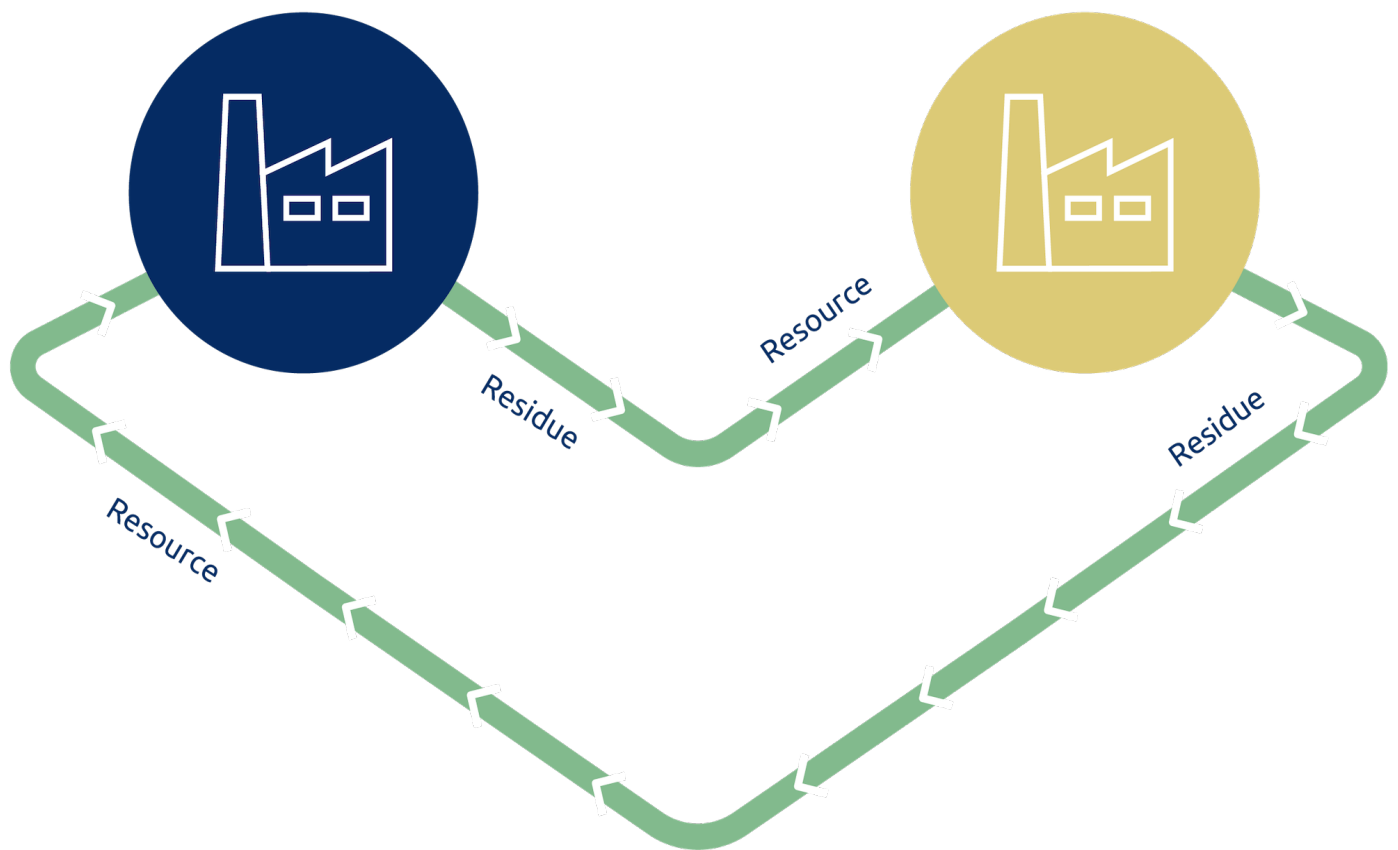


How Danish Industrial Symbiosis is cleaning up the Pacific Northwest



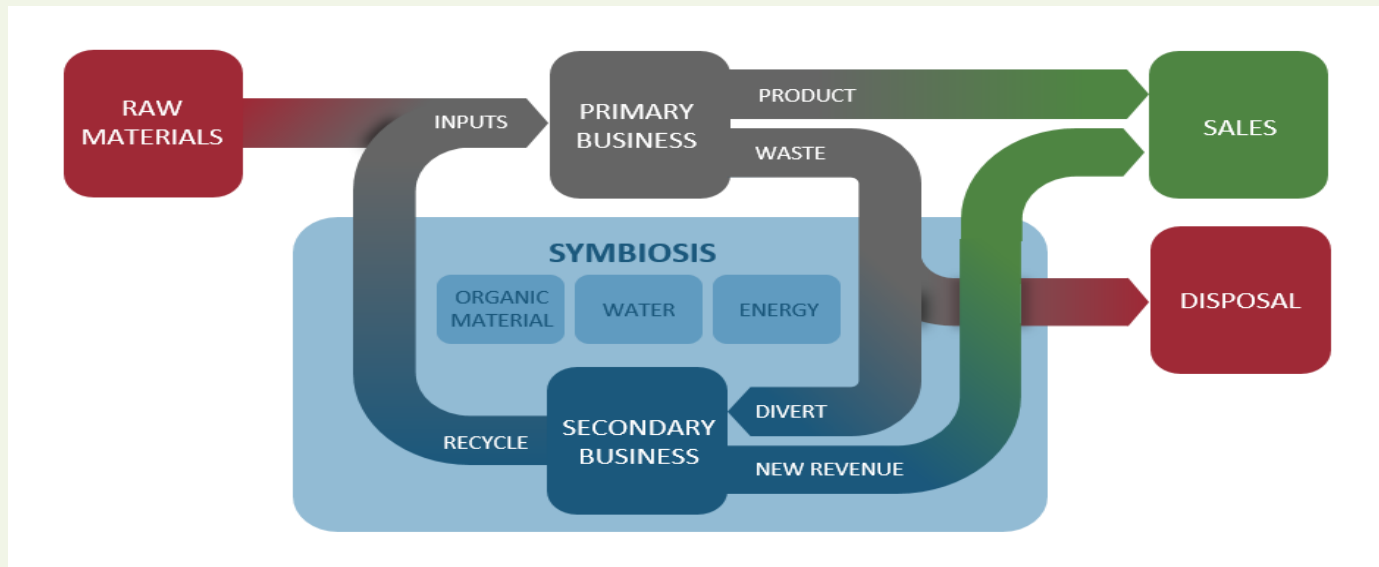
Advancing Danish-American Relations



Center for
**Sustainable
Infrastructure**

What is Industrial Symbiosis?

