



## Decarbonizing the Gas Grid: Lessons from Denmark

April 15 to 20, 2024

FINAL Agenda – Updated April 15

Welcome to Denmark! We are so excited to have you with us, and we hope that you become equally excited about the Danish way of building sustainability into almost every aspect of daily life.

### Our only rules for the trip:

1. We leave exactly on time! We have a lot of ground to cover and want to be respectful of both our hosts and the other participants. This means if you miss a departure you will need to find your way to where we will be on your own. All departure times and addresses of our destinations are included in this itinerary.
2. We provide preselected wines for all group meals. If you would like to drink something different, such as a cocktail or an alternative wine, please let the wait staff know that you will be paying for that on your own.
3. Please let us know by early afternoon if you are not planning to join us at one of the group dinners. We want to be able to inform the restaurants in time so that good meals don't go to waste!

We encourage you to read I-SUSTAIN's report, *Decarbonizing the Gas Grid: The Role of Renewable Fuels in Denmark's Path to Carbon Neutrality*, in advance of our meetings. This report, available on the i-SUSTAIN web site at <https://www.i-sustain.com/decarbonizing-gas-2024background>, will provide valuable background and context.

### **MONDAY (15 April) - Copenhagen**

Directions to our hotel: With a station right at the CPH airport, it's easy to catch the Metro. Buy a 3-zone ticket to center city at the self-serve DSB vending machines in the main terminal. Then take the elevator up to the Metro station, where you will catch the M2 toward Vanløse Station. Trains depart every 3 minutes, so there's no need to run! Go eight stops (13 min.) to Kongens Nytorv Station. Once you're at Kongens Nytorv go up the two banks of escalators and keep walking in that direction until you see the Gade Street / Strøget exit. Take the stairs (or the elevator) up to street level, and with the Rolex sign behind you walk around the square toward the building with the Huawei sign. Nyhavn, a busy pedestrian-filled street, will then be to your right, and our hotel will be at the far end of the street. From Kongens Nytorv, it's a 9-minute walk (1/2 mile) to Hotel 71 Nyhavn.

*Afternoon – Check into our hotel in Copenhagen*

*Address: 71 Nyhavn*

King Christian IV founded the Nyhavn area to support the flourishing trade in the 1600s. The harbor was completed in 1673 as an alternative to the old port (the name Nyhavn was derived from "Den Nye Havn", the New Harbor) and for many years Nyhavn was a busy commercial port where ships from all over the world docked. The 1,500-foot-long canal in Nyhavn was constructed to make Denmark more competitive in the trade business by creating a waterway that led straight into Kongens Nytorv – the new upcoming city center of Copenhagen. The warehouse was built in 1805 and became a hotel in 1971. It's a great example of urban reuse.



*5.00p to 5.25p – Meet and greet in the hotel lobby*

*5.25p – Leave our hotel lobby to walk down to the water taxi, which we will take to BLOXHUB  
Address: BLOXHUB, Bryghusgade 8, 3, 1473, 1473 København K*

*6.00p to 7.00p – Introductory meeting at BLOXHUB*

We'll provide some background on the goals of the trip, review the itinerary and rules, and do a quick round of introductions.

*7.00p – Leave the lobby and walk together to Aamanns 1921 for our welcome dinner*

*7.30p – Group Welcome Dinner at Aamanns 1921  
Address: Niels Hemmingsens Gade 19-21, 1153 København K*



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## **TUESDAY (16 April) - Copenhagen**

*9.00a – Leave the hotel lobby and walk to Kongens Nytorv and then take the Metro to State of Green for our morning meetings*

*Address: Vesterbrogade 1E, 1620 København*

*9.30a to 12.00p – Series of meetings at House of Green*

This is a locked facility. You must be at the front door with the group by 9.25a to be let in for our meetings.

*9.30a to 10.00a – State of Green: Denmark's Green Transition*

State of Green is a not-for-profit, public-private partnership that seeks to foster relations with international stakeholders. This presentation will provide an introduction to Danish perspectives on the role of renewable energy and renewable fuels, with an emphasis on how Danish companies and solutions are allowing the nation to decarbonize the energy sector while achieving economic growth.



