

*A Total Systems Perspective
to Green Engineering*

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General Motors Company

Tree hugger vs. Modern tree hugger



GM Sustainability Goals

- All manuf. sites will have a wildlife habitat certification or equivalent (where feasible)
- GM will utilize 125 MW of renewable energy sources
- Reduce energy intensity by 20% (baseline 2010)
- Reduce carbon intensity by 20% (baseline 2010)
- Reduce total waste by 10% (baseline 2010)
- Reduce water intensity by 15% (baseline 2010)
- Reduce VOC intensity by 10% (baseline 2010)
- 100 mfg. sites and 25 non-manufacturing sites are landfill-free



A scenic sunset over a body of water with mountains in the background. The sky is a mix of purple, pink, and orange, with the sun low on the horizon. The water reflects the colors of the sky. In the distance, there are silhouettes of mountains and some buildings. The overall mood is peaceful and contemplative.

*Can you imagine the day we find solutions to our
greatest sustainability challenge, Global Turbulence*

Floods, hurricanes, tsunamis, tornados,

Terrorism

War, Poverty, Disease, Hunger

*It will be the day we realize how these conditions
are deterring sustainable development when at the
same time, sustainable solutions are what can
provide for improvement.*

We are within an extremely turbulent era, with a need to focus on sustainability factors with great intensity. In many areas around the world, basic human needs are not met and more are at risk from natural and man induced sources. These societal stressors will limit sustainable development and green chemistry applications





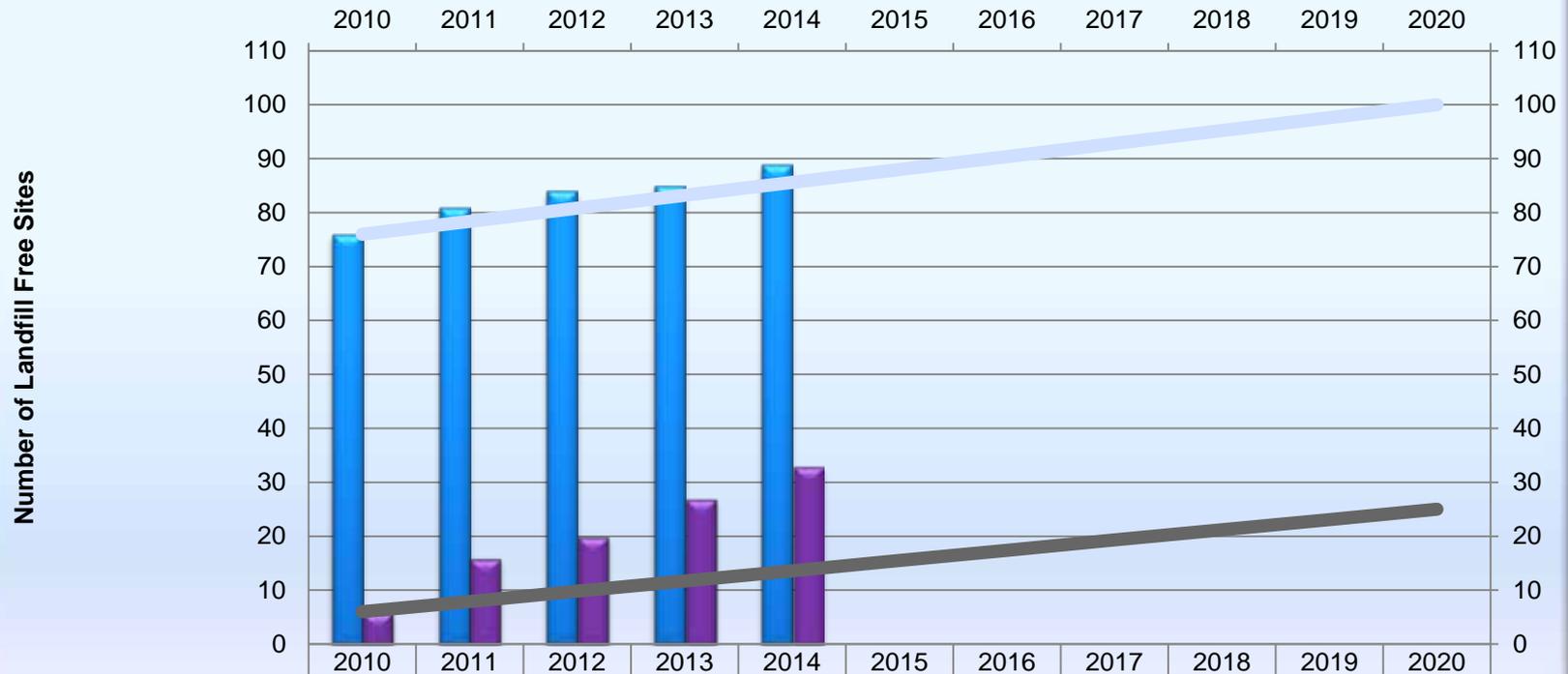
Can you imagine the day all wastes are viewed as resources