Industrial symbiosis (IS), pioneered in Denmark, is a ground-breaking, triple-bottom-line approach to infrastructure and economic development, where one industry's wastes – energy, water, materials – become valuable resources for other businesses.



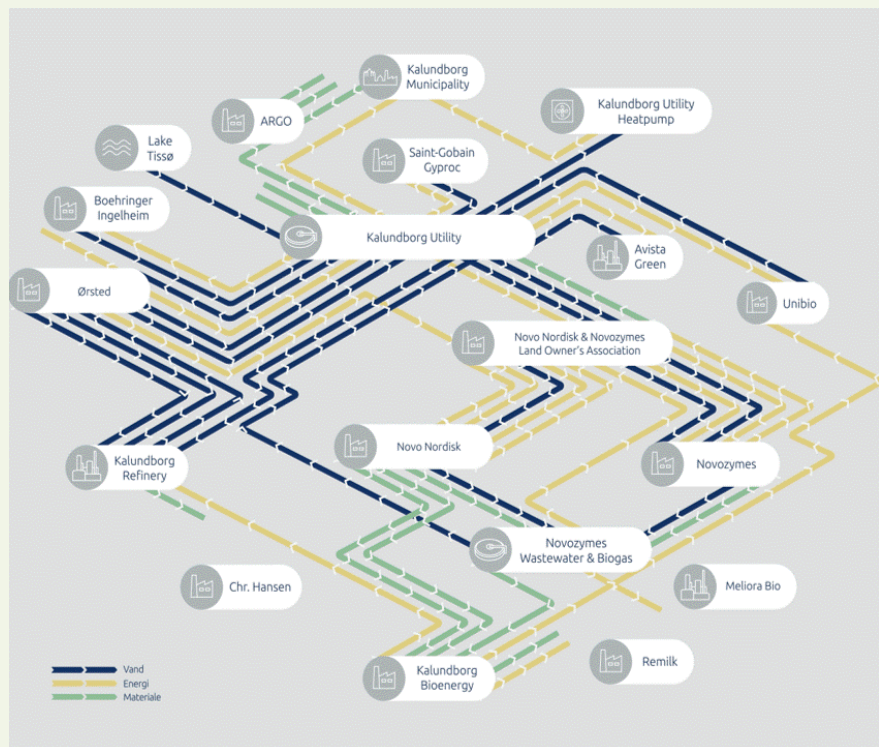
Where are the IS Practitioners?

