Working Waterfronts Pathway

WA Pathway Overview & Initiative Descriptions

Global Case Studies Appendix: To inspire WA demonstration project ideas

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Washington Maritime BLUE Strategy Framework

Blue Vision

Washington State will be home to the nation's most sustainable and *competitive* Maritime Industry by 2050.

Strategic Goals

What should success look like in 2050?

Development Pathways

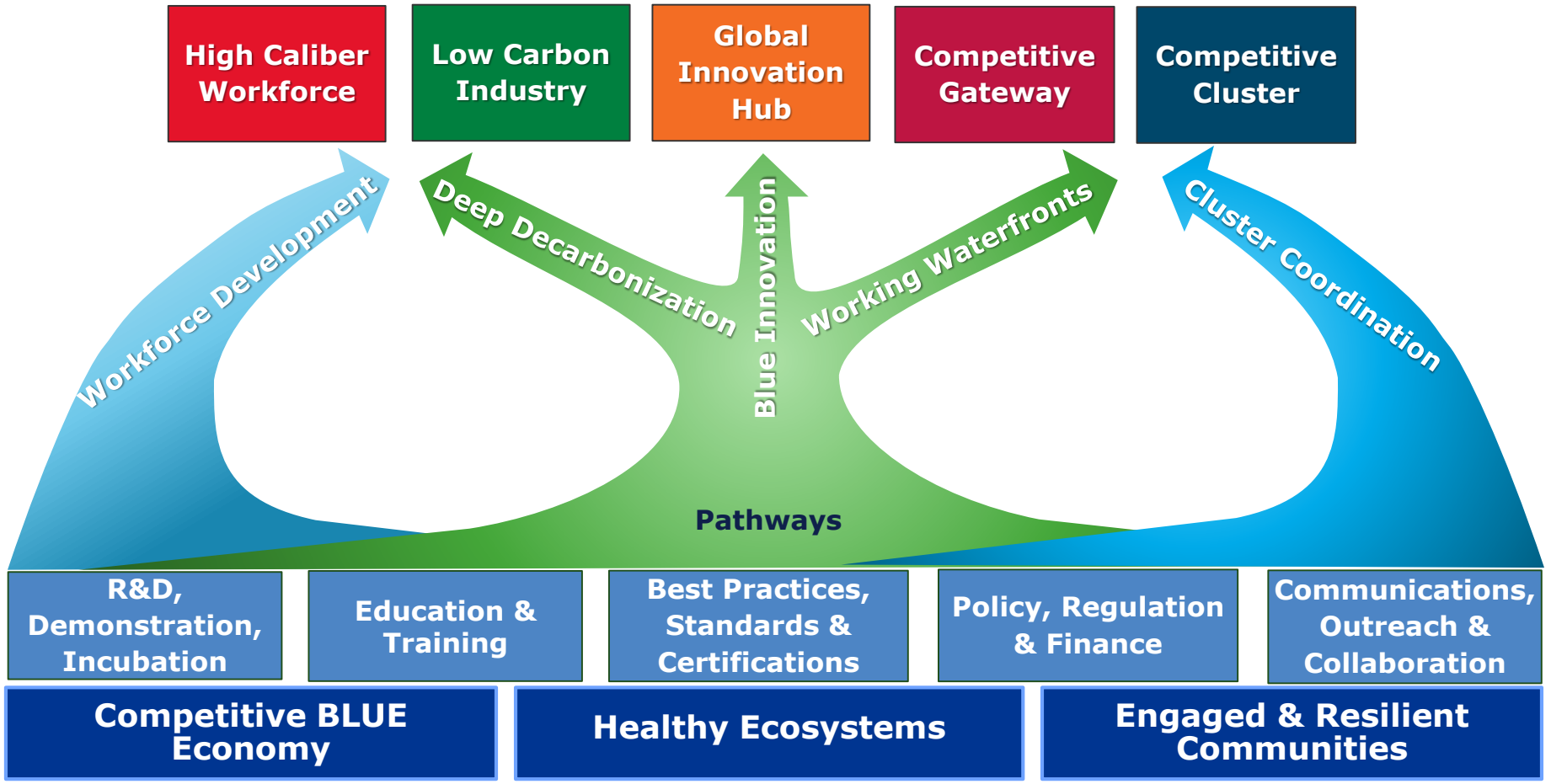
How will we achieve the goals?

Action Areas

What tools will be used to enable the pathways?

Value Statements

What will guide our actions?



Washington Maritime BLUE Strategy Framework

Blue Vision

Washington State will be home to the nation's most sustainable and *competitive* Maritime Industry by 2050.

Strategic Goals

What should success look like in 2050?

- High Caliber Workforce
- Low Carbon Industry
- Global Innovation Hub
- Competitive Gateway
- Competitive Cluster

Development Pathways

How will we achieve the goals?

- Workforce Development
- Deep Decarbonization
- Blue Innovation
- Working Waterfronts
- Cluster Coordination

Initiatives & projects

Pathways Work Groups will decide & prioritize the initiatives & demo projects.

- Smart Ports
- Infrastructure Strategy
- Regulatory Climate
- Green Gateway

Action Areas

What tools will be used to enable the pathways?

- R&D, Demonstration, Incubation
- Education & Training
- Best Practices, Standards & Certifications
- Policy, Regulation & Finance
- Communications, Outreach & Collaboration

Value Statements

What will guide our actions?

- Competitive BLUE Economy
- Healthy Ecosystems
- Engaged & Resilient Communities

Pathway Overview – Working Waterfronts

Pathway description

- Washington will lead the nation in efficient, clean and safe maritime practices across all sectors of the industry.
- Invest in technology and best practices to ensure maritime security and safety and drive operational efficiency and service
- Establish thought leadership for how the industry can leverage automated and digital technologies and digitalization for improved efficiencies and safe and sustainable operations.
- Adopt a collaborative and on-going approach to the development of environmental best management practices.

Proposed Initiatives

- Smart Ports
- Infrastructure Strategy
- Regulatory Climate
- Green Gateway

Strategic Goal: Competitive Gateway

Washington will be a competitive gateway for imports and exports with a reputation for safety, transparency, efficiency and sustainability

Initiative description – Smart Ports

Establish thought leadership for how the industry can leverage automated and digital technologies for improved efficiencies and safe and sustainable operations while growing and securing jobs

- Digitalized processes
  - Collaboration with Washington's Information & Communication Technology (ICT) sector, utilize big data, cybersecurity resilience (w/ Blue Innovation).
  - Pilot maritime use cases, standards and enabling technology.
  - e.g. BLUE-ware, digital twin (modeling), shipping & shore side logistics.
  - Support the development and adoption of cybersecurity best practices across the industry.

