OPERATIONAL FLEXIBILITY OF CO_2 TRANSPORT AND STORAGE

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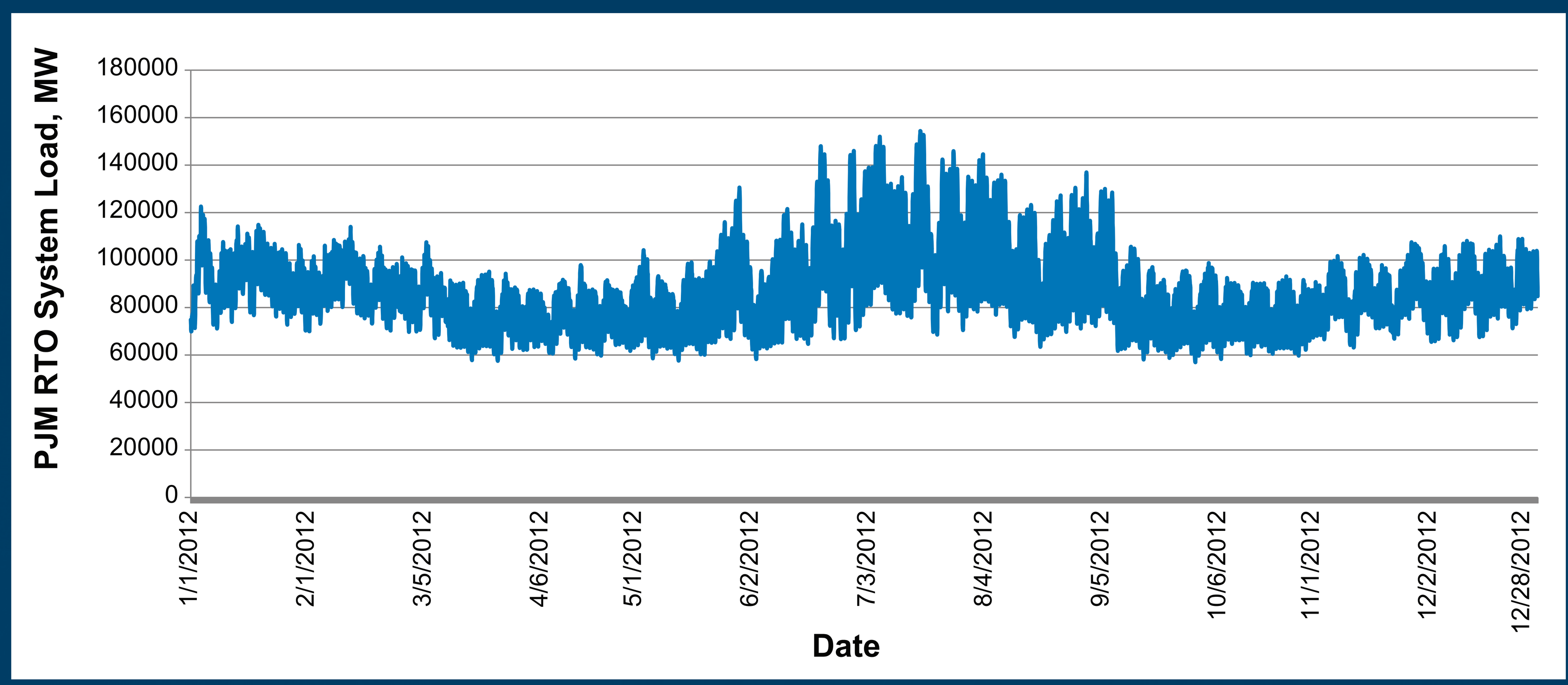
Introduction

Carbon dioxide (CO_2) is produced in large quantities during electricity generation and industrial processes. Each different process produces a CO_2 stream having a different composition. In addition, the CO_2 generation rate can vary substantially for at least some of the processes. For example, generation of CO_2 from electric power plants fluctuates with power demand, which varies both on a short-term (minute-to-minute) and a longer-term (seasonal) basis. The design and operation of the entire CO_2 capture, compression, transport, and storage system must account for these types of variations. The impact of a varying mass flow rate on pipeline and storage operation is not fully understood in terms of either operability or infrastructure robustness. It is important that the magnitude of the challenges posed by variation of CO_2 stream flow rate or composition be understood so that solutions can be offered to minimize deleterious effects.