Kalundborg, in the Zealand region of Denmark, is home to the world's oldest and-most advanced industrial symbiosis, where over two dozen resource-sharing agreements are delivering substantial economic and climate returns.

By the numbers:

- Generates \$28M/yr economic value
- 640,000 tons/yr of CO₂ reduced
- Local energy supply is CO₂ neutral

Visit symbiosis.dk for more information about Kalundborg Symbiosis.



GreenLab is a green and circular industrial park located in Skive, Denmark. Built on the belief that the energy system of the future is an integrated energy system – they work to develop and demonstrate this in practice by improving the way renewable energy is produced, transformed, stored, and utilized in a symbiosis system. For more information visit Greenlab.dk

Industrial Symbiosis Adopted by the Washington State Legislature

Since 2017, the Center for Sustainable Infrastructure (CSI) and Scan Design Foundation (SDF) have partnered to bring Industrial Symbiosis knowledge to the Northwest. Clean industry knowledge exchanges are a key tool CSI uses to advance its mission. These exchanges have centered on creating fruitful connections and collaborations between partners in Denmark and key leaders in the Pacific Northwest.

Over the past several years, the CSI-SDF collaboration on clean industry knowledge exchanges have yielded a surprising and rewarding bounty of results, with great potential to build on this platform of success going forward.

For the first-of-its-kind knowledge exchange study tours, CSI recruited three dozen Washington state legislators – evenly distributed between Republicans and Democrats – to travel to Denmark where they observed IS in action. These legislators received scholarships covering their participation costs courtesy of Scan Design Foundation, whose mission is to advance Danish American relations, with a focus

on environmental sustainability. The bipartisan cohort of legislators found significant common ground in seeing the potential to adapt Denmark’s IS model to benefit a wide range of Washington communities, from small towns to bigger cities, and at the same time gain substantial economic, environmental, and social benefits for Washingtonians.

Working collaboratively, these legislators have led successful efforts in six consecutive legislative sessions, making strategic investments to seed

“It has been amazing to see another country tackle the serious issues of our day like climate change sustainability and clean energy...I feel like I’ve seen the future for a rural district like mine!”

Mike Chapman, WA State Representative for the 24th legislative district



* retired

and grow IS in Washington State. In 2021 they launched the nation's first statewide IS program at the Department of Commerce. In the 2022 and 2023 legislative sessions, they secured over \$9 million in new investments for IS programs and projects.

