

# COASTAL RESILIENCE & ADAPTATION ECONOMY REGION 6 ACTION PLAN









# CONTENTS

Summary
Virginia's Coastal Resilience & Adaptation Economic Opportunities: Necessity is the Mother of Invention
<ul> <li>Growing Demand - Market Snapshot</li> <li>Region 6 Assets - Coastal Rural Virginia's Competitive Advantage</li> </ul>
Opportunities: Promising Coastal Resilience & Adaptation Economic Sectors
<ul> <li>Waterfront Homes &amp; Properties - Living Buildings</li> <li>Hybrid Blue-Green-Gray Infrastructure and Living Shorelines</li> <li>Waterfront, Water-Dependent Business Infrastructure</li> <li>Rural Wastewater &amp; Water Management</li> </ul>
Case Studies: Lessons from Coastal Resilience & Adaptation Economic Development
Immediate Needs: Action Items to Realize Opportunities
<ul> <li>Virginia Coastal Resilience &amp; Adaptation R&amp;D Campus – Resilience Innovation Center</li> </ul>
Accomplishments & Forthcoming Activities
<ul> <li>Continuing the Momentum</li> <li>Establishing the Culture of Innovation</li> </ul>
Next Steps: Advancing a Coastal Resilience & Adaptation Economy
Attachments
<ul> <li>References</li> <li>Workforce Needs Inventory</li> <li>Case Studies</li> </ul>
COVER PHOTO BY JAY CLARK / VIRGINIA SEA GRAN

#### CONTACT

Troy Hartley, Virginia Sea Grant. <u>thartley@vaseagrant.org</u> Sabine Rogers, Virginia Sea Grant, <u>sarogers@vaseagrant.org</u> Lewie Lawrence, Middle Peninsula Planning District Commission, <u>LLawrence@mppdc.com</u>





## **SUMMARY**

Managing the movement, storage, release, conservation, utilization, and treatment of water, and living and adapting to managing more water in the future is at the core of a coastal resilience and adaptation economy. Novel, innovative approaches to human-made and natural system infrastructure, materials, designs, and services are needed to adapt existing and new infrastructure to living with more water. A multi-stakeholder planning process identified Region 6's core strengths, assets, and opportunities in a coastal resilience and adaptation economy, including broader regional partnerships to launch this economic sector in several priority opportunities. There is a growing domestic and international market to address flooding and adapting, with current preventable losses of hundreds of millions of dollars in rural coastal Virginia alone. Water jobs pay more on average than all occupations nationally, and pay up to 50% more for employees at the lower ends of the economic scale.

GO Virginia Region 6's resilience and adaptation economy assets include: **Abundance of land and water** - blue/green assets that manage water quality and quantity; An available **network of publicly owned**, **water-front properties** as R&D field stations for testing innovations; Extensive and expanding **workforce development partnerships** between Region 6-based academic institutions and water technology and water-dependent industries, particularly the architectural and engineering (A&E) firms, aquaculture industry, and current adaptation businesses; Emerging **collaborative public-private partnerships** with A&E firms and adaptation businesses to protect tax base and launch innovation; and coastal rural challenges presenting **scalable innovation needs** for resilience and adaptation across the US and world. Region 6's innovation and potential commercialization opportunities exist in several sectors:

- Waterfront homes and properties. Greater integration of current home and building construction techniques with ecosystem sciences could enhance resilience, sustainability, and innovation, leading to the novel waterfront buildings of 2100, with global applications.
- **Hybrid blue-green-gray infrastructure and living shorelines.** The integration of engineering and ecosystem sciences to design for protection, water quality, and the management of water quantity and flooding simultaneously could lead to potential innovation, with commercialization opportunities.
- Waterfront, water-dependent business infrastructure. This remains a very broad, cross-cutting category of serving the vast array of water-front and water-dependent businesses in coastal rural communities to adapt their physical infrastructure and operations to live with more frequent flooding. It includes the need for innovation in construction and design, transportation, dredging, and finance methods.
- **Rural wastewater and water management.** Novel approaches to rural wastewater treatment and septic systems will need to simultaneously enhance resilience to flooding, be adaptable under future higher groundwater and saltwater intrusion levels, and achieve and surpass water quality standards.

Case studies of developments of related economic sectors illustrated the importance of tailoring the economic development to the region's existing strengths; providing a neutral location for public-private R&D partnerships to test proof of concepts; maintaining champions and several federal government partners; and establishing clear governance systems that enable partnerships.

There are immediate opportunities for Region 6 to grow its coastal resilience and adaptation economy footprint and its place in a Commonwealth-wide innovation ecosystem in this economic sector. Region 6 has the land and organizational capacity and partnerships for a Resilience Innovation Center, i.e., a public-private partnership for resilience design R&D. A collaboration with assets in GO Virginia Region 5 would expand access to commercialization, entrepreneurship, and business accelerator services.



# VIRGINIA'S COASTAL RESILIENCE & ADAPTATION ECONOMIC OPPORTUNITIES:

### NECESSITY IS THE MOTHER OF INVENTION

#### WHAT IS A COASTAL RESILIENCE & ADAPTATION ECONOMY?

Managing the movement, storage, release, conservation, utilization, and treatment of water, and living and adapting to managing more water in the future is at the core of a water management-related coastal resilience and adaptation economy. Water comes from many sources - precipitation, groundwater, sea levels, floods, etc. In some cases, this involves human-made and natural system infrastructure, materials, designs, and services - but not necessarily more of existing technologies. Novel, innovative approaches are needed to adapt existing and new infrastructure to living with more water. *Infrastructure* ranges from today's gray infrastructure (e.g., pipes, pumps, treatment systems and plants) to green infrastructure (e.g., living shorelines, swales, bio-retention technologies) to emerging hybrid green-gray designs and in many situations, integrated blue-green-gray designs that holistically view the water, tidal, and land systems. *Materials* used to build roads, homes, docks, waterfront businesses from foundations, to cisterns, to walls and roofs, to machinery and aquaculture cages. *Designs* shape integrated systems at lot, neighborhood, community and watershed scales, while *services* implement the design, construction and operation of water management, coastal resilience and adaptation solutions.

Virginia's place in a coastal resilience and adaptation economy will be determined by its own strengths and assets, meeting a global market demand for infrastructure, materials, designs and services in several economic sectors. An effective coastal resilience and adaptation economy would contain an entire innovation ecosystem - R&D capacity; technology development and commercialization capacity; entrepreneurship; and accelerator and support services to nurture successful businesses.

The rate of sea level rise, coupled with a high rate of land subsidence, is making Virginia one of the most vulnerable locations on the East Coast for flooding and coastal hazards. Virginia is feeling the impacts on its economies, environment, and communities today. And, while necessity is the mother of invention, invention can drive opportunities and economic development. Virginia has substantial assets that provide competitive advantages over others trying to find novel solutions to flooding and coastal resilience and adaptation challenges. Specifically, Virginia is poised to launch a coastal resilience and adaptation innovation economy by leveraging our rich and extensive blue/green assets, the scalability of solutions for the breadth of Virginia's coastal rural, suburban and urban settings, world-class university and higher education institutions, and emerging public-private partnerships focused on resilience and workforce development. Collectively, Virginia and GO Virginia Region 6, in particular, have a unique window of opportunity to assemble a public-private coastal resilience and adaptation R&D system to produce innovation, linked with commercialization capacity to launch businesses and position Virginia as a global leader in the coastal resilience and adaptation economy.



#### Growing Demand - Market Snapshot.

The global market for managing water is substantial. A 2010 market analysis for Milwaukee's Water Council concluded that the "world's market for water-related equipment and operations is projected to be...growing to well over \$600B by 2016. By contrast the world's IT market [in 2010] is \$650B; the cell phone market is \$600B..." (White, et al., 2010, pg. 8). Milwaukee's water industry cluster is composed of 175 firms in water technologies involving instruments, equipment and services, \$10.5B in revenues, and employing over 20,000 people (Mc-Dearman 2018). In the U.S. alone, in 2016 ~1.7M workers in 212 different occupations designed, constructed, operated and governed water infrastructure. Water jobs pay more on average than all occupations nationally, and pay up to 50% more for employees at the lower ends of the economic scale (Kane and Tomer, 2018). The Dutch water sector attending to flood protection and managing flood waters is a ~\$30B industry (Rago 2019). Further, all existing water-related infrastructure, and all sectors of the coastal economy, will need to adapt to more frequent flooding, greater shoreline erosion, stronger storms and coastal hazards, and other ramifications of living with more water. The demand for effective, efficient adaptation solutions is immense.

Virginia is on the leading edge of a global trend, with higher levels of relative sea level rise than other locations on the East Coast, and thus there is an opportunity to produce novel, cost-effective solutions to these challenges here in Virginia and then market them to the world. Rural coastal communities contain additional market opportunities. Rural areas account for 80% of the US landmass, and the demand for cost effective resilience solutions in coastal rural communities will be great (Lai, et al., 2011). A 2009 Middle Peninsula Planning District Commission report estimated that by 2050, the rural coastal Middle Peninsula could see \$187-\$249M worth of infrastructure (roads, houses, onsite waste disposal systems) and wetlands function impacted by sea level rise and flooding (MPPDC 2009). The Middle Peninsula's Mathews County county-wide property assessment recorded a lost \$75M in taxable property value caused by recurring flooding and erosion on their waterfront properties. In coastal rural communities, the majority of revenue is generated from real-estate taxes along the waterfront; it is a pressing need to preserve the tax base for as long as possible in order to continue to provide public services and have the resources to adapt.

