en de Staatssecretaris van Infrastructuur en Milieu, partij bij de Green Deal ultradiepe geothermie (UDG) (hierna: de Green Deal) van 19 juni 2017;
- Met de Green Deal streven Partijen er naar om voor het jaar 2020 de realisatie van één of meer pilotprojecten met ultradiepe geothermie mogelijk te maken, idealiter verdeeld over drie geïdentificeerde geologische regio's Noord, Midden en Zuid;
- De realisatie van de pilotprojecten moet bijdragen aan het behalen van de ambities van het Energieakkoord en moet inzicht geven in het perspectief op de verdere geologische en technologische risicoreductie voor en kostenefficiënte ontwikkeling van ultradiepe geothermie in Nederland tegen een voor de Consortia haalbare en positieve business case;
- In dat kader zijn de Partijen in de Green Deal overeengekomen samen een Exploratiewerkprogramma (hierna: het EWP-UDG) op te stellen dat gericht is op de gecoördineerde uitvoering van en het behalen van kosten- en synergievoordelen bij exploratieactiviteiten en ondergrond-modellering;

- Partijen zijn in werkgroepverband gekomen tot het opstellen van drie deelwerkprogramma's voor (1) exploratie en statisch model, (2) dynamische modellering en (3) ontwikkelconcepten. Deze deelwerkprogramma's vormen tezamen het EWP-UDG;
- In deze overeenkomst stellen Partijen het EWP-UDG en verdere afspraken voor de uitvoering ervan vast;

## **1. Doel van deze overeenkomst**

1. Het doel van deze overeenkomst is het vaststellen van het EWP-UDG en het vastleggen van de afspraken om tot verdere uitvoering van het EWP-UDG te komen.
2. In de uitvoering van deze overeenkomst en het EWP-UDG maken Partijen onderscheid tussen activiteiten op nationaal niveau, op regionaal niveau en op lokaal niveau, zoals weergegeven in Annex 2. Dit onderscheid wordt ook toegepast in de samenstelling van de uitvoeringscommissie en in de door de uitvoeringscommissie te behandelen onderwerpen en te nemen besluiten.
3. Bij de uitvoering van het EWP-UDG zullen Partijen zoveel als redelijkerwijs mogelijk samenwerken en ondergronddata en kennis delen om de doelen van de Green Deal en deze overeenkomst te behalen.

## **2. Het Exploratie-werkprogramma (EWP-UDG)**

1. Het EWP-UDG bestaat uit het exploratie-werkprogramma voor ultradiepe geothermie zoals opgenomen in Annex 3. Partijen stellen hierbij het EWP-UDG vast.
2. De budgetten voor de uit te voeren werkzaamheden zijn opgenomen in het EWP-UDG.
3. Partijen zijn gebonden aan het EWP-UDG en zullen zich inspannen om de werkzaamheden die uit het EWP-UDG voortvloeien binnen de daarin opgenomen budgetten en planning uit te (laten) voeren.
4. Wijzigingen in en aanvullingen op het EWP-UDG worden voorbereid in de werkgroep(en) die bij het betreffende deel van het EWP-UDG betrokken is (zijn). Wijzigingen en aanvullingen kunnen betrekking hebben op inhoud, budget (inclusief onvoorzien) en planning, maar kunnen geen betrekking hebben op een wijziging van de verdeling van de financieringslast tussen de bijdrage van de Minister van Economische Zaken en Klimaat/EBN enerzijds en de gezamenlijke Consortia anderzijds (welke aldus 50%/50% blijft). Het besluit tot wijziging of aanvulling wordt genomen door de uitvoeringscommissie in de samenstelling en op de wijze zoals beschreven in artikel 7.
5. Het EWP-UDG is opgesteld in de Engelse taal met een samenvatting in de Nederlandse taal. Partijen zullen de documenten die uit de uitvoering van het EWP-UDG voortvloeien of daarmee samenhangen, eveneens in de Engelse taal (laten) opstellen met, waar nodig, een samenvatting in de Nederlandse taal.
6. Waar hier wordt gesproken van:
 

Steering Committee Uitvoeringscommissie Regievoerder EBN Werkgroep Workshops	wordt daarmee in het EWP-UDG bedoeld: Steering Committee Executive Board Program Coordination Work Group workshops.
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7. EBN voert de regie over een separaat nationaal programma 'Seismische Campagne Aardwarmte Nederland (SCAN)' voor de exploratie van geothermische energie in gebieden met een lage geologische en geofysische informatiedichtheid in Nederland. De resultaten en de data die worden vergaard met het SCAN-programma zullen publiekelijk en kosteloos beschikbaar komen voor de



Consortia en zijn van invloed op de werkzaamheden zoals opgenomen in het EWP-UDG. Belangrijke input uit het SCAN-programma voor het EWP-UDG heeft betrekking op seismiek, datamanagement en -acquisitie. In het EWP-UDG is aangegeven waar de resultaten en de data uit het SCAN-programma als input gelden voor het EWP-UDG of invloed daarop uitoefenen. EBN zal de resultaten en data uit het SCAN-programma delen met de werkgroepen zoals bedoeld in artikel 6 van deze overeenkomst en zal de adviezen van de werkgroepen betrekken bij de uitvoering van het SCAN-programma.

### **3. Activiteiten van EBN**

1. EBN voert de regie over het EWP-UDG en is in dat kader eindverantwoordelijk voor de werkzaamheden die samenhangen met het opstellen en het uitvoeren van het EWP-UDG. Dat betekent het coördineren van het behalen van het eindresultaat van het EWP-UDG. EBN zal hiertoe onder meer:
  - de nodige menskracht ter beschikking stellen;
  - een coördinerende en voorbereidende rol vervullen ten aanzien van de werkgroepen, de workshops en de uitvoeringscommissie;
  - fungeren als liaison tussen de verschillende Consortia voor de uitvoering van het EWP-UDG;
  - bewaken van de integratie tussen de verschillende onderdelen van het EWP-UDG;
  - fungeren als liaison met Staatstoezicht op de Mijnen over de uitvoering van het EWP-UDG (ieder Consortium blijft zelf verantwoordelijk voor de communicatie met SodM over de uitvoering van hun geothermieproject).
2. Mede op basis van de kennis en data die met de uitvoering van het EWP-UDG wordt verkregen adviseert EBN, in overleg met TNO, de Minister van Economische Zaken en Klimaat:
  - over de wijze waarop de geologische risico's voor UDG-projecten zo effectief mogelijk kunnen worden afgedekt; en
  - over de wijze waarop de ontwikkeling van toekomstige UDG-projecten optimaal, en met zoveel mogelijk synergievoordelen, zou kunnen worden gestimuleerd.
3. EBN neemt samen met TNO de coördinatie op zich van activiteiten gericht op het publiekelijk beschikbaar stellen van kennis verkregen uit het EWP-UDG en de projecten van de Consortia, op de wijze als beschreven in artikel 10.
4. EBN laat zich in de uitoefening van haar regierol leiden door de algemene en specifieke overwegingen zoals die in de Green Deal zijn opgenomen.
5. EBN verdeelt de financiële bijdrage, zoals ter beschikking gesteld door de Minister van Economische Zaken en Klimaat, op de wijze zoals beschreven in artikel 8. Anders dan de activiteiten genoemd in dit artikel is EBN niet gehouden in het kader van deze overeenkomst enige financiële bijdrage te leveren uit haar eigen financiële middelen.
6. EBN beheert de UDG werkomgeving waarop Partijen met elkaar informatie en documenten delen, zoals beschreven in Task 1.1.1 van het EWP-UDG.

### **4. Activiteiten van TNO**

1. TNO stelt haar kennis en expertise vanuit haar brede en innovatieve kennisbasis van de ondergrond en ondergrondstechnologie op verzoek van EBN aan haar beschikbaar als bijdrage aan het EWP-UDG en ten behoeve van de uitvoering van de activiteiten van EBN zoals opgenomen in artikel 3.

2. TNO draagt in het bijzonder zorg voor een breed toegankelijke publieke ontsluiting (zoals beschreven in artikel 10) van alle ondergronddata en –kennis die in het kader van de Green Deal en deze overeenkomst door EBN, TNO en de Consortia worden ontwikkeld. TNO beheert daartoe het deel van de UDG werkomgeving dat alle ondergronddata bevat, zoals beschreven in Task 1.1.2 van het EWP-UDG.
3. TNO neemt deel aan de werkgroepen en woont als toehoorder de vergaderingen van de uitvoeringscommissie bij.
4. Buiten de werkzaamheden zoals die expliciet voor TNO in het EWP-UDG zijn opgenomen, doet TNO niet mee aan aanbestedingen van andere werkzaamheden uit het EWP-UDG.
5. TNO voert geen activiteiten uit die strijdig kunnen zijn met de taak van TNO om onafhankelijk te adviseren over vergunningverlening en de beoordeling van de SDE+ of de Garantieregeling Aardwarmte.
6. Het werk dat voor TNO uit het EWP voortvloeit zal in een nadere opdrachtbevestiging tussen EBN en TNO worden uitgewerkt. De resultaten van het werk van TNO zullen ter beschikking van de Consortia en derden worden gesteld. De opdrachtbevestiging zal eveneens afspraken bevatten over de eigendom en het gebruik van de achtergrondinformatie van TNO.

## 5. Activiteiten van de Consortia

1. De Consortia zijn te allen tijde zelf verantwoordelijk voor de verdere ontwikkeling van hun eigen UDGgeothermieproject, wat onder andere betekent dat zij, met uitzondering van het EWP-UDG, alle activiteiten en kosten voor hun rekening nemen die nodig zijn voor de (door)ontwikkeling van hun eigen UDG initiatief tot een volwaardig, robuust producerend UDG-project. Dit betekent echter niet dat een Consortium verplicht kan worden tot daadwerkelijke ontwikkeling van het eigen UDGgeothermieproject, indien het betreffende Consortium daar in zelfstandigheid niet toe besluit. Daartoe zal ieder Consortium zijn eigen commerciële afwegingen maken.
2. De Consortia dragen gezamenlijk 50% van de kosten van het EWP-UDG, zoals beschreven in het EWP-UDG en in artikel 8. De financiële inbreng van ieder van de Consortia is beperkt tot:
  - 50% van de kosten die verband houden met activiteiten van het betreffende Consortium op lokaal niveau zoals die voortvloeien uit het EWP en besluiten van de uitvoeringscommissie, en
  - het pro-rata aandeel van de kosten die verband houden met activiteiten van het betreffende Consortium op regionaal en nationaal niveau zoals die voortvloeien uit het EWP en besluiten van de uitvoeringscommissie.
 Daarmee draagt ieder consortium zijn eigen kosten en is niet aansprakelijk voor de kosten van een ander consortium.
3. De Consortia zoeken in hun geothermieproject zo veel mogelijk de samenwerking met de UDG-geothermieprojecten van andere Consortia met als doel om zoveel mogelijk synergievoordelen te benutten op het gebied van het verminderen van ondergrond- en projectrisico's, kosten en, waar mogelijk, het vergroten van de opbrengsten en wederzijdse voordelen.
4. De Consortia delen publiekelijk alle uit het EWP-UDG verkregen ondergronddata en kennis zodra deze beschikbaar is, en delen zo veel mogelijk kennis over hun geothermieproject gedurende alle fasen van de exploratie- en productielevenscyclus met elkaar, de Rijksoverheid, EBN en TNO. Ook stellen zij dezelfde kennis publiekelijk beschikbaar voor (ultradiepe) geothermie-initiatieven van derden.
5. Ieder van de Consortia wijst uit haar midden een vertegenwoordiger aan die het betreffende Consortium jegens de andere Partijen vertegenwoordigt. Ieder van de Consortia staat er voor in

dat deze vertegenwoordiger (zoals opgenomen in Annex 1) het betreffende Consortium kan binden in het kader van de uitvoering van deze overeenkomst en het EWP-UDG in het bijzonder.

## **6. De werkgroepen en de workshops**

1. De Partijen hebben drie werkgroepen ingesteld:
  - de werkgroep Exploratie en statisch model.
  - de werkgroep Dynamische modellering.
  - de werkgroep Ontwikkelconcepten.
2. De werkgroepen hebben tot taak:
  - de verschillende onderdelen van het EWP-UDG verder uit te werken en de uitvoering daarvan voor te bereiden voor de besluitvorming in de uitvoeringscommissie;
  - de uitvoering van het EWP-UDG te begeleiden met het oog op kwaliteitsbewaking;
  - te adviseren over de uitvoering van het GTI-programma zoals bedoeld in artikel 2.7 van deze overeenkomst;
  - te fungeren als platform voor het delen van kennis over lopende projecten;
  - de uitvoeringscommissie te adviseren over eventuele wijziging of aanvulling van het EWP-UDG.
3. Aan de vergaderingen van de werkgroepen kunnen alle Partijen deelnemen.
4. De vergaderingen van de werkgroepen worden voorbereid door EBN. EBN doet datumvoorstellen aan de andere Partijen. Partijen kunnen agendapunten aandragen. EBN stelt een agenda op, bereidt de begeleidende stukken voor en formuleert waar mogelijk de vast te stellen aanbevelingen of actiepunten. EBN verspreidt de stukken voor aanvang van de vergaderingen door publicatie op UDG werkomgeving.
5. De vergaderingen van de werkgroepen worden voorgezeten door een vertegenwoordiger van EBN. EBN notuleert de vergaderingen, inclusief de daarin genomen aanbevelingen en actiepunten, en verspreidt de notulen onder alle Partijen door publicatie op de UDG werkomgeving.
6. Naast de werkgroepen en de workshops die door EBN worden georganiseerd kunnen Partijen ook zelf workshops organiseren. In een workshop:
  - delen Partijen de resultaten en conclusies van de kennis opgedaan in een werkgroep met de andere werkgroepen en met de partijen uit de Green Deal.
  - kunnen EBN en TNO op specifieke onderwerpen de door hen in te brengen kennis delen met de partijen uit de Green Deal.
7. Voor zover kosten niet zien op het EWP-UDG dragen Partijen zelf hun eigen kosten, inclusief de kosten van de voorbereiding voor en de deelname aan de werkgroepen en de workshops.

## **7. De uitvoeringscommissie**

1. Partijen stellen hierbij een uitvoeringscommissie in. De uitvoeringscommissie heeft tot taak:
  - besluiten te nemen over de uitvoering van het EWP-UDG;
  - besluiten te nemen over de gunning van aanbestedingsopdrachten die uit het EWP-UDG voortvloeien;
  - besluiten te nemen over de wijziging van of aanvulling op het EWP-UDG zoals voorgesteld vanuit de werkgroepen.
2. De uitvoeringscommissie bestaat uit één vertegenwoordiger van EBN en één vertegenwoordiger van ieder van de consortia. De samenstelling van de uitvoeringscommissie is afhankelijk van het niveau en de regio waarop een onderwerp betrekking heeft:

- bij een onderwerp op nationaal niveau hebben één vertegenwoordiger van EBN en één vertegenwoordiger van ieder van de Consortia stemrecht;
- bij een onderwerp op regionaal niveau hebben één vertegenwoordiger van EBN en één vertegenwoordiger van ieder van de Consortia in de betreffende regio stemrecht;
- bij een onderwerp op lokaal niveau hebben één vertegenwoordiger van EBN en één vertegenwoordiger van het betreffende Consortium dat aldaar actief is, stemrecht.

Wijziging van en aanvulling op het EWP-UDG wordt beschouwd als een onderwerp op nationaal niveau.

3. De vergaderingen van de uitvoeringscommissie worden voorbereid door EBN. EBN doet datumvoorstellen aan de andere Partijen. Partijen kunnen agendapunten aandragen. EBN stelt een agenda op, bereidt de begeleidende stukken voor en formuleert waar mogelijk (in concept) de te nemen besluiten. EBN verspreidt de stukken onder de betrokken Partijen voor aanvang van de vergaderingen door publicatie op UDG werkomgeving.
4. De vergaderingen van de uitvoeringscommissie worden voorgezeten door de vertegenwoordiger van EBN. EBN notuleert de vergaderingen, inclusief de daarin genomen besluiten, en verspreidt de notulen onder alle Partijen door publicatie op de UDG werkomgeving.
5. TNO woont de vergaderingen van de uitvoeringscommissie als toehoorder en adviseur bij. TNO heeft geen stemrecht in de uitvoeringscommissie.
6. De besluitvorming in de uitvoeringscommissie vindt zoveel mogelijk plaats op basis van consensus. Indien het in het uiterste geval niet mogelijk blijkt om consensus te bereiken, zullen de vertegenwoordigers in de uitvoeringscommissie overgaan tot stemming over het te nemen besluit. De stemmen in de uitvoeringscommissie worden uitgebracht door de vertegenwoordiger van EBN en door één vertegenwoordiger per ieder van de betrokken Consortia. De zeggenschap is verdeeld naar rato van de financiële inbreng van de betrokken Partijen. Dat betekent dat EBN zeggenschap heeft voor 50% en dat de overige 50% evenredig verdeeld is over de betrokken Consortia, afhankelijk van het niveau (nationaal, regionaal of lokaal) en de regio waarop het betreffende besluit betrekking heeft. Voor een geldig besluit zijn de stemmen vereist die tenminste 75% zeggenschap van de in de vergadering aanwezige partijen vertegenwoordigen. Vertegenwoordigers van Partijen kunnen zich in de bijeenkomsten laten vergezellen door collega's en adviseurs, maar alleen de vertegenwoordiger kan een stem uitbrengen. Indien de vertegenwoordiger van een Partij verhinderd is deel te nemen aan een vergadering van een uitvoeringscommissie, dan kan de betreffende Partij een vervanger sturen, mits ook deze vervanger voldoet aan artikel 7.10. Bij het staken van de stemmen zal de betreffende kwestie door de uitvoeringscommissie ter besluitvorming aan de Stuurgroep van de Green Deal worden voorgelegd.
7. De uitvoeringscommissie kan besluiten buiten vergadering nemen, mits de vertegenwoordigers van alle betrokken Partijen zich daarmee schriftelijk of per e-mail akkoord verklaren. Het vorige lid is op besluitvorming buiten vergadering van overeenkomstige toepassing.
8. Besluiten (inclusief de daaruit voortvloeiende financiële verplichtingen) genomen door de uitvoeringscommissie binden de Partijen die onderdeel zijn van de betreffende uitvoeringscommissie.
9. EBN zal periodiek verslag doen aan de Stuurgroep van de Green Deal over de gang van zaken en de genomen besluiten binnen de uitvoeringscommissie.
10. Iedere Partij draagt er zorg voor dat zijn of haar vertegenwoordiger beslissingsbevoegd is ten aanzien van de onderwerpen waarover in de uitvoeringscommissie wordt besloten. Ieder van de andere Partijen mag ervan uitgaan dat een vertegenwoordiger van een Partij in de uitvoeringscommissie beslissingsbevoegd is.