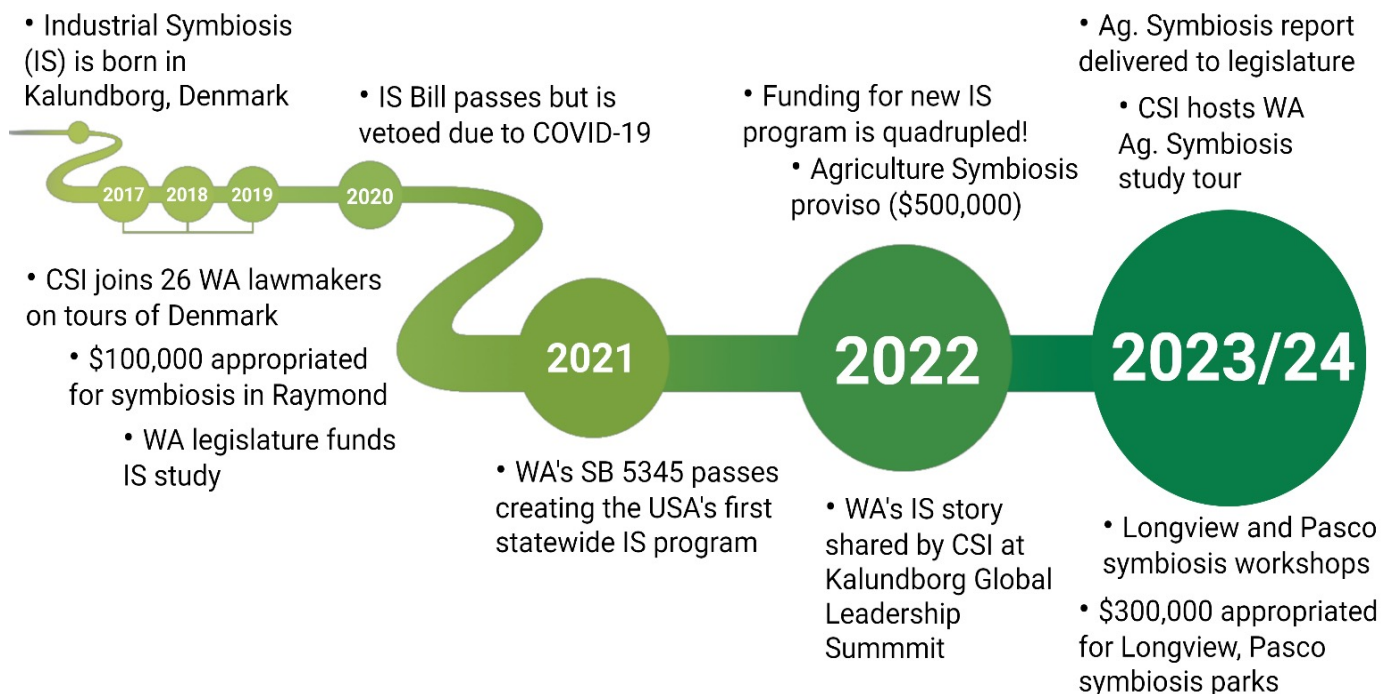
Initially funded in 2021 at \$500,000, in 2022 Washington's IS program budget increased to over \$2 million in ongoing funding for each future biennium. In addition, CSI proposed, and bipartisan legislators stepped up to secure \$500,000 in the 2022 Washington State supplemental budget to launch a new Agriculture Symbiosis initiative. This funding enabled CSI to work with Washington State University (WSU) and Pacific

Northwest National Laboratory (PNNL) to identify new opportunities for cost savings and additional revenue streams for farmers and food processors across Washington.

On account of these strategic investments by the Washington State Legislature, agriculture businesses and entrepreneurs are increasingly inspired to expand and develop new symbiosis projects, and Washington is gaining international attention as the leading U.S. state for industrial symbiosis. In October 2022, CSI was invited to share Washington's IS story at the Global Leadership Conference convened by Kalundborg Symbiosis, which drew together some of the world's top IS practitioners.

"I'm coming back from Denmark with a commitment to ensuring our industries, especially the aerospace industry, can be more energy efficient while also taking care of our environment."

Julio Cortes, WA State Representative for the 38th legislative district



Adapting IS to the Agriculture Sector

Agriculture Symbiosis (AS) weaves industries together to capture economic value from “waste” while cutting waste and costs and reducing climate impacts. CSI, with WSU and PNNL, delivered recommendations during the summer of 2023, in a report to the Washington legislature titled *Increasing the Economic Value and Sustainability of Washington’s Agriculture Sector Through Industrial Symbiosis*.

In the fall of 2023, CSI led an AS Study Tour in Denmark for Washington’s public and private leaders. The delegation, including a bipartisan group of 9 state legislators, learned how Danes are advancing the principles of industrial symbiosis to benefit the economic value and competitiveness of the agriculture sector, and improve its sustainability performance, at the same time. The intention was to super-charge Agriculture Symbiosis in WA State, magnifying and intensifying the political support, especially from Ag leaders, in partnership with Washington State University.

A grant of \$50,000 from Scan Design Foundation helped leverage an additional \$140,000 investment in both the study tour and larger

“While touring facilities here in Denmark, one of the tactical things I am taking back with me is how to use paper & plastic incinerators to produce clean energy.”

Nikki Torres, WA State Senator for the 15th legislative district

scale knowledge transfer between Denmark and Washington State. The Study Tour galvanized an influential and energized group of bipartisan legislators and agricultural leaders who are now equipped with the knowledge and passion to lead on clean industry and industrial symbiosis.