In Region 5, A 2012 Hampton Roads Planning District Commission report estimated over 877 miles of roadway and over 3,659 businesses at risk to flooding at one meter of sea level rise (HRPDC 2012) and a 2015 report by the Accomack Northampton Planning District Commission estimated more than 13% of roadways would be impacted at 3 feet of sea level rise (ANPDC 2015). A 2020 CCRFR report completed in support of the development of the Commonwealth's Coastal Resilience Master Plan estimates that statewide by 2040 over 140 square miles of land will be vulnerable to frequent recurrent tidal flooding or "nuisance flooding" including land area in all of the above planning district areas (McLeod 2020). In addition to new economic opportunities, there are substantial cost savings form better protecting existing assets.

In the Hampton Roads region (GO Virginia Region 5), 6% of total employment is in water technology-related industries (43,000 in 2015), with strengths in logistics services, engineering services, civil engineering construction, and water and sewer line construction (Filer, 2017). Hampton Roads contains the suburban/urban infrastructure, systems, and industrial capacity comparable to other urban areas with water management, coastal resilience and adaptation economy initiatives (e.g., New Orleans, Boston, Milwaukee). However, Virginia's competitive advantage would be enhanced by leveraging the rural assets and the innovation that could emerge from collaborating across Virginia's coastal zone.



## **OPPORTUNITIES:**

### PROMISING COASTAL RESILENCE & ADAPTATION ECONOMIC SECTORS

Virginia Sea Grant (VASG) was awarded a GO Virginia Region 6 planning grant to assess the assets and strengths, gaps, and potential opportunities for a coastal resilience and adaptation economy in Region 6, and build an action plan for moving forward to realize those opportunities. Below is a summary of the findings, including the identification of the most promising economic sectors within the coastal resilience and adaptation economy; lessons learned from other regions of the country trying to grow a water management, coastal resilience and adaptation economy; an action plan to realize Virginia's opportunities; and recent accomplishments and emerging projects that support the growth of a coastal resilience and adaptation economy.

VASG's GO Virginia Region 6 Planning project identified innovation and potential commercialization opportunities in the following economic sectors:

#### Waterfront Homes & Properties - Next Generation Living Buildings

Virginia's coastal rural communities contain historic properties and homes, as well as new-built retirement and family homes. Between 2005-2018, Gloucester Point home values dropped more than \$1.4M from flooding risk, with over 300 properties at high risk of flooding (Dietrich 2018). Between 2010-2016, Mathews County received ~\$6M in FEMA Hazard Mitigation Grants to elevate homes damaged from storms (Hubbard 2016), and lost \$75M in taxable property value in their last assessment. Thus, there is considerable need in Region 6 and coastal rural communities nationwide for solutions to protect homes and properties and the tax base that represents. Specifically, needs and opportunities were identified for:

• Fully integrating blue-green-gray resilience and adaptation solutions into individual home, property, and neighborhood design and construction.

#### **REGION 6 ASSETS - RURAL COASTAL VIRGINIA'S COMPETITIVE ADVANTAGE** OPPORTUNITIES ARISE FROM LEVERAGING REGION 6'S RURAL COASTAL STRENGTHS:

- Abundance of land and water blue/green assets that manage water quality and quantity.
- An available **network of publicly owned, water-front properties** as R&D field stations for testing innovations.
- Extensive and expanding **workforce development partnerships** between Region 6-based academic institutions (community colleges, undergraduate and graduate institutions) and water technology and water-dependent industries, particularly the architectural and engineering (A&E) firms, aquaculture industry, and current adaptation businesses.
- Emerging **collaborative public-private partnerships** with A&E firms and adaptation businesses to protect tax base and launch innovation with potential commercialization.
- Coastal rural challenges presenting *scalable innovation needs* for coastal resilience and adaptation across the US and world.



#### PLANNING PROCESS FOR REGION 6 ACTION PLAN

VASG's GO Virginia Region 6 planning grant launched a set of multi-stakeholder discussions including:

- Fact-finding workshop, Louisiana's water management economy and the Water Campus. November 2, 2018.
- Inventory Assets and Gaps workshop, informed by additional case studies. February 21, 2019.
- Prioritize Opportunities workshop. June 12, 2019.
- Case Studies and background research Louisiana Water Economy; Virginia Commonwealth Center for Advanced Manufacturing; Milwaukee Water Council; Rhode Island Newport Innovation District; Netherlands Golden Triangle. Due to Covid-19, site visits and interviews were shifted to virtual interviews.
- Building and materials sciences, developing new materials and designs for constructing and retro-fitting homes and other waterfront property building.
- Integrated landscape-home designs, integrating green and blue infrastructure with novel building materials. Designs that more effective live with water and drive toward net zero energy and greater carbon encumbrance.
- Road designs and materials for frequently flooded roadways, cutting off access to waterfront homes and properties.

Greater integration of current home and building construction techniques with ecosystem sciences could enhance resilience, sustainability, and innovation, leading to the novel waterfront buildings of 2100, with global applications.

#### Hybrid Blue-Green-Gray Infrastructure and Living Shorelines

Living shorelines contain natural features such as marshes and beaches, and can protect shorelines from erosion and flooding damage while providing water quality and habitat benefits. While living shorelines are the preferred shoreline protection technology for the Commonwealth of Virginia, they need improvements to be more fully implementable, including strategies to make them more cost competitive versus hardening shoreline strategies and easier to maintain for long-term reliability. Opportunities include:

- Affordable rock or alternative substrates, with better habitats, adaptable to future sea level rise.
- More affordable and easier living shoreline maintenance procedures.
- Supply of marsh plants for replanting, marsh plant businesses.
- Integrating oyster reefs, new designs for reefs, aquaculture operations, and other innovation in the open water to enhance living shoreline designs and viability.
- Insurance and financial products and services to fund and insure long-term performance of living shorelines, and repair them if they fail.
- Certifying the quality of dredge materials for beneficial reuse of dredge to expand marshes.

Engineered shorelines, often called gray infrastructure, include revetments, bulkheads, levees, seawalls, etc. and they are typically used in high-energy settings with large waves and fetch, or steep shoreline slopes. Much of the existing coastal resilience and adaptation technologies and systems are engineered (e.g., wastewater treatment plants and septic systems, cisterns, stormwater management pipes, and pumps). At the same time, existing green infrastructure includes rain gardens, bio-retention systems, swales, woodlands and trees, green roofs, porous pavements, sand filters, and other nature-based solutions.



The integration of engineering and ecosystem sciences to design for protection, water quality, and the management of water quantity and flooding simultaneously could lead to potential innovation, with commercialization opportunities.

#### **Rural Wastewater & Water Management**

Wastewater and water management is likely the most globally competitive sector of a coastal resilience and adaptation economy at this time. However, there are unique needs and opportunities in Region 6 and more broadly in Virginia for wastewater and water infrastructure; specifically:

- Designs for decentralized wastewater management and septic systems with higher groundwater tables and more saltwater intrusion.
- Stormwater management at zero grade, including design standards under future sea level rise conditions.
- Water retention and release technologies, strategies, and infrastructures, including ditch and dam designs, and new strategies to impound water given extensive land availability in coastal rural regions.

Novel approaches to rural wastewater treatment and septic systems will need to simultaneously enhance resilience to flooding, be adaptable under future higher groundwater and saltwater intrusion levels, and achieve and surpass water quality standards.

#### Waterfront, Water-Dependent Business Infrastructure

Working waterfronts provide access to the water and are used for water-dependent commercial, industrial, or government activities, including commercial fishing, recreational fishing, tourism, aquaculture, boat and ship building, boat and ship repair, boat and ship services, seafood processing, seafood sales, transportation, shipping, marine construction, military activities and other water-dependent uses. Working waterfronts are under substantial threats and pressures from rising sea levels and flooding, changing global economic conditions, loss of natural habitat that supports shellfish and finfish populations, and competition from residential development. Virginia is slowly losing its working waterfronts, an issue that will have consequences for local economies, the environment, coastal culture and quality of life. (VACZM 2016)

Coastal rural commercial waterfronts in particular are vital economic engines for rural communities and losing working waterfronts threatens the identity of the region. In coastal rural Virginia, much of the working waterfront infrastructure is privately owned. Thus, there are substantial needs and opportunities for developing adaptation technologies, strategies and services for:

- Aquaculture industry, including shellfish hatcheries, aquaculture farms, and seafood processing;
- Marinas and ports, including the accompanying hospitality and retail businesses (marinas) and military (ports).
- Ship and boat building, maintenance, service, repairs.
- Harbor dredging and dredge capacity, including testing and use of dredge materials.
- Road designs and materials for frequently flooded roadways that cuts off access to coastal facilities.

This remains a very broad, cross-cutting category of serving the vast array of waterfront and water-dependent businesses in coastal rural communities to adapt their physical infrastructure and operations to live with more frequent flooding. It includes the need for innovation in construction and design, transportation, dredging, and finance methods.