- Transactional transparency
  - Utilize Block Chain to increase transparency on cargoes, destinations, financial transactions and on the use of agents and intermediaries.

- Automation & autonomy
  - Leverage automation and autonomous systems & robotics including cross-sector collaboration with Washington's ICT & Manufacturing sectors (w/ Blue Innovation).
  - Thought leadership on applications to improve safety, security and efficiency
  - Establish workforce development to build, maintain and operate.
  - Establish enabling regulations and open water testbeds
    - Fed govt collaboration for establishing dedicated shipping lanes.

- Managing a "Just Transition"
  - Commitment to growth, training and technologies that enhance workers' performance, safety and health while not compromising overall jobs creation.

Initiative description – Infrastructure Strategy

Taking a long term perspective to maintaining maritime and industrial lands that support clean and efficient transportation solutions, family-wage jobs and minimize ecological impacts.

- Long term port infrastructure strategy
  - Discuss the longer term needs and technology developments in transportation
  - A regional approach to optimize siting
  - Modal optimization / Inter-port connectivity
  - An all-Washington approach to maritime development addressing the needs of rural maritime communities and export trades.
- Stormwater infrastructure
  - Ports are facing expensive upgrades
  - Need for public support
  - Sharing of Best Practices in stormwater management
- Inland infrastructure (rail, road and distribution centers)
  - Need for additional funding and focus on transportation infrastructure such as road and rail facilities to serve the maritime industry.
  - Address transportation challenges: two largest ports facing increasing difficulty getting goods in and out on a timely and efficient basis.

Initiative description – Regulatory Climate

Create a predictable and efficient regulatory structure supporting sustainable innovation, maintaining a long term maritime infrastructure and enhancing company competitiveness

- Adoption of best practices
  - Create an efficient and goal-based approach to regulatory implementation
  - Proactive and voluntary best practices and industry standards above and beyond compliance
  - Incentives for early adopters and high performers
- Regulatory predictability
  - Align and improve permitting processes for sustainable economic development projects in the state
  - Streamlined / transparent permitting process; e.g. shot-clock
  - Stable environment and long term predictability for investment decision-making
- Land Use and Environmental Reviews
  - Review and participate in Growth Management Act and its policies, as well as local comprehensive plans and zoning, to ensure there are plans for retaining or providing sufficient lands suitably zoned for maritime uses and cluster development
  - Integrated Planning for industrial zoning and economic development (supportive of innovation and commercialization activities)
  - Innovation zone permits to facilitate trialing of technologies in maritime space

Initiative description – Green Gateway

Build on Washington's brand as a Green Gateway and capitalize triple bottom line added value

- Promotion of Washington's maritime industry as a value-adding industry with economic, environmental and social benefits (through Cluster organization communication & profiling)
  - Generate competitive advantage through locational benefits, e.g. proximity to Asia Pacific, clean & low price electricity, hub for recreational enthusiasts
- Sector-driven Corporate Social Responsibility initiatives for environmental stewardship and inclusiveness
  - Build on existing Washington Ports commitments
  - Adoption of reporting and accounting standards
  - Collaborative environmental action (lost gear recovery, cleanup initiatives etc.)
- Eco- and Aqua-tourism
  - Become a passenger gateway not a corridor –
  - Generate revenue from embarking/disembarking cruise / agency partners
  - Increase development of BLUE tourism within Washington
  - Recreational fishing and boating

Appendix – Global Case Studies to inspire WA State project ideas

Smart Port: big data, digitalization and autonomous operations	L4.1	L4. Smart Logistics	Maritime Logistics and Shipping
Smart Port: fully automated port operations to increase competitiveness	L4.2		
Smart Port: virtual container yard	L4.3		
Smart Port: blockchain to reduce transportation administration costs	L4.4		
Green Port: port infrastructure and shuttles powered by clean energy	L3.1	L3. Improving air quality from use of renewable power	Maritime Logistics and Shipping
Singapore's Living Lab	L5.1	L5. Fostering Innovation	Maritime Logistics and Shipping
South Korea's Digital Shipyard	B3.1	B3. Digitalization & collaboration with other shipyards	Shipbuilding, repair and maintenance
Strategic Green Alliances for Denmark	B3.2		
Digitalization – Autonomous Ships	P3.1	P3. Digitilization	Passenger Water Transportation
Autonomous Electric Barge: Port Liner	B1.2	B1. Hybrid tugs & barges	Shipbuilding, repair and maintenance
First marine insurance blockchain platform	S.3.1	S3. Sustainability & efficiency Initiatives	Maritime Support Services
Sustainability reporting in US needs does not fulfil its goal	S.3.2		
Marine Habitat: financial incentives for reduction of underwater noise	L2.1	L2. Minimizing impact to marine habitat	Maritime Logistics and Shipping
Air Quality: ship exhaust scrubbing as an alternative to cold ironing	L1.1	L1. Improving air quality through emission reduction measures	Maritime Logistics and Shipping
Air Quality: cold ironing with Onshore Power Supply (OPS)	L1.2		
Air Quality: emissions reduction from Cargo Handling Equipment (CHE)	L1.3		

Smart Port: big data, digitalization and autonomous operations

Overview of Program

Background

By going digital, connectivity and automation will help reduce environmental footprints of the port industry along with intelligent transport systems, which have a huge potential to reduce CO2 emissions. As ships get bigger and international trade increases, ports around the world are improving maritime infrastructure and enhancing port facilities with smarter, more intelligent designs with the help of technology.

Description of the program

Improved Maritime and Port Operations Using Analytics-Based Technologies, Singapore: IBM and MPA Singapore are to develop and test-bed new analytics-based technologies, aimed at improving maritime and port operations to cater to increasing growth in vessel traffic in Singapore.