*10.00a to 11.00a – Danish Energy Agency: Biogas, PtX and Green Hydrogen Initiatives*

The Danish Energy Agency, established in 1975, is an agency of the Danish Ministry of Energy, Utilities and Climate and Energy. It is responsible for activities related to energy production, supply and consumption, as well as Danish efforts to reduce carbon emissions. This includes responsibility for the regulations regarding government subsidies and other support for sustainable biogas and hydrogen production. The Agency will discuss how the government's policies have accelerated the growing biogas economy, and will provide an overview of climate goals and government policies related to green hydrogen production through Power to X.



*11.00a to 11.15a – Coffee break*

*11.15p to 12.00p – Energinet / Gas Storage Denmark*

As the Danish national transmission system operator, Energinet owns, operates and develops the transmission systems for both electricity and natural gas in Denmark. Energinet also oversees the green certificates issued for carbon credits for biofuels, and established the quality guidelines for RNG that is injected into the national distribution system. The presentation will

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provide an introduction to Energinet, discuss the Danish biomethane experiences. And provide an update on the future Danish hydrogen backbone.

Gas Storage Denmark is a wholly owned subsidiary of Energinet. The existing Gas Storage Denmark facility at Lille Torup is proposed to be converted into the Green Hydrogen Hub (GHH), a facility for storing and using green hydrogen. This project will take some of the salt caverns currently used to store natural gas and repurpose them for green hydrogen storage and compressed air energy storage (CAES). When the weather allows for generation of more wind energy than what is demanded, this excess energy will be used for electrolysis to generate green hydrogen. Part of the hydrogen will be used to fuel the CAES facility, where air from the atmosphere is compressed and then stored. When renewable energy sources do not produce enough electricity to satisfy the demand, the compressed air can be released from the storage and through turbines in the CAES facility to generate green energy once again. The other part of the hydrogen that is produced by electrolysis will be stored in another cavern, to be used in its pure form as fuel or combined with carbon or nitrogen to produce sustainable e-fuels. The green hydrogen can be stored for as long as six months, which will enable GHH to provide green energy all year round, regardless of the weather.

*12.00p to 12.15p – Walk to Vesterport Station and take S-Train to TorvehallerneKBH for lunch  
Address: Frederiksborggade 21, 1362 København*

*12.15p to 1.30p – Casual lunch on your own at TorvehallerneKBH*

Torvehallerne is one of Copenhagen's gems for locals and tourists alike. You can find fresh vegetables and exquisite little food bars where you can get specialties from all over the world. The stalls in Torvehallerne are known for their high quality, which is predominantly sustainable and organic.

*1.30p to 2.00p – Travel by Metro from Nørreport to Crowne Plaza Copenhagen Towers  
Address: Ørestads Blvd. 114, 118, 2300 København, Denmark*

*2.00p to 3.00p – Ground source heating and cooling at Crowne Plaza Copenhagen Towers*

Ground source heating and cooling systems (geothermal systems) take advantage of the relatively constant temperatures beneath the earth's surface - this constant earth temperature is higher than average winter temperatures, and lower than average summer temperatures. Heat pumps can operate efficiently by transferring heat between a building and the earth. These systems can use either shallow ground loops or deep bore wells that are hundreds or even thousands of feet deep. Aquifer thermal energy storage (ATES) systems improve the efficiency of heat pump operations even more.

One of the world's most advanced ATES systems is located underground in the basement of the Crowne Plaza Hotel. Cold groundwater is used for cooling the guest rooms during the summer, while the heat rejected from this process is stored and reused for heating during the winter. No active refrigeration is required while the groundwater is circulated through the hotel's hydronic air conditioning system. By reversing the flow, the warm groundwater is also available for heating during the winter season. During the heating season, the chiller is turned into a heat pump. The groundwater is cooled and returned to



the aquifer's cold well. The water is returned at a temperature similar to the temperature of the untouched groundwater.

