16. marts 2021 

**Ansøgningsskema**

*Indkaldelse af ansøgninger - Projekter til dansk deltagelse i et vigtigt projekt af fælleseuropæisk interesse (IPCEI) for brint. I det følgende gennemgås de fremsatte kriterier samt hvordan de skal udfyldes i dette ansøgningsskema.*

**Baggrund**

Ansøgningsskemaet kan udfyldes på dansk eller engelsk bortset fra resumé/summary, der skal udfyldes på begge sprog.

Ansøgningsskemaet består af følgende afsnit, hvor afsnit 3-7 reflekterer de fem udvælgelseskriterier i henhold til indkaldelsen af ansøgninger.

* Afsnit 1. Generelle oplysninger
* Afsnit 2. Resumé/summary
* Afsnit 3. Udvælgelseskriterie 1: Projektets bidrag til opfyldelse af IPCEI-kriterier
* Afsnit 4. Udvælgelseskriterie 2: Projektets fokus og effekt
* Afsnit 5. Udvælgelseskriterie 3: Projektets budget og finansiering (se budgetskema)
* Afsnit 6. Udvælgelseskriterie 4: Projektets organisering
* Afsnit 7. Udvælgelseskriterie 5: Projektets struktur, realisering og gennemførlighed
* Afsnit 8. Samtykke til deling og behandling af informationer

Alle afsnit skal udfyldes substantielt således, at beskrivelsen kan læses i sammenhæng. Udfyldelsen af ansøgningsskemaet skal holdes så **kort og præcis** som muligt, men skal samtidig være tilstrækkelig informativ til at kunne danne grundlag for en **grundig** evaluering af den samlede ansøgning. Der kan dog herudover henvises til mere uddybende bilag.

# Afsnit 1: Generelle oplysninger

**Stamdata**

Udfyld nedenstående skemaer for at redegøre for projektets stamdata.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Projekttitel** | Green CCU Hub Aalborg | | | | |
| **Projektets beliggenhed** | Rørdalsvej | | | Aalborg | 9220 |
| **Projektets startdato** | 2022 | 04 | 01 |  | |
| **Projektets slutdato** | 2032 | 31 | 12 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Projektdeltagere** | **CVR. nr.** | **Adresse** | **Kontaktperson** | | |
| **Navn** | **Tlf. nr.** | **E-mail** |
| REintegrate | 41860030 | Langerak 15 | Søren Kær | 40204795 | Skk@reintegrate.dk |
| European Energy |  |  |  |  |  |
| [Evt. partnervirksomheds navn] |  |  |  |  |  |
| [Evt. partnervirksomheds navn] |  |  |  |  |  |
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**Placering i værdikæden for brint**

Hvilke dele af værdikæden for brint befinder projektet sig indenfor?

|  |  |
| --- | --- |
| Brintproduktion | Brinttransmission og -distribution |
| Brint og brintbaserede produkter i industrielle applikationer | Brint og brintbaserede produkter i mobilitet |
| Brint og brintbaserede produkter i energisektoren | Brint og brintbaserede produkter til boligapplikationer |
| Andet |  |

# Afsnit 2. Resumé/summary

Beskriv kort projektets formål i et mindre teknisk og tilgængeligt sprog på hhv. dansk og engelsk.

Denne beskrivelse vil blive offentliggjort på Erhvervsstyrelsen hjemmeside, hvis projektet får tilsagn om støtte, og indeholder derfor et begrænset antal ord.

**Resumé på dansk (maks. [350] ord)**

[…]

CCUS focus in North Denmark according to recent plan. With the proposed project we take the first step towards the realization support by Aalborg Portland, RenoNord and E.On as potential CO2 providers. REintegrate and European Energy provides the technical and financial basis and bridges the gap to the market represented by Circle K, Mærsk and Bunker One that all support the project as potential end-users of the produced e-methanol.

**Summary på engelsk (maks. [350] ord)**

[…]

# Afsnit 3: Udvælgelseskriterie 1. Projektets bidrag til at opfylde IPCEI-kriterier

I henhold til det overordnede kriterie ”1. Projektets bidrag til at opfylde IPCEI-kriterier” skal det sandsynliggøres, at projektet som delprojekt i et vigtigt projekt af fælleseuropæisk interesse (IPCEI) kan bidrage til at opfylde kriterierne for støtteberettigelse i IPCEI-retningslinjerne[[1]](#footnote-1). Det samlede IPCEI vil bestå af flere delprojekter fra forskellige medlemslande, hvorfor projektet, der ansøges om, ikke skal kunne sikre opfyldelsen af kriterierne alene.

Kriterierne udgør punkt 11-24 (afsnit 3) i IPCEI-retningslinjerne, og der bedes for hvert punkt redegøres for, hvordan projektet bidrager til at opfylde det enkelte punkt. Der vil særligt blive lagt vægt på bidrag til opfyldelse af punkt 13-19 og 22-24.

Kriterierne kan læses i sin fulde længde inklusiv fodnoter i anneks 1 til ansøgningsskemaet.