It will be a day of by-product synergies

GM Landfill Free Global Progress

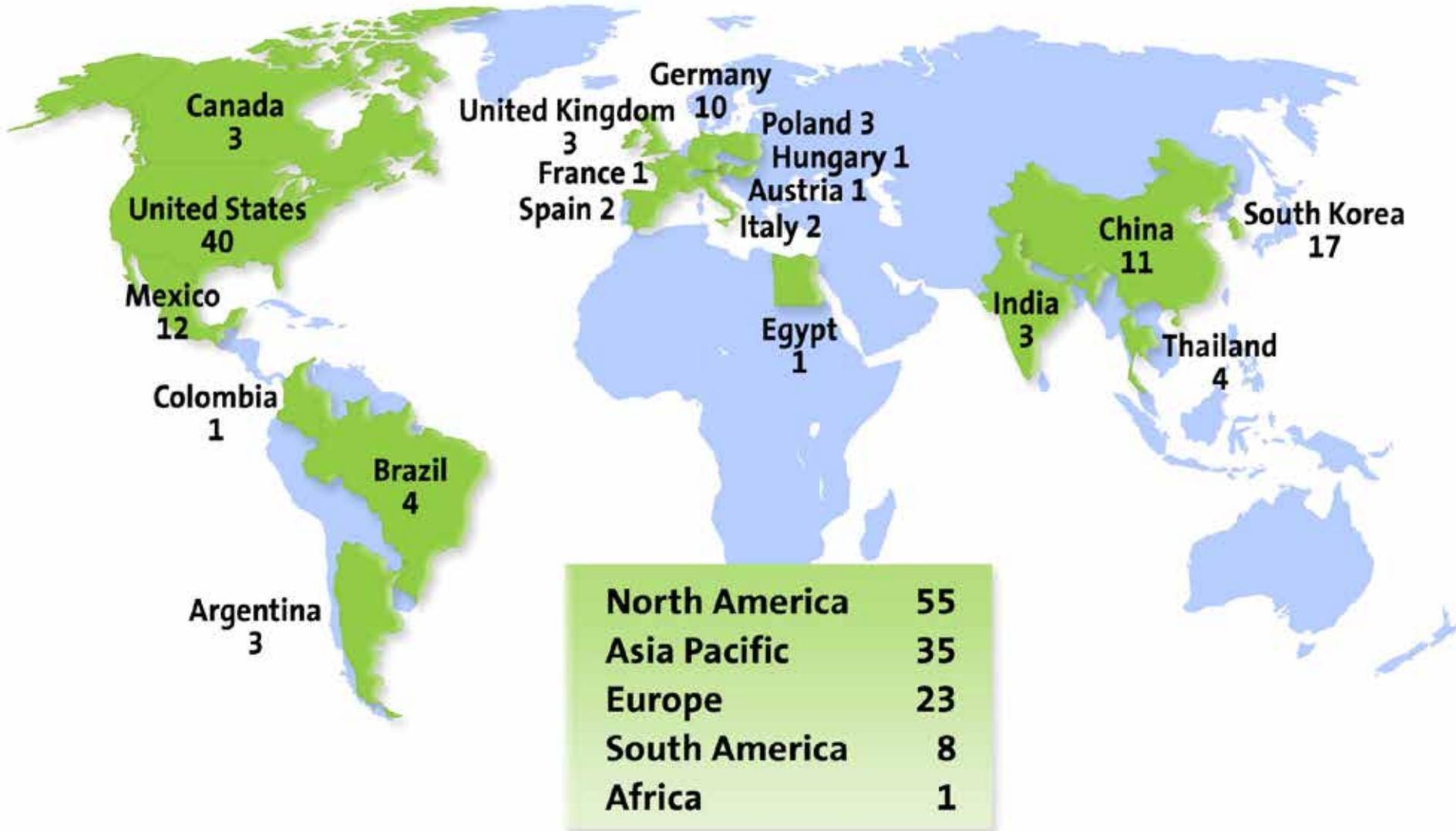
Landfill Free Operations Tracking Chart

Rev. 10-14-14



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mfg	76	81	84	85	89	0	0	0	0	0	0
Non-Mfg	6	16	20	27	33	0	0	0	0	0	0
Glidepath Non-Mfg	6	8	10	12	14	16	17	19	21	23	25
Glidepath Mfg	76	78	81	83	86	88	90	93	95	98	100