*3.00p to 3.30p – Travel by taxi to Copenhill Waste to Energy Plant (optional)*  
*Address: Amager Resource Center, Vindmoellevej 6, DK-2300 Copenhagen S*

Our trip to Copenhill and the happy hour there is optional. If you prefer to skip this you can just take the Metro back to our hotel, getting off at the Kongens Nytorv station.



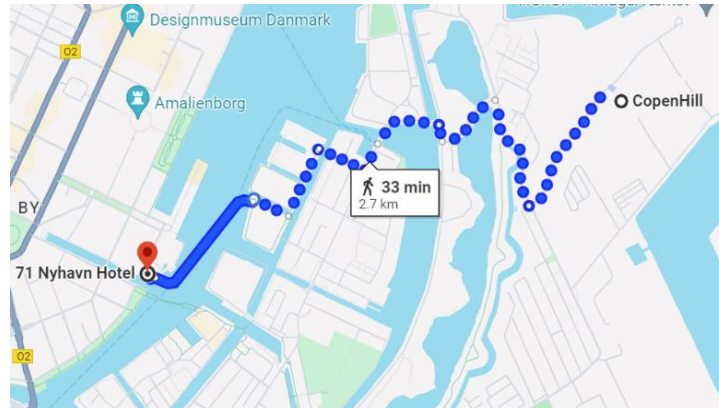
*3.30p to 4.00p – Informal walking tour of the exterior of Copenhill*

Amager Bakke (Amager Hill), also known Copenhill, is a combined heat and power, waste-to-energy plant and recreational facility within view of the city's downtown. The facility opened in 2017 and was designed to play a major role in Copenhagen's ambitions of meeting zero carbon requirements by 2025. This is the world's cleanest and most advanced waste processing plant, comfortably outperforming the EU's standards for best practice. The plant is currently working toward achieving carbon neutrality, with a new carbon capture demonstration plant, inaugurated in August 2023, capturing up to 4 tons of CO<sub>2</sub>/day. The goal is to commission a full-scale carbon capture unit that will capture up to 500,000 tons of CO<sub>2</sub> annually.

Although we won't be touring the waste management and energy production aspects of the plant, the building itself demonstrates how an industrial facility, typically designed to be hidden from public view, can be sited close to an urban center and provide important public amenities. The roof of the building is divided into four separate ski slopes, each with its own lift system, and all covered with green artificial snow mats. On the exterior wall of Copenhill you will find the tallest artificial climbing wall in the world, at more than 250 feet high. These recreational components, which also include 10 hiking trails, are used by an estimated 40 to 60 thousand visitors annually.

*4.00p to 5.00p – No host happy hour to enjoy the view from the top of Copenhill*

Stay to enjoy a no host brew at the rooftop café – perhaps your only opportunity ever to have a drink and enjoy views while sitting in a parklike setting on top of a garbage processing facility!



Map 1- CopenHill to Hotel via Walking and Water Taxi

*Approximately 5.00p to 5.30p – Walk or travel by taxi back to our hotel*

We'll take taxis back to our hotel. If you prefer you can go on your own and just meet us at the hotel, or at the BrewPub Copenhagen for dinner. For those that don't want to take a taxi it's a pleasant and scenic two-mile walk back to the hotel via the water taxi, which stops right by our hotel (Map 1).

*6.30p – Leave the hotel lobby with those that want to walk together to dinner, or you can just meet us at the restaurant. It will be about a 30 min walk down the Strøget, a bustling pedestrian walkway that is the longest pedestrian shopping street in Europe.*

*7.00p – Casual group dinner outside on the covered, heated patio at BrewPub Copenhagen (dress warm!)*

*Address: Vestergade 29, 1456 København K*

### **WEDNESDAY (17 April) – Copenhagen to Odense**

*8.15a – Make sure you are checked out of your room and your bags are on the group bus.*

*8.30a to 9.00a – Take our group bus to Dansk Metal*

*Address: Molestien 7, 2450 København SV*



### *9.00a to 10.30a – Meeting with Dansk Metal*

Dansk Metal is the union that represents the metal workers in Denmark, with workers in automotive, IT, telecommunications, construction, aviation, and other industries. Dansk Metal is also building new homes – including student and dormitory housing, as well as apartments – at the Sydporten in Copenhagen, where members of Dansk Metal have the first right to rent. The union represents many of the workers who are key to the growth of the green economy in Denmark. We will be hearing about their initiatives to provide training and workforce development for these critical skills.