11. Partijen dragen zelf hun eigen kosten van de voorbereiding voor en de deelname aan de uitvoeringscommissie.

## **8. Financiering en betaling**

1. De Minister van Economische Zaken en Klimaat stelt een financiële bijdrage van maximaal EUR 14 miljoen (als bedoeld in de Kamerbrief) ter beschikking aan EBN. Uit deze bijdrage draagt EBN voor 50% bij aan de vastgestelde uitgaven zoals die volgen uit het EWP-UDG of de besluiten van de uitvoeringscommissie. EBN zal daartoe het betreffende Consortium c.q. de betreffende Consortia voor 50% van de factuurwaarde exclusief BTW compenseren, op de wijze zoals aangegeven in artikelen 8.4 en 8.5.
2. De Consortia dragen gezamenlijk voor 50% bij aan de vastgestelde uitgaven zoals die volgen uit het EWP-UDG of de besluiten van de uitvoeringscommissie. Deze 50% zal door de Consortia worden gedeeld naar rato van het aantal betrokken Consortia op het niveau (nationaal, regionaal of lokaal) en de regio waarop de betreffende uitgaven betrekking hebben.
3. De genoemde 50/50-verhouding zal op alle niveaus (nationaal, regionaal en lokaal) worden toegepast.
4. Voor aanbestedingen die contractueel door EBN worden aangegaan, zal EBN het contract met de derde partij (de uitvoerder zoals bedoeld in artikel 9.1) op eigen naam en voor rekening en risico van de Consortia aangaan. EBN zal een factuur aan ieder van de betreffende Consortia sturen, waarbij het pro-rata aandeel in de factuur van de derde partij in rekening wordt gebracht (inclusief BTW), onder gelijktijdige verrekening van de 50% compensatie zoals bedoeld in artikel 8.1. EBN zal bij haar factuur aan ieder van de betreffende Consortia een kopie van de relevante factuur van de derde partij overleggen. De betrokken Consortia zullen ieder hun factuur van EBN binnen de daarin gestelde redelijke termijn aan EBN voldoen.
5. Voor aanbestedingen die contractueel door een Consortium worden aangegaan, zal het betrokken Consortium het contract met de derde partij (de uitvoerder als bedoeld in artikel 9.1) op eigen naam en voor eigen rekening en risico aangaan. Het betrokken Consortium zal een factuur aan EBN sturen, waarbij 50% van de factuurwaarde exclusief BTW van de factuur van de derde partij aan EBN in rekening wordt gebracht. Het betrokken Consortium zal bij zijn factuur aan EBN een kopie van de relevante factuur van de derde partij overleggen. Het betrokken Consortium zal in zijn factuur aan EBN geen BTW in rekening brengen. EBN zal de factuur van het betrokken Consortium binnen de daarin gestelde redelijke termijn aan het betrokken Consortium voldoen.
6. Een in-kind bijdrage van een Consortium die is opgenomen in het budget van het EWP-UDG, zal door EBN conform artikel 8.5 aan het betreffende Consortium worden vergoed.
7. EBN is uit het in artikel 8.1 genoemde bedrag geen bijdrage verschuldigd voor zover uitgaven eerder geheel of gedeeltelijk door EBN zijn vergoed of gecompenseerd.
8. Indien het door de Minister van Economische Zaken en Klimaat ter beschikking gestelde bedrag niet toereikend zal blijken te zijn voor de tijdige en volledige uitvoering van het EWP-UDG op basis van de genoemde 50/50-verhouding, dan zal EBN dit namens de uitvoeringscommissie onder de aandacht brengen van de Stuurgroep van de Green Deal en een voorstel doen voor besluitvorming door de Stuurgroep.
9. EBN zal een aparte projectadministratie voeren waarmee rekening en verantwoording kan worden afgelegd aan ieder van de Partijen over de besteding van de door de Minister van Economische Zaken en Klimaat ter beschikking gestelde bijdrage.



## **9. Aanbesteding aan uitvoerders**

1. Onder uitvoerder wordt verstaan een derde partij die in aanmerking komt voor de uitvoering van werkzaamheden of het verlenen van diensten, die voortvloeien uit het EWP-UDG of de besluiten van de uitvoeringscommissie. Onder aanbesteding wordt verstaan het uitbesteden van werkzaamheden aan en het inkopen van diensten bij een uitvoerder.
2. Aanbesteding aan uitvoerders wordt inhoudelijk voorbereid door EBN. EBN consulteert daartoe eerst de relevante werkgroep(en). Mede op basis van deze consultatie stelt EBN een aanbeveling voor een gedetailleerde uitvraag op voor de uitvoeringscommissie, die besluit over de uitvraag. Op basis van het besluit van de uitvoeringscommissie vraagt EBN offertes op bij uitvoerders. EBN beoordeelt de offertes en stelt een aanbeveling met onderbouwing ten behoeve van de besluitvorming in de uitvoeringscommissie op. De uitvoeringscommissie besluit vervolgens over de daadwerkelijke aanbesteding. De uitvoeringscommissie besluit eveneens of het daaruit voortvloeiende contract met een uitvoerder door EBN of door een Consortium wordt aangegaan. Ongeacht de partij die het betreffende contract aangaat zullen daarbij de wettelijke aanbestedingsregels in acht worden genomen. Betaling van de factuur van de uitvoerder vindt plaats in overeenstemming met artikelen 8.4 en 8.5.
3. Onverminderd het bepaalde in artikel 9.2 worden voor iedere aanbesteding tenminste drie offertes bij concurrerende uitvoerders opgevraagd op basis van de uitvraag als bedoeld in artikel 9.2. Uitzondering op deze regel is slechts toegestaan indien minder dan drie uitvoerders in staat zijn de gevraagde werkzaamheden of diensten aan te bieden, of wanneer de verwachte kosten voor de betreffende aanbesteding minder dan EUR 20.000,- bedragen.
4. De Partij die het contract met de uitvoerder aangaat zal bedingen dat de resultaten van de werkzaamheden of de diensten zonder beperkingen met de andere Partijen kunnen worden gedeeld en door iedere Partij openbaar mogen worden gemaakt.
5. Bij aanbestedingen die contractueel door een Consortium worden aangegaan, zal EBN door het betreffende Consortium worden betrokken bij de uitvoering van de betreffende werkzaamheden, op de momenten dat met de werkzaamheden wordt aangevangen en tussentijdse resultaten en/of (eind)concepten van documenten worden besproken of vastgesteld.
6. Een Consortium wiens vertegenwoordiger meedoet aan een aanbesteding zal voor de bespreking en besluitvorming van de betreffende aanbesteding in de uitvoeringscommissie een vervangende vertegenwoordiger (zijnde een vertegenwoordiger van een andere juridische entiteit binnen hetzelfde Consortium) aanwijzen. Die vervanging zal in de notulen van de uitvoeringscommissie worden vastgelegd.

## **10. Deling en openbaarmaking van kennis en data**

1. Alle data en kennis die door de Partijen wordt gedeeld, verkregen en ontwikkeld in de uitvoering van het EWP-UDG zal door EBN en TNO publiekelijk beschikbaar worden gemaakt.
2. De Consortia delen publiekelijk alle uit het EWP-UDG verkregen ondergronddata en kennis zo snel als redelijkerwijs mogelijk is nadat deze beschikbaar is, en delen zoveel mogelijk kennis over hun projectontwikkeling gedurende alle fasen van de exploratie- en productielevenscyclus met elkaar, de Rijksoverheid, EBN en TNO. Ook stellen zij deze kennis publiekelijk beschikbaar voor (ultradiepe) geothermie-initiatieven van derden.
3. Van de onder lid 1 bedoelde data en kennis zal TNO de ondergronddata en -kennis publiekelijk breed toegankelijk maken door middel van publicatie op door haar in stand gehouden publieke websites.

4. TNO en EBN coördineren samen het publiek toegankelijk maken van de kennis en data aan de betrokkenen en stakeholders als opgenomen in de Green Deal. Dit vindt onder andere plaats door middel van seminars voor relevante betrokkenen en stakeholders zoals potentiële UDG-projectontwikkelaars, financiers, toezichthouders, provincies, gemeenten, waterschappen, NGO's, de Mijnsraad, de Technische Commissie Bodembeweging en kennisinstellingen.
5. Om het delen en publiceren van de kennis en de data mogelijk te maken verlenen Partijen elkaar – voor zover nodig – over en weer een niet-exclusieve, niet-overdraagbare, wereldwijde, onherroepelijke en kostenvrije licentie voor het gebruik van de kennis en data zoals in deze overeenkomst en de Green Deal voorzien.

## **11. Geheimhouding**

1. Iedere Partij is tot geheimhouding van de vertrouwelijke bedrijfsgegevens van de andere Partij(en) verplicht en zal deze gegevens slechts binnen haar eigen bedrijf en voor zichzelf gebruiken, voor zover dit voor de uitvoering van deze overeenkomst noodzakelijk is. Voor bekendmaking van deze gegevens aan bij de uitvoering van deze overeenkomst ingeschakelde derden behoeft de betrokken Partij de goedkeuring van de Partij van wie de gegevens afkomstig zijn.
2. Als vertrouwelijke bedrijfsgegevens gelden:
  - de gegevens, die uitdrukkelijk als zodanig zijn gekwalificeerd door de Partij van wie zij afkomstig zijn;
  - de gegevens waarvan het vertrouwelijke karakter ook zonder een uitzonderlijke kwalificatie redelijkerwijze aan Partijen duidelijk moet zijn.
3. Partijen komen overeen in elk geval als vertrouwelijke bedrijfsgegevens te beschouwen de bescheiden, tekeningen en informatie met betrekking tot het aandeel van de andere Partij in de uitvoering van de opgedragen werkzaamheden.
4. Van de verplichting tot geheimhouding is uitgezonderd informatie die:
  - a. van algemene bekendheid is;
  - b. door de kennis-ontvangende Partij is ontvangen van een derde zonder plicht tot geheimhouding;
  - c. door de kennis-ontvangende Partij zelf is ontwikkeld buiten deze overeenkomst;
  - d. volgens de Green Deal bedoeld is om publiekelijk beschikbaar te worden gemaakt.

## **12. Uittreding uit deze overeenkomst**

1. Ieder Consortium heeft de mogelijkheid om zijn deelname aan het EWP-UDG te staken en uit deze overeenkomst te treden, alleen op de momenten en de wijze zoals hieronder beschreven.
2. In paragraaf 2.7 van het EWP-UDG zijn de uittreedmomenten opgenomen, aangegeven als 'go/no-go moments'. Na voltooiing van ieder van de activiteiten (genummerd 1 tot en met 5 in paragraaf 2.7 van het EWP-UDG) organiseert EBN een workshop over de betreffende activiteit. Binnen 6 weken na de dag van het plaatsvinden van de betreffende workshop heeft ieder Consortium de mogelijkheid om aan ieder van de andere Partijen een kennisgeving als bedoeld in lid 7 van dit artikel te doen en daarmee uit deze overeenkomst te treden. Een uittreding mag op ieder uittreedmoment om iedere reden plaatsvinden. Een Consortium dat niet tijdig een kennisgeving doet wordt geacht mee te doen aan de resterende activiteiten, tenminste tot het volgende uittreedmoment.
3. Een uittredend Consortium blijft gehouden zijn (pro-rata) financiële bijdragen te voldoen voor de fase waarin het EWP-UDG zich op het moment van kennisgeving van uittreden bevindt en zoals

deze voortvloeien uit het EWP-UDG of de besluiten van de uitvoeringscommissie. Dit geldt voor de financiële bijdragen op alle niveaus (nationaal, regionaal en lokaal).

4. Een Consortium:
  - dat na aanmaning door EBN in gebreke blijft zijn bijdrage als bedoeld in artikel 8.4 of artikel 8.5 te voldoen aan EBN, respectievelijk aan de derde partij, of
  - waarvan de vertegenwoordiger in surséance van betaling of in staat van faillissement geraakt, wordt geacht na afloop van de aanmaningstermijn respectievelijk op de datum waarop de surséance of het faillissement wordt uitgesproken, uit deze overeenkomst te zijn getreden.
5. Een Consortium dat gebruikmaakt van de mogelijkheid om uit deze overeenkomst te treden of wordt geacht te zijn uitgetreden, zal eveneens zijn deelname aan de Green Deal beëindigen.
6. Het is ieder van de Consortia duidelijk dat uittreding van een Consortium betekent dat hun pro-rata financiële bijdrage (zoals bedoeld in artikel 8.2) opnieuw zal worden berekend aan de hand van het aantal resterende Consortia op het betreffende niveau (nationaal en regionaal). Bij uittreding van een Consortium zal het regionale deel van het EWP-UDG dat door de uittreding wordt geraakt, opnieuw tussen EBN en de dan resterende Consortia worden besproken. De 50/50-verhouding zoals bedoeld in artikel 8.3 blijft onverminderd van toepassing.
7. Een kennisgeving waarmee een Consortium uit deze overeenkomst wenst te treden, zal door het betreffende Consortium op schriftelijke wijze aan de andere Partijen worden gedaan, op de adressen en aan de vertegenwoordigers zoals hieronder aangegeven.
8. De adresgegevens en vertegenwoordigers van de Consortia zijn opgenomen in Annex 1.
9. De adresgegevens en vertegenwoordigers van EBN en TNO zijn als volgt:

EBN: EBN B.V.  
t.a.v. [REDACTED]  
Daalsesingel 1, 3511 SV Utrecht  
Telefoon: +31 [REDACTED]  
Email: [REDACTED]@ebn.nl

TNO: Nederlandse Organisatie voor Toegepast-natuurwetenschappelijk onderzoek TNO  
t.a.v. •  
•  
Telefoon: •  
Email: •
10. Partijen geven wijzigingen van hun adresgegevens en vertegenwoordigers schriftelijk aan elkaar door.

### 13. Communicatie

1. Woordvoering en voorlichting die verband houdt met of voortvloeit uit deze overeenkomst of het EWP-UDG zal door EBN worden verzorgd. EBN zal daartoe – waar nodig – de nodige informatie en persuitingen opstellen in lijn met de werkafspraken in de werkgroep communicatie. Waar gezien de tijd redelijkerwijs mogelijk zal EBN die persuitingen vooraf met de andere Partijen delen.
2. Woordvoering en voorlichting die verband houdt met of voortvloeit uit het geothermieproject van een Consortium, zal door het betreffende Consortium worden verzorgd.

#### **14. Wet- en regelgeving**

1. Deze overeenkomst en het EWP-UDG in het bijzonder zullen op een voor mens, milieu en natuur veilige en maatschappelijk verantwoorde wijze worden uitgevoerd, en in overeenstemming met Nederlandse wet- en regelgeving.
2. De afspraken van deze overeenkomst zullen daarnaast in overeenstemming met het recht van de Europese Unie worden uitgevoerd, in het bijzonder voor zover de afspraken vallen onder de werking van de Europese regels met betrekking tot aanbesteding, mededinging, staatssteun, en technische normen en voorschriften.

#### **15. Aansprakelijkheid**

1. Behalve in geval van opzet en/of grove schuld is EBN en/of TNO niet aansprakelijk jegens de andere Partijen voor directe schade die voortvloeit uit of verband houdt met deze overeenkomst, ongeacht de rechtsgrond van een schadevordering.
2. De aansprakelijkheid van ieder consortium jegens de overige Partijen voor directe schade die voortvloeit uit of verband houdt met deze Overeenkomst, ongeacht de rechtsgrond van een schadevordering, is voor ieder Consortium beperkt tot een bedrag gelijk aan de hoogte van de financiële verplichtingen die het betreffende Consortium heeft onder het EWP-UDG en zoals blijkt uit de financiële tabel Annex 1 op het moment van het aangaan van deze overeenkomst.
3. Geen van de Partijen is aansprakelijk jegens een andere Partij voor indirecte of gevolgschade, inclusief maar niet beperkt tot schade als gevolg van verlies van omzet, verlies van klanten, verlies van winst, verlies van data of verlies van mogelijkheden. Onder indirecte of gevolgschade wordt eveneens verstaan schade als gevolg van beslissingen die genomen zijn op basis van informatie (seismisch, geologisch of anderszins) die Partijen in het kader van deze overeenkomst gehouden zijn met elkaar te delen.

#### **16. Wijziging van deze overeenkomst en Partijen**

1. Met uitzondering van wijziging van of aanvulling op het EWP-UDG in het kader van deze overeenkomst, komen wijzigingen in en aanvullingen op deze overeenkomst alleen tot stand in overleg met en na schriftelijke bevestiging door alle Partijen in de vorm van een addendum bij deze overeenkomst.
2. Het is een Partij niet toegestaan zijn rechten en/of verplichtingen uit deze overeenkomst geheel of gedeeltelijk over te dragen aan een derde, tenzij met voorafgaande schriftelijke toestemming van de andere Partijen in de vorm van een addendum bij deze overeenkomst.
3. Tot de Green Deal kunnen nieuwe partijen toetreden onder de in de Green Deal beschreven voorwaarden. Indien een dergelijke toetreding plaatsvindt, zal worden bezien of en, zo ja, onder welke voorwaarden een nieuwe partij kan toetreden tot deze overeenkomst. Toetreding tot deze overeenkomst kan plaatsvinden indien en voor zover alle Partijen daarmee schriftelijk instemmen, in de vorm van een addendum bij deze overeenkomst.

#### **17. Aangaan en duur van deze overeenkomst**

1. De vertegenwoordiger die deze overeenkomst namens een Consortium ondertekent staat er voor in dat hij of zij bevoegd is deze overeenkomst namens het betreffende Consortium aan te gaan en

zal na ondertekening van deze overeenkomst een kopie hiervan aan de partijen die deelnemen aan zijn of haar Consortium ter beschikking stellen.

2. Deze overeenkomst treedt in werking op het moment dat de Minister van Economische Zaken en Klimaat het besluit heeft genomen om aan EBN een bedrag van maximaal EUR 8 miljoen ter beschikking te stellen als bijdrage voor de uitvoering van het EWP-UDG. EBN zal de andere Partijen op de hoogte brengen van het besluit van de Minister van Economische Zaken en Klimaat.
3. Deze overeenkomst eindigt:
  - als het EWP-UDG volledig is uitgevoerd; of
  - als alle Partijen schriftelijk bevestigen dat deze overeenkomst eindigt; of
  - als het laatste Consortium uit deze overeenkomst treedt.
4. Bij uittreding of na beëindiging van deze overeenkomst blijven de artikelen 10, 15, 17 en 18 tussen Partijen gelden.

#### **18. Toepasselijk recht en geschilbeslechting**

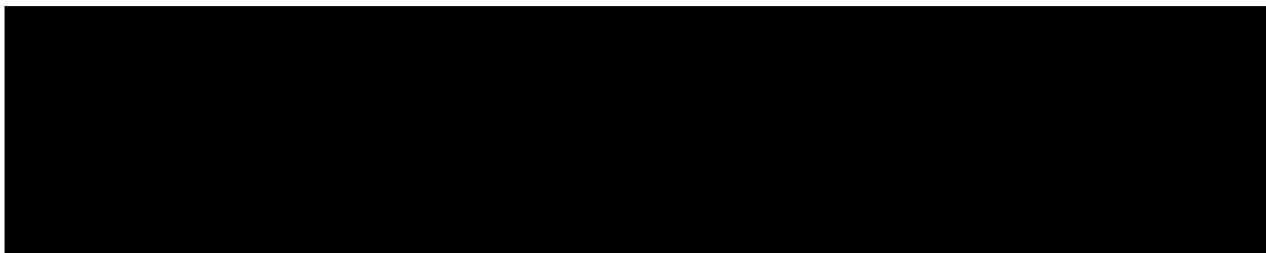
1. Op deze overeenkomst en de hieruit voortvloeiende of hiermee verbonden overeenkomsten is bij uitsluiting Nederlands recht van toepassing.
2. Partijen zullen trachten eventuele geschillen over deze overeenkomst of de uitvoering van het EWP-UDG zoveel mogelijk eerst in goed onderling overleg op te lossen. Indien en voor zover Partijen daar niet in slagen, zullen zij het geschil escaleren naar de Stuurgroep van de Green Deal. Indien een geschil vervolgens blijft bestaan, is ieder van de Partijen bevoegd een procedure overeenkomstig lid 3 van dit artikel te starten.
3. Alle geschillen die mochten ontstaan naar aanleiding van de onderhavige overeenkomst dan wel van nadere overeenkomsten die daarvan het gevolg mochten zijn, zullen exclusief worden beslecht door de rechtbank Midden-Nederland, locatie Utrecht.

*(handtekeningenpagina volgt)*



Aldus overeengekomen te \_\_\_\_\_ op \_\_\_\_\_ 2018

**EBN B.V.**



**Nederlandse Organisatie voor Toegepast-natuurwetenschappelijk onderzoek TNO**

.....

[naam]

**Consortium UDG Leeuwarden**

De Consortiumpartijen vertegenwoordigd door FrieslandCampina Nederland B.V.

.....

[naam]

**Consortium UDG GOUD**

De Consortiumpartijen vertegenwoordigd door Stichting Economic Board Utrecht

.....