# **CASE STUDIES:**

### LESSONS FOR DEVELOPING A COASTAL RESILIENCE AND ADAPTATION ECONOMY

Case studies were conducted, although site visits and in-person interviews were not possible due to COVID-19 travel restrictions. Topics of interest in the case studies included:

- Collaborators, stakeholders working together to produce innovation R&D, commercialization
- Governance and management systems e.g., MOUs, advisory boards, administrative capacity, procedures, key challenges, etc.
- Management of intellectual property (IP), including IP agreements.
- Partnerships and cost sharing arrangements
- Facilities and resources available to partners
- Long-term financial sustainability
- Other dimensions of a public-private partnership

See the attached case vignettes for more details; however, the summary findings include:

Milwaukee's water cluster is led by *The Water Council*, a 501(c)(3) non-profit organization, with collaboration and investment from academic institutions, the city of Milwaukee, and the Milwaukee Metropolitan Sewerage District, and launching support from a regional economic development organization (McDearman 2018). *Lesson:* tailor economic cluster to the region's existing strengths.

Louisiana Water Campus. The multi-phased build out of a water campus is a physical development along the Mississippi River in Baton Rouge, LA. More than \$100M has been spent on the first phase. The campus aims to strengthen efforts (R&D, university institutes, restoration management) to restore and enhance coastal environments. **Lesson:** critical need of neutral territory for university collaboration.

*Netherlands. Golden Triangle.* Academic-Industry-Government partnership. Applied R&D on designs and infrastructure. Place for proof of concepts – meeting codes, specifications, professional standards. These new ideas, creations and innovations are then fed to a commercialization entity. **Lesson:** role of government partners, mechanism for testing proof of concept.

Newport Innovation District. 30,000 square foot retrofitted property as a tech accelerator and flex space. Public-private partnerships. Plans for a larger 60-acre Innovative District Redevelopment Site as an R&D, tech transfer, job creation center. Race-to-Resilience collaborative competition with the City of Annapolis, MD (added incentive for innovation). Formal agreement with the Naval Undersea Warfare Center to commercialize its underwater technologies. **Lesson**: floundered without champions; federal partner (Navy) is important, although led to a narrow economic sector (autonomous underwater technology).

Commonwealth Center for Advanced Manufacturing (CCAM). A public-private partnership, CCAM is an applied research center and non-for-profit 501c3 with membership from industry, university and government. It is an innovation campus where industry, academia and government solve advanced manufacturing challenges and grow a qualified manufacturing workforce ecosystem. **Lesson:** critical to get the governance system fleshed out early (e.g., transparency, IP agreement, multi-university, private partnerships, advisory structure, administrative capacity, etc.,) for clear road map to enable partnerships.



# **IMMEDIATE NEEDS:**

### ACTION ITEMS TO REALIZE OPPORTUNITIES

The lifecycle of research, development and commercialization is referred to as an innovation ecosystem, a network of individuals, entities, resources, and structures that contribute to each other and collectively catalyze new products, ideas, methods, and systems. A productive innovation ecosystem generates economic growth through connecting public and private economic development resources and services across R&D activities, technology development and commercialization, entrepreneurship development, and then employment in the economic sector (TEConomy 2018). Virginia has elements of this life cycle for a coastal resilience and adaptation economy, although gaps exist – some of those gaps, Region 6 is poised to fill.

The R&D capacity to generate novel ideas that have commercialization potential is a significant gap in Virginia's existing coastal resilience and adaption innovation ecosystem - this is not unique to a resilience-related economic sector, but rather a common deficiency in Virginia's economic development capacity (TEConomy 2018). Region 6 is uniquely positioned to contribute to filling this gap through leveraging its current assets particularly, combining its Public Access Authority properties, abundance of land and water, and academic capacity into a state-of-the-art R&D capacity. Coastal resilience and adaptation innovation campus would focus on establishing a robust ecosystem that produces innovation, talent, workforce and economic opportunities to encourage the launch of businesses in Virginia and position Virginia as a global leader in the coastal resilience and adaptation economy.

#### Region 6 Resilience Innovation Center - Public-Private Partnership for Resilience Design R&D

Additional innovation, coordination, and facilitation capacity of a private sector-university R&D partnership in Region 6 would grow higher paying jobs and start-up businesses in Region 6. Further partnering with existing entrepreneurship and business accelerator capacity in the Commonwealth (e.g., state agencies, regional economic development organizations, universities) could target those services toward a coastal resilience and adaptation economy.

GO Virginia Region 6 has the assets to assemble a multi-university, public-private resilience and adaptation R&D campus with a central hub and a network of field stations to produce the innovation needed to grow businesses in one or more of the economic sectors of strength noted above, but particularly:

- Waterfront homes and properties Living Buildings
- Hybrid green-gray-blue infrastructure and living shorelines

Specifically, Region 6 contains a network of publicly owned, waterfront properties with a variety of existing infrastructure (roads, docks, residential homes, barns, garages, septic systems, pools, etc.) and under a range of environmental conditions (e.g., erosion rates, flooding levels, existing green infrastructure, etc.). The network provides a platform for field research station on innovative designs, an extension and complimentary partner to Hampton Roads' Living Laboratory for resilience innovation. Region 6 is home to an established and effective community college (Rappahannock Community College), highly ranked predominantly undergraduate university (University of Mary Washington), world-class coastal science research institute (Virginia Institute of Marine Science, VIMS) and a seven-university coalition (Virginia Sea Grant) that can leverage the unique strengths and breadth of disciplinary experts from across the Commonwealth. Virginia Sea Grant (VASG) is headquartered at VIMS with William & Mary, and composed of the University of Virginia, Virginia Tech, and George Mason, James Madison, Old Dominion, and Virginia Commonwealth Universities. VASG is well-positioned to facilitate and coordinate the development of a public-private partnership R&D campus.



		STATUS IN REGION 6
	R&D Activities	Currently Limited. There are a few firms conducting work on specialized adaptation technol- ogies (e.g., historic building rehabilitation, oyster reef construction, home raising, bio-retention systems), but limited and no comprehensive univer- sity-industry R&D partnership. These firms are not located in Region 6.
Ν	Tech Development & Commercialization	Limited, but emerging capacity in the water management economy, see RISE in Go Virginia Region 5 ( <u>https://riseresilience.org/</u> ) More broadly, university economic development offices attend to tech development and commercialization, although not tailored to the coastal resilience and adaptation economy.
INNOVATION ECOSYSTEM	Entrepreneurship Capacity-Building	Limited, although there are generic entrepreneurship programs at several Virginia universities, mostly in their business schools. Region 6's University of Mary Washington contains the EagleWorks Incu- bator program and the Center for Economic Development. Region 6's VASG member institution: e.g., JMU X-Labs to train innovators, including marine-related projects (https://jmuxlabs.org/), VT Knowledge- Works, UVAs Batten Institute for Entrepreneurship & Innovation and Social Entrepreneurship @UVA, GMUs Innovation Lab, VCUs da Vinci Center, ODU Institute for Innovation & Entrepreneurship, W&M Miller EC. RISE, in Region 5, provides coaching and technical assistance workshops for com- mercialization, targeting winners of its business plan competition.
	Successful & Expanding Industries	Virginia is home to many accomplished architectural and engineering firms that are active in the global water management market, although none are located in Region 6. Smaller firms with specialized niche resil- ience products (e.g., shoreline stabilization, historic home adaptation, arti- ficial oyster reef designs, etc.) are emerging but not located in Region 6. However, VASG, headquartered in Region 6, has workforce development and project partnerships with: AECOM; ARCADIS; ClarkNexsen; Dewber- ry; Hanbury; Jacobs; Kimley-Horn; Moffatt & Nichol Michael Baker International.



Collectively, Region 6 can access ecosystem scientists, engineers, landscape architects, architects, economists, lawyers, business faculty, and other relevant expertise. Workforce development capacity exists in Region 6 from Community College and undergraduate programming, to graduate research programs and workforce development partnerships with A&E firms.

Consistent with statewide trends, growing research through team-based, translational research centers, coupled with a strengthening of university capacities in technology transfer and commercialization, would spur innovation and entrepreneurship (TEConomy 2018). A resilience and adaptation R&D campus could bridge the disconnect between university research and Virginia-based company innovation. The stakeholder-driven GO Virginia planning grant process concluded that a Virginia resilience and adaptation R&D campus needs:

- Central Hub space that facilitates co-production of knowledge among academic researchers (faculty and students, private industry, non-profits, and government partners with:
  - A collaborative, team design-thinking studio space;
  - Laboratory and workshop to build and test prototypes at bench-scales and build full-scale prototypes for field testing
- A network of waterfront field stations with varying environmental conditions.
- Strong industry partners to ensure applications of research, identification of needs, and co-sponsor for research.
- Central coordination capacity including effective mechanisms for communication and technology transfer between universities and the private sector, clear and efficient intellectual property procedures, data management capacity, transparent governance with advisory councils, and other administrative infrastructure.
  - Engagement with existing commercialization, entrepreneurship and business accelerator support services across universities, NGOs, and government agencies.
  - Outreach and partnership with federal agencies to align R&D with resilience policy and federal infrastructure investments.
- Experimental R&D zones to streamline and coordinate multiple agency permitting requirements for novel prototypes and designs, given that they will be operating under highly rigorous monitoring protocols for performance (e.g., design standards, resilience enhancement, environmental impact, water quality, etc.).
- Formal relationships with academic programs to advance workforce development initiatives at community colleges, undergraduate and graduate schools (e.g., student opportunities for research, fellowships, apprenticeships, course work, potential certification and degree programs etc.).