GM's 122 LANDFILL-FREE FACILITIES



Can you imagine using scrap vehicle parts to make coats for the homeless?

4,000 yards of sound absorption material donated from production of Malibu and Verano sedans

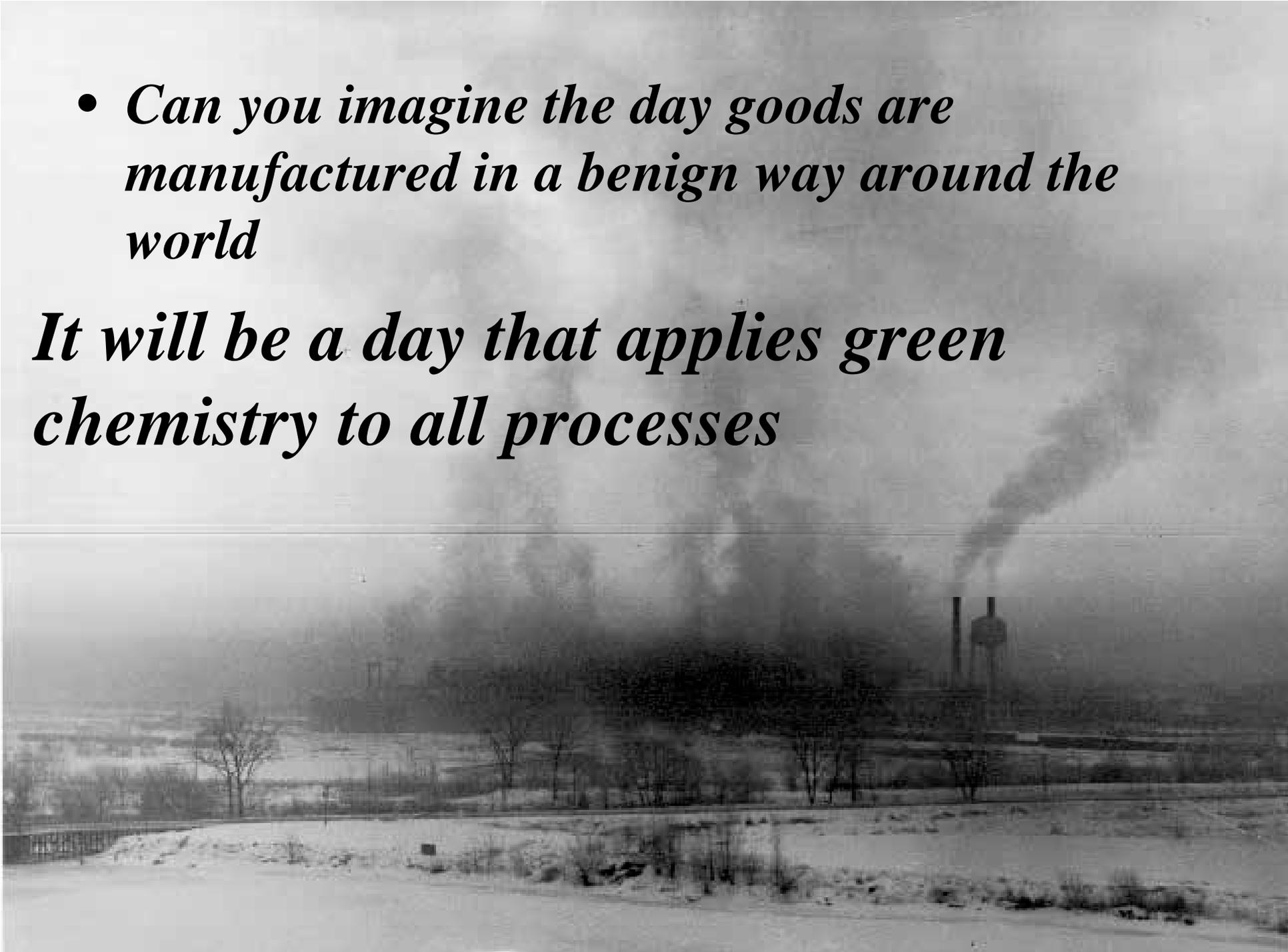


Insulates 800 self-heated waterproof coats that transform into sleeping bags for the homeless.