Port Road Management, Hamburg: this innovative traffic management system optimizes road traffic at Port of Hamburg. To improve the flow of traffic, potential incidents in the road network are recorded, automated messages are generated, and road users are informed via LED panels so congestion can be avoided. The IT-based traffic management includes: (1) an incident management system; (2) parking management in port; (3) current traffic information; (4) traffic information center; (5) dynamic traffic management via alternative routes; (6) terminal inflow management via pre-gate parking spaces

Digitization to Host Autonomous Ships, Rotterdam: Port of Rotterdam Authority and IBM joined forces on a multi-year digitization initiative to transform the port's operational environment using Internet of Things (IoT) technologies. One of its key goals is to accommodate autonomous ships.

Digitization for Efficient Traffic Management, Rotterdam: As part of its digitization initiative with IBM, Port of Rotterdam started developing a centralized dashboard application that will collect and process real-time data for a safer and more efficient traffic management at the port.

Autonomous Operations: automated ports in Hong Kong, Singapore and Taiwan can undertake 46 crane moves per hour, which is 43% more efficient than North American ports in unloading cargo. Additionally, at the Port of Rotterdam, almost every part of the process of unloading containers is handled by software, and office workers remotely control the cranes over their computers.

PitStop, Maersk Fleet: An app called Pit Stop rolled out to Maersk container vessel crews and operations staff in March 2018 to collect key operational data real-time at each port call to help optimize port calls and vessel operations.

Results / Gains

- Improved cargo unloading efficiency of 43%
- Efficient traffic management at ports (shore-based and marine traffic)
- Reduces environmental pollution
- Port of Hamburg realized 30% reduction of traffic movements

Investment Costs

- JV with data platform technology companies e.g. IBM or Microsoft
- Port authorities such as Singapore, Long Beach, Rotterdam and Hamburg are trailblazers in next generation port designs and technology

Implemented in

China (incl. Hong Kong), Germany, Netherlands, Singapore, USA (mainly California), Maersk (container fleet)

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA has an ambition to significantly reduce DPM and GHG emissions by 2020

Smart Port: fully automated port operations to increase competitiveness

Overview of Program

Background

Seven of the world's busiest container terminals are in China but now, one of them is completely void of workers. The eastern port of Qingdao is home to Asia's first fully-automated port, Qingdao New Qianwan Automatic Container Terminal (QQCTN), a change which is likely to revolutionize the global shipping business. Indeed QQCTN has become Asia's first fully automated port terminal after servicing its first containership, the 13,386 TEU COSCO in 2017.

Description of the program

After three years of development (to build the terminal from scratch), the terminal has completed its first fully automated phase to upgrade two berths across 660 m of quay with seven STS cranes operated by remote control, 38 automated stacking cranes (ASCs) and 38 battery-powered automated guided vehicles (AGVs).

- The terminal is controlled by artificial intelligence, laser scanners and positioning systems that can locate the four corners of each container to accurately clamp and move them onto driverless trucks. These smart autopilot trucks, driven by electricity, have their routes and tasks under digital control.
- Automated guided vehicles are programmed with routes and tasks and also have the artificial intelligence to recognize when a recharge is needed.
- The upgrade has essentially changed blue collar tasks into a white collar one. Workers used to operate the machines in sky-high cranes, but now much of the work has been left to a computer in the office.

What happens next

The terminal is part of China's One Belt One Road initiative and as a result QQCTN is planning to operate sustainably around the clock with four more fully automated berths.

Results / Gains

- Improved operational efficiency (e.g. amount of workers required to unload a cargo ship as the 13,386 TEU ship, has been reduced from 60 to nine)
- Terminal operational in complete darkness during night-time (thus reducing labor costs by 70% and increase overall efficiency by 30%)

Investment Costs

- Remotely controlled STS cranes
- Automated stacking cranes (ASCs)
- Battery-powered automated guided vehicles (AGVs)

Timeline

Terminal development duration: 3 years

Implemented in

China (Port of Qingdao – "Ghost Port")

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA has an ambition to significantly reduce DPM and GHG emissions by 2020

Smart Port: virtual container yard

Overview of Program

Background

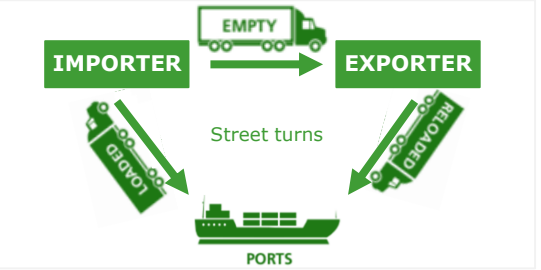
It has been estimated that 30-40% of intermodal trucks are hauling empty containers at any given moment, the result of an inefficient system in which containers are routinely returned to marine terminals or container depots after being unloaded. Those extra trips add up to a lot of wasted transportation time and expense for both carriers and shippers, and create traffic congestion and air pollution.

Description of the program

- Port of Long Beach: **Virtual Container Yard** (VCY) is a technology aimed at reducing empty container handling, primarily used by ocean and motor freight carriers. It is a cloud-based system that informs participating operators which containers are to be delivered back to the depot. It thus eliminates needless empty trips by matching available import containers "on the street" with export needs for equipment.
- Port of Rotterdam: **Container Exchange Route** (CER) is an internal means to connect all the terminals at a port with each other.
- Port of Rotterdam: **TEUbooker** offers a synchromodal solution, whereby it utilizes unused capacities of all transport modes to maximize exchange possibilities and reduce transportation costs. It is a 24/7 online booking portal for container transport in the Port of Rotterdam. With one click, users can book containers on existing barge, rail and truck movements in the Maasvlakte area. Bookers can follow the progress of the container transport via a personalized dashboard.

How VCY works

Basics of the VCY logistics: a carrier posts the availability of an empty container online, including its location. A trucker, seeking an empty container, uses an online search mechanism to locate available equipment by location. A match is identified, and the trucker requests a VCY transaction. An electronic authorization is issued, allowing the trucker to pick up the empty container and deliver it directly to the new customer. Note that the VCY integrates with ocean carriers' equipment management systems. As the carrier's system updates the status of each container, the information is transferred to the VCY and made available to approved trucking companies. A trucking company is allowed access to this information only if authorized by the ocean carrier.