Further, based upon a consistent lesson learned from the case studies, Virginia's resilience and adaptation R&D campus should reside in a neutral third-party location in order to promote use across multiple universities, and cross-university collaboration with the private sector.



# **ACCOMPLISHMENTS AND FORTHCOMING ACTIVITIES**

There has been considerable progress toward building a coastal resilience and adaptation economy in Virginia, beyond the specific tasks of the Planning Grant. These accomplishments and activities are continuing to assess and prioritize opportunities among the sectors of a coastal resilience and adaptation economy, as well as demonstrate the potential return on investment from these sectors and greater collaboration between GO Virginia Region 5 and Region 6.

#### **Continuing the Momentum**

Recent accomplishments will nurture continued growth and momentum of a water management economy. The October 2019 updates to the *Commonwealth Research and Technology Strategic Roadmap* added a priority on efforts to counter increased sea levels and associated flooding risks within agricultural and environmental technologies (SCHEV and VRIC 2019).

Additional initiatives and activities are currently being launched or are underway, illustrating the potential for a Virginia resilience and adaptation R&D campus and for collaboration across GO Virginia Region 6 and Region 5.

- International Resilience Design Competition. VASG in collaboration with Louisiana Sea Grant (LSG), the international Coastal Estuarine Research Federation (CERF), and VASG partner institutions are developing and administering a design competition that would enable inter-disciplinary teams across architecture, landscape design, engineering, ecology, planning and other disciplines to develop innovative solutions for a particular site facing resilience challenges. Teams from Delaware, Florida, Maryland, Mississippi, Pennsylvania, and Virginia are developing designs from the individual lot, through neighborhood, to community scale for the city of Hampton, VA. Students will be central to the teams and design work; private sector will provide sponsorships, judging expertise, and team coaching. The designs will be presented at the November 2021 CERF conference, originally planned for in Richmond, VA but due to Covid-19, now scheduled virtually.
- **Region 6 Resilience Innovation Center Development.** The GO Virginia Region 6 Growth and Diversification Plan identifies the potential for a Resilience Innovation Center, i.e., a multi-university, public-private resilience and adaptation R&D campus with a central hub and a network of field stations to produce the innovation needed to grow businesses. VASG has secured \$270,427 in NOAA funding to formalize the governance structure for the Region 6 resilience innovation center, e.g., Charter and MOUs with member universities and private sector partners, dues structure, operating procedures for the R&D hub and field stations, intellectual property policy, etc. Similar to an advanced manufacturing center, the resilience innovation center will be sustainable through member dues, grants, federal, state and local government partners, and foundation support. The Region 6 Resilience Innovation Center and the coastal resilience and adaptation economy are identified in the Middle Peninsula Comprehensive Economic Development Strategy, which makes them eligible for additional, dedicated competitive funding from the US Economic Development Administration. VASG and the Middle Peninsula Chesapeake Bay Public Access Authority continue to collaborate on the funding and structure of a Resilience Innovation Center.

#### Joint Region 6 - Region 5 GO Virginia Proposal

VASG, PAA, RISE and ODU have secured a GO Virginia Region 6 - Region 5 collaborative proposal to launch a coastal resilience and adaptation economy. The approach: 1) Builds resilience entrepreneurship through RISE's proven business plan competition and accelerator services, including product performance



validation in Region 6's network of real world R&D test sites (i.e., Resilience Innovation Center) as an expansion of the Hampton Roads resilience living laboratory; 2) Forms a multi-stakeholder, business-focused Region 5-6 Consortium to engage the broader business community in education about the risks and economic impacts of sea level rise, and builds capacity for adoption of resilient practices.

**Resilience Entrepreneurship Capacity & Accelerator Services.** [GO Virginia: \$2,480,592. Match: \$2,822,844. Lead: VASG.] The entrepreneurship, R&D, and small business commercialization activities will be conducted by VASG, RISE, and PAA, including:

**1. Business Plan Competition: Protecting Rural Public Assets Facing Resilience Challenges.** Administer a business plan competition, using RISE's proven Challenge model, for firms to conduct resilience improvement demonstration projects on public properties and address coastal rural flooding issues (i.e., Region 6's living laboratory). Preference given for companies with Virginia-based operations and out-of-state companies with a high probability of expanding operations into Virginia. Competition and project team will assess R&D and commercialization needs and potential of

the companies. Procure services from up to five selected firms to protect public properties through

demonstration projects that spur innovation and commercialization potential. **2. Entrepreneurship and Business Development Assistance.** Assess and aggregate procurement demand and other domestic and global market opportunities as further incentives to companies. Support commercialization and growth through business acceleration, executive coaching, and connection to other investors and customers. Identify immediate, technician-level workforce needs for business competition winners. [MATCH: Provide businesses with workshop space and co-working office space, entrepreneur network and peer mentoring with up to 15 winners of past RISE competitions.]

**3. Product Performance Validation.** Identify product validation testing needs for specific markets (e.g., meeting specifications and performance standards to qualify for projects with local municipalities, state and federal agencies, private commercial clients). Conduct product performance validation R&D between Virginia universities and businesses (e.g., graduate student and faculty to test products, verify performance standards, conducting pre- and post-site analyses to measure enhanced property resilience, recommend further refinements to improve performance). Characterize the environmental conditions and profiles of PAA sites with demonstration projects to enable pre- and post- analyses of pilot.

**4. Region 6 Resilience Innovation Center - Living Laboratory. [MATCH]** Finalize governance systems and operational procedures (e.g. MOUs, IP agreements, Charter, etc.), for a Region 6 Resilience Innovation Center of real world test sites in a living laboratory. To spur innovation, conduct a national resilience design competition and conduct joint resilience R&D with Louisiana Sea Grant, its Coastal Sustainability Studio, US Department of Homeland Security and US Department of Housing & Urban Development.

**Consortium.** [GO Virginia: \$456,571. Match: \$873,567. Lead: ODU.] The Consortium, led by ODU, will engage the broader business communities of Region 5 & 6 in the resilience economy to meet the GO VA Goals of regional collaboration, collaboration between business and government, growth and diversification of the coastal resilience and adaptation sector, and preparation of businesses for a future with water. While private firms, governments, universities, NGOs, and other partners in Regions 5 and 6 are actively involved in "resilience," the sector is fragmented, creating barriers to entry and hindering growth. Coalescence of businesses engaged in this sector is essential to catalyze growth in new and existing firms. This professional organization would be unique and set Coastal Virginia apart.

The Consortium will build on existing efforts including the Hampton Roads Adaptation Forum and architecture, engineering, and construction (AEC) industry sector coalition interest to engage in resilience and Region 6's Fight the Flood program. It will engage the chambers, regional economic development groups, industry associations, and CIT and other innovation centers to encourage broadening partici-





Coastal rural commercial waterfronts, like this one on the Rappahannock River, are vital economic engines for rural communities and losing working waterfronts threatens the identity of the region.

pation across all industry sectors (e.g. maritime, real estate, logistics, manufacturing, aquaculture, and forestry). The Consortium provides an opportunity to educate businesses about the coastal flooding risks related to sea level rise and the associated economic impacts, and to build capacity for resilience related to business operations and adoption of resilient strategies and practices. The Consortium provides an opportunity for Regions 5 & 6 industries to build urban and rural capacity and connectivity through knowledge and talent transfer, and create identification of best practices, and development of implementation pathways for priority resilient infrastructure projects in both regions.

The Consortium will provide education workshops for coastal Virginia businesses: Flooding Risk and Regional Economic Impacts (Year 1 Hurricane, Year 2 Nuisance Flooding); Business Continuity Planning (4 Sessions). The Consortium will organize the working groups to develop specific solutions and actionable strategies related to the economic sector that will build resilience in coastal Virginia: 1) Steering Committee; 2) Local Best Practices, 3) Infrastructure Investment Opportunities, 4) Resources and Capacities Analysis and; 5) Talent Gaps (Year 2).

Aligning with both Region's Growth & Diversification Plans, this initiative will build critical pathways and avenues for collaboration between the two regions and rural and urban economies. As this sector grows, all other economic sectors in coastal Virginia are buoyed by the increased regional resilience to flooding, storms, and other stressors.





### **NEXT STEPS:**

### ADVANCING A COASTAL RESILIENCE & ADAPTATION ECONOMY

There are many components to a comprehensive approach to develop a coastal resilience and adaptation economy in Region 6. There are statewide gaps in an innovation ecosystem in general and within the coastal resilience and adaptation sector. Certain organizations are better suited to participate and lead components of the innovation ecosystem.