[naam]





**Consortium UDG Renkum**

De Consortiumpartijen vertegenwoordigd door Tellus Renkum B.V.

**Consortium Geothermie Oost Brabant**

De Consortiumpartijen vertegenwoordigd door Hydreco Geomec B.V.

.....  
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**Consortium UDG Schiedam**

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**Consortium UDG Haven Rotterdam**

De Consortiumpartijen vertegenwoordigd door Havenbedrijf Rotterdam N.V.

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e. **Consortium UDG Schiedam**

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Eneco Warmte & Koudeleveringsbedrijf B.V.  
Hydreco Geomec B.V.

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f. **Consortium UDG Haven Rotterdam**

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Nederlandse Aardolie Maatschappij B.V.

Vertegenwoordigd door:

Havenbedrijf Rotterdam N.V.

T.a.v. [REDACTED]

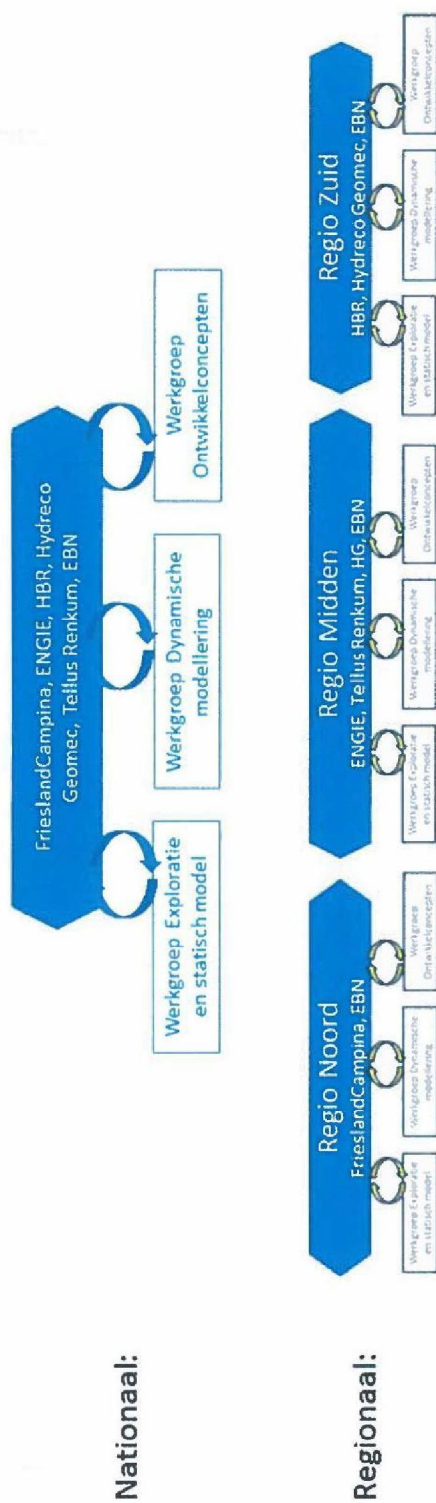
Wilhelminakade 909

3072 AP Rotterdam

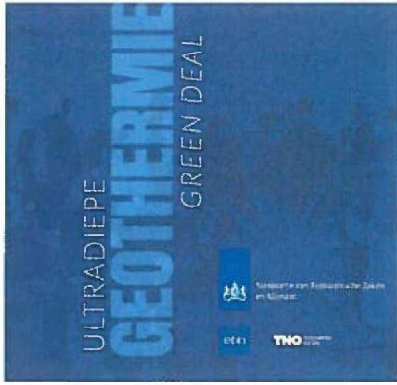
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## Annex 3      Exploratie-werkprogramma Ultradiepe Geothermie



# Exploration Work Program UDG

VERSION	Final
DATE	5 July 2018



0000000172

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## Samenvatting

Om de doelstellingen van het klimaatakkoord van Parijs te kunnen halen is het noodzakelijk om de energievoorziening in Nederland te verduurzamen. Op dit moment zijn er al succesvolle duurzame geothermie projecten gerealiseerd in Nederland om in die warmte te voorzien. De temperatuur van deze projecten is echter onvoldoende voor de levering van warmte aan de proces industrie. Vooral voor de warmtelevering van temperaturen boven de 130°, wordt verwacht dat ultra-diepe geothermie (UDG) potentieel een grote bijdrage kan leveren. In Nederland vinden we deze temperaturen in de ondergrond vanaf 4 km diepte. De Nederlandse ondergrond is op deze diepten nog niet uitgebreid onderzocht en is dus relatief onbekend.

In juni 2017 is de Green Deal UDG getekend door Hydreco Geomec, Huisman Equipment, Havenbedrijf Rotterdam, ASR, Parenco, Vermilion en FrieslandCampina, namens zeven consortia, elk bestaande uit meerdere bedrijven, samen met EBN, TNO, het Ministerie van Infrastructuur en Waterstaat en het Ministerie van Economische Zaken en Klimaat. De ambitie van deze partijen is de veilige en verantwoorde ontwikkeling van één of meerdere pilot projecten vóór 2020, idealiter verdeeld over de drie geologische regio's. De realisatie van deze pilotprojecten moet inzicht geven in de geologische en technische risico-reductie voor een veilige, verantwoorde en kosteneffectieve ontwikkeling van UDG in Nederland. De bovenstaande partijen hebben zich gecommitteerd om hierin door samenwerking de kennis over UDG activiteiten in Nederland te vergroten en daarmee direct de duurzame toepassing van UDG voor hoge temperatuur warmte, en daarmee de ambities van het Energieakkoord gedeeltelijk mogelijk te verwezenlijken.

De zes consortia bevinden zich op dit moment in ongeveer hetzelfde stadium van ontwikkeling. Een meer gedetailleerde exploratie is nu nodig om de ondergrond beter te begrijpen om zo de eerste UDG exploratieprojecten te plannen en op een veilige en verantwoorde manier te kunnen ontwikkelen. Het voorliggende Exploratie Werk Programma (EWP) beschrijft de studie-activiteiten voor de Dinantien kalksteen die nodig zijn voor elk van de zes projecten. Het EWP geeft een kick-start aan deze 6 projecten en creëert tegelijkertijd meerwaarde voor potentiële toekomstige projecten. Dit programma is opgesteld in nauwe samenwerking met de consortia, TNO en EBN. Het werk zal worden uitgevoerd met de beste technieken die momenteel beschikbaar zijn, het is dus geen onderzoeksproject. Er wordt gekozen voor een integrale projectontwikkeling-aanpak aangezien de activiteiten sterk met elkaar samenhangen. Waar mogelijk wordt zoveel mogelijk werk gezamenlijk uitgevoerd, wat resulteert in een hogere kwaliteit van de werkzaamheden, het voorkomen van dubbel werk en het verlagen van de kosten voor de individuele partijen. Aan het einde van het EWP wordt op basis van de resultaten en een exploratiestrategie per regio een goed onderbouwde business case opgesteld en kan een consortium besluiten of het wel of niet door wil gaan met de realisatie van een pilot project. Boringen zijn dus geen onderdeel van het EWP. Het werk gedefinieerd in het EWP houdt rekening met het werk dat wordt uitgevoerd in het nationale witte vlekken (SCAN) programma en hoe dit optimaal kan worden gebruikt om de uitkomsten van het EWP te maximaliseren.

Het EWP is gestructureerd in drie pilaren: 1) overkoepelende activiteiten op nationaal niveau (onder andere in SCAN) die noodzakelijk zijn voor alle consortia, 2) de activiteiten op regionaal niveau die noodzakelijk zijn voor een aantal consortia en 3) de activiteiten op lokaal niveau die noodzakelijk zijn voor een specifiek consortium.

Het werk in het EWP is verdeeld in negen verschillende werkpakketten waarin data en kennis wordt verzameld en opgebouwd:

- Ondergrond data/informatie als basis voor het ondergrond model voor de productiefase en resulteert in een beter te bepalen target, boorlocatie, overburden, boortrajecten en productietechnologieën;
- Het EWP focust op het verkleinen van de onzekerheid voor de ondergrond parameters in de business case;
- Informatie over het gesteente resulteert in betere bepaling van wat de optimale en veilige reservoir stimulatie mogelijkheden zijn (indien nodig);
- Het EWP zorgt voor een grotere kans op succes voor de ontwikkeling van de pilot boringen;
- Informatie om alternatieve oplossingen en beslissingen te kunnen maken bij onvoorziene problemen tijdens of in de eerste en tweede put, stimulatie, reservoir management en het risico management systeem;

- Informatie gecombineerd met de resultaten van de eerste pilot boring, geeft informatie om de tweede boring optimaal te kunnen plaatsen;
- De basis voor adequaat reservoir management gedurende decennia van productie;
- De basis voor risico management gedurende de levensduur van het project zodat op een veilig en verantwoorde manier gerealiseerd en geproduceerd/geïnjecteerd kan worden;
- Data/ondergrond informatie om risico's en onzekerheden voor eventuele vervolgprojecten in een play te verkleinen, de zogenaamde play-ontwikkeling en herhaalpotentieel.

Het EWP heeft een geschatte doorlooptijd van 2,5 tot 3 jaar waarbij de activiteiten gepland zijn te starten in het tweede kwartaal van 2018. De planning houdt rekening met een fasering van het werk waarbij gewerkt wordt van nationale schaal naar regionale en lokale schaal, en van grof naar fijn met daartussen door vijf verschillende go/no-go momenten. Alleen op ieder van deze momenten kan uit het EWP worden gestapt:

1. Na de (re)herbewerking en interpretatie van de seismiek en de afronding van het overkoepelende deel van het EWP met de gedeelde activiteiten op nationaal niveau – als het eerste leidt tot de conclusie dat er geen Dinantien reservoir potentieel aanwezig is op de locatie van een project;
2. Na het afronden van het werk op regionaal niveau;
3. Na het afronden van het lokaal geologisch model;
4. Na het afronden van het lokaal dynamische model;
5. Na afronden van het lokale conceptuele put ontwerp.

Het totale budget voor het EWP bedraagt ongeveer 22 miljoen Euro. In het totaalbedrag is een post onvoorzien aangehouden van 20% voor werkpakketten 2 tot en met 9. Dit percentage is gebaseerd op benchmarking van EBN voor vergelijkbare studies in de olie- en gasindustrie. Voor elk van de activiteiten in het EWP wordt 50% subsidie beschikbaar gesteld door het Ministerie van Economische Zaken en Klimaat, via EBN, sommige uitzonderingen daargelaten waar operators kosteloos data beschikbaar stellen voor dit programma. De resultaten van de activiteiten die mede gefinancierd zijn met subsidie, zullen openbaar worden gemaakt. De bijdrage van ieder consortium is afhankelijk van het type activiteit:

- Voor de overkoepelende activiteiten geldt dat 8,3% van de totaalkosten voor rekening komen van een individueel consortium (50% gedeeld door 6 consortia);
- Voor regionale activiteiten is het afhankelijk van de regio of het 25% dan wel 16,7% van het totaalbedrag voor de rekening van een consortium komt (50% gedeeld door 2 of 3 consortia);
- Voor de lokale activiteiten zijn de kosten 50% voor het consortium.

Dit document geeft een gedetailleerde beschrijving van de werkpakketten, de planning en het budget weer. De manier van werken is vastgelegd in een samenwerkingsovereenkomst tussen de consortia, EBN en TNO.

## Summary

In order to achieve the goals of the Paris Treaty the sustainability of the national energy supply needs to increase. At this moment, there are geothermal projects already in production. However, the temperatures associated with existing projects in the Netherlands are not sufficient for the provision of high-temperature heat to, for example, the process industry. In particular where temperatures over 130°C are necessary ultra-deep geothermal (UDG) energy could potentially make an important contribution to the energy transition. To reach these temperatures in The Netherlands, geothermal reservoirs at depths over 4 km are required. The Dutch subsurface at these depths has not yet been extensively explored, and is relatively unknown.

The Green Deal UDG was signed in June 2017. The signatories were Hydreco Geomec, Huisman Equipment, Havenbedrijf Rotterdam, ASR, Parenco, Vermilion and FrieslandCampina on behalf of seven consortia, each consisting of several companies, together with EBN, TNO, the Ministry of Infrastructure and the Water Management and the Ministry of Economic Affairs and Climate. The ambition of the parties is the safe and responsible realization of one or more pilot UDG projects before 2020. The realisation of these pilot projects should provide insight into the feasibility of further geological and technological risk reduction and safe, responsible and cost-effective development of UDG in the Netherlands. This will contribute to the achievement of the ambitions of the Energy Agreement. The signatories have committed themselves to work together to increase knowledge of UDG activities in the Netherlands and to apply and share this knowledge to increase the use of sustainable high-temperature heat.

The six projects are all currently at a similar stage, where more detailed exploration is required to understand the subsurface to ensure that the first UDG exploration project is developed in a safe and responsible manner. The underlying Exploration Work Program (EWP) captures the exploration activities for the Dutch Dinantian carbonate play that are required for each of the projects and has been drafted in close co-operation by the consortia, EBN and TNO. The activities will be undertaken using the best available technologies, the EWP is not a research program. As all activities are related to one another, integral project development is considered a key factor to assure safe and responsible project development. The work is, where possible, combined across the UDG projects. This considerably enhances the quality of the overall results, avoids duplication of work and reduces costs for all parties involved. At the end of the EWP each project will build a well-founded business case based on the results of the EWP. The business case together with the exploration strategy will form the basis on which a consortium can decide whether or not to continue with the realization of a pilot. The drilling of wells is not a part of the EWP. The work defined in the EWP takes into account the work that is carried out in the national white spots (SCAN) program, and how this can be used optimally to maximize the outcomes of the EWP.

The EWP is structured along three main pillars; 1) national activities, which represent activities that are relevant for all consortia, 2) activities at a regional level that are relevant for the consortia in the same region, and 3) activities at a local level that are only relevant for a specific consortium. The activities are defined in nine different work packages where data and knowledge is gathered and increased:

- Subsurface data and information to determine the right target, the drilling location, overburden, well trajectory, correct technologies that can be used;
- The basis for risk management during the lifetime of the project so it can be realised and produced in a verifiably safe and responsible manner;
- The uncertainty of the input subsurface parameters for the business case is reduced;
- Information on the rock properties results in an optimum approach for safe reservoir stimulation (if needed);
- The results from the EWP increase the probability of success for the pilot wells that will be drilled after completion of the EWP;
- Information that will help to identify alternative solutions and make decisions in the case of unexpected problems which may occur with the first and second well, stimulation, reservoir management and the risk management system;
- Information from the EWP, combined with the results from the first well, results in an optimal placement of the second well of the doublet;



- The basis for adequate reservoir management during the 30 years of production;
- Data and information about the subsurface which will reduce risks and uncertainty for follow-up projects in the same play - so-called 'play development'.

In summary, it can be said that the activities of the EWP will lay the foundations of successful geothermal projects.

It is estimated that the complete program will cover approximately 2.5 to 3 years, starting at the beginning of the second quarter of 2018. The planning takes into account a phasing of the project where the work is done during this period in sequence from large scale to local scale with five go/no-go moments. Consortia can decide to leave the program only at these five points in time:

1. After (re)processing and interpretation of seismic data and after completion of the shared program at the national level;
2. After completing the work on the regional level;
3. After completing the local static geological model;
4. After completing the local dynamic model;
5. After completing the local conceptual well design.

The total budget of the EWP amounts up to over 22 million Euro. Figure A1 lists the estimated budget for each work package. A contingency of 20% has been incorporated based on the benchmarking from EBN from similar studies in the hydrocarbon industry. For each of the activities defined in this program, the subsidy is 50% except where stated otherwise. The results of the activities for which subsidy is granted will be made publicly available. Costs for each consortium will depend on the beneficiary of the activity. For the activities that are beneficial to all, 50% of the costs will be carried by the Ministry of Economic Affairs and Climate (via EBN). The consortia will bear the remaining 50%. On the basis of six consortia, this means that:

- For shared activities at the national level, 8.3% of the total costs for an activity are for an individual consortium (50% divided by 6 consortia);
- For regional activities, depending on the region, 25% or 16.7% of the total costs for the activity are for an individual consortium (50% divided by 2 or 3 consortia);
- For local activities, the costs are 50% for the consortium.

This document provides a detailed description of the work packages, the schedule and the budget. The working relationship between the consortia, TNO and EBN is laid down in a cooperation agreement.

# 1. Introduction

## 1.1 Exploration Work Program (EWP)

The Exploration Work Program (EWP) is part of the Green Deal UDG<sup>1</sup>. The UDG parties have worked together for the realization of this EWP. This document is an annex of the “cooperation agreement” and it commits parties as set out in the corresponding cooperation agreement. Together, these documents define the elaboration of the commitments listed in the Green Deal related to the EWP.

The EWP captures the exploration activities for the Dutch Dinantian play that are required for each project. The work is combined between UDG projects where possible. This enhances the quality of the overall results considerably, also because the results of the activities of each project have a high degree of information value for all other projects. Combining further avoids doubling of work, and reduces costs for all parties involved. This document is written in English since it forms the basis for (international) experts to work on.

## 1.2 Geothermal Energy and the Energy Transition

To achieve the decrease in CO<sub>2</sub> emission defined in the Paris Treaty, the national energy supply needs to increase its sustainability. At this moment there are successful geothermal projects already in production that replace fossil fuel heating as a sustainable alternative. However, the application of geothermal energy in existing projects in the Netherlands is not sufficient for the provision of high-temperature heat in, for example, the process industry. In particular the demand for higher-temperature heat, where temperatures over 130°C are necessary, it is anticipated that ultra-deep geothermal (UDG) energy can potentially make an important contribution to the transition towards a sustainable heating system. To reach these temperatures in the Netherlands, geothermal reservoirs at depths over 4 km are required. The Dutch subsurface at these depths has not been explored extensively yet and is relatively unknown.

## 1.3 Green Deal UDG

At the beginning of 2016, the Ministry of Economic Affairs and Climate, EBN and TNO embarked on a collaboration to explore the possibilities for the development of UDG in the Netherlands. The goal is to investigate its potential by identifying the best exploration pilot project(s) that can be developed in the near future, preferably before or around 2020, for heat production. Both geologically and technologically, these pilot projects are complex and will require innovative methods. Based on the (still limited) amount of subsurface data and knowledge of the Dutch subsurface at great depths, the Dinantian play was identified by studies of EBN and TNO as the most promising play with matching heat demand having most repetitive potential to exploit for ultra-deep geothermal energy. The Dinantian geothermal play in the Netherlands can, based on present knowledge, geologically be subdivided into the Northern Dinantian subplay, the Mid Dinantian subplay, and the Southern Dinantian subplay as depicted in Figure 1.1.

During several workshops in 2016, the Ministry of Economic Affairs and Climate, EBN and TNO, together with industry parties in the market, have been screening the present status of UDG in the Netherlands. In this process seven concrete UDG initiatives have been identified, which were all in the same phase of project development, i.e. formation of consortium, knowledge of potential reservoir, customers and their requirements. As a result of this process, Hydreco Geomec, Huisman Equipment, Havenbedrijf Rotterdam, ASR, Parenco, Vermilion and FrieslandCampina have signed the Green Deal UDG on behalf of seven consortia, each consisting of several companies, together with EBN, TNO, Ministry of Infrastructure and Water Management and the Ministry of Economic Affairs and Climate. They have committed themselves to work together to increase the knowledge about and for UDG activities in the Netherlands and to apply and share this knowledge to increase the sustainable application of high-temperature heat. These projects are located in three regions of the Dinantian play as seen in Figure 1.1.