Results / Gains

- Transparent exchange of data between participants
- Elimination of gate fees, storage charges and terminal handling fees
- Fuel savings
- Optimization of port logistics process
- Ease of business for operators, shippers and forwarders

Investment Costs

- n/a

Timeline

n/a

Implemented in

Netherlands (Port of Rotterdam), USA (Port of Long Beach)

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA has an ambition to significantly reduce DPM and GHG emissions by 2020

Smart Port: blockchain to reduce transportation administration costs

Overview of Program

Background

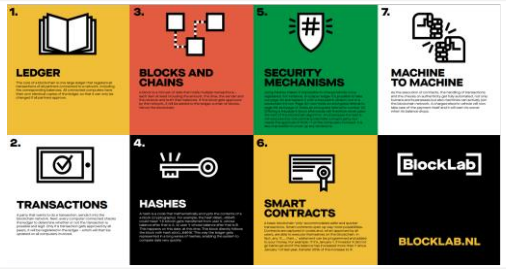
The shipping industry is increasingly committed to the wider application of blockchain across the global logistics and shipping businesses as it will lead to much greater operating efficiencies, security and transparency. Blockchain technology is expected to minimize transport costs of goods as it is estimated that the maximum cost of required trade documentation to process and administer these goods is one-fifth of the actual physical transportation costs. According to the World Economic Forum, by reducing barriers within the international supply chain, global trade could increase by nearly 15 percent.

Description of the program

Rotterdam, Blockchain Technology Field Lab: launch of new applied research lab (BlockLab) for the development of concrete applications and solutions based on blockchain technology in Sept 2017. BlockLab is an initiative of the Port of Rotterdam Authority and the Municipality of Rotterdam, and is supported by the regional development corporation InnovationQuarter.

PIL, PSA and IBM: Pacific International Lines (PIL), PSA (Singapore) and IBM have finished a successful blockchain trial from Chongqing to Singapore – and believe the concept can be taken to the next stage. The three companies agreed in Aug 2017 to collaborate on blockchain-based supply chain business network innovations and successfully worked on a proof of concept exercise, built on the IBM Blockchain Platform, applying and then testing a blockchain-based supply chain to track and trace cargo movement from Chongqing to Singapore via the Southern Transport Corridor.

AP Moller–Maersk and IBM: established a JV in June 2016, aimed at offering a global trade digitization platform by using blockchain technology, and address the need for greater transparency and simplicity in the movement of goods across borders and trading zones. Commercialization plans: (1) shipping information pipeline to provide end-to-end supply chain visibility and enable all players managing a supply chain to securely and seamlessly exchange shipment information in real time; (2) Paperless Trade, to digitize and automate paperwork filings by enabling end-users to securely submit, validate and approve documents across organizational boundaries, ultimately to reduce time and cost for clearance and cargo movement. Upon regulatory clearance, solutions from the joint venture are expected to become available within six months. Multiple parties have piloted the platform including DuPont, Dow Chemical, Tetra Pak, Port Houston, Rotterdam Port Community System Portbase, the Customs Administration of the Netherlands, U.S. Customs and Border Protection.



Results / Gains

- Transparent and trustworthy execution of multimodal logistics capacity booking
- Regulatory-compliant execution of multimodal logistics capacity booking process
- Real-time track and trace
- Permissioned access control for ecosystem participants

Investment Costs

- Joint ventures and financing (e.g. Municipality of Rotterdam financing the BlockLab)

Timeline

n/a (platform development < 1 year)

Implemented in

Netherlands (Rotterdam), Singapore, USA (New York)

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA could improve the efficiency of its ports' administrative operations

Green Port: port infrastructure and shuttles powered by clean energy

Overview of Program

Background

Ports are increasingly looking to reduce their environmental footprints, whilst seeking to add new jobs to the green sector workforce. Several leading ports around the world have already invested in renewable sources to power part of their infrastructure such as warehouses, and terminals, as well as to provide OPS to ships berthing there.

Description of the program

Current or recent projects include:

- Use of **emission-free fully-electric barges for port shuttles** (container sailings between ports in the Netherlands, Belgium and Germany. The larger vessels can accommodate 270 containers and can sail for at least 35 hours with four container batteries. Recharge time is 4 hours, or batteries can be exchanges at port terminal. Because electric motors do not need a large engine room, the loading area is 8% larger than that of comparable ships.
- Gothenburg Port Authority has become a **climate-neutral** company by investing in solar panels, biogas, district heating and other environmental initiatives, so that its emissions have been reduced to a minimum. The remainder will be offset by purchasing Chinese wind power.
- APM Terminals' power consumption (at Maasvlakte II) supplied by European wind parks, including its crane and box handling equipment, and electric vehicles for staff transportation onsite.
- Use of solar energy (1 MW) for Port of Los Angeles' World Cruise Center as the first phase of a multi-location solar power program to eventually produce 10 MW of solar generation capacity.

Mechanisms to set up

Various ports have different funding mechanisms, such as:

- Port of Los Angeles is self-supporting and has grant programs available to support air quality improvements from port.
- EU provided € 7 million euro grant for construction of 11 fully-electric inland vessels for container sailings between ports in Netherlands, Belgium and Germany, with first vessel delivery in Aug 2018.

Monitored by

Emissions in ports are monitored by U.S. EPA

Results / Gains

- Six barges (zero-emission transport) expected to remove 23,000 trucks from Netherlands' roads annually
- Solar PV installation (1 MW) with an expected annual $200,000 energy cost savings, and a lifetime reduction of 22,800 metric tons of CO2 (approx. annual GHG of 4,367 cars)

Investment Costs

- €7 million euro grant for construction of 11 fully-electric inland vessels
- Solar panel installation for 10 MW, estimated as $10.8 million project

Timeline

n/a

Implemented in

Germany, Netherlands, Sweden, UK, USA

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA has an ambition to significantly reduce DPM and GHG emissions by 2020

Singapore's Living Lab

Overview of Program

Background

Singapore's maritime sector is undergoing significant transformation. To enhance Singapore's hub port competitiveness, the Maritime and Port Authority of Singapore (MPA), PSA and Jurong Port are leveraging technology to promote growth in the fields of Efficient & Intelligent World Class Next Gen Port, Smart Autonomous Vessel & Maritime Operations, Strategic Sea Space & Maritime Traffic Management and Effective Maritime Safety & Security.