**R&D activities and workforce development** are best led through public-private partnerships, connecting businesses with universities, and enabling R&D on promising resilience and adaptation innovations. A neutral, multi-university consortium is an effective model, and there are existing organizations (VASG) that provide these platforms to plan, develop, and administer a Region 6 Resilience Innovation Center – i.e., a multi-university, public-private resilience and adaptation R&D campus with a central hub and a network of field stations to produce the innovation needed to grow businesses.

The opportunity to develop R&D and workforce development activities aligns well with Region 6's existing strengths and assets However, other elements of the innovation ecosystem also need development, including opportunities to enhance entrepreneurship capacity and the business assistance services to ensure successful business growth. A business incubator facility, accompanying the resilience and adaptation R&D campus, would enhance Region 6's strengths in this emerging economic sector. In partnership with RISE in Region 5 and the entrepreneurship programs at Virginia universities, there are opportunities to bridge this capacity gap.

**Technology development & commercialization** activities on a coastal resilience and adaptation economic sector need further partnership activities. The technology development beyond the initial R&D on the innovation can continue in the public-private R&D partnership and on Region 6's resilience and adaptation R&D campus. However, commercialization requires additional partners, expertise and activities. Partnerships with NGOs (e.g., RISE, Wetlands Watch, regional economic development organizations) and universities with commercialization and technology transfer capacity can assist in achieving these elements of an innovation ecosystem.

**Entrepreneurship capacity-building** will best be accomplished in Region 6 through partnerships with existing entrepreneurship training at NGOs (e.g., RISE) and universities (e.g., W&M, Mary Washington), although the university programming will need to learn about the strengths, limitations, and opportunities in the resilience and adaption economic sector. University entrepreneurship programming have not attended to resilience and adaptation opportunities in the past, and very few have experience with water quality or management economic development issues.

**Successful & expanding industries** require longer-term support (e.g., business incubator capacity; access to venture capital; professional network and mentoring, etc.). Region 6 does not have such capacity dedicated to the resilience and adaptation economic, and the Commonwealth has very limited capacity as well (e.g., RISE in Region 5 provides peer mentoring, coaching, and access to venture capital for their business challenge grant winners). Some business schools in universities provide executive coaching with volunteer, retired executives (e.g., W&M), although few coaches have direct experience in a resilience and adaptation economy. Region 6 would need to further partner with these entities, redirect their services to resilience and adaptation, and look for new partners to meet this gap in the innovation ecosystem.



		REGION 6								
EM	R&D Activities	<ul> <li>VASG - Virginia's universities and community colleges, in partnership with the private sector and Rappahannock Community College, Resilience Innovation Center (resilience and adaptation R&amp;D campus with a central hub and a network of field stations)</li> <li>Government: Middle Peninsula Public Access Authority.</li> <li>FEMA infrastructure investments. FEMA is looking to reprogram \$10B into the Building Resilient Infrastructure and Communities program for pre-disaster designs. (Flavelle 2021)</li> <li>HUD community development block grant.</li> </ul>								
ATION ECOSYSTEN	Tech Development & Commercialization	Partnership with NGOs: RISE, Wetlands Watch. Universities. Government incentives: Fight-the-Flood subsidies to businesses.								
NONI	Entrepreneurship Capacity-Building	University entrepreneurship training. NGOs: RISE Universities: University of Mary Washington								
	Successful & Expanding Industries	Business park incubator facility and capacity, accompanying the pub- lic-private R&D campus. Economic Development Organizations. NGOs: RISE								



### REFERENCES

- Dietrich, T. September 10, 2018. Study: Sea level rise has already cost Virginians \$280 million in home values since 2005. *DailyPress*. <u>https://www.dailypress.com/news/dp-nws-home-value-loss-20180910-story.html</u>
- Kane, J. and A. Tomer. June 2018. *Renewing the Water Workforce: Improving water infrastructure and creating a pipeline to opportunity*. Brookings Institute: Washington, DC.
- Filer, L. August 2017. From Filling a Local Demand to Becoming an International Brand: An Analysis of a Water Technology Cluster in Hampton Roads, Virginia. CCRFR Report 1. Commonwealth Center for Recurrent Flooding Resiliency: Norfolk, VA.
- Flavelle, C. January 25, 2021. New U.S. Strategy Would Quickly Free Billions in Climate Funds. *The New York Times*. <u>FEMA Plan Would Free Up Billions for Preventing Climate Disasters The New York Times (nytimes. com)</u>
- Hubbard, F. December 26, 2016. Mathews shoreline threatened while officials debate planning. *Daily Press* <u>https://www.dailypress.com/news/gloucester/dp-nws-evg-sea-level-mathews-20161223-story.html</u>,
- McDearman, B. July 2018. *Rethinking Cluster Initiatives: Case Study Milwaukee, Water Technology*. Brookings Institute: Washington, DC.
- Rago, G. March 22, 2019. Virginia as the "Silicon Valley" of sea level rise? It could happen. *The Virginian-Pilot*. <u>https://pilotonline.com/news/government/virginia/article\_627a6e44-45b8-11e9-9eb6-ab83b2886550.</u> <u>html</u>.
- SCHEV (State Council of Higher Education for Virginia) and VRIC (Virginia Research Investment Committee). October 2019. Commonwealth Research and Technology Strategic Roadmap. SCHEV, Richmond, VA.
- TEConomy Partners, LLC. January 2018. Assessment of Virginia's Research Assets: Strategic Directions to Advance Innovation-Led Growth and High-Quality Job Creation across the Commonwealth. Prepared for State Council of Higher Education for Virginia (SCHEV) on behalf of the Virginia Research Investment Committee. SCHEV: Richmond, VA. <a href="https://www.schev.edu/docs/default-source/VRIC/Asset-Assessment-Study-Reports/full-report--corrected---assessment-of-virginias-research-assets.pdf">https://www.schev.edu/docs/default-source/VRIC/Asset-Assessment-Study-Reports/full-report--corrected---assessment-of-virginias-research-assets.pdf</a>
- VACZM (Virginia Coastal Zone Management Program). September 2016. Virginia Working Waterfront Master Plan: Guiding communities in protecting, restoring and enhancing their water-dependent commercial and recreational activities. <u>https://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/Virginia-Working-Waterfront-Plan-Final-Nov-16.pdf?ver=2017-03-14-142711-097</u>. Virginia Department of Environmental Quality: Richmond, VA.
- White, S.B., J.F. Biernat, K. Duffy, M.H. Kavalar, W.E. Kort, J.S. Naumes, M.R. Slezak, C.R. Stoffel. November 1, 2010. Water Markets of the United States and the World: A Strategic Analysis for the Milwaukee Water Council, Milwaukee, Wisconsin. Final Report. Sponsored by the U.S. Economic Development Administration. University of Wisconsin-Milwaukee.



# WORKFORCE NEEDS INVENTORY

GENERAL FIELD	JOB	DB ANNUAL HO		EDUCATION	Ουτιοοκ				
	HYDROLOGIST	79,370	38.16	Bachelor's	7%				
	CHEMIST/MATERIALS SCIENTIST	78,330	37.66	Bachelor's	4%				
Natural Sciences	MICROBIOLOGIST	71,650	34.45	Bachelor's	5%				
	BOTANIST (SOIL/PLANTS)	62,430	30.01	Bachelor's					
	COASTAL ECOLOGIST	71,130	34.20	Bachelor's	8%				
	ENVIRONMENTAL	87,620	42.13	Bachelor's	5%				
	ENVIRONMENTAL TECHNICIANS	50,560	24.31	Associate's	9%				
	AGRICULTURAL	77,110	37.07	Bachelor's	5%				
	CIVIL	86,640	41.65	Bachelor's	6%				
	CIVIL TECHNICIANS	52,580	25.28	Associate's	5%				
	INDUSTRIAL	87,040	41.84	Bachelor's	8%				
Engineering	INDUSTRIAL TECHNICIANS	55,460	26.66	Associate's	-1%				
	GEOLOGICAL	92,250	44.35	Bachelor's	3%				
	GEOLOGICAL TECHNICIANS	53,300	25.62	Associate's	7%				
	MECHANICAL	87,370	42.00	Bachelor's	4%				
	MECHANICAL TECHNICIANS	56,250	27.04	Associate's	3%				
	ELECTRICAL	99,070	47.63	Bachelor's	2%				
	ELECTRICAL TECHNICIANS	64,330	30.93	Associate's	0%				
	SOFTWARE	105,590	50.77	Bachelor's	21%				
Law Policy	ATTORNEY/LAWYER	120,910	58.13	Doctoral/Professional	6%				
and Planning	URBAN & REGIONAL PLANNERS	73,050	35.12	Master's	11%				
and hanning	ENVIRONMENTAL PLANNER	Same as ab	ove		1				
Docian	LANDSCAPE ARCHITECT	68,230	32.80	Bachelor's	4%				
Design.	ARCHITECT	79,380	38.16	Bachelor's	8%				
Finance	ECONOMIST	104,340	50.16	Master's	8%				
T Indirec	ACCOUNTANT	70,500	33.89	Bachelor's	6%				
Communication	PUBLIC RELATIONS	60,000	28.85	Bachelor's	6%				
Communication	MARKETING/MARKET RESEARCH	63,120	30.35	Bachelor's	20%				
management	BUSINESS MANAGEMENT								
	CONSTRUCTION MANAGERS	93,370	44.89	Bachelor's	10%				
	CONSTRUCTION LABORERS	34,810	16.74	Varies	11%				
	ROOFERS	39,970	19.22	None	12%				
	FRAMERS/CARPENTERS	46,590	22.40	HSD or equivalent	8%				
	INSULATORS	41,910	20.15	None	5%				
On the Ground	ELECTRICIANS	55,190	26.53	HSD or equivalent	10%				
	PLUMBERS	53,910	25.92	HSD or equivalent	14%				
Implementation	MASONRY/CONCRETE	44,810	21.54	HSD or equivalent	11%				
		112,690	54.18	Bachelor's	5%				
	MECHANICAL CONTROLS	58,350	28.05	Associate's	1%				
	DRYWALL	47,360	22.//	None	2%				
	PAINTERS	40,280	19.37	None	6%				
	GRADING	48,160	23.16	HSD or equivalent	10%				
	PAVERS	48,160	23.16	HSD or equivalent	10%				
	LANDSCAPERS	30,440	14.63	HSD or equivalent	70/				
	INSPECTORS	60,710	29.19	HSD or equivalent	1%				