### *10.30a to 12.30p – Take group bus to Odense*

#### *12.30p to 1.45p – Group lunch at Kong Volmer in Odense*

*Address: Kong Volmer, Brandts Passage 13, 5000 Odense*

This variation on a traditional Danish restaurant breathes new life into the classic smørrebrød (open face sandwich). The restaurant's mission is to modernize the smørrebrød, culminating in the development of Kong Volmer's snack size Smørrebrødshapsere, or snapas, which are smørrebrød made in Tapas sizes.

#### *1.45p to 2.00p – Travel by group bus to Fjernvarme Fyn*

*Address: District Heating Funen, Havnegade 120, DK-5000 Odense C*

#### *2.00p to 2.45p – Presentation on District Heating at Fjernvarme Fyn*

In Denmark district heating serves almost 70% of the homes, distributing hot water through 40,000 miles of insulated pipes. The heat can be produced at a Combined Heat and Power (CHP) plant, using heat pumps to transfer heat to/from the ground or sea water, or by capturing waste heat generated by data centers and industrial processes. Fjernvarme Fyn operates one of the largest district energy systems in the world, serving 70,000 customers in and around Odense through an increasingly decentralized generation and distribution system.



#### *2.45p to 3.00p – Travel by bus to Fjernvarme Fyn's Plant adjacent to the META data center*

*Address: M. P. Allerups Vej 57, Odense*

#### *3.00p to 4.00p – Presentation and site tour of waste heat capture from META's data center*

META's data center was located and designed with heat recovery in mind from the outset. Fjernvarme Fyn, the local district energy utility, uses their facility adjacent to the data center to recover the low

temperature heat generated by the thousands of servers and delivers this heat for free to the community. The goal is to recover and donate 100,000 MWh of energy annually from the servers — enough to warm 11,000 homes.

*4.00p to 4.15p – Travel by bus to Hotel Odeon*

*Address: Odeons Kvarter 11, 5000 Odense*

*6.00p – Hosted Happy Hour at S'vineriet Vinapotek*

*Address: S'vineriet Vinapotek, Klaregade 34-36, 5000 Odense*

Come meet us there for wine and appetizers. It's a 10 to 15 min walk from the hotel.

*Evening – Stroll through lovely Odense and enjoy dinner on your own*

### **THURSDAY (18 Apr) – Odense to Skive (round trip)**

*We will be staying at our hotel for a second night, so you do not need to check out or pack your bags today! We will have a long bus ride today, so it's a good chance to catch up on work or reading.*

*9.00a to 12.00p – Take group bus to KulturCenter Skive*

*Address: Skyttevej 12-14 - 7800 Skive*

We'll be stopping in Brande, at about the mid-point of the drive, for 20 to 30 minutes to give you some time to stretch your legs and see the public murals the town is known for.

*12.00p to 12.45p – Lunch at KulturCenter Skive*

*12.45p to 1.30p – Presentation on GreenLab Skive*



GreenLab is a unique, green and circular industrial park, established in 2019 to test, demonstrate and accelerate the green transition by improving the way renewable energy is produced, converted, stored and utilized. It generates sustainable energy, supplies it to the businesses located there, and transforms it into heat, electrofuels, and other green products. The GreenLab Biogas plant produces 21M m3 of biogas per year, and handles both manure and industrial waste from nearby production facilities.

With its projects, GreenLab is also a frontrunner in green hydrogen and has helped to solve the knots that arise when a whole new market is created, and value chains are assembled. GreenLab's unique SymbiosisNet™ enables the park's companies to share surplus energy - in all its forms - with each other, ensuring an efficient and higher utilization of renewable energy and a meaningful conversion from electricity to e-fuels.