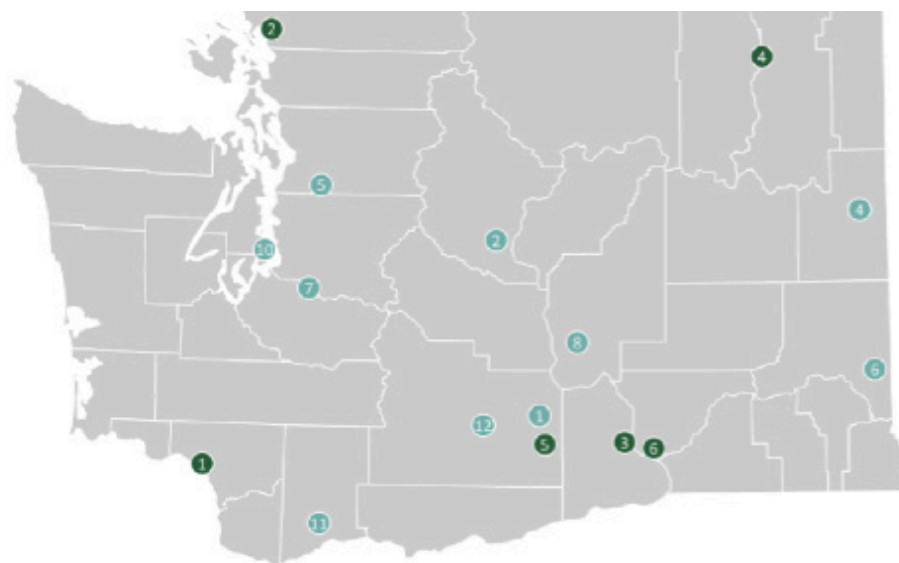
In the 2024 Washington legislative session, legislators secured \$300,000 to begin development of industrial symbiosis parks in both Pasco and Longview. CSI will play a supporting role in partnership with Denmark’s GreenLab. These will be first-of- their-kind pilot projects in Washington.



AGRICULTURE SYMBIOSIS PROJECTS IN WA STATE

Projects in Active Development (as of Summer 2023):

1 Divert Longview	Longview	Divert works with grocers to reduce wasted food, and to divert remaining food waste from landfills to biogas production facilities that efficiently convert methane to a valuable renewable natural gas product. They are pursuing development of a facility in Longview to process food waste from up to 650 grocery stores across the Pacific Northwest.
2 HeartFoods	Bellingham	Mark and Jessie Buehrer have launched HeartFoods to pilot a closed loop model for organic greenhouse agriculture that "utilizes food waste to transform how local communities grow healthy food." Their aim is to achieve net zero energy, water, and carbon while creating local food and jobs by cycling and optimizing flows of nutrients, water, and energy.
3 Lamb Weston Plant	Richland	Lamb Weston has committed to sell raw renewable natural gas made at its Richland site to Pine Creek RNG who will finish the gas before selling to Cascade Natural Gas along with RNG from Horn Rapids Landfill. Raw natural gas produced at Lamb Weston's Richland location is generated at their agricultural biogas recovery system and is currently being flared, but will be captured, processed and distributed through Cascade's system at the end of 2023.
4 Myno Carbon	Kettle Falls	Myno Carbon is developing a large-scale biochar carbon removal facility that will utilize forestry and mill waste residuals to produce 40,000 tons of biochar and 18 megawatts of carbon negative electricity per year, integrated with Avista's Kettle Falls Generating Station. They are also exploring combining waste carbon dioxide with crushed basalt to create a liming soil amendment.
5 Pacific Ag Renewables	Sunnyside	Pacific Ag Renewables plans to begin construction soon on a series of digesters to convert agricultural wastes – crop residues and dairy manure – into pipeline-quality renewable natural gas, and potentially other products like molded fiber packaging.
6 Pasco Process Water Reuse Facility (PWRf)	Pasco	The City of Pasco, in a public private partnership with Burnham RNG, broke ground in the second quarter of 2023 on a \$137 million modernization and expansion of the PWRf to treat 2 billion gallons per year of industrial wastewater from seven major food processors. Anaerobic digestion will be the source for 900 million btu/day of pipeline-quality renewable natural gas, after which the growth of algae will remove nitrogen from the water so it can be beneficially reused for irrigating crops, and provide feedstock for a nitrogen-rich fertilizer product.