Nedenstående skema bedes udfyldt.

|  |  |
| --- | --- |
| **Punkt 13** | [Redegørelse for, hvordan projektet på nuværende tidspunkt eller i den nære fremtid forventes at kunne bidrage til at opfylde kriteriet: ”*13. Kommissionen kan også betragte et »integreret projekt«, dvs. en gruppe individuelle projekter, der indgår i en fælles struktur, en fælles køreplan eller et fælles program, der har samme mål og bygger på en kohærent systemisk tilgang, som støtteberettiget. De enkelte dele af det integrerede projekt kan relatere til forskellige niveauer i forsyningskæden, men skal være komplementære og være en forudsætning for, at det vigtige fælleseuropæiske mål kan opfyldes."*] |
| **Punkt 14** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*14. Projektet skal på en konkret, klar og identificerbar måde bidrage til et eller flere EU-mål og skal have en væsentlig indflydelse på EU's konkurrencedygtighed, på bæredygtig vækst, på sociale udfordringer eller på værdiskabelsen i hele EU.”*] |
| **Punkt 15** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*15. Projektet skal repræsentere et væsentligt bidrag til EU's mål, f.eks. ved at være af afgørende betydning for Europa 2020-strategien, det europæiske forskningsrum, den europæiske strategi for centrale støtteteknologier, Europas energistrategi, rammen for klima- og energipolitikkerne frem til 2030, den europæiske strategi for energiforsyningssikkerhed, Europas elektronikstrategi, det transeuropæiske transport- og energinet, Unionens flagskibsinitiativer, såsom Innovation i EU, den digitale dagsorden for Europa, et ressourceeffektivt Europa eller den integrerede industripolitik for en globaliseret verden.”*] |
| **Punkt 16** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*16. Projektet skal normalt involvere mere end én medlemsstat, og dets fordele må ikke være begrænset til de medlemsstater, der finansierer det, men skal komme en væsentlig del af EU til gode. Fordelene ved projektet skal være klart fastlagt på en konkret og identificerbar måde.”*] |
| **Punkt 17** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*17. Fordelene ved projektet må ikke være begrænset til de pågældende virksomheder eller den pågældende sektor, men skal være af bredere relevans og anvendelse for EU's økonomi eller samfund ved hjælp af positive afsmittende virkninger, som er klart defineret på en konkret og identificerbar måde (f.eks. ved at have systemiske virkninger på flere niveauer af værdikæden eller på markeder i forgående eller efterfølgende omsætningsled eller have alternative anvendelsesmuligheder i andre sektorer eller føre til modalskift)*”.] |
| **Punkt 18** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: *”18. Projektet skal indebære samfinansiering fra støttemodtageren”*] |
| **Punkt 19** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*19. Projektet skal respektere princippet om udfasning af miljøskadelige subsidier, jf. køreplanen til et ressourceeffektivt Europa og adskillige rådskonklusioner*”.] |
| **Punkt 22** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: ”*22. Projekter, der indebærer industriel anvendelse, skal gøre det muligt at udvikle et nyt produkt eller en ny tjeneste med højt forsknings- eller innovationsindhold og/eller at indføre en fundamentalt innovativ produktionsproces. Regelmæssige ajourføringer uden en innovativ dimension af eksisterende faciliteter og udvikling af nye versioner af eksisterende produkter kan ikke regnes for vigtige projekter*”] |
| **Punkt 23** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet: *”23. Miljø-, energi- eller transportprojekter skal enten være af stor betydning for EU's miljøstrategi, energistrategi, herunder energiforsyningssikkerhed, eller transportstrategi eller bidrage væsentligt til det indre marked, herunder, men ikke begrænset til disse specifikke sektorer”*] |
| **Punkt 24** | [Redegørelse for, hvordan projektet bidrager til at opfylde kriteriet ”*24. Et projekt skal for at kunne betegnes som et vigtigt projekt have stor kvantitativ eller kvalitativ betydning. Det skal enten være særligt stort i størrelse eller anvendelse og/eller indebære en meget betydelig teknologisk eller finansiel risiko.*”] |
| **Øvrige punkter *(11, 12 og 20)*** | [Redegørelse for, hvordan projektet bidrager til at opfylde de øvrige kriterier i IPCEI-retningslinjernes 3. afsnit, herunder punkt 11, 12 og 20] |

# Afsnit 4: Udvælgelseskriterie 2. Projektets fokus og effekt

Der skal redegøres for projektets fokus og effekt i henhold til det overordnede kriterie ”2. Projektets fokus og effekt”. Redegørelsen struktureres efter delkriterierne.

**2.a Projektets fokus på at fremme udviklingen og implementeringen af vedvarende brint, der kan bidrage til at indfri Danmarks og EU’s klimamål for 2030, samt understøtte den langsigtede omstilling til klimaneutralitet i 2050.**

[Redegør for, hvordan projektet via et fokus på at fremme udviklingen og implementering af vedvarende brint kan bidrage til at indfri Danmark og EU’s klimamål for 2030, herunder Danmarks målsætning om 70 pct. drivhusgasreduktion i 2030 samt EU’s 2030-klimamål på mindst 55 pct. drivhusgasreduktion i 2030 og klimaneutralitet i 2050. Dertil skal der redegøres for, hvordan projektet bidrager til at fremme udviklingen af et europæisk brintmarked i henhold til EU’s brintstrategi[[2]](#footnote-2).]

REintegrate is a global pioneer in e-methanol in terms of actual production capacity and signed off-take agreements. By 2022 the first plant with a production capacity of 15.000 tons/y of e-methanol will come into operation. This facility will be the largest renewable e-methanol plant world-wide. A more recent project which is due to be completed in 2023 will create a second plant of similar size which will be brought into operation in Denmark to meet the market demand for renewable e-methanol.

European Energy is a rapidly expanding developer of wind and photovoltaics projects world-wide. European Energy will grid connect 750 MW of renewable electricity generation capacity in 2021 and maintains an annual growth rate of 30-40%.