Description of the program

The MPA Living Lab will provide a technology partnership platform, with sufficient scale and real operating conditions in the port of Singapore, that technology providers and industry partners can plug into for the co-development and piloting of innovations. The PSA Living Lab will enable start-ups and technology solution providers to collaborate with PSA to develop ideas and test-bed integrated systems in a live port environment at PSA Singapore. Jurong Port's Living Lab will join MPA and PSA's Living Lab, through its collaboration with the Nanyang Technological University (NTU) to jointly pursue R&D in areas such as Smart Multi-Energy Systems, Alternative Energy Source Applications and Environmental Monitoring Solutions. The Living Labs will achieve innovation, productivity and internationalization, through a automated digital systems, international markets accessibility and an innovative ecosystem.

Mechanisms to set up

MPA's Living Lab will focus on Maritime Data Analytics & Intelligent Systems, Autonomous Systems & Robotics, JIT Planning and Coordination Systems and Next Gen Vessel Traffic Management. Through Blockchain, new ways of sharing data will be explored. Some of PSA's Living Lab key projects are the Automated Guided Vehicle (AGV) system, which will ramp up operations, and the unboXed Incubator program, to revolutionize container terminal operations, and enhance the efficiency of international trade with better visibility and security. Port Jurong's and NTU's MoU, will have both parties jointly conduct research projects and testbed solutions, conduct mutual exchange of expertise including staff secondment programmes, and organize events to promote greater environmental sustainability through maritime outreach activities and thought leadership as part of Jurong Port's Living Lab programme.

Results / Gains

- Innovative technologies
- Higher efficiency
- Improved operations and logistics
- Knowledge sharing
- Improve sustainability

Investment Costs

- $76 million into the Maritime Cluster Fund (MCF)

Timeline

MPA and Jurong: Set up in 2017, 5 years
PSA: Set up in 2016, 3 years

Implemented in

Singapore

Weighted Relevance Criteria Scoring for WA

Relevance to WA

Boosting maritime-related competence and innovation in WA

South Korea's Digital Shipyard

Initiative Overview

Background
Green innovation is practised in South Korea by means of introducing green technologies into the existing industry. There is a rising demand for the Green Shipyard due to the Greenhouse Gas emission reduction goal of the shipbuilding industry. This initiative was presented in the context of the Organization for Economic Co-operation and Development (OECD) workshop aiming to encourage transparency and consulting between economies.

Description of the Initiative
South Korea supporting the new environmental regulations by the IMO regarding the reduction of CO2 emissions, implements the Green Ship and Green Shipyard initiatives under its Green Growth commitment. Regarding the greening of the shipbuilding industry South Korea aims to achieve a 30% GHG emission reduction by 2020.

Mechanisms to set up
Specifically in the shipbuilding industry, the GHG emissions come from electricity (50%), combustion (transportation) (34%), combustion on land (11%), fugitive emission and process emission. Energy efficiency can be achieved through electricity reduction by improving the construction process and increasing productivity i.e. automatic control systems, power saver for motor, max-power management system. The **digital shipyard** is an upcoming development with real-time energy consumption monitoring system and efficiency enhancement in logistics i.e. monitoring system for energy consumption of each facility and equipment. An upgrade of facilities and equipment is also necessary for high energy efficient facilities and process improvement, through the replacement of inefficient facilities and equipment and a fuel switch of heating furnace.

Monitored by
South Korean authorities

Results/ Gains

- Impact on environment, cost and efficiency
- Compliance to IMO regulations
- Reduction in GHG emissions
- Technological innovation

Costs
xx

Timeline
Established in 2011
Achieve by 2020

Implemented in
South Korea

Weighted Relevance Criteria Scoring for WA

Relevance to WA
WA can expand its sustainability goal, by implementing technological and efficiency improvements in its shipyards.

Strategic Green Alliances for Denmark

Initiative Overview

Background

Denmark, South Korea and China have ambitious national plans for a transition to greener and more energy efficient economies. South Korea is the third-largest export market for Denmark in Asia and an important market for Danish shipping. The Chinese ship building industry are interested in partnering with Danish companies that possess unique green-tech know-how in the field of optimization of ship design and fuel consumption. The main purpose of the alliances is to pave the way for increased Danish exports of environmental technology to South Korea and China, while gaining knowledge from their developed shipbuilding practices.

Description of the Initiative

The **Danish-South Korean** agreement commits the countries to having annual meetings with ministerial participation. The Danish Minister for Business and Growth's meeting with the South Korean Minister of Oceans and Fisheries is important for further developing the close co-operation.
Delegates from the **Chinese** organisation Shipbuilding Information Center of China (SICC) together with Danish Maritime recently visited FORCE Technology in Lyngby. The meeting was an initial step towards a future cooperation where SICC can assist in projects between FORCE Technology and Chinese companies within the ship building industry.

Mechanisms to set up

The focus of the 2017 **Danish-South Korean** Green Growth Alliance roundtable meeting was circular economy and how this can be a driver for growth and sustainable shipbuilding. The main agendas included the role of the state in accelerating the transition towards a circular economy.

Results/ Gains

- Impact on environment and efficiency
- Green energy and technology
- Knowledge exchange
- Circular economy

Costs

xx

Timeline

South Korea: Started in 2011, ongoing
China: Started 2017

Implemented in

- Denmark
- South Korea
- China

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA could consider initiating partnerships with other countries in order to exchange tech knowledge and green practices.

First marine insurance blockchain platform

Initiative Overview

Background
The blockchain platform supports the marine insurance industry to address the challenges of its complex international ecosystem involving multiple parties, long paper chains and duplication, high transaction volumes and significant levels of reconciliation — all potentially preventing transparency, compliance and accurate exposure management.

Description of the Initiative
EY and Guardtime announce the world's first blockchain platform for the marine insurance sector. The platform launches in collaboration with A.P. Møller-Maersk A/S, ACORD, Microsoft, MS Amlin, Willis Towers Watson and XL Catlin and after a 20-week proof of concept. The global blockchain platform connects clients, brokers, insurers and third parties to distributed common ledgers that capture data about identities, risk and exposures, and integrates this information with insurance contracts. The platform's capabilities include the ability to create and maintain **asset data** from multiple parties; to link data to policy contracts; to receive and act upon information that results in a pricing or a business process change; to **connect client assets**, **transactions and payments**; and to capture and validate up-to-date first notification or loss data.

Mechanisms to set up
The blockchain platform is built on Microsoft Azure global cloud technology and is positioned to provide significant value to the insurance industry.

Monitored by
EY and Guardtime.