<sup>1</sup> <http://www.greendeals.nl/wp-content/uploads/2017/06/GD217-dealtekst-Ultradiepe-Geothermie.pdf>



To work together and increase the knowledge level of the UDG, the parties have committed themselves, among others, to the following:

- Executing an exploration work program (EWP) focused on exploration activities and subsurface modelling. This includes the acquisition, (re)processing and interpretation of required subsurface data and development of three dimensional subsurface models, to increase our understanding of the subsurface geothermal reservoir, and developing conceptual well and stimulation designs, to optimize production strategies.
- The Consortia share all subsurface data and knowledge obtained from the EWP as soon as they are available and share as much knowledge as possible about their project development with each other, the Ministry of Economic Affairs and Climate, EBN and TNO. They also make this knowledge publicly available for (ultra-deep) geothermal initiatives of third parties.
- EBN coordinates all activities associated with the drafting and the execution of the EWP.
- The consortia are at all times responsible for further development of their individual initiatives, which means that they are responsible for the activities and costs beyond the EWP that are necessary for the development of their initiative to a robust UDG project.
- Each consortium includes an operator working on the requirements of the Mining Act so the projects can be developed in a safe and responsible manner.
- The consortia contribute 50% of the costs for their share within the EWP, while EBN contributes the other 50% as made available by the Minister of Economic Affairs and Climate.
- The activities of the EWP are described in this document.

All parties underline that a precondition for a successful project is a safe and responsible development in all stages and aspects of a geothermal project. The conclusions in the recent SodM report Staat van de Sector Geothermie<sup>2</sup> are taken into account.

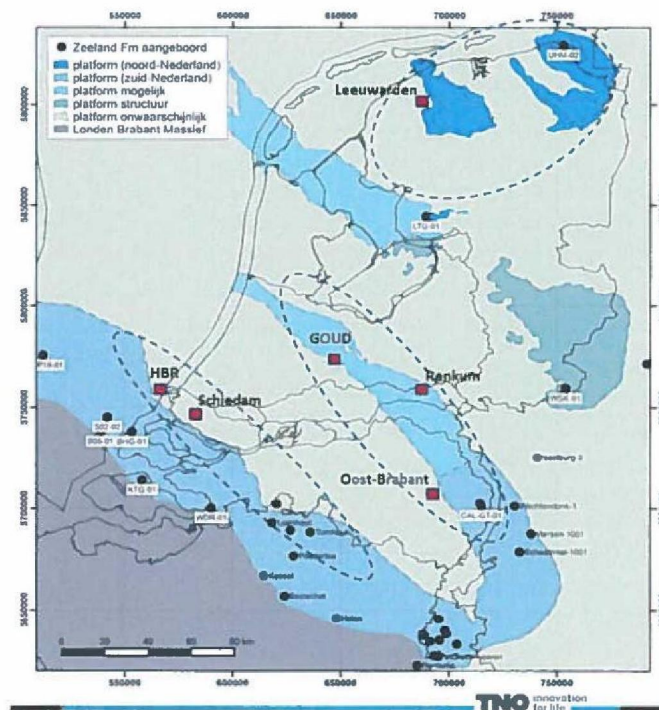


Figure 1.1 Geological map of the Dinantian based on current-day knowledge, showing the three regional subplays – North, Mid and South – indicated by the dashed ellipses.

#### 1.4 Knowledge and Expertise Program (KEP)

The EWP is embedded in a broader Knowledge and Expertise Program (KEP) on UDG, which forms the basis for the build-up and sharing of know-how in order to increase the success rate of safe and responsible developments of UDG (pilot) projects. Based on an integrated project development approach that is also further referred to in paragraph 2.2, activities

<sup>2</sup> <https://www.sodm.nl/documenten/rapporten/2017/07/13/staat-van-de-sector-geothermie>

have been identified to further co-develop within the UDG context. The activities of the broad UDG knowledge and expertise program (KEP) are grouped together in eight different themes, shown in figure 1.2. Since all activities are related to one another, an integrated approach is required for a successful UDG project. Integral project development is considered a key factor to assure its safe and responsible development. All themes together form the KEP. Themes 2, 3 and 4 together form the EWP.

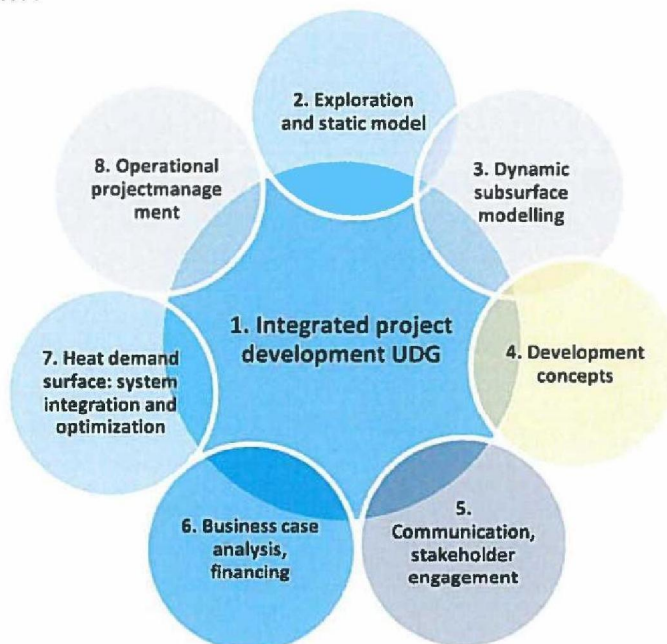


Figure 1.2: The eight themes of the KEP. Themes two, three and four together form the EWP.

Sharing knowledge within and outside the program is anchored on three levels among the Green Deal parties:

- **Workgroup level:** a workgroup consists of one or two members or representatives from each consortium with knowledge on the topics addressed in that work package. The workgroup supervises studies conducted in project teams and discusses the progress, lessons learned and results. The workgroup is also responsible for the quality control of the results delivered in the specific work package and identifies whether changes of the program are necessary.
- **Workshop level:** During workshops, knowledge is shared with the Green Deal partners on subjects like drilling, seismic acquisition and (re)processing, communication models, input for business cases, etc. These workshops are organized around the eight themes in the UDG KEP. Examples of activities during the workshops include: sharing results and lessons learned from workgroups among the Green Deal parties or learning from an expert outside the Green Deal, invited to share his or her relevant experience. The workshops are open to all Green Deal parties involved and are coordinated by EBN. Relevant stakeholders, such as SodM, TNO-AGE, NGOs, etc. will be invited for certain workshops, to ensure that insights in the outside world grow alongside the insights of the consortia.
- **With the large UDG community:** Knowledge sharing with the larger UDG community will take place with the relevant stakeholders of UDG at two different levels, namely the semi-public and public levels. The stakeholders for the semi-public level are identified by the workgroup on communication (Theme 5) and will be kept up to date with the developments. Stakeholders at this level include SodM, VNG, IPO, KNMI, DAGO, Stichting Platform Geothermie, etc. These will also include future UDG projects that are at an earlier stage of development and that are now not part of the Green Deal UDG. The public communication level aims at sharing information to all parties that are interested. This includes among others individual provinces, municipalities, consultants, suppliers, media, interested citizens and future potential UDG initiatives.



## 2. Exploration Work Program

### 2.1 Objective

The ambition of the Green Deal UDG parties is the safe and responsible realization of one or more pilot UDG projects before 2020, ideally divided among the three regions. The realization of one or more pilot projects should provide insight into the feasibility of further geological and technological risk reduction and safe, responsible and cost-effective development of UDG in the Netherlands. This will contribute to the achievement of the ambitions of the Energy Agreement. The signatories have committed themselves to work together to increase knowledge of UDG activities in the Netherlands and to apply and share this knowledge to increase the use of sustainable high-temperature heat.

The six projects are all currently at a similar stage, where more detailed exploration is required to understand the subsurface in order to be able to develop the first UDG exploration project in a safe and responsible manner. This will be done by using the best available technologies. Fundamental research questions may be identified, but are out of the scope of activities within this program and thus not part of the EWP. These questions or opportunities can be brought into (international) research programs that are already running or that may be run in the near future.

At the end of the EWP, each project can decide whether to continue to the development phase (figure 2.1). The decision will be based on the business case, the results of the EWP and the exploration plan.

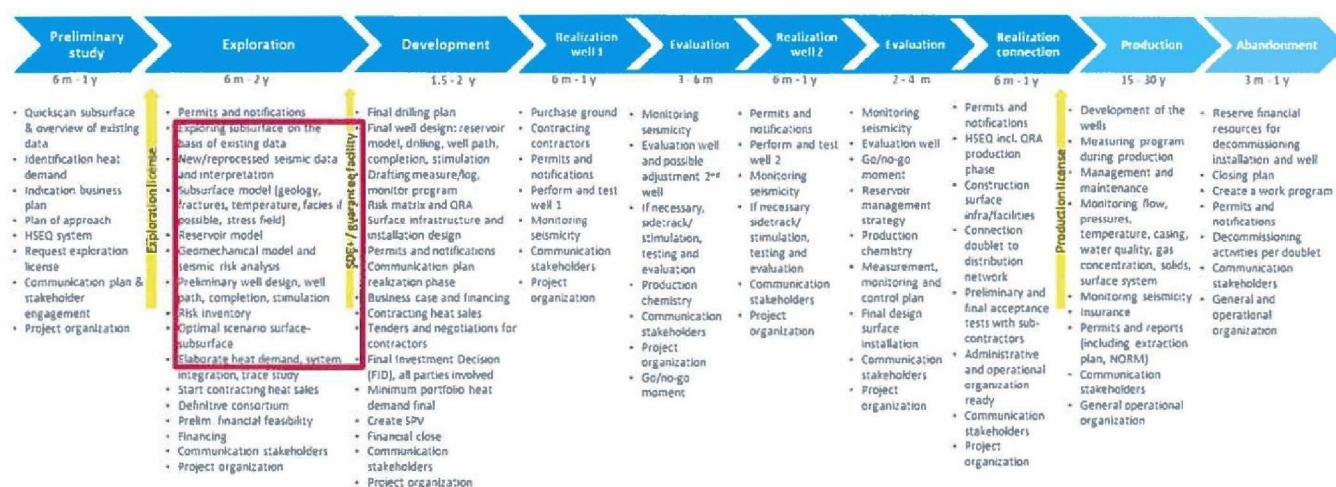


Figure 2.1 Overview of the project phases and activities within the lifecycle of an UDG project. The EWP, marked by the red box, covers the subsurface-related activities in the exploration phase. The other activities are the responsibility of each individual consortium.

### 2.2 Value of Information

The value of information (VOI) during the exploration phase of both project development and play development of the Dinantian is high.

Most activities in the lifecycle of an UDG project depend strongly on one another, an integral project development approach is applied throughout the EWP, KEP and project development activities as depicted in Figure 2.2. This means, among other things, that the activities of this EWP form the basis for all engineering choices and designs during the development phase and also for how reservoir management during the production phase can optimally be applied. To be more specific, the quality of the reservoir model in the exploration phase not only determines where and how exactly the wells should be designed and drilled; it also forms the base for the understanding and the management of well and reservoir behaviour during the expected 25–30 years of production. Deep understanding of the subsurface and the integral project is also linked to clear and solid information for the business case, risk management and mitigation, a communication plan, all licenses, et cetera. Adhering to the integral project management approach ensures a strong



knowledge base for safe and responsible project development, and optimizes cost and benefits as well as the overall quality of all activities during the life cycle of a project development.

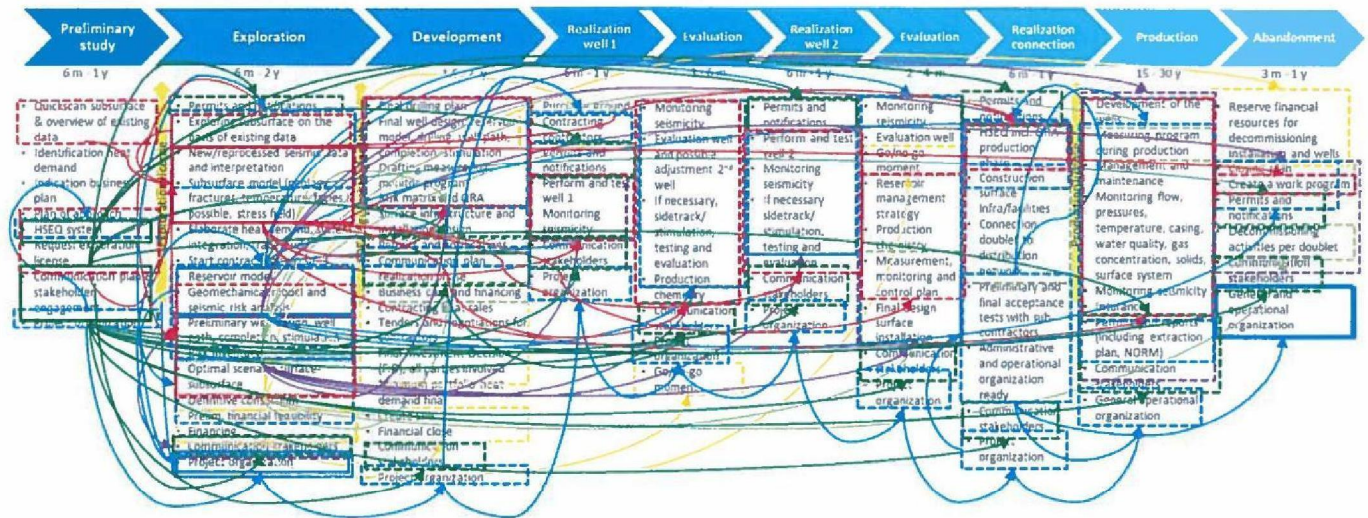


Figure 2.2 Overview of the linked activities within the full lifecycle of an UDG project.

The geological complexity and variations in the subsurface requires in-depth understanding of its risks and opportunities as well as knowledge of the relationships between all activities during the exploration and production lifecycle of a UDG project. In this phase the risks and uncertainties in the subsurface may be reduced strongly by applying exploration activities of analogue studies, seismic acquisition, reprocessing and interpretation. The activities of the exploration phase also lay the foundation for a successful geothermal project. The activities of the underlying EWP result in the following VOI for project development:

- Subsurface data and information to determine the right target, the drilling location, overburden, well trajectory, correct technologies that can be used;
- The basis for risk management during the lifetime of the project so it can be realised and produced in a verifiably safe and responsible manner;
- The uncertainty of the input subsurface parameters for the business case is reduced;
- Information on the rock properties results in an optimum approach for safe reservoir stimulation (if needed);
- The results from the EWP increase the probability of success for the pilot wells that will be drilled after completion of the EWP;
- Information that will help to identify alternative solutions and make decisions in the case of unexpected problems which may occur with the first and second well, stimulation, reservoir management and the risk management system;
- Information from the EWP, combined with the results from the first well, results in an optimal placement of the second well of the doublet;
- The basis for adequate reservoir management during the 30 years of production;
- Data and information about the subsurface which will reduce risks and uncertainty for follow-up projects in the same play - so-called 'play development'.

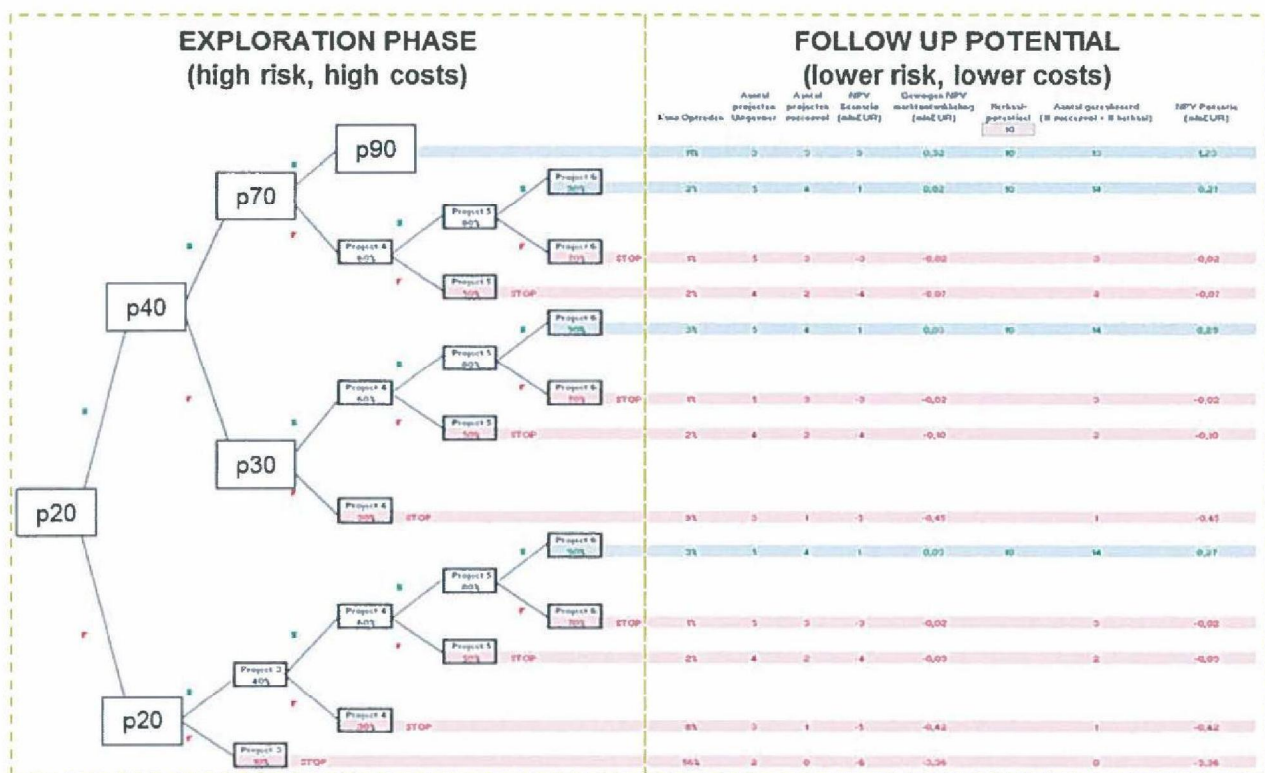
The VOI during a play development is also very high. The information of the EWP and resulting exploration pilot projects de-risk the potential follow-up projects to a large extent and therefore they represent a high value. This value can be estimated by a probabilistic tree that can be applied on the changing rate of success and failure of projects during a geothermal play development as illustrated in Figure 2.3.

The first exploration well in a play, a so-called "play opener", has relatively little chance of success because of the limited data and information on the subsurface available in the pre-drill stage. By developing the project and measuring, monitoring and coring the wells, the data and information acquired strongly reduces risk and uncertainty for the follow-up projects in the similar geological (sub)play. This means that, if the new information shows positive results, the chance of success of following projects increases strongly. The investment for the follow-up project has been de-risked, in the



example below with 20%. On the costs of the next well of, for example, 25 M €, this 20% risk reduction represents 5 M €. This is however, still a rather conservative method of valuing the information. The data and information does not only relate to the drilling of the first well, but to all value and cash flows included in the activities of the life cycle of the project as depicted in Figure 2.2, hence to all cash flows and risks captured in the business case during the lifetime of a project. These numbers are chosen based on expert judgments and are for the demonstration of the synergy effect. It is clear that the risk is too high for one project to be developed individually. By using the learnings from one project to the next, the probabilities and thus the chance of success changes, reducing the risk.

Also, the EWP and the publicly sharing of the data and information that result from it, represent a large VOI for both the development of the pilot project and the development of the geothermal subplays of the Dinantian carbonates, and of the geothermal Dinantian carbonate play as a whole. Using the simple, conservative method, the value of the EWP activities can be estimated as follows. The EWP is expected to influence the starting value of the probabilistic tree of Figure 2.3 by 10%. This corresponds with a present estimate of the situation of a chance of success of P10 without the EWP to a future situation of the EWP activities of P20. This increase of the rate of success stems from a much better insight into the overall geological composition, structure, location and development of the Dinantian and its overburden. This change in probability of success for the first well of 25 M € results in a value of 2–3 M€ for each individual project considered for realisation by the consortia. Besides all VOI as given for a safe and responsible integral project development as mentioned above, this is a conservative quantitative estimate of the value that the EWP contributes to the development of the pilot projects.