Together, REintegrate and European Energy have the required foundation to develop PtX facilities not only in Denmark but throughout Europe and beyond making a substantial contribution to greenhouse gas reductions.

The project contributes substantially both to the 70% Danish Carbon emissions reduction Target and to the 55% percent European Target by installing substantial additional renewable electricity generation capacity. Renewable electricity penetration into into other sectors of the energy system than the classical electricity sector via so-called sector coupling has to be secured. Hydrogen has a unique ability to bridge the use of electricity to parts of the transport sector that are hard or prohibitively expensive to electrify directly.

Direct use of hydrogen requires massive investments in infrastructure and new heavy duty fuel cell trucks that will not be available in sufficient quantity to make substantial contributions towards the 2030 target. The only viable near terms option is to further process the hydrogen to liquid fuels such as methanol and use largely existing technologies and infrastructure. This is fully in line with the viewpoints of the gasoline companies that are supplying the energy for heavy transport today (mostly diesel). The main hurdle to overcome is to close the funding gap during the next 8-10 years maturation period to establish cost competitiveness in the longer term.

The Green CCU Hub Aalborg will contribute with a CO2 reduction of approximately 700.000 tons during the 5-year operation period from 2025 to 2030 with the first phase of the project alone. In 2028 a four to five-fold increase in production capacity is planned. This expansion is driven by innovation in electrolyzer cost, efficiency improvements and the development of a more mature hydrogen and e-methanol market. The 2-year period between 2028 and 2030 will contribute with an additional CO2 reduction of 1.000.000 tons. Depending on the development of the green fuels market, the CO2 reduction may partly take place in international shipping. Irrespective of the end-use sector, the project will help drive the cost of hydrogen past the tipping point mainly through efficiency improvements and scale. Scale is achieved by opening a large new hydrogen market to produce e-methanol.

These are some additional points that could be brought up to make a contribution to European goals.

**Schuman recommendations:**

* Explain and estimate the project’s contribution to reducing emissions from transport
  + passenger cars
  + commercial vehicle
  + heavy trucks
  + trains
  + ships
  + planes
  + modal shift
* Explain and estimate the project’s contribution to refuelling infrastructures
* Explain and estimate the project’s contribution to improved transportation networks
* Explain and estimate the creation of new firms, SMEs and start-ups in the green economy
* Explain and estimate investments in research and innovation activities
* Explain and estimate the contribution to the transition to low-carbon technologies and economic diversification based on climate-resilient investments and jobs
* Explain and estimate contribution to setting standards for sustainable growth across global value chains

The Green CCU Hub Aalborg has a close link to local industry with ambitious CO2 reduction plans, including Aalborg Portland and Reno-Nord. Building a CCU facility will create a foundation to recycle the biogenic part of their captured CO2 and form an important business opportunity that will make a considerable contribution towards funding the CCS of fossil CO2. This synergy between CCU and CCS is a very important aspect of the Green CCU Hub Aalborg project and the indirect contribution to CO2 reductions from industry can potentially be very significant.

The Green CCU Hub Aalborg is perfectly aligned with the European hydrogen strategy and the development of a European hydrogen market. European Energy is present in major European countries with renewable electricity production capacity and has very ambitious plans to expand its production capacity. The consortium of REintegrate and European Energy will leverage this renewable electricity production capacity for the European expansion of e-methanol production. With development of the Green CCU Hub Aalborg, REintegrate and European Energy intends to contribute towards the strategic vision for a climate-neutral EU published in November 2018, that aims for a share of hydrogen in Europe’s energy mix growing from the current less than 2% to 13-14% by 2050.

**2.b Projektets høje teknologiske modenhed og bidrag til substantiel skalering af PtX-teknologier med henblik på kommerciel anvendelse og markedsbaseret udrulning.**

[Redegør for, hvordan projektet er karakteriseret ved høj teknologisk modenhed. Projekter karakteriseret ved høj teknologisk modenhed defineres som havende et TRL-niveau (Technological Readiness Level) på 7-9[[3]](#footnote-3) ved projektets start.

Dertil skal der redegøres for, hvordan projektet bidrager til substantiel skalering af PtX-teknologier med henblik på kommerciel anvendelse og markedsbaseret udrulning. Beskrivelsen skal anføre, hvordan projektet konkret skalerer PtX-teknologier substantielt, herunder hvilke PtX-teknologier, der er tale om. Samtidig skal det anføres, hvordan projektet fører til kommerciel anvendelse af den konkrete teknologi, og hvordan projektet kan bidrage til udrulning af teknologien på markedsbaserede vilkår.]

**Schuman additional recommendations:**

* Clarify the market intended to be served by the company through the IPCEI in terms of products, potential customers, applications, geographical coverage
* Mention the key potential suppliers impacted by the company’s planned production
* Use a table to summarize the information at the end of the section

The project is a further development and innovation of the technology developed in the Danish Energy Technology Development and Demonstration Program and the Danish Energy Authorities funded projects “Power2Met” and “Greenlab Skive PtX” focusing on production of renewable e-methanol. These projects have matured the basic Danish e-methanol technology to TRL7-8. With the Green CCU Hub Aalborg project, the technology is taken to the next stage by innovation in efficiency improvement, cost reduction and dynamic operation capability taking it one step closer to commercial deployment at TRL9. REintegrate has already demonstrated the ability to close offtake agreements with customers and the enclosed support letters from Mærsk, Circle K and Bunker One provide solid evidence that REintegrate has the required commercial platform to scale offtake.