TOTAL SALARIES: \$

\$2,914,320





WORKFORCE NEEDS INVENTORY										Grad, Under						Undergrad						Grad Law, policy,				Under, Grad				
/											Nat	tural	Scier	nces			En	ginee	ring	_		pla	anning	3	De	sign	Fina	ince		
									//	/ /					/ /	/ /	/ /			//			/ /	/ /	/ /	/ /	/	/		
										/ /	//	/				/ /	/ /	//		/ /	//					/ /				
									//	/ /	//	/	/	/		/ /	/ /			/ /	//	/	//					/ si		
						/	/	/	//		/ /	//	/	/	/			/ /	//		/ /	/ /	/ /					\$ <sup>\$</sup> /		
					/		//	/		/ /	/ /	/ /	//	//	/			/ /	1			/ /			en la compañía de la comp	. /				
				/	/	/ /	/ /	/	//		/ /	/ /	/ /	/ /	//				8	č./						100		2/05		
						, ž.		/.S	<u>```</u>		/ /	/ /	/ /	/ /			\	$\langle \rangle$		//	/		5 / 3		20	$\langle \rangle$	\$\	ž/		
		ve.	e la	$\mathbb{X}_{\mathbb{X}}$		Yz)	$\langle \mathcal{E} \rangle$	NO.	<u>}</u> }/		$\langle \tilde{\mathcal{O}} \rangle$	<u>,</u> ?	$\langle \mathbf{x} \rangle$	2/2			S/A		) <u>~</u> /		Jan 1	ð)	18	ST			5),	: E/		
	OTHER	55	X	$\sim$	1	]z		$\sum$	$\mathbb{X}$	\$ <u>`</u>	\$\S		XX		<u>~</u> >	<u>````</u>	NIO/	5%		$\sum$		X			15	<u></u>	200	ILUDE		
		Y	<u>%/</u>	$\sim$	\$ <u>/</u>	9	8/8	\$\$/ C	5/~67	/&/	$\langle \langle \rangle \rangle$	2/4	2/2	\$7	<u>/</u> *	9 E	/ ^>/	N/	45/	PC/	<u> </u>	Me	%∕∕	6/	<u>رەر</u>	$\gamma \diamond$	ŶŶŶ	/		
Wastewater/Water Management	1	1	1						<u> </u>			-							_											
Septic system designs	X					v		X		XX			X	X	Х	X	x	-	_	_		_	X		X	X	X	X		
Stormwater mgt at zero grade	X				v	X		X					X	Х	V	X	<u> </u>	-	_	-		_	X		X		X	<u> </u>		
water retention/release strategies & infrastructure	X				X	X		X		X /	(		X		X	X	X	κ					X	X	X	X	X			
Waterfront, Water-Dependent Business Infrastructure										_	_	_													-	_	_			
Shellfish hatcheries, aqauculture farms, seafood processing		Х	X			X	X	Х			_		Х				<u>X X</u>	X	<u> </u>	X	X	X		<u> </u>				<u> </u>		
Marinas						X		X					V		X	X	XX	×		X		X	_	X	X	X	X	<u> </u>		
Ship and boat building, maintenance, service, repairs		<u> </u>	v		×	X		X	X				X	V	X	X	<u>x </u>	X V		X		X	X	X	X	X	X	<u> </u>		
Dredging capacity/use & testing of dredge materials		X	X		X	X		Х		x /	(		X	X	X	X		×		X	X	X	X	X	X	-		<b> </b>		
Beyond Region 5 Military, Port/snipping																														
Waterfront Homes and Properties			1	I								1	1									1								
House designs raising, flood vents, etc.								X						X	Х		X /	X	_	_		_	X	X	X	X	X	X		
Garage, sheds, barns, out-buildings								X						X			<u>x </u>	×	_	_		_	_	X	X	<u> </u>		<u> </u>		
Docks/slips						X		X		<u> </u>	(		1	X	Х									X	X					
Living Shorelines, Hybrid Green/Gray Infrastructure							_			_	_	_														_	_	_		
Small and large scale restoration designs	Х				Х	Х					_		Х	X	X	X	x	X		X			X	X	X	<u> </u>		<u> </u>		
Econonic benefits														X	Х			X			Х	X								
Energy Systems (other critical utilitites? Communication/cell)	-									_	_	_						_	_						_					
Micro-grids						Х		Χ	X	XX	( X			Χ	Χ	Χ		Х	X		Х	Х	Х	X	Х					
Agriculture/Forestry																														
Salt-tolerant crops			Х	Х	Χ		Χ								Х	Χ	Х	Х			Х	X		X	Х					
Buffering plants/protection from saltwater GW intrusion	Х			Х	Χ	Х	Х								Х	Χ	Х							Х	Х					
Information Access, Data Analytics, Public Communication																					•				•					
monitoring/real timenavigating flooded roadways, public services																														
and genreal public audiences						Х																		X	X					
Beyond Region 5 big data analytics, integration, access																														
Human Diminensions																														
Economics benefit/cost calculations														Χ	Х	X		X	X											
Insurance models												Х		Χ	Х	Х		Х			Х	Х								
Finance models												Х		Χ	Х	Х		Х	X		Х									
Social and economic justice													Χ	Χ	Χ	Χ														
Displacement management													Х	Χ	Χ	Х		Х	X	Х	X	Х								
Communicating info re: nuisance flooding, alternate routes														Х	Х	X														

### COASTAL RESILIENCE & ADAPTATION ECONOMY REGION 6 ACTION PLAN





# **CASE STUDY**

#### **LESSONS LEARNED:**

A neutral, physical space is important for collaboration. Intellectual property becomes the property of the entity that paid for the research. Variety of funding sources, diversifying funding, important for financial stability.

### COMMONWEALTH CENTER FOR ADVANCED MANUFACTURING (CCAM):

#### SOLID FOUNDATION AND STILL EVOLVING

The Commonwealth Center for Advanced Manufacturing is an applied research center that bridges the gap between fundamental research typically performed at universities and product development routinely performed by companies. CCAM seeks to find solutions to industry challenges and accelerates the translation of innovative research from the laboratory to commercial use.

The 60,000sq ft physical space for CCAM consists of large-scale research labs, high bay production space for factory scale research equipment and surface coating processes, advanced tools and equipment. The structure of CCAM allows universities and private industry to collaborate in a research consortium, limiting the expenditure of resources by pooling talent, tools, and technology to improve and increase innovation for commercialization.

#### ENGAGEMENT WITH PUBLIC INSTITUTIONS/UNIVERSITIES

CCAM has a number of university partners, including Old Dominion University, Virginia Commonwealth University, Virginia Tech, and the University of Virginia. Universities support the research program with GRAs and in-kind contributions. There are also a handful of university faculty that serve a research and technical capacity, actively involved in research at their respective universities and at CCAM. These Fellows direct work at the CCAM facility that is funded by the universities.

In addition, university partners propose projects that align with private industry member interests and priorities. These projects are reviewed and those that most closely align with the wants and needs of the private industry member are funded.

#### ENGAGEMENT WITH THE PRIVATE INDUSTRY IN THE R&D CAPACITY

The majority of CCAM members are from the private sector. They support the R&D capacity through funding and in-kind contributions of machinery used in the R&D process. The annual fee for private industry partners provides them access to university engineering researchers through which they can pursue directed (member sponsored) and generic (conducted by CCAM on behalf of all members) research. The collaborative structure of CCAM seeks to deliver new solutions to manufacturing industry challenges while providing private industry with access to research professors, doctoral candidates, graduate students and undergraduates who ensure the workforce of tomorrow.

#### PARTNERSHIP/MEMBER STRUCTURE

CCAM is comprised of university partners, private industry, and government members. The levels of membership include organizing, strategic, principle, affiliate, and government. Organizing members sponsor directed research and collaborate in core research, and have a significant influence on strategic direction, operations, and research serving on the Board of Directors, Industry Operations Board, and Technical Advisory Council. Strategic members also sponsor directed research and participate in core research, but are limited





to serving on the Industry Operations Board and Technical Advisory Council. Principal members participate in core research and serve on the Technical Advisory Council. Affiliate members serve on the Technical Advisory Council and commit an in-kind contribution of equipment, tools, and research instruments as their dues. Government members can sponsor external research and participate on the Technical Advisory Council. Membership dues range from \$100,000 to \$400,000 annually.