**Figure 2.3** Probabilistic tree showing the development of the increase in P-value when sharing the knowledge between the projects. The horizontal axis shows the time, including the exploration phase where the pilot wells will be drilled, and the amount of potential projects that can be realized after the exploration phase. The vertical axis shows branches that are associated with different possible outcomes.

### 2.3 Link to National program

EBN manages a national program called SCAN for the exploration of geothermal energy in areas with low data density within the Netherlands. The results of and data gathered in the SCAN program will be publicly available and are of influence on the work defined in this EWP UDG. The deliverables of the SCAN program are listed where they provide input (to avoid duplication of work) or influence the work within this EWP-UDG. The planning of the work is incorporated in the overall EWP-UDG planning.

### 2.4 Structure and General Content of the Program

The activities of the EWP aim at laying the foundations of successful ultradeep geothermal projects, they are built on three main pillars; 1) national activities, which represent activities that are relevant for all geothermal initiatives in the Dinantian Carbonates (including all consortia), 2) activities at a regional level that are relevant for the consortia in the same region, and 3) activities at a local level that are only relevant for a specific consortium. All activities of the EWP represent a large VOI compared to its costs, both in terms of safe and responsible development as on de-risking of the economics. Data management and model integration and seismic acquisition and (re)processing are two work packages in this work program that both cover all three pillars.

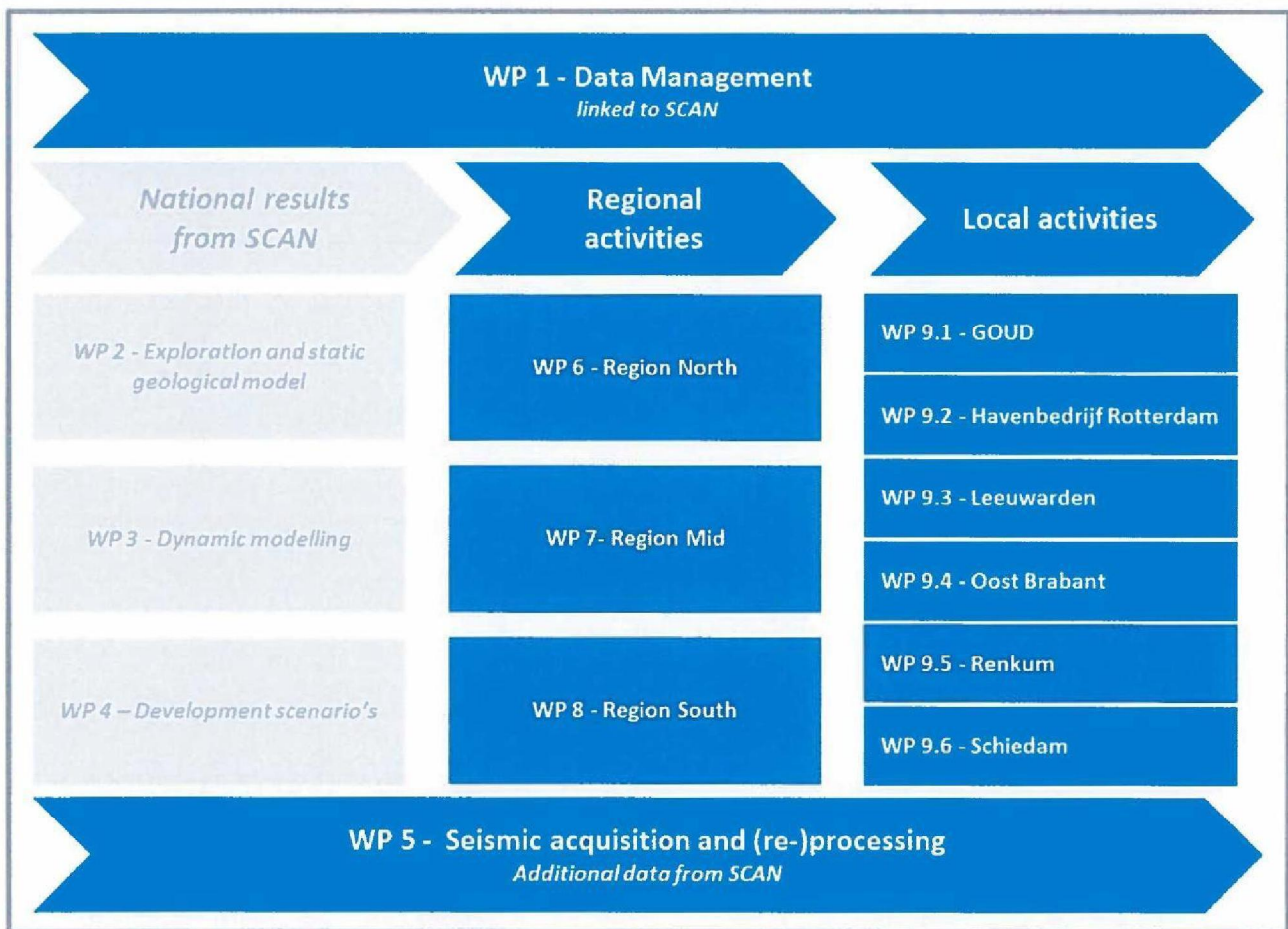


Figure 2.4 Structure of the EWP with nine work packages and three pillars of shared, regional and local activities.

WP1 **Data management and acquisition** is a necessary aspect needed for knowledge sharing and development of best practices, templates and checklists. This work package includes work necessary for the master project that will evolve during the EWP due to new data and the UDG SharePoint.

The **national activities** in WP 2–4 are activities which are conducted within the SCAN program. The activities focus on the data, information and models that all consortia would otherwise use or develop for their individual project. The results of



the SCAN related activities to the UDG program are best practices, templates and checklists based on the state of the art, which can be used in the regional and local activities within the EWP-UDG.

Seismic acquisition and (re)processing influence the work on all different scales and the work has therefore been combined in this WP 5, **Seismic acquisition and (re)processing**. The aim is to obtain the best possible seismic dataset serving the different purposes at different scales. This work package includes all the acquisition, (re)processing and interpretation of the seismic data.

The **regional activities** in WP 6–8 contain tasks that can be shared between projects that are located on the same geological region namely, North, Mid and South (see figure 1.1). The objective is to apply the knowledge, best practices, templates and checklists to the region, develop knowledge and achieve cost reduction by combining the tasks where possible.

The **local activities** in WP 9 apply knowledge, lessons learned, best practices and checklists developed on the shared or regional activity levels to each project individually. The aim is to determine the local input parameters for the business case. The investment costs will be estimated with an uncertainty range of 30% which is deemed sufficient for a go/no-go decision whether or not to proceed to the development phase in which the final well design will be made.

2.5 UDG Program Organisation

The UDG program organisation is defined as shown in figure 2.5.

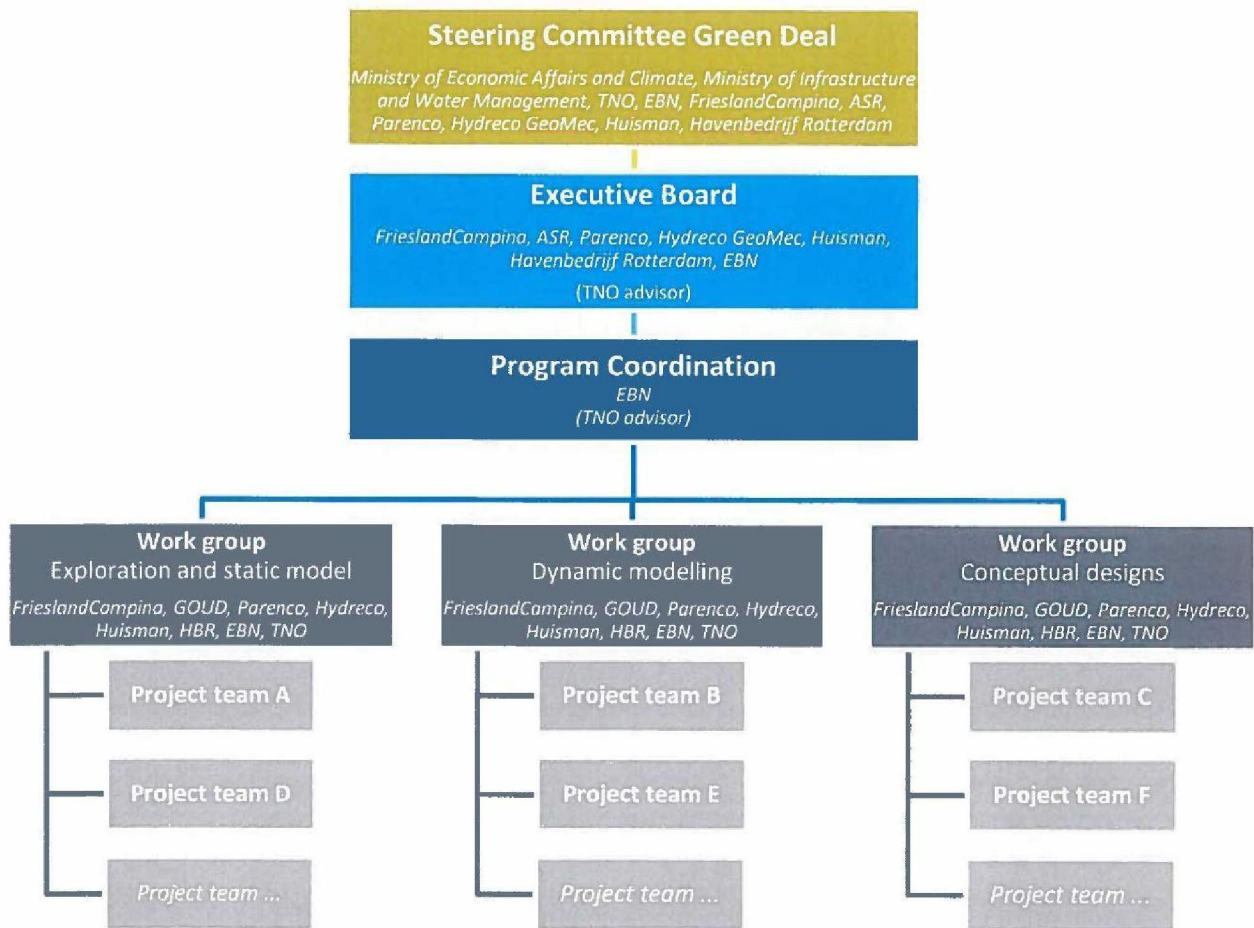


Figure 2.5 Project organisation chart.

The **Steering Committee** (stuurgroep) is the highest level of the program as defined in article 12 of the Green Deal. This committee is comprised of the 11 parties that signed the Green Deal on June 19, 2017. The Steering Committee monitors the progress of the knowledge and expertise program (KEP) on a high level. This committee decides on changes outside the scope of this work program or outside the budget limit defined in this program.

The **Executive Board** (uitvoeringscommissie) makes decisions on awarding tendering procedures, the compilation of project teams and changes of the EWP-UDG as long as it is within the total budget limit defined within the EWP. Each item to be decided on will be prepared by the program coordinator.

The **Program Coordination** (regievoerder, EBN) monitors the day-to-day business of the workgroups. The program coordination also prepares the terms of reference for tendering of certain tasks when necessary. The offers will be evaluated and a summary with advice is prepared for the executive board who will make the tender decision.

A **work group** (werkgroep) works on a certain topic and consists of one or two members or representatives from each consortium with knowledge on the topic. The work group supervises the day-to-day business of the studies that are conducted in project teams and shares the progress, lessons learned and the results. The work group is also responsible for the quality control of the results. The workgroup will also be engaged in the work related to UDG which is conducted in SCAN. The chairman and secretary of each work group is provided by EBN.

A **project team** (project team) will perform an activity relevant for UDG as defined by EWP-SCAN. In some cases the project team consists of a commercial party that has been awarded the work after a tender procedure, in other cases the project team consists of TNO. In most cases, the work will be executed by a project team consisting of experts from commercial parties, TNO and/or EBN. Such teams are led by a project lead from TNO or EBN and members of the team will be selected by a tendering procedure. Such a team is preferred for many of the shared activities to allow experts from different organisations with different opinions to work together to obtain the best results.

## 2.6 EWP Implementation Principles

The following principles apply for the EWP, to ensure that the best set-up for each activity is chosen in a consistent and transparent way:

- What can be done by commercial parties, should be done by commercial parties. At the same time, expertise from TNO has to be included and connected, to avoid re-inventing the wheel and to ensure the inclusion of what has been done before.
- The aim is to have realistically the best team for the job for the shared activities to get the best results. Different opinions and background often lead to different insights.
- Expertise can be found both within and outside the Netherlands.
- Each task has a project lead. This project lead is responsible for defining the terms of reference for the tendering procedure, the project management of that task and discussing the results within the work group.
- Many work packages are phased, and during the first phase existing reports, data sets, models etc. are collected, reviewed and merged to avoid duplication of work in the Netherlands and abroad. It is possible that in this phase the work defined in this program is adjusted to what is necessary. The activities and additional data collection then take place in the next phase(s) of the work package.

## 2.7 Planning

A planning has been made for the whole program based on the activities in chapter 3. An estimation of duration has been made for each individual task. Dependencies between tasks have been taken into account by combining the individual estimations. The assumption is that the activities can start in the second quarter of 2018.

The planning takes into account a phasing of the project where the work is done from large scale to local scale with go/no-go moments between them. These go/no-go moments are inherent to de-risking in the subsurface. By planning the project in this fashion, the financial risk of the project is scaled from low to high. The highest risk reduction steps that cost a relatively small amount of money are taken in the beginning of the project, and the detailed work that has higher costs



is only done when all previous results are positive. The following points have been agreed upon in the drafting of the EWP:

- The timing of a go/no-go moment is a logical moment from the de-risking point of view. At the go/no-go moments, a parameter should be de-risked, otherwise you cannot make a decision;
- The planning is optimal for all projects and does not depend on the slowest project;
- The go/no-go moments should decrease the amount of financial risk for all consortia when one of the consortia decides to leave the EWP and thus the Green Deal at a given point;
- The go/no-go moments should be such that the program is still workable;
- The time path for the realization of the first or more pilot projects is 2020–2023, as described in the Green Deal UDG.
- It is possible to leave the exploration work program in between these moments. As described in the cooperation agreement, the financial commitments continue until the next go/no-go moment.

Based on these considerations, the following go/no-go moments have been identified;

1. After (re)processing and interpretation of seismic data and after completing the shared program at the national level;
2. After completing the work on the regional level;
3. After completing the local static geological model;
4. After completing the local dynamic model;
5. After completing the local conceptual well design.

The resulting planning with the go/no-go moments is visualized in figure 2.6. The planning at local scale will differ between projects, since that phase will include additional seismic acquisition for certain projects.

		2018			2019				2020			
WP		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q3
WP 1	Data management											
WP 2	Exploration and static model											
WP 3	Dynamic modelling											
WP 4	Conceptual designs											
WP 5	Seismic acquisition and (re)processing											
WP 6	Region north											
WP 7	Region mid											
WP 8	Region south											
WP 9	Local activities											

Figure 2.6 Planning of the EWP with the go/no-go moments indicated by a yellow diamond.

The individual activities in this work program are also phased. A task can consist of, for example, two subtasks of which the second depends on the result of the first. The first phase is generally an evaluation of the existing data and analogues; what studies have already been conducted, what is missing, is there any new relevant data available, etc. The second subtask contains the additional analyses of the new relevant data and will only be done when necessary. The phasing within the task does not lead to go/no-go moments of the program as a whole.

## 2.8 Budget

A budget estimation has been made for all the activities in the EWP individually. For each of the activities defined in this program, the subsidy is 50% unless stated otherwise. It depends on the beneficiary of the activity what the costs are for each consortium. For the activities that are beneficial to all, 50% of the costs are for EBN on behalf of the ministry of Economic Affairs and Climate and the consortia are accountable for the other 50%. Taking six consortia into account, this means that:

- For shared activities at the national level, 8.3% of the total costs for an activity are for an individual consortium;
- For regional activities, depending on the region, 25% or 16.7% of the total costs for the activity are for an individual consortium;
- For local activities, the costs are 50% for the consortium.

The budgets for all work packages and each individual consortium are listed in Appendix 2.



### 3. Activities EWP

This chapter contains a description of each work package. For each of the work packages the aim, qualitative value of information and the activities are described. It also lists what other work package or tasks the activities depend on. The activities are described to a level such that a detailed scope of work is necessary at the beginning of each task for tendering procedures.

#### 3.1 Shared Activities at National Level

##### WP 1 - Data management

<b>AIM</b>
A digital platform will gather and unlock all presentations, documentation, data and information for the consortia.
<b>VALUE OF INFORMATION</b>
A vast amount of relevant data and information about the Dinantian exists in the public domain. By sharing, storing and maintaining existing and newly developed data and knowledge, this work package will ensure that all consortia will work on the latest data and information and on the best available and suitable methodologies.
<b>TASKS</b>
<b>Task 1 - Work environment</b> This platform will share presentations, reports, agendas, meetings, contact persons and action lists etc. EBN is responsible for this platform.
<b>DELIVERABLES</b>
D1 Sharepoint environment for the UDG work environment.
<b>INPUT FROM SCAN</b>
<ol style="list-style-type: none"> <li>1. A master project containing all subsurface data, i.e. seismic surveys, seismic interpretations, layer models, well data (logs, stratigraphy, etc.) relevant for researching the reservoir. The intention is to iteratively update the models when new data or insights become available. It is compiled in a Petrel project and made available to all parties. Data stored in the Petrel project will be made available in standard ASCII-type formats (ESRI ASCII-grid, ZMAP, LAS, CSV, etc.). All data will be available via Sharepoint, with the exception of data that is too large, e.g. 3D seismic cubes that are too large to handle in such a way.</li> <li>2. Critical datasets will be made available for the project.</li> </ol>
<b>DEPENDENCY ON OTHER WORK PACKAGES OR TASKS</b>
The initial models for the master project are dependent on other work packages or tasks within this project as is the work environment. The intention is to iteratively update the master project and the work environment when new data or insights become available from other work packages. This means that this work package depends on all the other work packages as well as the SCAN project.

##### WP 2 - Exploration and Static Model

<b>INPUT FROM SCAN</b>
<p>The input from SCAN will result in updates of all relevant subsurface parameters: presence, facies, depth, thickness, temperature and reservoir quality (porosity, permeability). The enhanced insights will result in an increased certainty of those reservoir parameters. This implies that prior to drilling, the geothermal power can be estimated with a higher degree of certainty. The difference between the expected and pessimistic cases will therefore become smaller, resulting in a business case that is better defined. The input from SCAN consists of developed (conceptual) models on a national scale that contain and/or predict the distribution of the Dinantian carbonate reservoir and the relevant reservoir properties. The insights, best practices and models that result from this work will be applied by the consortia in their local projects in work packages 6-9.</p> <p>The input from SCAN is formed by</p> <ol style="list-style-type: none"> <li>1. Updated depth maps, thickness maps and facies of the Dinantian, e.g. division in Members, and distribution of inner platform, platform margin / slope and basinal facies. Updated large-scale 3D fault planes and 2D fault polygons for the Dinantian.</li> </ol>



2. Updated version of the latest Velmod-3 velocity model to include the relevant velocity zones of the Carboniferous.
3. Reconstruction of the tectonic history of the Dinantian carbonates in the Netherlands, including a structural restoration in logical time steps and large-scale prediction of fluid flows and diagenesis.
4. Gravity (and possibly magnetic) anomaly maps for basement, top Dinantian and other levels, as a result of gravity back-stripping.
5. Insight into the potential of CSEM and MT methods for the Dinantian, including recommendations for local-scale application.
6. Basin-scale model for facies distribution and primary reservoir quality as function of the Dinantian carbonate systems for Tournaisian and Visean, distribution, stratigraphy, lithology.
7. A set of reference fracture models of the Dinantian that can be applied to any of the project locations, and that can be used to predict flow (combination with 8)
8. A set of reference diagenetic models of the Dinantien that can be applied to any of the project locations, and that can be used to predict flow (combination with 7).
9. Updated version of the temperature model, including uncertainty maps of the temperature prediction at various depth levels that can be applied to the local situations.
10. A large scale inventory of in situ stress orientation and magnitude at Dinantian levels. Best practices of how to develop conceptual models for in situ stress distribution.