The Green CCU Hub Aalborg leverage the experience in SymbiosisNet™ from GreenLab Skive (please refer to letter of support and collaboration from GreenLab) and will establish a scalable platform with this first industrial deployment project being step one in the innovation chain bridging the crucial gap towards commercial operation. Another critical aspect of this first industrial deployment is the financial de-risking of the investment driving the cost of capital down. The Green CCU Hub Aalborg project will pave the way for the second step that involves expansion to 500 MW of electrolyzer capacity by 2028 and the third step of at least 1 GW by 2035. Sufficient CO2 is available in the CCU Hub to realize this roadmap as carbon capture technologies are matured and deployed (please refer to attached support letters from Aalborg Portland, RenoNord and E.On). As the project progresses to stages 2 and 3, efficiency and cost improvements combined with expected increase in CO2 taxation will make the technology competitive on commercial terms. Between 2025 and 2030 REintegrate will build, own and operate at least two production facilities based on the Green CCU Hub Aalborg concepts in Denmark and another three in Europe creating a very significant spill-over from the Green CCU Hub Aalborg already by 2030. Towards 2050, the roll-out will continue throughout Europe and beyond in close collaboration with end-users.

The e-methanol technology creates a platform to solve one of the key challenges of pure hydrogen, scalability. The use of pure hydrogen for mobility faces critical scalability challenges as the required offtake will not be in place due to a lack of infrastructure and vehicles in sufficient quantity to achieve the required scale until after 2030. When a hydrogen market for direct use in heavy-duty opens around 2030, it will benefit from already existing, cost efficient electrolyzer installations at the Green CCU Hub Aalborg and other facilities in Denmark and Europe deployed based on the same concept. REintegrate intends to use this advantage to supply hydrogen for direct use in transport in addition to e-methanol production.

**2.c Projektets bidrag til at indfri missionen *Grønne brændstoffer til transport og industri (Power-to-x mv.)* i regeringens forskningsstrategi om fremtidens grønne løsninger.**

[Redegør for, hvordan projektet bidrager til at indfri missionen *Grønne brændstoffer til transport og industri (Power-to-x mv)* i regeringens forskningsstrategi om fremtidens grønne løsning. Beskrivelsen af missionen i forskningsstrategien er indsat herunder.[[4]](#footnote-4)]

|  |
| --- |
| **2. Grønne brændstoffer til transport og industri (Power-to-X mv.)**  Uden en målrettet indsats, især inden for tung land-, skibs- og lufttransport samt nogle dele af industrien, vurderes det ikke muligt, at Danmarks energisystem i 2050 er baseret på 100 pct. vedvarende energi.  Der skal udvikles løsninger til at lave nye grønne brændstoffer. Det kan for eksempel ske ved at omdanne strøm fra vedvarende energi til produkter, der kan anvendes til at reducere udledningerne fra dele af transport- og industrisektoren, hvor der ikke eksisterer omkostningseffektive alternativer til fossil energi. Potentialet for CO₂-reduktion fra Power-to-X er stort, da det teoretisk set kan erstatte al fossilt brændstof forudsat, at der er tilstrækkeligt VE-strøm, og eventuelt kulstof, tilgængeligt. Der vurderes at være et langsigtet teknisk reduktionspotentiale på 1,5-7,5 mio. t., heraf 1-4 mio. t. i international skibs- og luftfart (som ikke tæller med i den danske opgørelse af drivhusgasudledninger). Frem mod 2030 vurderes det tekniske indenlandske potentiale at være 0,5-3,5 mio. t. CO₂ (der er overlap med potentialet for CCUS, idet kulstof både kan lagres og anvendes til f.eks. Power-to-X-produkter jf. ovenfor).4  Efterspørgslen efter grøn brint og andre Power-to-X-produkter er ikke tilstrækkelig til, at der er sket en markedsdrevet udbygning, hverken i Danmark eller i udlandet. Det kan skyldes, at der er store omkostninger forbundet med produktionen, så prisen på den grønne brint og andre brintbaserede produkter bliver relativt høj ift. fossile alternativer. Der er behov for en målrettet forskning-, udvikling- og demonstrationsindsats for at bringe disse delteknologer til et niveau af teknologisk modenhed, som muliggør kommerciel anvendelse, ligesom der er behov for at demonstrere, hvordan Power-to-X-systemer kan integreres i det samlede energisystem, f.eks. sammen med varmesektoren.  Danmark kan bygge på en stærk forskningsmæssig tradition inden for især brint og elektrolyse med forskningsmiljøer på flere universiteter. Der er et stort potentiale for en dansk erhvervsmæssig styrkeposition inden for Power-to-X. Erhvervsstyrker inden for grøn energiteknologi, maritime erhverv, transport og logistik, kemikalier mv. giver mulighed for at opbygge partnerskaber, som kan dække hele Power-to-X-værdikæden.  (1)  Potentialet er behæftet med meget høj usikkerhed både i forhold til effekt, dokumentation og udbredelsespotentiale. Der skal derfor tages et markant forbehold i forhold til realiseringen af potentialet. Skønnene kan ikke lægges sammen grundet flere mulige overlap. Der kan ikke sættes lighedstegn mellem igangsættelsen af forskningsmissionerne og realiseringen af reduktionspotentialerne, jf. appendiks i bilag 1. |

The Green CCU Hub Aalborg project will make a substantial contribution towards the mission Green fuels for industry and transport. REintegrate is a first-mover in Denmark and globally with the e-methanol production facility being built in Skive as stated in the support letter from Mærsk. The technology is a spin-out from Aalborg University that is further developed and innovated by REintegrate and built with Danish subcontractors. REintegrate is leading the way as market integrator and with the Green CCU Hub Aalborg project, REintegrate and European Energy team up with customers Mærsk, Bunker One and Circle K to take Danish PtX production to the next level to maintain the global first-mover position.