#### **INTELLECTUAL PROPERTY**

When a private industry partner pays for directed research, whether to CCAM or in collaboration, the member owns the resulting IP. If more than one industry partner funds a particular project it becomes up to those partners to determine how IP is handled. CCAM maintains a neutral perspective when it comes to IP.

#### FINANCIAL SUSTAINABILITY MODEL

Currently CCAM is funded by its members, with smaller contributions from state and federal grants, and receives about 10% from the state (General Assembly) and university funding. The goal is to obtain 50% of their funding from memberships, 40% from external grants, and 10% support through universities. Future plan includes expanding external funding through grants

#### **GOVERNANCE STRUCTURE**

CCAM is a non-profit, tax-exempt member-based scientific, research and education entity. Members and CCAM's university partners govern CCAM operations through board participation determined by their respective membership level.

CCAM has been re-organized in 2021 and is now a part of the Virginia Innovation Partnership Authority (VIPA). VIPA was established in 2020 to support the life cycle of innovation, from translational research; to entrepreneurship; to pre-seed and seed-stage funding; as well as acceleration, growth, and commercialization, resulting in the creation of new jobs and company formation. VIPA aims to provide a collaborative, consistent, and consolidated approach to identifying Virginia's entrepreneurial strengths, including the identification of talents and resources that make the Commonwealth a unique place to grow and attract technology-based businesses. In addition to CCAM, other elements of VIPA include: Commonwealth Center for Advanced Logistics Systems (CCALS); VA Catalyst; Center for Innovative Technology (CIT); Commonwealth Cyber Initiative (CCI); and the Virginia Academy of Science, Engineering and Medicine (VASEM).



# **CASE STUDY**

#### **LESSONS LEARNED:**

Their structure as an independent research institute is a valuable asset giving them access and the potential to work collaboratively with organizations and decision makers around the world.

Role of government partners, mechanism for testing proof of concept.

### **DELTARES**:

### INDEPENDENT ADVISOR WITHIN THE GOLDEN TRIANGLE

About one third of the Netherlands lies below sea level. Battling water for over 800 years, Dutch communities began organizing to manage water systems and build dikes to protect against flooding from the sea and rivers. An area that is home to 9 million people, they have learned to adapt to life in the Delta, and have managed to transform their unique location into a strength.

As an independent, non-profit research institute in the field of water, subsurface and infrastructure, Deltares works on innovations, solutions and applications for people, the environment, and society.

"Enabling Delta Life" is Deltares' mission and it drives what they do. Working closely together with government authorities, companies, research institutions and NGOs in The Netherlands as well as abroad, they use their expertise to facilitate innovative and sustainable solutions for global issues pertaining to the use and risks of water and soil. They are a solution-oriented, transparent organization that focuses on collaboration.

Based in Delft and Utrecht in the Netherlands, Deltares is part of the Golden Triangle (government, business, and research institutes) and is one of the many links in the overall innovation ecosystem.

#### **COLLABORATORS IN THE R&D SPACE**

Two thirds of contract research comes from the government and one third comes from business. Deltares has alliances and projects involving all government authorities in the Netherlands: municipal authorities, water authorities, provincial authorities and central government. Increasingly, their research involves collaboration with end users, for example in living labs. In that respect, the government is increasingly an alliance partner as well as a client. The Netherlands departments of Economic Affairs, as well as Infrastructure and the Environment are partners of Deltares.

#### ENGAGEMENT WITH PUBLIC INSTITUTIONS/UNIVERSITIES

Universities co-develop research initiatives and provide Deltares with both ideas and people. Employees, from professors to doctorate and undergraduate students, are shared between Deltares and universities. Professors are supported financially and students are hosted and supervised by Deltares.

#### ENGAGEMENT OF PRIVATE INDUSTRY COMPANIES IN THE R&D CAPACITY

One third of their revenue comes from private bodies. They aim to raise this to approximately 40% so that innovations are implemented where they can contribute value and so that we can, at the same time, continue to provide an adequate response to requests from government.





The Deltares Tidal Lagoon simulator. The institute uses its expertise to facilitate innovative and sustainable solutions for global issues pertaining to the use and risks of water and soil.

# GOVERNANCE AND MANAGEMENT SYSTEMS: ADVISORY BOARDS, ADMINISTRATIVE CAPACITY, PROCEDURES, MOUS IN PLACE WITH COLLABORATORS?

The Supervisory Board monitors the policy of the management and matters in general at Deltares, and advises the management. Strategic alliances with business, universities, research institutes, and governments are set out in memorandums of understanding covering several years.

#### FINANCIAL SUSTAINABILITY MODEL

Currently, Deltares receives a contribution of 9.3 million euros from the Dutch government for financial planning. In order to maintain the long-term vitality of Deltares, they estimate needing an total annual contribution from government of 15 to 20%, which equates to approximately 16-22 million euros. With respect to sales to private industry, they aim to increase this to approximately 40 million euros a year and anticipate obtaining 40% of their total revenue from outside the Netherlands in the coming years.

![](_page_24_Picture_0.jpeg)

# **CASE STUDY**

**LESSONS LEARNED:** 

Strength of a government partner

### **INNOVATE NEWPORT:**

POTENTIAL BUT STALLED

Innovate Newport is a collaborative initiative between the City of Newport, Newport County Development Council, and The Economic Development Foundation of Rhode Island. The partners have repurposed a former public school building into a hub to grow the innovation economy. It serves as a technology accelerator and incubator for small businesses and entrepreneurs complete with coworking space, private offices, social and professional events. Its mission is to advance Newport's innovation economy through collaboration, community, and strategic partnerships.

Originally envisioned with a focus on resilience related technologies, products and designs, including ocean engineering, defense, and alternative or renewable energy, the hub is home to a variety of entrepreneurs, but does include a number of Blue Tech companies.

The City of Newport initially envisioned itself as a Resilience Innovation Hub, a model of integrated resilience and innovation leadership for coastal cities around the world. The aim was to position Newport as a scientific, technological, and convening center focused on resilience, ocean, and defense technologies. The majority of slated projects associated with this effort have stalled. Due to COVID, Innovate Newport has also slowed in its projected growth. However it is currently building a partnership with the Blue Institute, located in the Cape Cod area of Massachusetts with plans to grow into Newport. They will initially have space within the coworking space of Innovate Newport but then relocate to a bigger space.

#### WHAT DOES ENGAGEMENT WITH PUBLIC INSTITUTIONS/UNIVERSITIES LOOK LIKE?

Many of the entrepreneurs and businesses in the blue tech industry that call Innovate Newport home have included the concentration of universities as a reason for locating in Newport. Beyond that there is no formal engagement with universities.

#### WHAT IS YOUR PARTNERSHIP/MEMBER STRUCTURE? ARE THERE ASSOCIATED FEES?

Innovate Newport offers four different membership options ranging in cost from \$50 (community member) to \$325 (full time co-worker with a dedicated desk) per month. Each membership includes a number of amenities with meeting and event spaces having an additional hourly rate charge.

# HOW DO PRIVATE INDUSTRY COMPANIES SUPPORT/ENGAGE IN THE R&D CAPACITY WITHIN IN YOUR ORGANIZATION?

There is currently no R&D capacity established at Innovate Newport.

#### WHAT DO MOUS IN PLACE WITH COLLABORATORS LOOK LIKE?

There are currently no MOUs in place.

![](_page_25_Picture_0.jpeg)

![](_page_25_Figure_2.jpeg)

#### WHAT IS THE STRUCTURE OF YOUR IP AGREEMENTS?

There are currently no IP agreements in place.

#### WHAT DOES YOUR FINANCIAL SUSTAINABILITY MODEL INCLUDE?

Funding for Innovate Newport comes from membership costs and partnerships that are being built to provide members with services, programming, and access to resources to aid them in building their businesses.

![](_page_26_Picture_0.jpeg)

# **CASE STUDY**

#### **LESSONS LEARNED:**

A physical place is important. It is hard to build a program without a place to bring people, disciplines, and ideas together. In addition, it is critical that the place be neutral. All of the players involved in collaborating to find solutions need to feel as though they belong in the space, that it is shared, and that it is a valuable resource for all. Most partners are commonly competitors.

### LOUISIANA WATER CAMPUS:

### UNIVERSITIES, GOVERNMENT AGENCIES, NGOS. STILL EMERGING

Louisiana's coast is one of the most vulnerable to the impacts of climate change and rising water seeing an estimated loss of one football field of wetlands approximately every 40 minutes. This harsh reality has incentivized collaboration among the public and private sector, NGOs, academia, and the military – similar to the relevant sectors in Virginia.