#### DEPENDENCY ON OTHER WORK PACKAGES OR TASKS

The results depend on the SCAN project. The SCAN project will also make use of the data from WP 5 to deliver the required input.

### WP 3 - Dynamic Modelling

#### INPUT FROM SCAN

Within SCAN reference models and methods to assess risks for seismicity and monitoring guidelines will be developed. Also, reference conceptual reservoir (natural) flow models of Dinantian carbonate reservoirs, including geochemical and geomechanical rock-fluid interaction will be developed. Testing and validation of these models takes place by data and experience from field analogues (from oil/gas and geothermal). This is considered critical as relevant data and models are available to a limited extent. The key insights, conceptual and template models and best practices delivered in this WP are to be applied in local studies in WP 9.

The input from SCAN is formed by

1. Generic workflow and models to assess risks of seismicity at each individual UGD project in WP9. Recommendations for monitoring of UDG pilot projects.
2. A number of representative reference models and boundary conditions for the local dynamic models including the effects of fractures and including the long-term (chemical, mechanical, thermal) effects of drilling, completion, production and injection.
3. Literature overview of learnings from analogues and outcrops.
4. Literature overview of the (chemical) effects of drilling, completion, production and injection
5. Literature overview of the effects of fractures on production and injection in various scenarios relevant to UDG.

#### DEPENDENCY ON OTHER WORK PACKAGES OR TASKS

The results from SCAN for this work package form the basis for safe, responsible and adequate reservoir management during the decades of years of production for all projects. The models will be used for optimal well placement in the subsurface and form the basis for location specific work in WP9. It also forms the basis for the management of seismic risk during the lifetime of the project.

### WP 4 - Development Scenarios

#### INPUT FROM SCAN

Within SCAN a catalogue of stimulation options is built along with a technical risk inventory and a conceptual well design that can be adjusted to local project situations in a later stage.

1. A technical risk inventory. The safe and socially acceptable development of an UDG (pilot) project is a boundary condition. The register contains hazards, risks and mitigation measures. Some of these risks will form boundary



conditions for the preliminary well and stimulation designs. Other risks like environment, regulation/authorities, surroundings, population etc. are not included from SCAN but will be added by the work groups of the specific theme within the UDG Green Deal as part of the integrated project development.

1. Catalogue of stimulation techniques for the Dinantian carbonates, based on an uniform approach to determine the boundary conditions for successful reservoir stimulation, applying state-of-the-art technology. The catalogue consists of different stimulation options including expected results with uncertainty level, cost estimation and level of maturity of the technique.
2. Feasible conceptual well design taking into account the minimum casing/tubing diameters needed for an economic flow rate. The completion design will also take into account the maximum pressure that is needed for stimulation (when required) and the mitigation measures from the technical risk inventory.

#### DEPENDENCY ON OTHER WORK PACKAGES OR TASKS

The technical risk inventory forms the basis for risk management during the lifetime of the project so it can be realized and produced in a verifiably safe and responsible manner. It forms input for the work in WP 6-9. Stimulation is likely to be a requirement to increase the geothermal power. Hence it has very large influence on the validity of the business case. The work on stimulation concepts is necessary to determine the optimal way of reservoir stimulation for each location when needed in a later phase.

The conceptual well design gives a good indication whether it is feasible to drill the wells necessary for UDG. The conceptual designs are the basis for the well design and cost estimation on local scale in WP 9.

### WP 5 - Seismic Acquisition and (Re)Processing

#### AIM

The overall objective is to get the best possible seismic dataset serving different purposes at different scales and locations. At local to regional scale, a good seismic dataset is required to understand the smaller-scale distribution of the reservoir, the presence of faults, and also to determine target location for wells. At regional to national scale, a good seismic dataset is required to better understand the larger-scale distribution of the reservoir and gain insights into the geological development impacting reservoir quality in multiple ways (fractures, diagenesis). This is also required to improve seismic risk analyses at project scale.

#### VALUE OF INFORMATION

Seismic data gives information on the presence, depth, thickness and structure of the reservoir. Furthermore, the seismic data is used for determining where secondary permeability is to be expected from faults and karsts. The data therefore is the basis for the reservoir model. It is also necessary for determining technical risks and the optimal well paths and to improve seismic risk analyses at projects.

#### TASKS

This work package comprises the acquisition and (re)processing of 2D and 3D seismic data at local, regional and (possibly) national scale. The Dinantian strata are the primary target; however, fall-back options at shallower (e.g. Triassic, Rotliegend) or deeper (Devonian) levels have to be kept in mind.

A project lead from EBN will overview the entire work package, to ensure consistency in approach and quality, optimize timing, and make sure that synergy between acquisition and (re)processing projects is reached wherever possible. In practice this means that acquisition or (re)processing of seismic data for different projects or at different locations may be combined for tender and award. This project lead is in charge of the tender processes of seismic acquisition and (re)processing activities, Appendix 2 contains a detailed overview of all seismic acquisition and (re)processing tasks.

Note that all reprocessing of 2D in this chapter assumes availability of the raw 2D data. Cost and time estimates of the 2D reprocessing do not include collection of the data.

#### Task 5.1 - Region North

The goal of this task is to create a seismic dataset required for the understanding of distribution and reservoir quality of Dinantian carbonates within the three regions. This will also improve the interpretation of large faults within the region.

The task contains of two subtasks, both planned for phase 1, this work is planned before the first go/no-go of the EWP.

The following items are fixed:

- 5.1.1  
Review of seismic 3D data connection Leeuwarden and UHM-02 using the best available dataset\*.
- 5.1.2  
Review 2D seismic to connect Leeuwarden and LTG-01.

\*The availability of NAM's latest Friesland re-processed / PSDM dataset for Task 5.1.1 and Task 5.5.1 is still under discussion.

#### **Task 5.2 - Region South**

This task contains the following activities for the region South which is planned before the first go/no-go of the EWP. The following items are fixed:

- 5.2.1  
Review of recently reprocessed and depth imaged nearby datasets to assess the possible uplift of reprocessing and depth imaging in the study area

The following items are conditional and depend on the results of the fixed activities:

- 5.2.2  
3D seismic reprocessing and depth imaging for the Dinantian will be done in-house by NAM. The HBR part of the project will be brought into the program in-kind by NAM to the consortium HBR.
- NAM will provide a quote and project plan, with specifications of estimations for the different areas of interest. The plan and estimates have to be approved by the executive committee.
- A "3D in – 2D out" test using Kirchhoff / FLATER depth imaging will be performed after the pre-processing of the 3D, in order to assess which improvement in image of the Dinantian and the fall back option Triassic can be expected after depth imaging.

#### **Task 5.3 - GOUD**

This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults and can be used for well planning purposes. This task contains the following activities for the project of GOUD:

##### **Phase 1**

This work is planned before the first go/no-go of the EWP. The following items are fixed:

- 5.3.1  
Acquisition of 2 2D lines

##### **Phase 2**

This work is planned after task 5.3.1 has been finished and after the work of WP 9.1 shows positive indications for the Dinantian carbonates at Utrecht. The following items are therefore conditional:

- 5.3.2  
Acquisition of 3D seismic data at local scale to understand local-scale distribution of reservoir, presence of faults and to determine target location for pilot well (area to be specified)

#### **Task 5.4 - Havenbedrijf Rotterdam**

Most of the seismic activities of Havenbedrijf Rotterdam are combined with the activities of Schiedam, see section 5.2. This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults and can be used for well planning purposes.

##### **Phase 1**

This work is planned before the first go/no-go of the EWP. The following items are conditional:

- 5.4.1  
Reprocessing existing 3D, HBR part, depending on the results from 5.2.1. This data will be brought in-kind into the project by NAM. The same conditions apply as listed at task 5.2.1.

##### **Phase 2**

This work is planned after task 5.2.1 has been finished and has not delivered the success as hoped for. This task also depends on the results from the reprocessing of the 2D lines in this area performed within SCAN. The following items are therefore conditional

- 5.4.2  
Acquisition of 3D (or 2D) in small area in case the reprocessing of the existing data is not deemed feasible after task 5.2.1.
- 5.4.3  
Acquisition of seismic data for well location

#### **Task 5.5- Leeuwarden**

This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults, and can be used for well planning purposes. This task contains the following activities for the project of Leeuwarden:

##### **Phase 1**

This work is planned before the first go/no-go of the EWP. The following item is fixed:

- 5.5.1  
Review of reprocessed NAM 3D seismic (2016) in Leeuwarden area using the best available dataset\*..

\*The availability of NAM's latest Friesland re-processed / PSDM dataset for Task 5.1.1 and Task 5.5.1 is still under discussion.

##### **Phase 2**

This work is planned after task 5.5.1 has been finished. The following items are conditional and depending on the results of preceding subtask 5.5.1:

- 5.5.2  
Feasibility study and actual reprocessing 3D seismic in Leeuwarden area
- 5.5.3  
Feasibility study and actual low frequency reprocessing and inversion of 3D seismic data in Leeuwarden area
- 5.5.4  
Acquisition 2D line from location Leeuwarden to 3D

#### **Task 5.6 - Oost Brabant**

This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults, and can be used for well planning purposes. This task consists of two activities.

##### **Phase 1**

This work is planned before the first go/no-go of the EWP. The following items are fixed:

- 5.6.1  
Acquisition of 2D lines in "Helmond 2017 survey" in progress. This task is funded by the Green Deal Brabant and therefore not financed from the EWP.

The following item is conditional:

- 5.6.2  
Acquisition of additional seismic and change of scope of 5.6.1 due to using explosives instead of vibroseis.

##### **Phase 2**

This work is planned after task 5.6.1 and 5.6.2 have been finished and after the local work of 9.4 shows positive indications for the Dinantian carbonates at one of the locations. The following items are therefore conditional:

- 5.6.3  
Acquisition of seismic data at local scale to understand local scale distribution of reservoir, presence of faults, and to determine target location for pilot well (area to be specified)

#### **Task 5.7 - Renkum**

This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults, and can be used for well planning purposes. This subtask contains the following activities for the project of Renkum:

##### **Phase 1**

This work is planned before the first go/no-go of the EWP. The following items are fixed:



- 5.7.1  
Acquisition of 8 2D lines in Renkum-Nijmegen area

**Phase 2**

This work is planned after task 5.7.1 has been finished and after the local work of WP 9.5 has started and showing positive results for the Dinantian. The following items are therefore conditional:

- 5.7.2  
Acquisition of 3D seismic data at local scale to understand local scale distribution of reservoir, presence of faults, and to determine target location for pilot well (area to be specified)

**Task 5.8 - Schiedam**

Most of the seismic activities of consortium Schiedam are combined with the activities of consortium Havenbedrijf Rotterdam, see section 5.2. This task aims at the creation of a seismic dataset at local scale that will be used for the local understanding of the Dinantian, identification of faults, and can be used for well planning purposes.

**Phase 1**

This work is planned before the first go/no-go of the EWP. The following items are conditional:

- 5.8.1  
Reprocessing existing 3D, Schiedam part

**Phase 2**

This work is planned after the first go/no-go of the EWP and depends on the results of task 5.1 and 5.8.1. The following items are conditional:

- 5.8.2  
Acquisition seismic data for well location

**INPUT FROM SCAN**

- 2D seismic dataset at national scale, associated reporting, proper database of seismic data and reports
- Regional scale 2D lines for region Mid, associated reporting, proper database of seismic data and reports

**DELIVERABLES**

D5.1 2D seismic dataset at regional scale for the regions, associated reporting, proper database of seismic data and reports  
 D5.2 3D seismic datasets at regional scale for the region South, associated reporting, proper database of seismic data and reports  
 D5.3 2D seismic datasets at local scale, associated reporting, proper database of seismic data and reports (GOUD, Renkum, Oost-Brabant)  
 D5.4 3D seismic dataset at local scale, associated reporting, proper database of seismic data and reports (Leeuwarden, Havenbedrijf Rotterdam, Schiedam).

**DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

This work package depends on the availability of data and not on other work packages. The results of the tasks will be used as input in SCAN, WP 6–8 and WP 9.

**3.2 Shared Activities at Regional Level****WP 6 - Regional activities North****AIM**

The aim is to apply models and insights from national scale activities at a regional scale first, before going to local scale.

**VALUE OF INFORMATION**

The tasks in this work package are aimed at getting an understanding of the regional structure of the Friesland Platform at Dinantian level. Understanding can be reached that would otherwise have been missed when these activities would only be performed locally. The regional work forms a necessary step in developing the subsurface model, which in its turn is the input for the 3D reservoir model on which eventually the right drilling target can be identified and used during the 30 years of production.

**TASKS**

The activities comprise regional interpretation of seismic data, develop a conceptual model for the reservoir quality of the Tytsjerk platform, develop a regional model for depth conversion, evaluate the regional stress regime and regionally consider geological, drilling and other risks.

#### **Task 6.1 Regional interpretation of the seismic data**

The task includes a regional interpretation based on 2D/3D lines tying UHM-02 and LTG-01 with the Friesland Carbonate platforms. The aim of this task is to refine the national framework of horizons and faults to regional scale. This will be done by regional seismic interpretation and includes: the well-to-seismic ties where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. The building of a velocity model for time-depth conversion is included in this task. The existing Velmod-3 model will be adapted to the regional well data for the levels to the top of the Carboniferous. The new insights for the Upper Carboniferous and the Dinantian from WP 2 will be used for the respective deeper levels. The task also includes a review and use of available gravity study for interpretation purposes when the shared national inventory is inconclusive.

#### **Task 6.2 Regional conceptual model**

The activities in this task develop a conceptual model for the Friesland carbonate platform based on national work using regional datasets of well logs, cores, images and analogue data that are valid to the region. The conceptual model will be used to predict reservoir quality distribution across the Friesland carbonate platform when possible. Seismic inversion may be tested and, if useful, be used to define facies/rock type and the regional reservoir quality model in more detail. The model includes a geostatistical analysis.

#### **Task 6.3 Regional subsurface stress analysis**

This task has the aim to evaluate the regional stress regime based on the results from WP 2 and the regional geology. The results from WP 2 are refined to the regional level in this task. The basis will be the regional fault interpretation from task 6.1 and a regional scale analysis of the possible impact of local geological factors on orientation and magnitude of the in situ stresses, such as evaporites, faults, facies, slope, etc. using the results of WP 2. The following sources of information will be used:

- Borehole image logs, caliper, break-out and other well information
- Slip and dilation tendency
- Focal point mechanisms / micro-earthquakes
- Use seismic anisotropy velocity information from 3D processing where a good dataset is available
- Compare to analogues

#### **DELIVERABLES**

D6.1 Regional interpretation that can be fine-tuned to local scale in WP 9

D6.2 Conceptual model including reservoir quality

D6.3 Velocity model to be used for time-depth conversion on local scale

D6.4 Regional stress regime

#### **DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

The activities in this work package depend on results from WP 1, WP 2, WP 3, WP 4 and WP 5.

### **WP 7 - Regional activities Mid**

#### **AIM**

The aim is to create synergy and cost efficiency among the two consortia in this region. By going to local scale for activities as late as possible, costs are shared longer between the projects and go/no-go moments can be incorporated. This will result in knowledge increase and lower costs.

#### **VALUE OF INFORMATION**

The tasks in this work package are aimed at getting an understanding of the regional structure of the Peel-Maasbommel-Zandvoort High at Dinantian level so that the three different projects situated on this high are geologically aligned. By combining these activities, the knowledge of the region and the quality of the interpretations will increase, which will add



value to each individual project. Understanding can be reached that would otherwise have been missed when these activities would only be performed locally. The regional work forms a necessary step in developing the subsurface model, which in its turn is the input for the 3D reservoir model on which eventually the right drilling target can be identified and used during the 30 years of production.

#### TASKS

##### Task 7.1 Regional interpretation of the seismic data

The task includes a regional interpretation based on 2D lines tying CAL-GT to the three different projects on the Peel-Maasbommel-Zandvoort High. The aim of this task is to refine the shared national framework of horizons and faults to regional scale. This will be done by regional seismic interpretation and includes: the well-to-seismic ties where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. The building of a velocity model for time-depth conversion is included in this task. The existing Velmod-3 model will be adapted to the regional well data for the levels to the top of the Carboniferous. The new insights for the Upper Carboniferous and the Dinantian from WP 2 will be used for the respective deeper levels. The task also includes a review and use of available gravity study for interpretation purposes when the shared national inventory is inconclusive.

##### Task 7.2 Use magnetic/gravimetric data to validate models.

Existing magnetic and gravimetric data may be used to validate the seismic interpretation and structural analysis at the shared national level. Adjustments and refinements of the results at national scale (WP 2) will be made when necessary.

##### Task 7.3 Regional conceptual model

Develop a conceptual model for the Peel-Maasbommel-Zandvoort High based on the shared national work using regional datasets of well logs, cores, images and analogue data that are valid to the region. This includes at least the CAL-GT wells and relevant German wells. The conceptual model will be used to predict reservoir quality distribution across the Peel-Maasbommel-Zandvoort High when possible.

##### Task 7.4 Regional subsurface stress analysis

This task has the aim of evaluating the regional stress regime based on the results from WP 2 and the regional geology. The results from WP 2 are refined to the regional level in this task. The basis will be the regional fault interpretation from task 7.1 and a regional scale analysis of the possible impact of local geological factors on orientation and magnitude of the in situ stresses, such as evaporites, faults, facies, slope, etc. using the results of WP 2. The following sources of information will be used:

- Borehole image logs, caliper, break-out and other well information
- Slip and dilation tendency
- Focal point mechanisms / micro-earthquakes
- Use seismic anisotropy velocity information from 3D processing where a good dataset is available
- Compare to analogues

#### DELIVERABLES

D7.1 Regional interpretation that can be fine-tuned to local scale in WP 9.

D7.2 Conceptual model of the Dinantian on the Peel-Maasbommel-Zandvoort High, including reservoir quality when possible

D7.3 Velocity model to be used for time-depth conversion on local scale

D7.4 Regional stress regime

#### DEPENDENCY ON OTHER WORK PACKAGES OR TASKS

The activities in this work package depend on results from WP 1, WP 2, WP 3, WP 4 and WP 5.

### WP 8 - Regional activities South

#### AIM

A number of activities will be done together by the two consortia within the sub-play region south (Havenbedrijf Rotterdam and Schiedam), to create synergy and cost efficiency amongst these two consortia.



**VALUE OF INFORMATION**

The tasks in this work package are aimed at getting an understanding of the regional structure of the northward extension of the Dinantian towards the southern edge of the West Netherlands Basin at Dinantian level. By combining these activities, the knowledge of the region and the quality of the interpretations will increase, which will add value to each individual project. Understanding can be reached that would otherwise have been missed when these activities would only be performed locally. The regional work forms a necessary step in developing the local subsurface models, which in its turn is the input for the 3D reservoir model on which eventually the right drilling target can be identified and used during the 30 years of production.

**TASKS**

The activities comprise regional interpretation of seismic data (2D/3D), possibly combined with use of EM/gravity data to validate models, the development of shared "local" static and temperature models incorporating regional analyses on reservoir quality and temperature, regional assessment of subsurface stresses. The activities are described in five tasks.

**Task 8.1 Regional interpretation of the seismic data**

The aim of this task is to refine the shared national framework of horizons and faults to regional scale. This will be done by regional seismic interpretation and includes: the well-to-seismic ties where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. Existing offshore interpretation provided by ONE of Z3WES1997A will be incorporated. If feasible, seismic inversion will be applied to visualize the rock properties in the 3D volume in task 8.3 but can also be used to refine the interpretation. The velocity model will be adapted so that it honours the regional data. This model will then be used by both projects for the time-depth conversion at regional and local scale.