Results/ Gains

- Streamline and automate the interaction with the insurance market
- Improved capital and efficiencies
- Increased transparency
- Reduced manual data entry or reconciliation and administration costs

Costs
na

Timeline
Delivery: 2018

Implemented in
United Kingdom

Weighted Relevance Criteria Scoring for WA

Relevance to WA
WA can adopt such developments to boost the efficiency in its professional services supporting the maritime industry.

Sustainability reporting in US needs does not fulfil its goal

Initiative Overview

Background
The financial performance of publicly traded companies is reported in accordance with Securities and Exchange Commission requirements. However, financial statements do not give much information about the impact that such companies' activities have on their environment, customers, employees, and the broader community. In order to gather that information, one must examine the environmental, social, and governance disclosures of companies, commonly referred to as sustainability or corporate social responsibility (CSR) disclosures, which are often provided separately from the annual financial report.

Description of the Issue
From data collected from the sustainability or corporate social responsibility reports of the 100 smallest companies in the S&P 500, the question arises of whether most sustainability reporting is merely an attempt towards conformity with peer practices, or if there is a sincere and systematic effort to actually reduce an entity's environmental footprint. Most companies did not provide a clearly established sustainability program or discuss the economic impact of its sustainability initiatives.

Mechanisms to set up
The United States has an independent organization, the Sustainability Accounting Standards Board (SASB), to establish sustainability accounting standards corporations can use to report sustainability information in a more uniform way while making it useful to stakeholders, and these practices are presently optional and still evolving on an industry-by-industry basis. Washington can provide tax or funding incentives and professional assistance and develop industry standards in the maritime industry for companies to implement the optional Sustainability Reporting. This way transparency and sustainable practices will be encouraged across the industry. Companies practicing correct sustainability reporting will enhance their green image in the industry and gain a competitive advantage.

Results/ Gains

- Impact on environment
- Promotes sustainable business practices
- Transparency
- Companies measure the environmental impact of what they do

Costs
xx

Timeline
xx

Implemented in
USA

Weighted Relevance Criteria Scoring for WA

Relevance to WA
WA can adopt such standards to communicate to business leaders that sustainability accounting can have an impact.

Digitalization – Autonomous Ships

Initiative Overview

Background

YARA Birkeland will initially operate as a manned vessel, moving to remote operation in 2019 and expected to be capable of performing fully autonomous operations from 2020. The new zero-emission vessel will be a game-changer for global maritime transport contributing to **meet the UN sustainability goals**.

Description of the Initiative

The vessel **YARA Birkeland** will be the world's first **fully electric and autonomous container ship, with zero emissions**. **KONGSBERG** is responsible for development and delivery of all key enabling technologies including the **sensors and integration required for remote and autonomous ship operations, in addition to the electric drive, battery and propulsion control systems.**

NTNU (Norwegian University of Science and Technology) has conducted research into developing autonomous ferries that can transport passengers and vehicles across channels. **The ferries would need minimum amounts of on-deck structures and could be alternatives to building bridges or tunnels between islands and mainland**. **Rolls-Royce and Wärtsilä are developing technology for remote monitoring and control of passenger ships while NTNU has built simulators for teaching future ferry operators.**

Mechanisms to set up

The Norwegian government enterprise **ENOVA** has granted **NOK 133.6 million** to Yara towards the construction of the world's first electric and autonomous container ship. This will cover about **one third of the estimated cost**. Private-public collaboration (Yara, Kongsberg, Marin Teknikk, SINTEF, ENOVA)

Results/ Gains

- The vessel will reduce NOx and CO2 emissions by reducing diesel-powered truck transport by around 40,000 journeys per year.

Costs

NOK 401 million

Timeline

2017-2020

Implemented in

- Norway

Weighted Relevance Criteria Scoring for WA

Relevance to WA

Technological innovation

Source: KONGSBERG (2017)

Autonomous Electric Barge: Port Liner

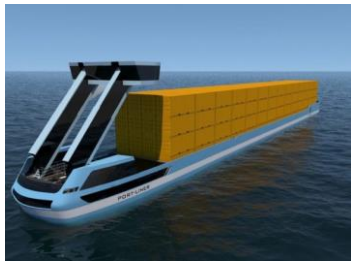
Initiative Overview

Background
The European Union is investing in Port Liner's autonomous electric barges development as part of its initiative to improve port efficiency through innovative technology. The Dutch company Port Liner will be introducing the autonomous electric barges for the European market beginning in August of this year. Port Liner believes it could produce about 500 barges a year to revolutionize the freight industry, although the electric motors and batteries could also be retrofitted into older boats.

Description of the Initiative
The 5 autonomous electric barges to be built will be operating between the De Kempen intermodal terminal in the Netherlands and Antwerp, Belgium. This will be a big boost for the industry's green energy credentials. These barges will be the first in the world to sail on carbon-neutral batteries.

Mechanisms to set up
The barges are designed to operate without any crew, although the vessels will be manned in their first period of operation as new infrastructure is erected around some of the busiest inland waterways in Europe. The batteries will be mounted in a container of their own, which means they can be used by existing vessels. This will allow the retrofitting of barges already in operation. Dubbed the "Tesla of the canals", their electric motors will be driven by 20-foot batteries, charged on shore by the carbon-free energy provider Eneco, which sources solar power, windmills and renewables. The barges will be fitted with a power box giving them 15 hours of power. As there is no need for a traditional engine room, the boats have up to 8% extra space.

Monitored by
Port Liner, Port of Antwerp



Results/ Gains

- Impact on environment and costs
- Zero CO2 emissions
- Crewless vessels

Costs
$8.7million by EU
$250,000 by Port of Antwerp

Timeline
First delivery August 2018

Implemented in
Netherlands

Weighted Relevance Criteria Scoring for WA

Relevance to WA
WA can build upon existing battery technologies used in ferries and apply them to the building of barges.

Marine Habitat: financial incentives for reduction of underwater noise

Overview of Program

Background
While there are plenty of naturally occurring sounds in the ocean, an increase in commercial vessel traffic is the main reason for increased underwater noise. In the North Pacific Ocean, underwater noise has been doubling in intensity every decade for the past 60 years. Most underwater noise from large vessels is caused by propeller cavitation. Other sources of vessel underwater noise include engine and onboard machinery; drag from poor hull maintenance; bow/stern thrusters.