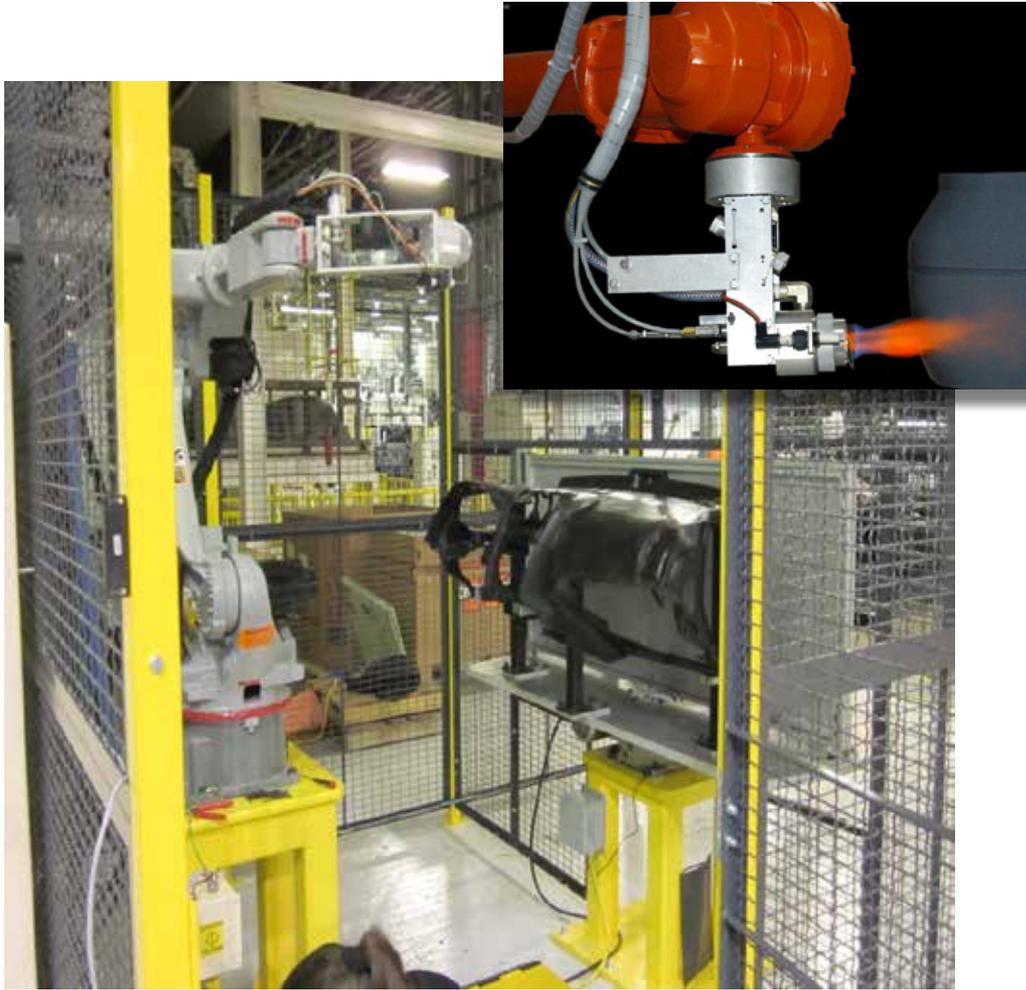
- *Can you imagine the day goods are manufactured in a benign way around the world*

It will be a day that applies green chemistry to all processes



Creation vs. Deployment

Flame Treatment of TPO IP' s



- Lower Costs:
 - Lower Energy Usage Over Traditional Processes
 - Lower Emissions - Carbon Footprint
 - Significant Reduction in CO2 Emissions
 - No VOC' s or HAP' s produced
- Near Zero Production of Solid Waste
 - No Clean Up Costs
 - No Disposal Costs
- Reduced Cost Of Compliance
- Reduced Risk Of Cost Of Non-Compliance

Developing a total systems perspective to green, considering demand, creation, development, manufacturing, usage & reuse.