**Task 8.2 Use magnetic/gravimetric data to validate models.**

Existing magnetic and gravimetric data may be used to validate the seismic interpretation and structural analysis at the national level. Adjustments and refinements of the results at national scale (WP 2) will be made when necessary.

**Task 8.3 Regional static geological model**

The activities in this task are aimed at using the shared national level horizons and faults to build a static model at the regional level using regional datasets of well logs, cores, images and analogue data that are valid to the region. A detailed correlation is made with wells O18-01, P16-01, S05-01, S02-02, BHG-01, KTG-01 and WDR-01 so that the regional conceptual model incorporates the data points in the region. Seismic inversion may be tested and if useful be used to define facies / rock type and the regional reservoir quality model in more detail. A combined static model will be built for both consortia. This model covers both locations and includes a geostatistical analysis.

**Task 8.4 Regional temperature model**

Refining and validating the temperature model from national scale to regional scale is the objective of this task. This will be done by using (interpreted) seismic data, well information, rock properties and heat conduction coefficients to build a regional temperature model. This update will be cross-checked with the temperature model database available at NAM. The local update can later be integrated into the temperature model at national scale.

**Task 8.5 Regional subsurface stress analysis**

The results from WP 2 are refined to the regional level in this task. The basis will be the regional fault interpretation from task 8.1 and a regional scale analysis of the possible impact of local geological factors on orientation and magnitude of the in situ stresses, such as evaporites, faults, facies, slope, etc. using the results of WP 2. The following sources of information will be used:

- Borehole image logs, caliper, break-out and other well information
- Slip and dilation tendency
- Focal point mechanisms / micro-earthquakes
- Use seismic anisotropy velocity information from 3D processing where a good dataset is available (offshore?)
- Compare to analogues

**DELIVERABLES**



Deliverables for each task will be specified in more detail in separate scope of work documents once the EWP has been agreed upon by all parties involved.

D8.1 Velocity model for both projects to be used for time-depth conversion on both regional and local scale

D8.2 Regional interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture that can be fine-tuned on local scale

D8.3 Refined regional temperature model to be used for the temperature calculations at both projects

D8.4 Static geological model covering both projects which includes depth, expected temperature, faults/fractures, nearby existing gas/oil fields and reservoir properties.

D8.6 Regional stress model that forms the input for the stress modelling in the local geomechanical model

#### **DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

The work in this work package is dependent on the results of WP 2 and the results of WP 5 for those activities that are applicable to both Havenbedrijf Rotterdam and Schiedam.

### **3.3 Activities at Local Level**

#### **WP 9.1 - GOUD<sup>3</sup>**

##### **AIM**

The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.

##### **VALUE OF INFORMATION**

The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.

##### **TASKS**

##### **Task 9.1.1 - Local risk assessment**

Based on the risk assessment on a national and regional scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.

##### **Task 9.1.2 - Local interpretation**

This task includes a detailed interpretation of the available 2D seismic data resulting from WP 5. This includes: the well-to-seismic ties from regional interpretation where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. The velocity model from task 7.1 will be used for time-depth conversion.

##### **Task 9.1.3 - Local temperature model**

Refining and validating the temperature model from national scale to local scale is the objective of this task. This will be done by using seismic data, well information, rock properties and heat conduction coefficients to build a local temperature model. The local update will be integrated into the temperature model at national scale.

<sup>3</sup> At the start of this work package, the executive board consisting of GOUD and EBN will define the work in more detail and what work can be done in-kind by partners within the GOUD consortium.



**Task 9.1.4 - Local static model**

This task focuses on the building of a static model using the input from tasks 9.1.2 and 9.1.3. This task also includes adjusting the national and regional conceptual models to the local scale based on task 9.1.2. The results of this task form the input for the next tasks.

**Task 9.1.5 - Local reservoir model**

Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.1.6 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.

**Task 9.1.6 - Local geomechanical model**

This task comprises the building of a local (conceptual) geomechanical model using the generic workflow from WP 2. The regional stress field will be analysed for the impact of local geological factors on the orientation and magnitude of in situ stress, e.g. the presence of evaporites, faults, slope, etc., and adjusted if needed. This model should be of sufficient detail so that risks can be quantified as far as possible and required (as input for task 9.1.1). The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. Using the results of task 9.1.5 and the generic approach developed in WP 3, a local seismic hazard assessment is carried out. This model will be tested and updated if necessary after the drilling of the first pilot well in the next phase.

**Task 9.1.7 - Local conceptual stimulation concept**

Based on the local static, geomechanical and reservoir models, those concepts that are valid for the project will be selected and applied.

**Task 9.1.8 - Local conceptual well design**

The well design developed on the national level will be re-evaluated for the local situation. This includes adjustment to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.

**DELIVERABLES**

D9.1a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)

D9.1b. Local risk register including the local risk on induced seismicity

D9.1c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%

**DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

All tasks are dependent on the results from WP 1, WP 2, WP 3, WP 4, WP 5 and WP 7.

**WP 9.2 - Havenbedrijf Rotterdam****AIM**

The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.

**VALUE OF INFORMATION**

The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and



responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.

#### **TASKS**

##### **Task 9.2.1 - Local risk assessment**

Based on the risk assessment on a national scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.

##### **Task 9.2.2 - Local interpretation**

The national to regional scale maps and faults (output of WP 2 and Task 8.1) will be used as input for a detailed local interpretation. The seismic data will be interpreted in the highest detail possible for the top and base Dinantian, overburden around the planned well paths, faults and internal features (when possible). Seismic inversion may be tested and if useful be used to define facies / rock type / karst and the regional reservoir quality model in more detail but can also be used to refine the interpretation.

##### **Task 9.2.3 - Local static model**

The regional static model (output of task 8.3) will be updated based on the results from the local interpretation in task 9.2.1. This task includes adjusting the national and regional conceptual models to the local scale. The results of this task form the input for the next tasks.

##### **Task 9.2.4 - Local reservoir model**

Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.2.5 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.

##### **Task 9.2.5 - Local geomechanical model**

This task comprises the building of a local (conceptual) geomechanical model using the generic workflow from WP 2. The regional stress field will be analysed for the impact of local geological factors on the orientation and magnitude of in situ stress, e.g. the presence of evaporites, faults, slope, etc., and adjusted if needed. This model should be of sufficient detail so that risks can be quantified as far as possible and required (as input for task 9.2.3). The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. Using the results of task 9.2.4 and the generic approach developed in WP 3, a local seismic hazard assessment is carried out. This model will be tested and updated if necessary after drilling of the first pilot well in the next phase.

##### **Task 9.2.6 - Local conceptual stimulation concept**

Based on the local static, geomechanical and reservoir models (tasks 9.2.2, 9.2.4 and 9.2.5), those concepts that are valid for the project will be selected and applied.

##### **Task 9.2.7 - Local conceptual well design**

The well design developed on the national level will be re-evaluated for the local situation. This includes adjustment to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.

#### **DELIVERABLES**

D9.2a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)

D9.2b. Local risk register including the local risk on induced seismicity

D9.2c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%

#### **DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

All tasks are dependent on the results from WP 1, WP 2, WP 3, WP 4, WP 5 and WP 8.



## WP 9.3 – Leeuwarden

<b>AIM</b>
The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.
<b>VALUE OF INFORMATION</b>
The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.
<b>TASKS</b>
<p><b>Task 9.3.1 - Local risk assessment</b></p> <p>Based on the risk assessment on a national and regional scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.</p> <p><b>Task 9.3.2 - Local interpretation</b></p> <p>This task includes a full 3D interpretation of the (reprocessed/inverted) seismic data of WP 5 at the relevant location. This includes: the well-to-seismic ties from regional interpretation where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. Seismic inversion may be used (after feasibility) to define facies / rock type / karst and the regional reservoir quality model in more detail. The velocity model from task 6.1 will be used for time-depth conversion.</p> <p><b>Task 9.3.3 - Local temperature model</b></p> <p>Refining and validating the temperature model from national scale to local scale is the objective of this task. This will be done by using seismic data, well information, rock properties and heat conduction coefficients to build a local temperature model. The local update will be integrated into the temperature model at national scale.</p> <p><b>Task 9.3.4 - Local static model</b></p> <p>This task focuses on the building of a static model using the input from tasks 9.3.2 and 9.3.3. This task also includes adjusting the national and regional conceptual models to the local scale based on the same interpretations. The results of this task form the input for the next tasks.</p> <p><b>Task 9.3.5 - Local reservoir model</b></p> <p>Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.3.6 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.</p> <p><b>Task 9.3.6 - Local geomechanical model</b></p> <p>Safety and responsible development are key for a successful project. First, a local scale analysis of impact of local, geological factors on orientation and magnitude of in situ stress of relevance to UDG (evaporites, faults, facies, slope, etc.) is made based on conceptual guidelines / best practices from WP 2 and the results in 6.3. The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. The level of detail of the local geomechanical model will be such that it is sufficient for stakeholders before drilling can</p>



commence. The necessary data gaps will be identified and these data will be gathered in the well to be drilled. A full detailed geomechanical model will be made after drilling of the first well and data gathering and analysis is completed.
<b>Task 9.3.7 - Local conceptual stimulation concept</b> Based on the local static, geomechanical and reservoir models, those concepts that are valid for the project will be selected and applied.
<b>Task 9.3.8 - Local conceptual well design</b> The well design developed on the national level will be re-evaluated for the local situation. This includes adjustments to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.
<b>DELIVERABLES</b>
D9.3a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)
D9.3b. Local risk register including the local risk on induced seismicity
D9.3c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%
<b>DEPENDENCY ON OTHER WORK PACKAGES OR TASKS</b>
All tasks are dependent on the results from WP 1, WP 2, WP 3, WP 4, WP 5 and WP 6.

#### WP 9.4 - Oost Brabant

<b>AIM</b>
The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.
<b>VALUE OF INFORMATION</b>
The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.
<b>TASKS</b>
<b>Task 9.4.1 - Local risk analysis</b> Based on the risk assessment on a national and regional scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.
<b>Task 9.4.2 - Local interpretation</b> This task includes a detailed interpretation of the available 2D seismic data, resulting from WP 5. This includes the new seismic data that is acquired in addition to the seismic data in the Green Deal Brabant. The work includes the well-to-seismic ties from regional interpretation where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. The velocity model from task 7.1 will be used for time-depth conversion.
<b>Task 9.4.3 - Local gravimetry/EM data (optional)</b> New magnetic and gravimetric data may be used to validate the seismic interpretation and structural analysis at the local level. Adjustments and refinements of the results at national scale (WP 2) will be made when necessary.

<p><b>Task 9.4.4 - Local temperature model</b></p> <p>Refining and validating the temperature model from national scale to local scale is the objective of this task. This will be done by using seismic data, well information, rock properties and heat conduction coefficients to build a local temperature model. The local update will be integrated into the temperature model at national scale.</p> <p><b>Task 9.4.5 - Local static model</b></p> <p>A local static model will be built based on the local interpretations of tasks 9.4.2 to 9.4.4. This task also consists of adjusting the national and regional conceptual models to the local scale. This includes using the well evaluation for facies type, rock physics models, lithostratigraphy, fractures from WP2 of the relevant wells. The results of this task form the input for the next tasks.</p> <p><b>Task 9.4.6 - Local reservoir model</b></p> <p>Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.4.7 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.</p> <p><b>Task 9.4.7 - Local geomechanical model</b></p> <p>This task comprises the building of a local (conceptual) geomechanical model using the generic workflow from WP 2. The regional stress field will be analysed for the impact of local geological factors on the orientation and magnitude of in situ stress, e.g. the presence of evaporites, faults, slope, etc., and adjusted if needed. This model should be of sufficient detail so that risks can be quantified as far as possible and required (as input for task 9.4.1). The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. Using the results of task 9.4.6 and the generic approach developed in WP 3, a local seismic hazard assessment is carried out. This model will be tested and updated if necessary after drilling of the first pilot well in the next phase.</p> <p><b>Task 9.4.8 - Local conceptual stimulation concept</b></p> <p>Based on the local static, geomechanical and reservoir models, those concepts that are valid for the project will be selected and applied.</p> <p><b>Task 9.4.9 - Local conceptual well design</b></p> <p>The well design developed at the national level will be re-evaluated for the local situation. This includes adjustment to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.</p>
<b>DELIVERABLES</b>
<p>D9.4a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)</p> <p>D9.4b. Local risk register including the local risk on induced seismicity</p> <p>D9.4c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%</p>
<b>DEPENDENCY ON OTHER WORK PACKAGES OR TASKS</b>
All tasked are linked or dependent on to WP 1, WP 2, WP 3, WP 4, WP 5 and WP 7.

#### WP 9.5 - Renkum

<b>AIM</b>
The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.
<b>VALUE OF INFORMATION</b>



The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.

#### TASKS

##### Task 9.5.1 - Local risk analysis

Based on the risk assessment on a national and regional scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.

##### Task 9.5.2 - Local interpretation

This task includes a detailed interpretation of the available 2D seismic data resulting from WP 5. The work includes the well-to-seismic ties from regional interpretation where necessary for the interpretation, the interpretation of the relevant overburden horizons and top/base of the Dinantian, faults, intra-Dinantian horizons (when possible) and interpretation of basement architecture. The velocity model from task 7.1 will be used for time-depth conversion.

##### Task 9.5.3 - Local gravimetry/EM data (optional)

New magnetic and gravimetric data may be used to validate the seismic interpretation and structural analysis at the local level. Adjustments and refinements of the results at national scale (WP 2) will be made when necessary.

##### Task 9.5.4 - Local temperature model

Refining and validating the temperature model from national scale to local scale is the objective of this task. This will be done by using seismic data, well information, rock properties and heat conduction coefficients to build a local temperature model. The local update will be integrated into the temperature model at national scale.

##### Task 9.5.5 - Local static model

A local static model will be built based on the local interpretations of task 9.5.2 to 9.5.4. This task also consists of adjusting the national and regional conceptual models to the local scale. This includes using the well evaluation for facies type, rock physics models, lithostratigraphy, fractures from WP 2 of the relevant wells. The results of this task form the input for the next tasks.

A local static model will be built based on the local interpretations of task 9.5.2 to 9.5.4. This task also consists of adjusting the national and regional conceptual models to the local scale. This includes using the well evaluation for facies type, rock physics models, lithostratigraphy, fractures from WP 2 of the relevant wells. The results of this task form the input for the next tasks.

##### Task 9.5.6 - Local reservoir model

Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.5.7 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.

##### Task 9.5.7 - Local geomechanical model

This task comprises the building of a local (conceptual) geomechanical model using the generic workflow from WP 2. The regional stress field will be analysed for the impact of local geological factors on the orientation and magnitude of in situ stress, e.g. the presence of evaporites, faults, slope, etc., and adjusted if needed. This model should be of sufficient detail



so that risks can be quantified as far as possible and required (as input for task 9.5.1). The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. Using the results of task 9.5.6 and the generic approach developed in WP 3, a local seismic hazard assessment is carried out. This model will be tested and updated if necessary after drilling of the first pilot well in the next phase.

#### **Task 9.5.8 - Local conceptual stimulation concept**

Based on the local static, geomechanical and reservoir models, those concepts that are valid for the project will be selected and applied.

#### **Task 9.5.9 - Local conceptual well design**

The well design developed at the national level will be re-evaluated for the local situation. This includes adjustment to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.

#### **DELIVERABLES**

D9.5a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)

D9.5b. Local risk register including the local risk on induced seismicity

D9.5c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%

#### **DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

All tasks are linked or dependent on to WP 1, WP 2, WP 3, WP 4, WP 5 and WP 7.

### **WP 9.6 - Schiedam**

#### **AIM**

The aim of these activities is to generate reliable input for the business case analysis so that a go/no-go decision can be made at the decision gate on whether to continue the project to the development phase. The cost estimation for the wells will have reached a level of uncertainty of 30%. Each consortium will perform a large number of activities on a local scale, often refining and applying results and findings from activities at the national or regional level.

#### **VALUE OF INFORMATION**

The static, dynamic and geomechanical models will be used to determine the subsurface location of the first pilot well with the highest probability of success and the lowest risk. The models will also be used for evaluating the well after drilling, and are updated when necessary. This may lead to necessary adjustments of the location or well design of the next well before the drilling can commence. In the event that the geothermal system starts production, the updated reservoir and geomechanical models will be used for monitoring purposes so the system can be optimized and operated in a safe and responsible way. The conceptual design gives input for the business case since it delivers a cost estimation of the project with an uncertainty of approximately 30%. This is deemed sufficient to make a reliable final investment decision.

#### **TASKS**

##### **Task 9.6.1 - Local risk assessment**

Based on the risk assessment on a national scale, the risks that are applicable to the project will be identified and quantified where possible. This includes, for example, the risk on the presence of hydrocarbons. The risks will be reported using the template that is the result of WP 4.

##### **Task 9.6.2 - Local interpretation**

The national to regional scale maps and faults (output of WP 2 and Task 8.1) will be used as input for a detailed local interpretation. The seismic data will be interpreted in the highest detail possible for the top and base Dinantian, overburden around the planned well paths, faults and internal features (when possible). Seismic inversion may be tested and if useful be used to define facies / rock type / karst and the regional reservoir quality model in more detail but can also be used to refine the interpretation.

##### **Task 9.6.3 - Local static model**

The regional static model (output of Task 8.3) will be updated based on the results from the local interpretation in Task 9.3.1. This task also consists of adjusting the national and regional conceptual models to the local scale. This includes using

the well evaluation for facies type, rock physics models, lithostratigraphy, fractures from WP 2 of the relevant wells. The results of this task form the input for the next tasks.

#### **Task 9.6.4 - Local reservoir model**

Based on the local static model and the reference models developed in WP 2, WP 3 and WP 4, a reservoir model will be built to determine the subsurface well locations and the expected flow rates. The reservoir model will be tested using the geomechanical model in task 9.6.5 and adjusted if needed. The model forms the basis for the reservoir model during production and should be a 3D model when possible. The model should be sufficient for application for SDE+.

#### **Task 9.6.5 - Local geomechanical model**

This task comprises the building of a local (conceptual) geomechanical model using the generic workflow from WP 2. The regional stress field will be analysed for the impact of local geological factors on the orientation and magnitude of in situ stress, e.g. the presence of evaporites, faults, slope, etc., and adjusted if needed. This model should be of sufficient detail so that risks can be quantified as far as possible and required (as input for task 9.6.1). The developed model will be input for the assessment of the risk of induced and triggered seismicity, using the generic approach developed in WP 3. Using the results of task 9.6.4 and the generic approach developed in WP 3, a local seismic hazard assessment is carried out. This model will be tested and updated if necessary after drilling of the first pilot well in the next phase.

#### **Task 9.6.6 - Local conceptual stimulation concept**

Based on the local static, geomechanical and reservoir models (Tasks 9.6.3, 9.6.4 and 9.6.5), those concepts that are valid for the project will be selected and applied.

#### **Task 9.6.7 - Local conceptual well design**

The well design developed at the national level will be re-evaluated for the local situation. This includes adjustment to the local geology, depth and project-specific risks that are not yet included in the well design from the national level.

#### **DELIVERABLES**

D9.6a. Local static, geomechanical and reservoir models with uncertainty bandwidths necessary for the flow calculations (with and without stimulation)

D9.6b. Local risk register including the local risk on induced seismicity

D9.6c. Feasible conceptual well design and conceptual stimulation accompanied by a cost estimation for the wells with an uncertainty of 30%

#### **DEPENDENCY ON OTHER WORK PACKAGES OR TASKS**

All tasked are linked or dependent on to WP 1, WP 2, WP 3, WP 4, WP 5 and WP 8.

## Appendix 1 Detailed Budget Estimation – Confidential

The tables below show the budget estimates, including contingencies. Two estimations are shown, one for the worst case and one for the best case.



**EWP kosten specificatie (7th June '18)**

Worst case

Based on estimated costs as per June 2018.  
Spreadsheet available on digital work space  
UDG.

WP 1-4 are executed under the GTI program.

Any costs and risks involved with these  
activities will be fully carried by the GTI  
program.