### *1.30p to 2.00p – Presentation on Green Hydrogen Systems’ PtX facility at GreenLab Skive*

Green Hydrogen Systems (GHS) is a frontrunner in PtX and is now testing the world’s first full-scale PtX electrolyzer module, rated at 6MW. That will enable the production of green hydrogen, scalable hydrogen storage and distribution, as well as PtX symbiosis activities such as methanol production. Later this year GHS plans to begin construction of a 100 MW electrolysis plant involving several national and international partners. The GreenHyScale plant will employ pressurized alkaline electrolysis to enable large-scale production of green hydrogen, enabling the establishment of a commercially viable hydrogen infrastructure. Alkaline electrolysis is the most cost-efficient type of electrolysis, and a technology that efficiently works with the variable load from renewable electricity sources.

### *2.00p to 2.15p – Short drive on our group bus to GreenLab Skive*

Address: Næstildvej 10A, DK-7860 Spøttrup

### *2.15p to 3.00p – Walking tour of GreenLab Skive and Green Hydrogen Systems’ PtX facility*

### *3.00p to 6.00p – Take group bus back to our hotel in Odense, Hotel Odeon*

Address: Odeons Kvarter 11, 5000 Odense

### *Evening – Our bus will drop you off for a fun and casual group dinner at Storms Pakhus*

Address: Storms Parkhus, Lerchesgade 4, 5000 Odense

Storms Pakhus is a unique and lively indoor global street food experience, inside of an old, repurposed timber warehouse. We will provide you with a prepaid card so you can choose your meal at any of the two-dozen food and drink stalls and then join everyone at our reserved group table. It’s an easy walk back to our hotel – you can stay late, or leave as early as you want.

## **FRIDAY (19 April) – Odense to Copenhagen**

*8.30a – Make sure you are checked out of your room and your bags are on one of the group buses.*



We will be splitting into two equal sized groups to visit different biogas plants, so you'll need to decide which of the biogas plants you prefer to visit. Both plants are operated by Nature Energy, which began in 1979 as Naturgas Fyn, a natural gas distribution company. It established its first biogas plant in 2015, and today is Denmark's largest producer of biogas, and one of the leading producers of biogas in the world. Nature Energy currently has 11 operational biogas plants throughout Denmark, consuming manure and food waste, with several more under development.

We will be providing brown bag lunches for you to eat on the bus after your morning site visit.

### **GROUP 1**

*8.45a to 10.30a – Take group bus to Nature Energy's Køng Biogas Plant  
Address: Næstvedvej 392, DK-4750 Lundby*

*10.30a to 12.30p – Nature Energy Køng Biogas Plant, presentation and site visit*

The Køng Biogas Plant is a good example of co-digestion, as it processes multiple streams of different feedstocks in a single facility - a small amount of manure is added to 100,000 tons of beet pulp from sugar factories, straw and spent grain from a brewery. Due to the biomass mix, the layout includes a large open silo storage facility. The plant produces about 550 to 650 million ft<sup>3</sup> of gas annually.

*12.30p to 2.00p – Take group bus to BLOXHUB  
Address: Bryghusgade 8, 3, 1473, 1473 København K*

Brown bag lunches will be provided, and your luggage will be delivered to our hotel, Copenhagen Island.

### **GROUP 2**

*9.00a to 9.45a – Take group bus to Nature Energy's Nordfyn Biogas Plant  
Address: Odensevej 158, 5400 Bogense.*

*9.45a to 11.30p – Nature Energy's Nordfyn Biogas Plant, presentation and site visit*

The Nordfyn Biogas plant was one of Nature Energy's first plants, originally designed to handle 300,000 tons of biomass annually, but expanded in 2020 to a capacity of 500,000 tons. The plant processes manure, deep litter, industrial residues, and grain residues and produces about 800 million ft<sup>3</sup> of gas annually.