- Operational**
- 1 The Augean Project
 - 2 Beta Hatch
 - 3 Edaleen Cow Power
 - 4 Inland Empire Paper
 - 5 Qualco Energy
 - 6 Qualterra
 - 7 Rainier Biogas
 - 8 Royal Dairy
 - 9 Vander Haak Dairy
 - 10 Vashon Bioenergy Farm
 - 11 Wind River Project
 - 12 Yakama Nation Farms
- Active Development**
- 1 Divert Longview
 - 2 HeartFoods
 - 3 Lamb Weston
 - 4 Myno Carbon
 - 5 Pacific Ag Renewables
 - 6 Pasco Process Water Reuse Facility

Source: WA State Dept of Commerce

PROJECTS IN MOTION

GreenLab is a remarkably successful clean and circular industrial park that has quickly emerged as a globally significant model for industrial symbiosis. In a few short years, GreenLab has attracted \$450 million in public and private investment to build six major industrial facilities, supplying these producers with carbon-free power, heat, steam, water, instrumental air, and nitrogen. Infrastructure to supply or deliver to market clean hydrogen, methanol, and recovered CO₂ is in development.

Delegates on the Agriculture Symbiosis study tour to Denmark in September 2023 were inspired by what they learned about GreenLab. After returning home, as a group they prioritized some specific actions to bring the innovations and inspiration back home to benefit Washington.

At the top of the list: Request capital budget funding from the Legislature for each of two Industrial Symbiosis Innovation Park pilot projects for initial planning and development work. One on the east side - Pasco - with an agriculture emphasis, and one on the west side - Longview - with a forest products emphasis:

- In Pasco, ag producers and processors, utilities engaged in clean energy transformation, researchers focused on ag innovation, and government entities with the vision to grow the clean industry economy are focusing efforts on developing an Agricultural Symbiosis industrial park.
- In Longview, municipal, tribal and private sector partners are committed to furthering industrial symbiosis by, among other things, working with an industrial corridor of private sector manufacturers to potentially repurpose a 540-acre former aluminum and wire rope facility into an industrial symbiosis park.

In order to advance the proposed pilot projects and frame up a request to the 2024 legislature, senior leaders from GreenLab came to Washington to lead very productive workshops in Pasco and Longview. Both workshops helped dozens of key local leaders to begin aligning on the broad outlines for each community's Industrial Symbiosis Park projects.

As part of GreenLab's week in Washington, a legislator briefing was organized in Olympia, to



bring state policymakers up to speed on the two projects.

The idea of submitting a funding request to the 2024 legislature faced very significant hurdles but both the Longview Industrial Symbiosis Park and the Pasco Industrial Symbiosis Park projects were specifically called out in the supplemental capital budget and were awarded \$150,000 each. Significant credit is due to two study tour delegates Randy Hayden, Port of Pasco, and Ted Sprague, Cowlitz EDC, who have dedicated a lot of work to framing up and aligning support for these new projects. CSI has continued discussions with GreenLab following delivery of their initial recommendations. In addition, CSI is pursuing EPA Community Change grant funds (~\$10M) in partnership with Cowlitz EDC that would kick-start design and construction of the integrated infrastructure systems required to support the Longview Industrial Symbiosis Park.

"I was inspired to see how the Danes make the best use of resources while also being economically viable. It was also very encouraging to see first-hand the power of getting people around the table with a common vision & a spirit of getting things done."

Kelley Minty, Klamath County
Commissioner, OR.

About the Center for Sustainable Infrastructure (CSI)

CSI's mission is to catalyze state-of-the-art sustainable infrastructure solutions that help communities of every kind thrive economically, socially, and environmentally. Because greenhouse gas emissions from industry are both undercounted and in need of new solutions, CSI has a strategic focus on promoting industrial infrastructure solutions that unlock decades of lower emissions while growing prosperity and community resilience. CSI's collaboration-based strategies bring influential, politically and geographically diverse leaders together to support policy and project actions that advance a positive, shared vision and innovation agenda. www.sustaininfrastructure.org
Photos in this booklet are courtesy of CSI unless otherwise noted.

About Scan Design Foundation (SDF)

Honoring the legacy of Inger & Jens Bruun, SDF's mission is to advance Danish American relations by supporting cultural exchanges focused on environmental sustainability. We envision a future enriched by the exchange between the US & Denmark of people, ideas and cultural experiences.
www.scandesignfoundation.org

Additional resources:

The following set of video testimonials from legislators and industry leaders who participated in the Study Tour demonstrates how valuable the experience was for participants.

Legislators: <https://www.youtube.com/playlist?list=PLrDbKxcWvXV6QdHkR3cpj0O99yMMvxMYf>

Industry Leaders: <https://www.youtube.com/playlist?list=PLrDbKxcWvXV4I3pWzkWMxb49OxDBILflz>