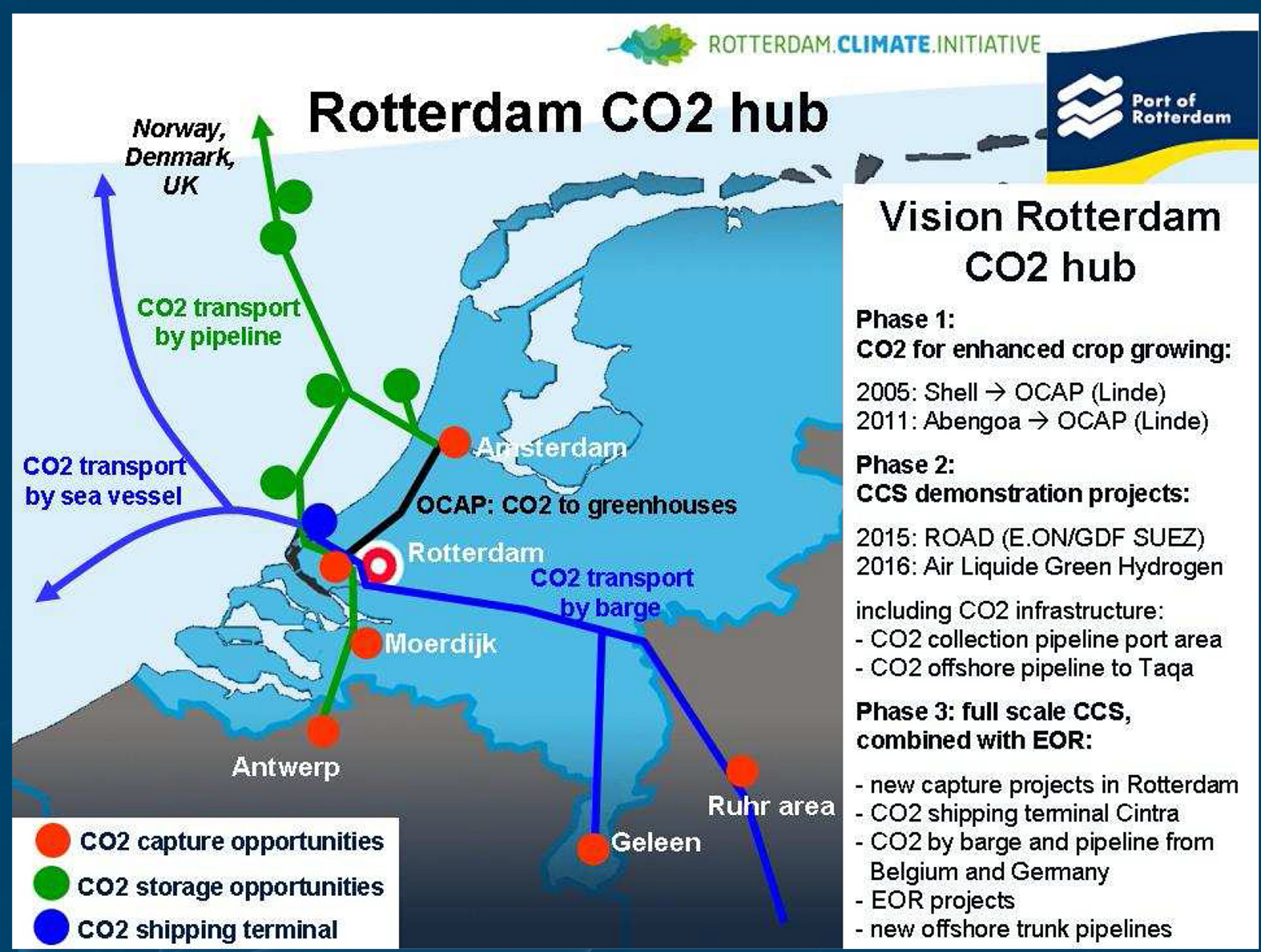
The goal of this study, which is still in progress, is to ascertain the extent of the technical challenges posed by the transport, and storage of CO_2 from emission sources that do not produce a consistent CO_2 stream in terms of composition and/or mass flow rate. A literature search was performed to provide a basis for understanding the various issues associated with the transport and geologic storage of variable and/or intermittent CO_2 streams. Publicly available information has been collected on the operational flexibility of existing CO_2 pipelines and geologic storage facilities as well as modeled scenarios. Telephone interviews are being conducted with experts in CO_2 pipeline transport, injection, and storage to acquire real-world, anecdotal information that can augment information found during the literature searches.

This project began in February 2014 and will be completed in January 2015.



Electrical system load is directly related to the emission of CO_2. This shows the variation of the system load for the PJM Interconnection Regional Transmission Organization in the eastern United States during 2012.

There are more than 6600 km (4100 mi) of CO_2 pipelines in the United States. Additional pipelines are planned in Canada and the United States, but are not shown on this map.



Map of the Rotterdam CO_2 Hub in the Netherlands. The OCAP CO_2 pipeline carries CO_2 through a 97-km pipeline from a refinery to greenhouses to enhance plant growth.[1]

Denbury's Green Pipeline was designed to transport both natural and anthropogenic CO_2 and is routed near several potential industrial CO_2 sources.[2]

A Range of Issues Is Being Studied:

- The extent of variables from various source types.
- Process control strategies; health, safety, and environmental issues; and parameters affecting capital, operating, and maintenance costs of flexible CO_2 pipelines and geologic storage sites.
- Design options for a pipeline network that can minimize the effects of source variation.
- The effects of CO_2 stream composition on both injection/subsurface behavior and phase change during transient pipeline conditions.

The Sleipner A CO_2 injection platform is on the right.[3]

Findings to Date

- Intermittent flow potentially can cause hydrate formation and salt precipitation in the reservoir/downhole environment.
- Pipeline control strategy depends upon the ability to control the volumes received from the sources and delivered to the storage sites.
- Techniques, procedures, and protocols developed by the CO_2 enhanced oil recovery industry to minimize the effects of variable or intermittent CO_2 flow on both pipelines and well and reservoir operations are likely applicable to other carbon capture and storage situations.

Acknowledgments

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