*11.30p to 2.00p – Take group bus to BLOXHUB  
Address: BLOXHUB, Bryghusgade 8, 3, 1473, 1473 København K*

Brown bag lunches will be provided, and your luggage will be delivered to our hotel, Copenhagen Island.



### *2.30p to 5.00p – Mandatory debrief meeting at BLOXHUB*

We will use this time to discuss what we saw during the week, its significance, its relevance to our own region, and potential next steps.

### *5.00p to 5.30p – Walk back along the waterfront to our hotel, Copenhagen Island*

*Address: Kalvebod Brygge 53, 1560 København, Denmark*

### *8.00p – Leave hotel to walk to our dinner restaurant, Fleisch*

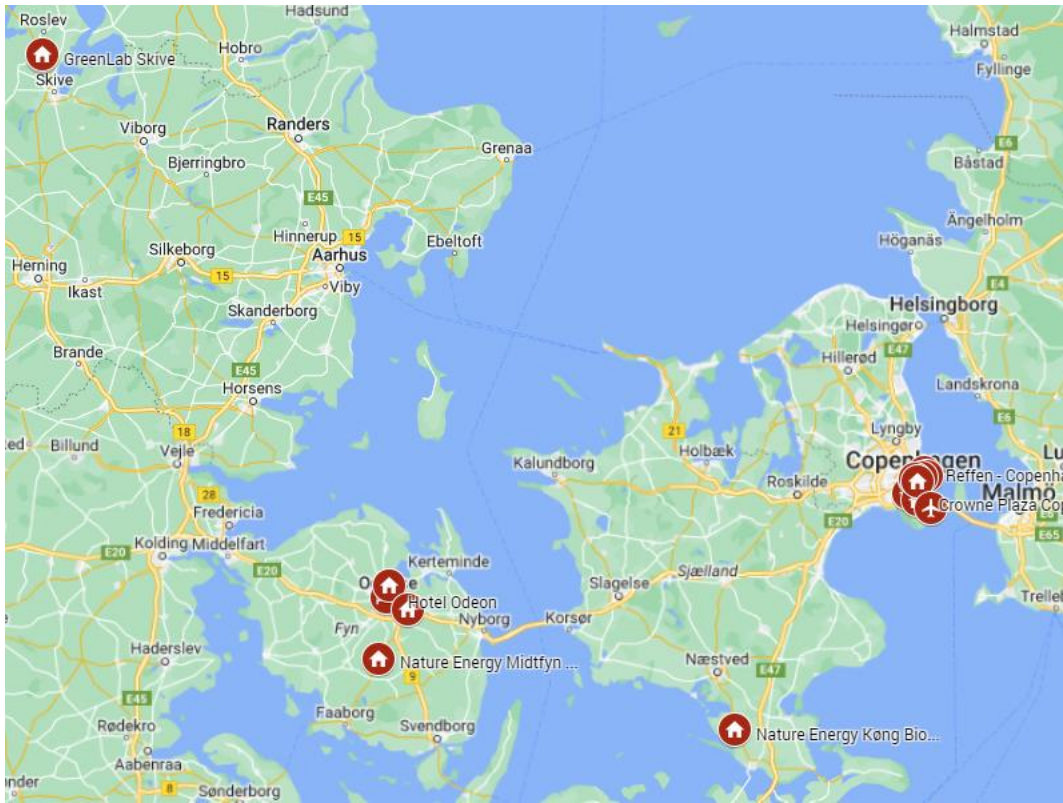
*Address: Fleisch, Slagterboderne 7, 1716 København V*

This will be about a 20-minute walk through the Meatpacking District, a revitalized industrial area known for its trendy dining scene and buzzing nightlife. Please let us know if you prefer to just meet us there, or if you will not be joining us for the farewell dinner.

### *8.30p – Farewell dinner at Fleisch*

## **SATURDAY (20 April) - Departure**

*Our i-SUSTAIN program is over!*



Map 3 - Overview of Site Visits

Click on this map to go to an interactive, on-line view with labels for all the places we will be visiting.