In Green CCU Hub Aalborg REintegrate will leverage the integration potential with the district heating grid using the SymbiosisNet™ concept from GreenLab Skive to bring down cost and improve total energy efficiency. The electrolyzer will be grid connected at the transmission system level and provide balancing capacity to the grid to facilitate integration of additional intermittent renewable electricity generation capacity. All of these are crucial components in the electrification of the energy system through intelligent sector coupling. The electricity will be supplied by European Energy through PPA agreements to ensure the renewable properties of the used electricity.

**2.d Projektets bidrag til at fremme konkurrencedygtige og omkostningseffektive løsninger indenfor brintområdet.**

[Redegør for hvordan projektet bidrager til at fremme løsninger, der er konkurrencedygtige i forhold til at kunne konkurrere på markedsvilkår og omkostningseffektive i forhold til at levere drivhusgasreduktioner.]

The Green CCU Hub Aalborg project will produce ultra-low CO2 (Greenhouse Gas Reduction of more than 90%) renewable fuels for heavy-duty road transport and shipping. These sectors contribute significantly to CO2 emissions and are not feasible to electrify directly, thus indirect electrification through PtX is a necessity. With the funding requested through this proposal, a cost competitive CO2 reduction option is established for these sectors enabling off-take agreements to be signed on commercial terms.

The Green CCU Hub Aalborg will establish a platform for further technical innovation and cost reduction (PtX plant itself, cost of capital through de-risking of the investment, and cost of renewable electricity) towards 2030 that will bring the cost level to the point where e-methanol can provide cost competitive CO2 reductions compared with other renewable fuels. Introduction of CO2 taxation will contribute further towards closing the cost gap to fossil fuels and open a much larger market for PtX products. With the electrolyzer capacity established to serve an early market for e-methanol, cost competitive hydrogen can be supplied for direct use in transport as the demand grows towards 2030 and after.

To illustrate, in concrete terms, how the cost will be brought down, a cost breakdown of e-methanol production in 2022 (GreenLab Skive PtX) and 2030 is outlined.

The 2022 case takes the following data from the GreenLab Skive PtX project where REintegrate is establishing the first e-methanol production plant:

Cost of electricity: 30 €/MWh

Electrolyzer efficiency: 50 MWh/ton of H2

Electrolyzer CAPEX and OPEX (excl. electricity): 1000 €/ton of H2

Methanol plant CAPEX and OPEX (excl. H2): 200 €/ton of methanol

Based on these numbers the cost of hydrogen in 2022 is 2500 €/ton. The methanol production requires 0,192 ton of H2 per ton of methanol hence the hydrogen cost alone per ton of produced methanol is around 480 €/ton. Adding the methanol plant CAPEX and OPEX (excl. the H2) of 200 €/ton, the cost is just below 700 €/ton of methanol in 2022.

The 2030 case takes the following data based on REintegrate prognosis and information obtained during discussions with electrolyzer OEM’s:

Cost of electricity: 25 €/MWh

Electrolyzer efficiency: 45 MWh/ton of H2

Electrolyzer CAPEX and OPEX (excl. electricity): 500 €/ton of H2

Methanol plant CAPEX and OPEX (excl. H2): 100 €/ton of methanol

Based on these numbers the cost of hydrogen in 2030 is 1625 €/ton. The methanol production requires 0,192 ton of H2 per ton of methanol hence the hydrogen cost alone per ton of produced methanol is around 310 €/ton. Adding the 2030 targeted methanol plant CAPEX and OPEX (excl. the H2) of 100 €/ton, the cost is just above 400 €/ton of methanol in 2030. For comparison, the cost of fossil methanol is nearly 400 €/ton when it is high thus approaching fossil parity.

**2.e Projektet nytte efter støtteperiodens ophør.**

[Redegør for nyttiggørelsen af projektet efter støtteperiodens ophør, herunder forventninger til, hvorvidt og hvordan projektet vil kunne fortsætte på markedsbaserede vilkår.]

REintegrate intends to continue to operate the plant after the public support period as several factors point towards a viable business case can be established provided that the critical financial support to form the foundation is granted.

* The site can be further developed to increase production capacity and improve economic feasibility.
* The electrolyzer will require an overhaul after 8-10 years where efficiency improvements in core technology will benefit the continued operation (more hydrogen is produced per MWh of electricity consumed).
* Continued cost reduction of renewable electricity will bring down production cost and improve cost competitiveness of the plant.
* Implementation of CO2 taxation will support a price premium over fossil fuels and a growing market for renewable fuels.

From close contact with large end-users of e-methanol, REintegrate is confident that there will be a market for the produced fuel after the project period.

# Afsnit 5: Udvælgelseskriterie 3. Projektets budget og finansiering

Der skal redegøres for projektets budget og finansiering i henhold til det overordnede kriterie ”3. Projektets budget og finansiering”.

[Redegør for følgende:

* Projektets budget i overordnede tal i tillæg til et udfyldt og vedlagt budgetskema. Angiv forudsætninger for alle centrale budgetposter og beskriv dertil den samlede plan for finansiering af projektet, herunder en vurdering af, at planen er realiserbar.

REintegrate and European Energy request a public cost share of DKK 400 mio. to realize the Green CCU Hub Aalborg project. With this public funding contribution, the project will be economically viable by 2024.