The Water Campus, located in Baton Rouge, Louisiana, is a physical campus being developed as a hub for collaboration to develop solutions for challenges that affect Louisiana's coastal communities and wetlands. It is a phased private-public partnership plan to build an applied research center dedicated to the study of coastal restoration and sustainability complete with public, private and commercial space. The end result aspires to provide a place for scientists and engineers across disciplines to live and work collaboratively to develop innovative solutions to challenges in water resource management, deltaic living, coastal restoration, and flooding. The Water Campus is a multi-use community development project, including housing and retail as well as R&D infrastructure. It is still under development and current residents include university institutes, NGOs, and state government agencies; \$100M phase 1 development is complete. In addition to the state agency funding restoration and adaptation projects in Louisiana, a few of the key occupants include:

The Coastal Sustainability Studio (CSS) brings together faculty, researchers, and students from different disciplines to study and develop design options to issues facing the coast. A collaborative laboratory, the studio incorporates training, learning, and demonstration to help educate and train students (e.g., planners, architects, engineers), staff, and faculty on the principles and practice of coastal sustainability. CSS seeks to:

- Enable new models of integrated research and design applications
- Develop "design thinking" with a systems approach using performance-based methods
- Maintain a studio space to foster openness and collaboration across disciplines and sectors
- Work closely with community-based partners and stakeholders to co-produce solutions
- Leverage and work in support of local, state, and federal initiatives to promote implementation

The Water Institute of the Gulf, created by the Baton Rouge Area Foundation, is a non-profit, independent applied research and technical services institution whose aim it is to connect and coordinate experts and efforts across the state. Much of the Institutes work is focused on modeling, decision-support tools, and forecasting that aims to inform the planning efforts of policy makers, communities, and businesses.

![](_page_27_Picture_0.jpeg)

![](_page_27_Figure_2.jpeg)

#### **COLLABORATORS IN THE R&D SPACE**

Through the CSS, Institute, and Water Campus collaborators in the R&D space include researchers and students from universities, private industry, and state and local government.

#### **ENGAGEMENT WITH PUBLIC INSTITUTIONS/UNIVERSITIES**

Housed at Louisiana State University, the CSS engages faculty and students from across disciplines in a systems approach to solving coastal issues. Financial support is provided to selected trans-disciplinary teams comprised of at least three disciplines. Led by a full-time faculty member, teams are encouraged to include members from design, engineering, or coastal sciences and must include an outreach and engagement component. The studio funds between 2 and 4 small projects each year through a competitive process. These projects are intended to grow the CSS base by providing a type of incubator for trans-disciplinary projects and teams. Projects should be outside-the-box, trans-disciplinary, and utilize a wide sense of participation.

The Water Institute of the Gulf awards contracts to universities and colleges for joint projects or research that demonstrates an ability to advance the understanding of coastal and deltaic systems. They have also developed partnerships with universities that include sharing resources and opportunities for hands-on research training for graduate and undergraduate students.

![](_page_28_Picture_0.jpeg)

The Water Campus houses LSU's Center for River Studies and its 10,000sq ft river model of the Mississippi River Delta. The model offers scientists, engineers, and students the ability to see, experience, and conduct research and is used for outreach, engagement, and advocacy for coastal restoration and river management.

#### ENGAGEMENT OF PRIVATE INDUSTRY COMPANIES IN THE R&D CAPACITY

Private industry partners provide project-specific financial support. Some of the projects at the LSU CSS are funded through the support of private industry gifts.

The Water Institute of the Gulf can be contractually retained for its various program services from modeling, to community engagement, and engineering expertise. They also offer funding through contract awards to corporations that demonstrate the ability to advance the understanding of coastal and deltaic systems through joint projects or research.

#### GOVERNANCE AND MANAGEMENT SYSTEMS: ADVISORY BOARDS, ADMINISTRATIVE CAPACITY, PROCEDURES

Executive Committee comprised of senior research officials from Louisiana's universities and research organizations. External review board which includes independent scientists and engineers from universities located outside of LA. They provide technical feedback, serve as a panel for proposal review, and provide outside perspective. The Technical Working Group help to develop the Research Needs document and is composed of subject matter experts.

#### MOUS IN PLACE WITH COLLABORATORS?

CSS develop individual agreements for each project, but not a formal MOU.

#### **IP AGREEMENTS**

Not applicable yet.

#### PARTNER/MEMBERSHIP STRUCTURE, E.G., ASSOCIATED FEES

It is anticipated that The Water Campus will become home to an estimated 4,000 scientists, engineers, and researchers. The Water Institute of the Gulf is housed in the Center for Coastal & Deltaic Solutions building on The Water Campus. The master plan includes space for basic and applied research, academic functions, public education resources and displays, and administrative offices. Although there is no formal membership structure, space at The Water Campus can be leased.

#### FINANCIAL SUSTAINABILITY MODEL

Initially funded through the Louisiana Coastal Protection and Restoration Authority and the Baton Rouge Area Foundation, the Water Institute of the Gulf is a non-profit that has become self-sustaining through grants, contributions, and program services.

LSUs CSS projects are funded through gifts made directly to the LSU Foundation and through grants. Faculty are LSU employees.

The development of The Water Campus has been funded through a partnership between the State of Louisiana, the City of Baton Rouge, and the Baton Rouge Area Foundation. Future funding from public and private entities, along with income from rental/lease spaces throughout the campus will provide is with long-term financial sustainability.

![](_page_29_Picture_0.jpeg)

# **CASE STUDY**

#### **LESSONS LEARNED:**

Industry involvement is critical for success, setting the strategic priorities and actively participating on a Board of Directors. While the Water Council facilitate partnerships, they purposefully do not get involved in intellectual property agreements, leaving that to the university and private sector partner. This helps protect neutrality. The Water Council is one of the players in a comprehensive innovation ecosystem, including other partners that focus on R&D, entrepreneurship, and business accelerator services.

### THE WATER COUNCIL:

#### AN ESTABLISHED ECONOMIC CLUSTER

The Water Council (TWC) is a non-profit, membership organization that brings together and highlights the work being done to advance water technologies. Thinking of themselves like an Economic Development Organization, TWC focuses on entrepreneurship and commercialization with small businesses and start-ups. Their mission is to drive economic development, attract talent to Milwaukee, and support water-focused technical innovation.

Largely driven by private industry businesses, TWC attributes its success to collaboration between public, private, and academic sectors with a strong, shared commitment to innovation.

#### **ENGAGEMENT WITH PUBLIC INSTITUTIONS/UNIVERSITIES**

Academic institutions are core collaborators and financial contributors to the work of The Water Council. Partnering with a number of academic institutions in the southeastern part of Wisconsin to train talent, TWC was integral in the development of the School of Freshwater Sciences at the University of Wisconsin - Milwaukee. Other programs of research at academic institutions engaging with TWC include everything from water quality to water law and policy and aquaculture to water technician programs. In addition to their workforce development component, the academic institution members of TWC partner with industry to grow innovation in water technology products. TWC acts as the network facilitator of the water industry, connecting startups and small businesses with the capacity and expertise of academic partners to drive innovation.

#### **ENGAGEMENT OF PRIVATE INDUSTRY IN THE R&D CAPACITY**

Private industry members support and engage in R&D a number of ways. TWC pairs industry with research faculty at various partner universities to test and refine potential products. Competitions funded by industry to develop a targeted solution are another avenue in which industry supports and engages in R&D in water technology. This connects industry with the startups and small businesses that in turn benefit from engagement with bigger industry partners giving rise to a confluence of ideas.

#### PARTNER/MEMBERSHIP STRUCTURE

TWC is made up of a variety of members including industry, academic partners, non-profits, municipal utilities, public sector, and startups. The 2-tiered membership structure provides members with various benefits and opportunities ranging from access to a growing network of entrepreneurs and startups, access to funding programs, and collaboration with TWC executive team to workshop access, sponsorship opportunities, and opportunities for introductions to capital.

![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_2.jpeg)

Industry, academic, the public sector, and startups can select from either Tier 1 or Tier 2, with Tier 1 providing more benefits at a higher cost. Startups wishing to join must meet certain requirements including the impending launch or scale-up of an idea or technology. Nonprofits and municipal utilities are limited to Tier 2 membership.

#### **GOVERNANCE STRUCTURE**

The Water Council operates under a 3-year strategic plan as well as an operating plan. They are guided by a Board of Directors with representation from private industry, academia, nonprofit, federal and state officials, and municipal utilities. Dean Amhaus, president of TWC, says establishing a Board of Directors was "a really good decision" for TWC.

The Water Council has MOUs with various organizations, however they do not contain a lot of details. They become more refined when a strategic partnership is formed, one where there is an exchange of money.

#### INTELLECTUAL PROPERTY

The Water Council purposefully does not get involved in IP. Once they make a match between companies, or between private industry and the academic community, the issue of IP becomes theirs to sort out.

#### FINANCIAL SUSTAINABILITY

The current financial sustainability model of TWC includes membership dues from a network of over 200 members, grants from local foundations, contract work with the Small Business Administration, their annual summit that generates funds, the Alliance Stewardship, and the Global Water Center (physical hub of TWC).

![](_page_31_Picture_0.jpeg)

# **COASTAL RESILIENCE & ADAPTATION ECONOMY**

**REGION 6 ACTION PLAN** 

![](_page_31_Picture_3.jpeg)

![](_page_31_Picture_4.jpeg)

![](_page_31_Picture_5.jpeg)

©2021 VIRGINIA SEA GRANT