Description of the program
The Enhancing Cetacean Habitat and Observation (ECHO) Program is a Vancouver Fraser Port Authority-led initiative aimed at better understanding and managing the impact of shipping activities on at-risk whales throughout the southern coast of British Columbia. The long-term goal of the ECHO Program is to develop mitigation measures that will lead to a quantifiable reduction in potential threats to whales as a result of shipping activities.

Mechanisms to set up
In January 2017, Vancouver added a new incentive criteria to its existing EcoAction program to include harbour due rate discounts for quieter ships, making Canada the first country in the world with a marine noise reduction incentive.
The ECHO Program benefited from early input and advice from scientists, shipping industries, conservation and environmental groups, First Nations individuals and government agencies to help the program focus efforts and set goals and objectives.
Funding contributors include Fraser River Pile and Dredge; Trans Mountain; Transport Canada; Vancouver Fraser Port Authority.

Monitored by
Adoption of technologies/practices (e.g. various vessel-quieting designs, technology and maintenance options) which reduce underwater noise, subject to the evaluation process of the noise reduction effectiveness in the EcoAction program.

Results / Gains
- Harbor due rate discounts for quieter ships
- Beneficial to whales throughout the southern coast of British Columbia

Timeline
2014-2018: plan and execute projects to inform mitigation
2016-2019: development and trialling of potential mitigation solutions, targets and incentives
2017-onwards: implement incentive / voluntary programs; monitor and manage measurable threat reduction

Implemented in
Canada (Port of Vancouver)

Weighted Relevance Criteria Scoring for WA

Investment Costs
- n/a

Relevance to WA
Preserving WA's mammal marine life is of prime concern to WA's population

Air Quality: ship exhaust scrubbing as an alternative to cold ironing

Overview of Solution

Background

When berthed, ships require electricity to support activities like loading, unloading, heating and lighting, cargo refrigeration, and other onboard activities. This power is generally provided by auxiliary engines and boilers that emit carbon dioxide (CO2) and air pollutants, affecting local air quality and ultimately the health of both port workers and nearby residents. The same holds for noise nuisance.

Description of the solution / technology

As an alternative to cold ironing (which is a process where ships shut off their diesel-powered engines and use shore-based power for their electrical needs, preventing and/or significantly reducing harmful emissions during each port visit), specialized barges (or shore-based system) can be used by connecting to the exhaust vents of ocean-going vessels (especially container ships) to scrub pollution.

AMECS – Advanced Maritime Emissions Control System, also known as "Baghouse System", consists of ECS (Exhaust Capture System) and ETS (Emissions Treatment System) and can also be used by non-regular ships whilst on dock. AMECS is approved by CARB as a certified alternative to cold ironing which allows ships not equipped with shore power to achieve cold ironing compliance.

Unlike shore power, AMECS does not require any modification to the ship, and does not require major power system infrastructure upgrades that are associated with shore power. AMECS patented "direct connect" technology safely connects to each vessel exhaust port to provide 100% exhaust gas capture. Barge-based system can be moved from vessel to vessel to remove criteria pollutants from the vessel's exhaust gas while the vessel is hoteling. Continuous emissions monitoring provides assurance to regulatory agencies that pollutants are being removed.

Provider of AMECS

In 2013, Port of Long Beach provided about $2 million in seed money to help test AMECS. Advanced Cleanup Technologies Inc. (ACTI) can market AMECS to vessel operators as an alternative to container ships plugging into the electrical grid to reduce emissions while at berth. Container and cruise ships must significantly reduce at-berth emissions to meet state regulations, but the existing "shore power" option requires retrofits to each vessel.

Monitored by

Emissions in ports are monitored by U.S. EPA. Pollutants' monitoring by AMECS.

Implemented in

USA (technology approved by CARB to achieve cold ironing compliance)

Weighted Relevance Criteria Scoring for WA

Results / Gains

- Proven emissions reductions: 95% PM, 99% NOX, 99% SOX, 99% VOCs
- Less expensive than shore power
- No vessel or berth retrofit required
- Eliminates ship blackout concerns associated w/ grid
- Rapid connection
- Can handle multiple exhaust ports at the same time
- Same emission reductions regardless of fuel type used

Investment Costs

AMECS is less expensive than OPS and requires no vessel or berth retrofit

Timeline

n/a

Relevance to WA

WA has an ambition to significantly reduce DPM (diesel particulate matter) and GHG (greenhouse gas) emissions by 2020

Air Quality: cold ironing with Onshore Power Supply (OPS)

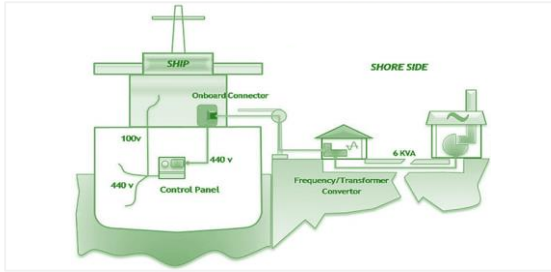
Overview of Program

Background
When berthed, ships require electricity to support activities like loading, unloading, heating and lighting and other onboard activities. Today, this power is generally provided by auxiliary engines that emit carbon dioxide (CO2) and air pollutants, affecting local air quality and ultimately the health of both port workers and nearby residents. The same holds for noise nuisance.

Description of the program
Cold ironing is a process where ships shut off their diesel-powered engines and use shore-based power for their electrical needs, preventing and/or significantly reducing harmful emissions during each port visit. In this way ships' operations can proceed uninterrupted, while eliminating negative side-effects. Electricity can be from renewable sources, or cleaner fuels like LNG.

Mechanisms to set up
Tougher environmental legislation, greater focus on emissions in ports from shipping and rising fuel prices are factors pushing ports to consider cold ironing. The European Commission issued a recommendation stating that "Member States should consider the installation of shore-side electricity for use by ships at berth in ports; particularly in ports where air quality limit values are exceeded or where public concern is expressed about high levels of noise nuisance, and especially in berths situated near residential areas". There is an EU directive which requires all ports in the 28-member bloc to make shore power available by 2025. In California, its Air Resources Board (CARB) adopted a regulation in 2007 to reduce emissions from diesel auxiliary engines on ships while at-berth for container, cruise and reefer vessels. Port authorities and governments may subsidize the project costs, which could be a public-private collaboration.
To build up a clear and comprehensive idea of the potential for cold ironing at a particular port requires input from many different parties. A working group comprising experts and representatives from different stakeholders (e.g. port authority, targeted shipping lines (frequent-callers), terminal operator, local community, suppliers of electricity and automation technology, environmental engineers) should discuss the issue and create a well-founded business case.

