Nuchar® FuelSorb™
Activated Carbon Monoliths
for Adsorbed Natural Gas (ANG) Vehicles
Low pressure ANG technology provides significantly more natural gas storage compared to compressed natural gas alone.

Driven by Experience
With over 100 years of experience in activated carbon development, Ingevity is the leading global supplier of activated carbon products used in automotive gasoline vapor emission control systems. Nuchar activated carbon products have proven life-of-vehicle performance and have been used for over 40 years in nearly one billion vehicles worldwide. With the development of FuelSorb activated carbon monoliths, Ingevity is advancing ANG technology that will shape the future of light-duty natural gas vehicles.

Adsorbed Natural Gas Technology
ANG technology is the high-density storage of natural gas at low pressures (below 1,000 psi, or 67 bar) using highly porous adsorbents, such as activated carbon. Under controlled depressurization, the natural gas is released and exits the tank in response to the demands of the vehicle’s engine.

Natural Gas for Vehicles CNG vs. ANG—a Comparison

<table>
<thead>
<tr>
<th>Compressed Natural Gas (CNG)</th>
<th>Adsorbed Natural Gas (ANG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,600 psig</td>
<td>900 psig (25% of CNG)</td>
</tr>
<tr>
<td>Cylindrical tanks (conformability factor &lt;0.55)</td>
<td>Nested, cylindrical tanks (conformability factor &gt;0.65)</td>
</tr>
<tr>
<td>Cost of compression $0.20–0.25 per GGE/DGE</td>
<td>Cost of compression $0.10–0.15 per GGE/DGE</td>
</tr>
<tr>
<td>Expensive public fueling infrastructure, ~1,000 CNG stations in U.S. ($1–3 MM per station)</td>
<td>Affordable private fueling appliances (~$2,500 per unit)</td>
</tr>
</tbody>
</table>

Shape-specific carbon monoliths fully occupy the interior of the ANG cylinder array, maximizing natural gas storage capacity.

Low Pressure ANG Offers Flexible Design Options
ANG storage systems enable more conformable tank designs with thinner walls than traditional CNG cylinders. This provides vehicle designers and retrofitters greater flexibility when designing tanks to fit the available space on the vehicle. Greater flexibility on fuel tank location and configuration means usable storage space on the vehicle doesn’t need to be sacrificed in order to accommodate the tank.
ANG fuel systems are shaping the future of natural gas light-duty vehicles—providing a safer, more cost effective alternative.

Collaboration is Key
Collaboration has been the key to success for ANG vehicle technology development and commercialization. Ingevity is part of a manufacturing coalition led by Adsorbed Natural Gas Products (ANGP). Members also include United Technologies Research Center, the inventor of ANG conformable tank technology, and Worthington Industries who is leading the effort to manufacture the first generation ANG cylinders.

“We call ANGP’s plug-in hybrid natural gas vehicle the PHANGV™. The ‘plug-in’ refers to the connection to a low-pressure, private fueling appliance that will enable the use of natural gas as a primary motor vehicle fuel in the U.S. where natural gas is in abundant supply. The PHANGV was designed to provide automakers with a commercially-viable technology to reduce greenhouse gas emissions of large-frame, light-duty vehicles like large SUVs, pick-up trucks and service vans. Approximately 4.5 million new large-frame, light-duty vehicles are sold each year in the U.S. Over time, if just 250,000 of those were PHANGV vehicle platforms, then over 590,000 metric tons of CO2 would be removed from the atmosphere each year.”
—Bob Bonelli, president and CEO, ANGP

“The coalition’s initial goal is to commercialize ANG cylinders, which are CSA-approved, interim-requirement compliant. They are to be installed as a direct replacement for bed-mounted CNG cylinders on a pick-up truck using Ford’s established QVM/QCM network. Our ultimate goal is to work with vehicle manufacturers to design ANG tanks and mounting locations for a wide variety of light-duty vehicles, overcoming the inconvenience of existing CNG cylinder mounting locations.”
—Brad Reed, director of business development and innovation, performance materials, Ingevity