REintegrate and European Energy already have close links to financial institutions including the Danish Green Growth Fund that will finance part of the REintegrate Skive plant. For comparison, European Energy will invest a total of DKK 5.000 mio. in 2021 and has the financial strength to realize the Green CCU Hub Aalborg project with REintegrate as well as the expansion plans outlined in this proposal provided public funding is provided to ensure the innovation required to reduce cost and financial risk associated with this first industrial deployment.

* Finansieringsbehov inklusiv en opgørelse over de omkostninger, der ansøges om tilskud til at få dækket, i henhold til Kommissionens definition af støtteberettigede omkostninger (se anneks 2 for støtteberettigede omkostninger).
* Størrelsen på eventuel anden finansiering, herunder anden offentlig finansiering og/eller EU-finansiering, og hvorfra denne stammer samt hvilke omkostninger denne dækker.

REintegrate proposed to the newly established Growth team for Northern Jutland to provide financial support towards maturing the Green CCU Hub Aalborg project. Specifically, the proposal is to kick-start the basic engineering and permitting phases as part of the CCUS theme set for the region of North Denmark. This will accelerate the timeline by approximately one year making it feasible to start operation already by 2024/2025. Since this funding was not yet granted, this proposal covers the full investment toward the realization.

* Størrelsen på egenfinansiering, idet det vil indgå i vurderingen, hvor stor en andel egenfinansieringen udgør af den samlede finansiering.

European Energy is committed to provide the capital required to close the financing gap between total CAPEX and the requested public support. This financing gap will be as loan, co-investments from third party, and equity directed through REintegrate as new capital. A letter from CEO Knud Erik Andersen of European Energy confirming this commitment is enclosed with the application.

* At projektet har den nødvendige soliditet og likviditet for at kunne gennemføres.]

# Afsnit 6: Udvælgelseskriterie 4. Projektets organisering

Der skal redegøres for projektets budget og finansiering i henhold til det overordnede kriterie ”4. Projektets organisering”.

[Redegør for følgende:

* Ansøgers faglige, organisatoriske og finansielle styrke med henblik på at sikre den nødvendige robusthed ved gennemførelsen af det ansøgte projekt som delprojekt i et IPCEI.

The project will be managed jointly by REintegrate and European Energy. REintegrate is currently expanding the organization to execute the first PtX project in GreenLab Skive and to develop a project pipeline in Europe. Already by the end of 2021 REintegrate will have a team of 10 people focusing entirely on growing the PtX business and in 2022 another 6-8 employees will join. With European Energy as a strong capital partner and key investor in REintegrate they provide the required backing with legal support, financing experts and very strong business development skills hence fully capable to complete the state aid process. In practice, REintegrate operates as a fully integrated daughter company in the European Energy group.

* At ansøger har de nødvendige juridiske og økonomiske kompetencer til at gennemføre statsstøtteprocessen.
* De deltagende ressourcepersoners kompetencer, herunder projektledelseskompetence og de eventuelt medvirkende virksomheders relevante erfaringsområder.

Søren Knudsen Kær will be the overall project manager from REintegrate. From his long career as professor at Aalborg University, Søren has very strong experience in project management related to new energy technologies. Lars Udby will support Søren on the business and economics. Lars was responsible for the first largescale electrolyzer installation in Denmark, HyBalance, with a total budget exceeding DKK 100 mio. The technical management of the plant construction will be headed by Karsten H. Møller from REintegrate. Karsten has 30 years of experience from construction of large complex process plants. Most recently Karsten successfully managed the reconstruction of Avista Oil in Kalundborg and the large-scale heat pump installation in Farum both with budgets well beyond DKK 100 mio.

From European Energy Head of Innovation Knud Abildgaard Kragh will contribute to the overall project management from the European Energy side. Knud will be supported by specialists in legal matters, electricity trading and financing from the European Energy organization counting more than 200 employees. In addition, Director of EPC Carsten Jensen from European Energy will support REintegrate in the construction phase of the project.

The core project organization outlined above will be supported by an advisory panel with members from the companies that provided support letters to the application. This will ensure direct access to specialist covering the full value chain and ensuring, not only successful execution of the Green CCU Hub Aalborg project, but also further expansion to other sites.

* At der deltager flere led i værdikæden af relevante aktører for at medvirke til at sikre gennemførelsen af det ansøgte projekt i henhold til dets formål og for at medvirke til at fremme udbredelse af tilsvarende teknologiløsninger efter projektets afslutning.]

Port of Aalborg will engage in the work with their strong experience in fuel logistics and will make the required land available to build the Green CCU Hub Aalborg facilities. This is fully aligned with Port of Aalborg’s strategic plans as shown by their letter of support for the project.

Aalborg Portland, Reno-Nord and E.On will work with REintegrate and European Energy on the supply of CO2 for the e-methanol production. In the short term biogas CO2 will be liquefied and trucked to the facility pending the installation of carbon capture plants at Aalborg Portland and Reno-Nord. The collaboration with Aalborg Portland can form the basis for similar technologies being installed at other cement factories in the Cementir Group. Reno-Nord is a typical Danish waste incineration plant, and their experience from the Green CCU Hub Aalborg can be replicated at other Danish waste incineration plants. E.On represents several large biogas plants in Denmark and with more than 100.000 tons of biogas CO2 available already today.