Monitored by
Emissions in ports are monitored by U.S. EPA



Results / Gains
- Reduced emission of air pollutants, CO2, noise and vibration
- Shore power cuts air pollution from ships at berth by 95%
- Can remove as much as 1,000 pounds of diesel exhaust pollutants during a single port call of a typical container ship

Investment Costs
- Quayside: US$ 300,000 to 4 million per berth, depending various factors
- Shipside: US$ 300,000 to 2 million, depending on various factors

Timeline
n/a

Implemented in
Belgium, Canada, Finland, Germany, Netherlands, Norway, Sweden, USA **(incl. WA State partially)**

Weighted Relevance Criteria Scoring for WA

Relevance to WA
WA has an ambition to significantly reduce DPM (diesel particulate matter) and GHG (greenhouse gas) emissions by 2020

Air Quality: emissions reduction from Cargo Handling Equipment (CHE)

Overview of Program

Background
Vessels arrive and depart ports around the clock, which mean equipment and machinery at these ports are always operating. Cargo handling equipment, together with the trucks that are coming to port to pick up or discharge cargo, is the second largest source of air pollution and greenhouse gas emissions in ports. Cargo handling equipment at ports generally include yard tractors, cranes, forklifts, container handlers (e.g. top picks and side picks), and bulk handling equipment, such as tractors, loaders, dozers, excavators, and backhoes. Among these equipment types, yard tractors, container handlers, and forklifts are the most common types of equipment at ports.

Description of the program
To reduce the amount of pollutants emitted from ports, ports are beginning to retrofit these cargo handling equipment types with emissions control systems, replace older equipment with newer cleaner equipment, or use cleaner fuel technologies, such as electrification.

Mechanisms to set up
Such programs are usually self-funded by the port terminals and port authorities and/or service providers. However, governmental grants might also be available. For example, the Port of Los Angeles secured a $5.8 million state grant to purchase and test a new fleet of 25 zero and near-zero emission yard tractors at its container terminal. The grant will also fund a companion project to equip 100 more drayage trucks with smart technology aimed at reducing emissions by streamlining their time on the road and improving the flow of containers to and from the port complex. This grant was by the California Energy Commission (CEC), which supports freight transportation projects at California seaports under its Alternative and Renewable Fuel and Vehicle Technology Program. The purpose is to advance commercialization of clean fuels and technologies that cut greenhouse gas emissions, reduce petroleum use and improve the health and quality of life of communities disproportionately burdened by environmental pollution.

Monitored by
Emissions in ports are monitored by U.S. EPA

Results / Gains

- Yard hostlers with hydraulic hybrid technology are expected to achieve 60-70% improvement in fuel economy and a 40% reduction in emissions.
- Electric trucks can be 4-9 times cheaper to operate than diesel trucks, depending on fuel costs and operating conditions.

Investment Costs

- Electric yard hostler: $189,950
- Electric truck: $208,500

Timeline

n/a

Implemented in

Canada, Singapore, USA **(incl. WA State partially)**

Weighted Relevance Criteria Scoring for WA

Relevance to WA

WA has an ambition to significantly reduce DPM (diesel particulate matter) and GHG (greenhouse gas) emissions by 2020

Related Initiatives For reference from Blue Innovation Pathway:

- Digital Transformation
- Blue Tech

Initiative description - Digital Transformation

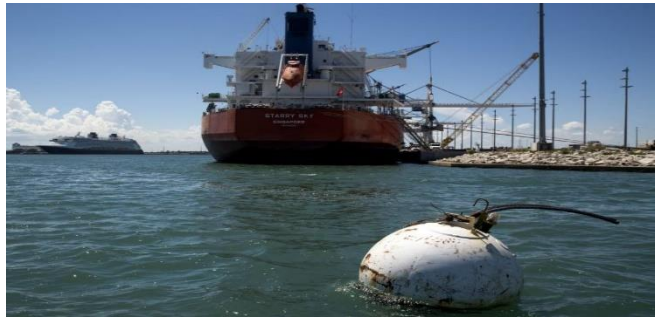
Create commercial opportunities for Washington State in pursuing the digital transformation of the maritime sector

- Maritime data science (collection, analytics & sharing)
  - Establish baselines where data lacking
  - *Utilize Block Chain to increase transparency on cargoes, destinations, financial transactions and on the use of agents and intermediaries.*
  - Advance knowledge about the ocean and marine life by compiling and sharing operational data about ocean conditions. Such increased knowledge can inform more effective governance of the oceans.
  - Use ships to collect research data on the oceans using digital technologies and sensors. Such collection and sharing with the international research community will increase understanding of the ocean space, of acidification, and of marine ecosystems.
- *Pilot maritime use cases, standards and enabling technology*
  - *e.g. BLUE-ware, digital twin (modeling), shipping & shore side logistics*
  - *Digitalization enabling technology and practices e.g. sensors/data architecture /formats – positioning to influence international standards development*
- Leverage automation and autonomous systems & robotics including cross-sector collaboration with Washington's ICT & manufacturing sectors

Initiative description – Blue Tech

Leveraging Blue Tech in ocean space activities to overcome challenges and create commercial opportunities

- Increase spending on R&D in the ocean space and in related industries and join public and/or private partnerships to develop infrastructure to support sustainable resource exploitation.
- Create commercial advantage by leveraging Washington State's ocean science/ocean space expertise to promote R&D and implementation of demonstration projects.
  - Ocean exploration/data gathering/instrumentation
    - UAV, robotics, submarines, etc.
  - Maritime CleanTech
    - Emission and discharge control and treatment
    - Sound abetments/controls
    - Clean water
  - Marine Biomedicine/Biotechnology
    - organisms with different enzymes and components can be used in biotechnology and production of medicines
  - Ocean renewable energy
    - Promote R&D and implementation of ocean renewable energy sources.
    - Biomass, tides, wind and waves can be exploited to harvest fuel/energy
    - Explore opportunities to implement ocean energy for remote operations.
    - Provide shipping services and technology related to harvesting offshore energy, for example solar, tidal, wind, wave and biomass energy.
    - Provide shipping services for distributing renewable energy – dependent on the type of energy and location of production.



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