Summary		Budget per partij (Worst case) in kEuro							
Phase	WP	GOUD	Havenbed rjf	Leeuward	Oost Brabant	Renkum	Schiedam	EBN	Total
Phase 1	5	344	3	6	425	694	3	1 473	2 946
Phase 2	5	1.500	559	333	1.500	1.500	625	6 016	12 033
Phase 2	6			58				58	116
Phase 2	7	25			25	25		74	148
Phase 2	8		48				48	95	190
Phase 3	9	130	130	173	210	260	130	1 033	2 065
Subtotal		1 998	739	589	2 160	2 478	805	8 749	17 498
Contingency		400	148	114	432	496	161	1 750	3 500
Total		2 398	887	682	2 592	2 974	966	10 499	20 997

**Breakdown of costs (without contingencies)**

WP	Task	Sub-ta	Description	Phase	Verdeling	GOUD	Havenbed rjf Rotterda	Friesland	Oost Brabant	Renkum	Schiedam	EBN	Total
5.5.5	5.5.1		Review of reprocessed NAM 3D seismic in Leeuwarden area	Phase 1	d-Campina			2 500				2 500	5 000
5.5.5	5.5.1		Feasibility reprocessing 3D seismic (L3NAM1987F & L3NAM1992A)	Phase 2	d-Campina			7 500				7 500	15 000
5.5.5	5.5.1		Reprocessing seismic 3D data (L3NAM1987F & L3NAM1992A) (200K)	Phase 2	d-Campina			200 000				200 000	400 000
5.5.2	5.2.1		Review of reprocessed NAM 3D seismic, connection Leeuwarden - UHM-02	Phase 1	Noord			1 500				1 500	3 000
5.5.2	5.2.1		Review lines, connection Leeuwarden - LTG-01	Phase 1	Noord			1 500				1 500	3 000
5.5.5	5.5.2		Low frequency processing of inversion	Phase 2	d-Campina			87 500				87 500	175 000
5.5.5	5.5.2		Acquisition 2D line from location Leeuwarden to 3D	Phase 2	d-Campina			37 500				37 500	75 000
5.5.6	5.6.1		Acquisition of 2 "must have" 2D lines for City of Utrecht	Phase 1	GOUD	343 750						343 750	687 500
5.5.6	5.6.2		Contingent additional 2D lines / 3D survey (unspecified)	Phase 2	GOUD	1 500 000						1 500 000	3 000 000
5.5.4	5.4.1		Review of recently reprocessed and depth imaged nearby 3D datasets	Phase 1	Zuid		2 500				2 500	5 000	10 000
5.5.7.1	5.7.1		Acquisition of 3D (or 2D) in small area	Phase 2	Rotterdam		340 000					340 000	680 000
5.5.7	5.7.2		Acquisition of seismic data for well location	Phase 2	Rotterdam		218 750					218 750	437 500
5.5.9	5.9.2		Additional acquisition due to change of scope 5.9.1	Phase 1	oost Brabant				425 000			425 000	850 000
5.5.9	5.9.3		Additional seismic for well location Oost Brabant	Phase 2	oost Brabant				1 500 000			1 500 000	3 000 000
5.5.10	5.10.1		Acquisition of 5 2D lines as proposed by project Renkum	Phase 1	Renkum					400 000		400 000	800 000
5.5.10	5.10.1		Acquisition of 3 2D lines project Nijmegen	Phase 1	Renkum					293 750		293 750	587 500
5.5.10	5.10.2		Acquisition 3D seismic, ca. 20 km <sup>2</sup> - area and acquisition parameters to be defined based on the results of phase 1 (feasibility), H1 2019 (unspecified)	Phase 2	Renkum					1 500 000		1 500 000	3 000 000
5.5.11	5.11.2		Acquisition of 2D lines for well location	Phase 2	Schiedam						625 000	625 000	1 250 000
6.6.1			Regional interpretation (excl HRV)	Phase 2	d-Campina			10 000				10 000	20 000
6.6.2			Validation using grav/mag data (excl HRV)	Phase 2	Noord			12 000				12 000	24 000
6.6.3			Regional conceptual model	Phase 2	Noord			24 000				24 000	48 000
6.6.4			Regional stress analysis	Phase 2	Noord			12 000				12 000	24 000
7.7.1			Regional interpretation	Phase 2	Midden	6 667			6 667	6 667		20 000	40 000
7.7.2			Validation using grav/mag data	Phase 2	Midden	6 667			6 667	6 667		20 000	40 000
7.7.3			Regional conceptual model	Phase 2	Midden	10 000			10 000	10 000		30 000	60 000
7.7.4			Regional stress analysis	Phase 2	Midden	1 333			1 333	1 333		4 000	8 000
8.8.1			Regional interpretation	Phase 2	Zuid		25 000				25 000	50 000	100 000
8.8.2			Validation using grav/mag data	Phase 2	Zuid		6 000				6 000	12 000	24 000
8.8.3			Regional conceptual model	Phase 2	Zuid		12 000				12 000	24 000	48 000
8.8.4			Temperature model	Phase 2	Zuid		2 500				2 500	5 000	10 000
8.8.5			Regional stress analysis	Phase 2	Zuid		2 000				2 000	4 000	8 000
9	9.1.1		Local risk assessment	Phase 3	GOUD	20 000						20 000	40 000
9	9.1.4		Local static model	Phase 3	GOUD	30 000						30 000	60 000
9	9.1.5		Local reservoir model	Phase 3	GOUD	10 000						10 000	20 000
9	9.1.6		Local geomechanical model	Phase 3	GOUD	40 000						40 000	80 000
9	9.1.8		Local conceptual well design	Phase 3	GOUD	30 000						30 000	60 000
9	9.2.1		Local risk assessment	Phase 3	Rotterdam		20 000					20 000	40 000
9	9.2.3		Local static model	Phase 3	Rotterdam		20 000					20 000	40 000
9	9.2.4		Local geomechanical model	Phase 3	Rotterdam		40 000					40 000	80 000
9	9.2.5		Local reservoir model	Phase 3	Rotterdam		20 000					20 000	40 000
9	9.2.7		Local conceptual well design	Phase 3	Rotterdam		30 000					30 000	60 000
9	9.3.1		Local risk assessment	Phase 3	d-Campina		20 000					20 000	40 000
9	9.3.4		Local static model	Phase 3	d-Campina		72 500					72 500	145 000
9	9.3.5		Local reservoir model	Phase 3	d-Campina		10 000					10 000	20 000
9	9.3.6		Local geomechanical model	Phase 3	d-Campina		40 000					40 000	80 000
9	9.3.8		Local conceptual well design	Phase 3	d-Campina		30 000					30 000	60 000
9	9.4.1		Local risk assessment	Phase 3	oost Brabant				20 000			20 000	40 000
9	9.4.3		Local interpretation	Phase 3	oost Brabant				80 000			80 000	160 000
9	9.4.5		Local static model	Phase 3	oost Brabant				30 000			30 000	60 000
9	9.4.8		Local reservoir model	Phase 3	oost Brabant				10 000			10 000	20 000
9	9.4.7		Local geomechanical model	Phase 3	oost Brabant				40 000			40 000	80 000
9	9.4.9		Local conceptual well design	Phase 3	oost Brabant				30 000			30 000	60 000
9	9.5.1		Local risk assessment	Phase 3	Renkum					20 000		20 000	40 000
9	9.5.2		CSEM	Phase 3	Renkum					120 000		120 000	240 000
9	9.5.5		Local static model	Phase 3	Renkum					40 000		40 000	80 000
9	9.5.6		Local geomechanical model	Phase 3	Renkum					10 000		10 000	20 000
9	9.5.7		Local reservoir model	Phase 3	Renkum					40 000		40 000	80 000
9	9.5.9		Local conceptual well design	Phase 3	Renkum					30 000		30 000	60 000
9	9.6.1		Local risk assessment	Phase 3	Schiedam						20 000	20 000	40 000
9	9.6.3		Local static model	Phase 3	Schiedam						20 000	20 000	40 000
9	9.6.4		Local reservoir model	Phase 3	Schiedam						20 000	20 000	40 000
9	9.6.5		Local geomechanical model	Phase 3	Schiedam						40 000	40 000	80 000
9	9.6.7		Local conceptual well design	Phase 3	Schiedam						30 000	30 000	60 000

**EWP kosten specificatie (7th June '18)**

Best case

Based on estimated costs as per June 2018.  
Spreadsheet available on digital work space  
UDG.

WP 1-4 are executed under the GTI program.

Any costs and risks involved with these  
activities will be fully carried by the GTI  
program.

Summary		Budget per partij (Best case) in kEuro							
Phase	WP	GOUD	Havenbedrijf	Leeuwarden	Oost Brabant	Renkum	Schiedam	EBN	Total
Phase 1	5	344	138	8	425	694	127	1 732	3 464
Phase 2	5	1 500		125	1 500	1 500		4 625	9.250
Phase 2	6			58				58	116
Phase 2	7	25			25	25		74	148
Phase 2	8		48				48	95	190
Phase 3	9	130	130	173	210	260	130	1 033	2 065
Subtotal		1 998	315	361	2 160	2 478	304	7 617	15.233
Contingency		400	63	72	432	496	61	1 523	3 047
Total		2 398	378	433	2 592	2 974	365	9 140	18.280

**Breakdown of costs (without contingencies)**

WP	Task	Sub-ta	Description	Phase	Verdeling	GOUD	Havenbed Rotterda	Friesland	Oost Brabant	Renkum	Schiedam	EBN	Total
5.5.5	5.5.1		Review of reprocessed NAM 3D seismic in Leeuwarden area	Phase 1	1-Campina			2.500				2.500	5.000
5.5.5	5.5.1		Feasibility reprocessing 3D seismic (L3NAM1987F & L3NAM1992A)	Phase 2	1-Campina								
5.5.5	5.5.1		Reprocessing seismic 3D data (L3NAM1987F & L3NAM1992A) (200K)	Phase 2	1-Campina								
5.5.2	5.2.1		Review of reprocessed NAM 3D seismic, connection Leeuwarden - UHM-02	Phase 1	Noord			1.500				1.500	3.000
5.5.2	5.2.1		Review lines, connection Leeuwarden - LTG-01	Phase 1	Noord			1.500				1.500	3.000
5.5.5	5.5.2		Low frequency processing of inversion	Phase 2	1-Campina			87.500				87.500	175.000
5.5.5	5.5.2		Acquisition 2D line from location Leeuwarden to 3D	Phase 2	1-Campina			37.500				37.500	75.000
5.5.6	5.6.1		Acquisition of 2 "must have" 2D lines for City of Utrecht	Phase 1	GOUD	343.750						343.750	687.500
5.5.6	5.6.2		Contingent additional 2D lines / 3D survey (unspecified)	Phase 2	GOUD	1.500.000						1.500.000	3.000.000
5.5.4	5.4.1		Review of recently reprocessed and depth imaged nearby 3D datasets	Phase 1	Zuid		2.500				2.500	5.000	10.000
5.5.7.1	5.7.1		Acquisition of 3D (or 2D) in small area	Phase 2	Rotterdam								
5.5.7	5.7.2		Acquisition of seismic data for well location	Phase 2	Rotterdam								
5.5.9	5.9.2		Additional acquisition due to change of scope 5.9.1	Phase 1	1st Brabant				425.000			425.000	850.000
5.5.9	5.9.3		Additional seismic for well location Oost Brabant	Phase 2	1st Brabant				1.500.000			1.500.000	3.000.000
5.5.10	5.10.1		Acquisition of 5 2D lines as proposed by project Renkum	Phase 1	Renkum					400.000		400.000	800.000
5.5.10	5.10.1		Acquisition of 3 2D lines project Nijmegen	Phase 1	Renkum					293.750		293.750	587.500
5.5.10	5.10.2		Acquisition 3D seismic, ca. 20 km <sup>2</sup> - area and acquisition parameters to be defined based on the results of phase 1 (feasibility), H1 2019 (unspecified)	Phase 2	Renkum					1.500.000		1.500.000	3.000.000
5.5.11	5.11.2		Acquisition of 2D lines for well location	Phase 2	Schiedam								
6.6.1			Regional interpretation (excl HRV)	Phase 2	1-Campina			10.000				10.000	20.000
6.6.2			Validation using grav/mag data (excl HRV)	Phase 2	Noord			12.000				12.000	24.000
6.6.3			Regional conceptual model	Phase 2	Noord			24.000				24.000	48.000
6.6.4			Regional stress analysis	Phase 2	Noord			12.000				12.000	24.000
7.7.1			Regional interpretation	Phase 2	Midden	6.667			6.667	6.667		20.000	40.000
7.7.2			Validation using grav/mag data	Phase 2	Midden	6.667			6.667	6.667		20.000	40.000
7.7.3			Regional conceptual model	Phase 2	Midden	10.000			10.000	10.000		30.000	60.000
7.7.4			Regional stress analysis	Phase 2	Midden	1.333			1.333	1.333		4.000	8.000
8.8.1			Regional interpretation	Phase 2	Zuid		25.000				25.000	50.000	100.000
8.8.2			Validation using grav/mag data	Phase 2	Zuid		6.000				6.000	12.000	24.000
8.8.3			Regional conceptual model	Phase 2	Zuid		12.000				12.000	24.000	48.000
8.8.4			Temperature model	Phase 2	Zuid		2.500				2.500	5.000	10.000
8.8.5			Regional stress analysis	Phase 2	Zuid		2.000				2.000	4.000	8.000
9	9.1.1		Local risk assessment	Phase 3	GOUD	20.000						20.000	40.000
9	9.1.4		Local static model	Phase 3	GOUD	30.000						30.000	60.000
9	9.1.5		Local reservoir model	Phase 3	GOUD	10.000						10.000	20.000
9	9.1.6		Local geomechanical model	Phase 3	GOUD	40.000						40.000	80.000
9	9.1.8		Local conceptual well design	Phase 3	GOUD	30.000						30.000	60.000
9	9.2.1		Local risk assessment	Phase 3	Rotterdam		20.000					20.000	40.000
9	9.2.3		Local static model	Phase 3	Rotterdam		20.000					20.000	40.000
9	9.2.4		Local geomechanical model	Phase 3	Rotterdam		40.000					40.000	80.000
9	9.2.5		Local reservoir model	Phase 3	Rotterdam		20.000					20.000	40.000
9	9.2.7		Local conceptual well design	Phase 3	Rotterdam		30.000					30.000	60.000
9	9.3.1		Local risk assessment	Phase 3	1-Campina			20.000				20.000	40.000
9	9.3.4		Local static model	Phase 3	1-Campina			72.500				72.500	145.000
9	9.3.5		Local reservoir model	Phase 3	1-Campina			10.000				10.000	20.000
9	9.3.6		Local geomechanical model	Phase 3	1-Campina			40.000				40.000	80.000
9	9.3.8		Local conceptual well design	Phase 3	1-Campina			30.000				30.000	60.000
9	9.4.1		Local risk assessment	Phase 3	1st Brabant				20.000			20.000	40.000
9	9.4.3		Local interpretation	Phase 3	1st Brabant				80.000			80.000	160.000
9	9.4.5		Local static model	Phase 3	1st Brabant				30.000			30.000	60.000
9	9.4.6		Local reservoir model	Phase 3	1st Brabant				10.000			10.000	20.000
9	9.4.7		Local geomechanical model	Phase 3	1st Brabant				40.000			40.000	80.000
9	9.4.9		Local conceptual well design	Phase 3	1st Brabant				30.000			30.000	60.000
9	9.5.1		Local risk assessment	Phase 3	Renkum					20.000		20.000	40.000
9	9.5.2		CSEM	Phase 3	Renkum					120.000		120.000	240.000
9	9.5.5		Local static model	Phase 3	Renkum					40.000		40.000	80.000
9	9.5.6		Local geomechanical model	Phase 3	Renkum					10.000		10.000	20.000
9	9.5.7		Local reservoir model	Phase 3	Renkum					40.000		40.000	80.000
9	9.5.9		Local conceptual well design	Phase 3	Renkum					30.000		30.000	60.000
9	9.6.1		Local risk assessment	Phase 3	Schiedam						20.000	20.000	40.000
9	9.6.3		Local static model	Phase 3	Schiedam						20.000	20.000	40.000
9	9.6.4		Local reservoir model	Phase 3	Schiedam						20.000	20.000	40.000
9	9.6.5		Local geomechanical model	Phase 3	Schiedam						40.000	40.000	80.000
9	9.6.7		Local conceptual well design	Phase 3	Schiedam						30.000	30.000	60.000

Work packages 1 to 4 will be executed under the SCAN programme. Any costs and risks involved with these activities will be carried by the SCAN programme.

## Appendix 2 Seismic acquisition and (re)processing

Task	Subtask	Consortia	Phase*	Activity (acquisition, (re)processing)	Fixed or Conditional	Level
5.1	5.1.1	Leeuwarden	Phase 1	Review of reprocessed NAM 3D seismic, connection Leeuwarden - UHM-02	fixed	regional
5.1	5.1.2	Leeuwarden	Phase 1	Review lines, connection Leeuwarden - LTG-01	fixed	regional
5.2	5.2.1	Havenbedrijf Rotterdam, Schiedam	Phase 1	Review of recently reprocessed and depth imaged nearby 3D datasets	fixed	regional
5.2	5.2.2	Havenbedrijf Rotterdam, Schiedam	Phase 1	Reprocessing and depth imaging 3D seismic, shared part HBR and Schiedam	conditional	regional
5.3	5.3.1	GOUD	Phase 1	Acquisition of 2 "must have" 2D lines for City of Utrecht	fixed	local
5.3	5.3.2	GOUD	Phase 2	Contingent additional 2D lines / 3D survey (unspecified)	conditional	local
5.4	5.4.1	Havenbedrijf Rotterdam	Phase 1	Reprocessing and depth imaging 3D seismic, part HBR	conditional	local
5.4	5.4.2	Havenbedrijf Rotterdam	Phase 2	Acquisition of 3D (or 2D) in small area	conditional	local
5.4	5.4.3	Havenbedrijf Rotterdam	Phase 2	Acquisition of seismic data for well location	conditional	local
5.5	5.5.1	Leeuwarden	Phase 1	Review of reprocessed NAM 3D seismic in Leeuwarden area	fixed	local
5.5	5.5.2	Leeuwarden	Phase 2	Feasibility reprocessing 3D seismic (L3NAM1987F & L3NAM1992A)	conditional	local
5.5	5.5.2	Leeuwarden	Phase 2	Reprocessing seismic 3D data (L3NAM1987F & L3NAM1992A) (200K)	conditional	local
5.5	5.5.3	Leeuwarden	Phase 2	Low frequency processing of inversion	conditional	local
5.5	5.5.4	Leeuwarden	Phase 2	Acquisition 2D line from location Leeuwarden to 3D	conditional	local
5.6	5.6.1	Oost Brabant	Phase 1	Acquisition of 2D lines Helmond 2017 survey (not in UDG-EWP budget, funded by Green Deal Brabant)	fixed	local
5.6	5.6.2	Oost Brabant	Phase 1	Acquisition of additional seismic and change of scope of 5.6.1	conditional	local
5.6	5.6.3	Oost Brabant	Phase 2	Additional seismic for well location Oost Brabant	conditional	local
5.7	5.7.1	Renkum	Phase 1	Acquisition of 5 2D lines as proposed by project Renkum	fixed	local
5.7	5.7.1	Renkum	Phase 1	Acquisition of 3 2D lines project Nijmegen	fixed	local
5.7	5.7.2	Renkum	Phase 2	Acquisition 3D seismic, ca. 20 km <sup>2</sup> - area and acquisition parameters to be defined based on the results of phase 1 (feasibility), H1 2019 (unspecified)	conditional	local
5.8	5.8.1	Schiedam	Phase 1	Reprocessing and depth imaging 3D seismic, part Schiedam	conditional	local
5.8	5.8.2	Schiedam	Phase 2	Acquisition of 2D lines for well location	conditional	local

\* Phase 1 activities are planned to take place before the first go/no-go moment, Phase 2 activities will take place after the first go/no-go moment