On the offtake side, Green CCU Hub Aalborg works with leading companies in shipping, Mærsk and Bunker One, as well as in road transport with Circle K being one of the world’s largest gasoline retailers. Together, these partners provide a solid link to end-users and are fully capable of ensuring the required offtake to scale the hydrogen value chain in Denmark and beyond. With their letters of support and Circle K’s already existing offtake agreements with REintegrate they show their strong commitment and interest to with REintegrate.

# Afsnit 7: Udvælgelseskriterie 5. Projektets struktur, realisering og gennemførlighed

Der skal redegøres for projektets budget og finansiering i henhold til det overordnede kriterie ”5. Projektets struktur, realisering og gennemførlighed”.

[Redegør for projektets tidsplan, herunder tidsplan for indhentning af nødvendige tilladelser og lokale plangrundlag. Gennemførelsen af projektet bedes beskrives i form af arbejdspakker med et passende antal relevante milepæle.

Dertil skal der redegøres for, at projektet kan gennemføres indenfor de gældende rammebetingelser og lovgivning for køb og salg af el og energi, energiaftaler mv. eller inden for vedtagne eller forventede, men endnu ikke implementerede ændringer heraf. I tillæg hertil skal der redegøres for, at projektet kan opnå de nødvendige fysiske etableringstilladelser som bygge- og miljøgodkendelser mv. indenfor en rimelig tidshorisont.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The Green CCU Hub Aalborg project is divided into several work package to efficiently structure and manage the execution. Overall, the plan follows the experience REintegrate and GreenLab Skive developed in the GreenLab Skive PtX project. The timeline is provided as months after project kick-off, for example M10 means 10 months after starting the project.

* Include some KPI’s in the WP, additionally it is recommended a summary table(like the following), be included:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **What?** | **KPI** | **How?** |
| WP3 |  |  |  |
| WP4 |  |  |  |
| …… |  |  |  |
| …… |  |  |  |

* For each WP, describe what is the current state of the art as well as the relevant technical KPIs (not costs-related)
* For each WP, specify what technical obstacles the sector encounters that prevent further improvements in the field (current limits of the state of the art)
* For each WP, describe in sufficient detail the objectives / innovations that the company aims at in the IPCEI with the associated technical KPIs (the “what?”)
* For each WP, prove that these objectives / innovations have never been met on the market so far (new to the world)
* For each WP, describe in sufficient detail what activities will be carried out to reach the objectives (the

It should be clear which WP includes the start and end of the FID phase.

**Schuman additional recommendations with respect to the FID phase:**

* According to the footnote (1) to the annex of the IPCEI Communication, “First industrial deployment refers to the upscaling of pilot facilities, **or** to the first-in-kind equipment and facilities which cover the steps subsequent to the pilot line including the testing phase” (our emphasis); please make your choice in one of the two possibilities
* Explain in detail what the objectives of the FID phase are (the “what?”), provide the start date and the end date
* Explain in detail what activities will be carried out to reach these objectives (the “how?”)

**Work package 1: Site planning and conceptual engineering (M1-M6)**

This work package will develop the site plan including interfaces to the electricity grid, the district heating grid, the CO2 supply and storage, fuel storage and handling, waste water treatment.

Innovation and development will be carried out to improve efficiency, integrate with district heating, improve dynamic operation capability (grid balancing) and secure scalability of the complete solution. Complete overall facility design calculations including all production capacity numbers and front-end engineering design. Finish conceptual 3D illustrations to be used for the construction permit application. Consolidation of CAPEX and OPEX budgets as well as the overall business case.

Milestones:

Site plan completed (M3)

Conceptual engineering completed (M6)

**Work package 2: Permitting (M1-M18)**

Preparation of all official documents required for the construction permit application and the VVM approval. Submission of the documents and dialog with the authorities during the processing of the applications.

REintegrate has proposed work package 1 and 2 to the regional growth teams in Region North Denmark as it is perfectly aligned with the focus of their work being CCUS (see [Regionale vækstteams skal skabe vækst og arbejdspladser i hele Danmark (em.dk)](https://em.dk/nyhedsarkiv/2021/marts/regionale-vaekstteams-skal-skabe-vaekst-og-arbejdspladser-i-hele-danmark/)). If funding is granted to start the work, it will accelerate the timeline to production start.

Milestones:

VVM application submitted (M6)

VVM approved and construction permit obtained (M18)

**Work package 3: Detailed engineering and procurement (M6-M18)**

REintegrate will engage with a consulting engineering to complete detailed engineering of the Green CCU Hub Aalborg e-methanol facility based on the innovations from work package 1. The work will establish the complete technical foundation to produce the required tender documents for procurement and construction of the production plant.

An open tender process will be held including dialog with potential suppliers, contract negotiations and signing of final supplier contracts.

Milestones:

Detailed engineering completed (M12)

Complete tender material prepared (M15)

All major subcontractor agreements signed (M18)

**Work package 4: Construction and commissioning (M12-M36)**

This work package is focused on the site civil work required for site preparation, preparation of electrical installations towards the transmission grid, required installations for the connection to the district heating grid, construction of fuel storage and handling infrastructure, construction of CO2 handling and storage infrastructure.

Factory prefabrication of the complete methanol synthesis plant will be carried out closely monitored by the REintegrate project manager. The production of long lead items including the electrolyzer will be initiated in due time to meet the deadline for site installation.

Site installation of all equipment including the methanol synthesis plant, the electrolyzer, final approval and line walk of the complete facility. Commissioning of the entire plant and production ramp-up.

Milestones:

Site preparations completed (M24)

Factory prefabrication completed (M30)

Site installations completed (M34)

Production ramp-up completed (M36)

**Work package 5: Operation (M36-M60)**

This work package covers the first years of production with the required fine tuning of the production plant. This work also covers the first years of fuel supply to the early adopters of e-methanol and secures the required technical and financial support to enable the end-use cases.

Milestones:

First delivery of e-methanol to end-user (M36)

End of financial support period (M60)

**Work package 6: Management and dissemination (M1-M60)**

This work package concerns the project management activities including the financial and technical reporting towards the funding body.

Dissemination activities will be carried out under this work package including quarterly update of a dedicated project website hosted and managed by REintegrate. The website will communicate all non-confidential aspects of the project to ensure the obtained knowledge is made available to stakeholders across Europe.

During the project execution REintegrate and European Energy will work with GreenLab Skive to use their dissemination platform to show case the project activities. REintegrate will be open to allow interested parties to tour the facilities to the extent that safety regulations allow.

Milestones:

Project website established (M3)

Project communication plan developed (M6)

*Der skal redegøres for, at projektet ikke vil blive gennemført i den ansøgte version – enten slet ikke eller i en betydeligt svækket version, hvis der ikke opnås støtte. Det skal anføres, hvorledes tilskud til det ansøgte projekt vil øge indsatsens omfang, udstrækning, tempo set i forhold til en situation, hvor der ikke opnås støtte.*

Without the requested financial support, it is not economically viable to establish the Green CCU Hub Aalborg. At this scale, the economic risk is too large for the project to be realized on commercial terms alone. Although the participating end-users are ready to cover part of the cost premium over fossil fuels, the cost of the produced green fuel will be too high to secure offtake agreements and make the project bankable. In addition, being the first industrial deployment at this scale entails a significant technical risk that is too high to be covered by the companies alone. Consequently, without the requested support the project will not be realized in the described form resulting in a significantly slower deployment of PtX in Denmark. REintegrate estimates that the requested funding will leverage a deployment of 500-1000 MW of electrolyzer capacity before 2030. Without public cost share, the deployment will be much less, on the order of 100-150 MW before 2030.

Endelig skal det anføres, hvordan projektets resultater bliver opsamlet og offentligt formidlet med den nødvendige impact. Der skal redegøres for, hvem projektets resultater vil blive formidlet til, hvordan resultaterne vil blive formidlet (kommunikationsplatforme, besøgstjeneste mv.) samt hvordan resultater undervejs vil blive opsamlet og bearbejdet, herunder der vil være eventuelle undtagelser i formidlingen som følge af IPR-spørgsmål eller lign. (fortrolige oplysninger).]

REintegrate will work with GreenLab, Aalborg University, Danish Hydrogen Association, and other similar stakeholders and networks to disseminate the project results to as broad an audience as possible. GreenLab is planning to establish an innovation and visitor center at their site in GreenLab Skive. A dedicated area in the building will be allocated to show recent photos and descriptions of the Green CCU Hub Aalborg plant. REintegrate will host interns from Aalborg University and other Danish universities to allow the students to get hands-on experience with all aspects of the PtX value chain.

After production start month 36, an inauguration ceremony will be held where interested stakeholders will have an opportunity to visit the plant.

Example text:

Re-integrate commits to undertake the following dissemination actions of non-IP protected results from the IPCEI on Hydrogen:

* Share results with the scientific & technological community through conferences/workshops
* Share results with the scientific & technological community through publications
* Share results with the scientific & technological community through the participation in large European research projects (e.g. Horizon Europe)
* Share Results with the scientific & technological community through R&D collaborations with universities and public research organisations
* Share results with the scientific & technological community through actions in industry associations
* Promote/fund the completion of doctoral work in the field
* Promote/fund the completion of post doctoral work in the field
* Set up/ Participate in courses & training
* Set up/Participate in apprenticeship programs

# Afsnit 8: Samtykke til behandling og deling af informationer

De indsendte informationer vil håndteres i overensstemmelse med databeskyttelsesforordningen, og den udarbejdede samtykkeerklæring i anneks 3, der uddyber ansøgers rettigheder for informationsdeling.

[Du bedes her angive, om du vil give dit samtykke til, 1) at dine oplyste kontaktoplysninger mv. behandles af Erhvervsstyrelsen (JA/NEJ)

og 2) om du vil give samtykke til, at oplysningerne deles med Kommissionen og andre danske myndigheder virksomheder (JA/NEJ)]

Læs mere om samtykket og dine rettigheder i Anneks 3 om samtykkeerklæring.

1. Meddelelse nr. 2014/C 188/02 om kriterier for analysen af, hvorvidt statsstøtte til fremme af gennemførelsen af vigtige projekter af fælleseuropæisk interesse er forenelig med det indre marked Meddelelsens anvendelse er forlænget til den 31. december 2021 i henhold til Europa-Kommissionens meddelelse nr. 2020/C 224/02. [↑](#footnote-ref-1)
2. Meddelelse fra Kommissionen ”En strategi for brint med henblik på et klimaneutralt Europa” ([Link](https://eur-lex.europa.eu/legal-content/DA/TXT/PDF/?uri=CELEX:52020DC0301&from=DA)) [↑](#footnote-ref-2)
3. Læs her for nærmere definition fra Europa-Kommissionen: <https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf> [↑](#footnote-ref-3)
4. Fremtidens grønne løsninger - Strategi for investeringer i grøn forskning, teknologi og innovation, s. 21 ([Link](https://ufm.dk/publikationer/2020/filer/1-fremtidens-gronne-losninger-strategi-for-investeringer-i-gron.pdf)) [↑](#footnote-ref-4)