Buick Verano
Recycled cardboard
used in headliner

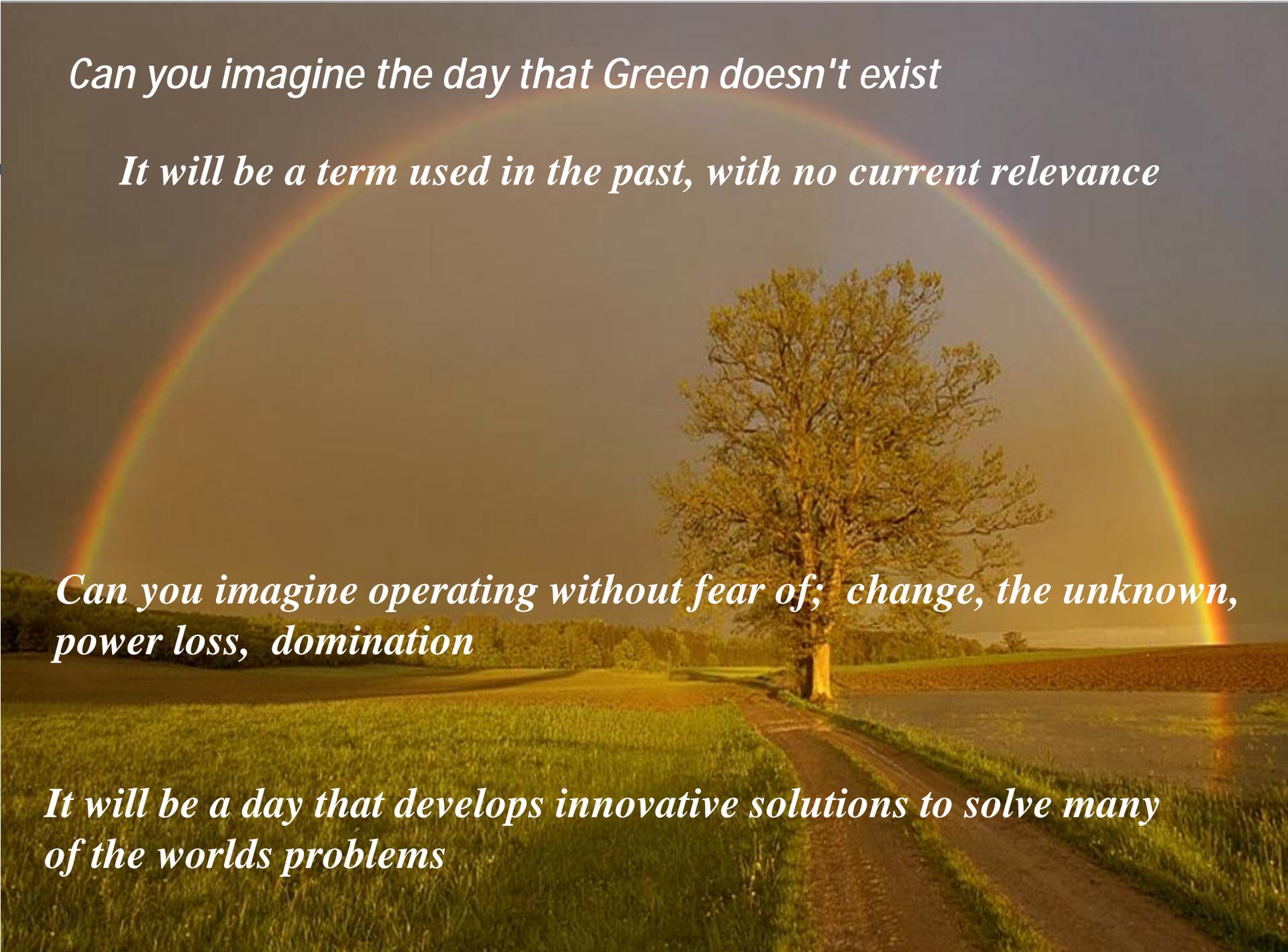


GMC Sierra
Plastic caps and
shipping aids used
in radiator shrouds



Chevrolet Volt
Old tires used in air
and water baffles



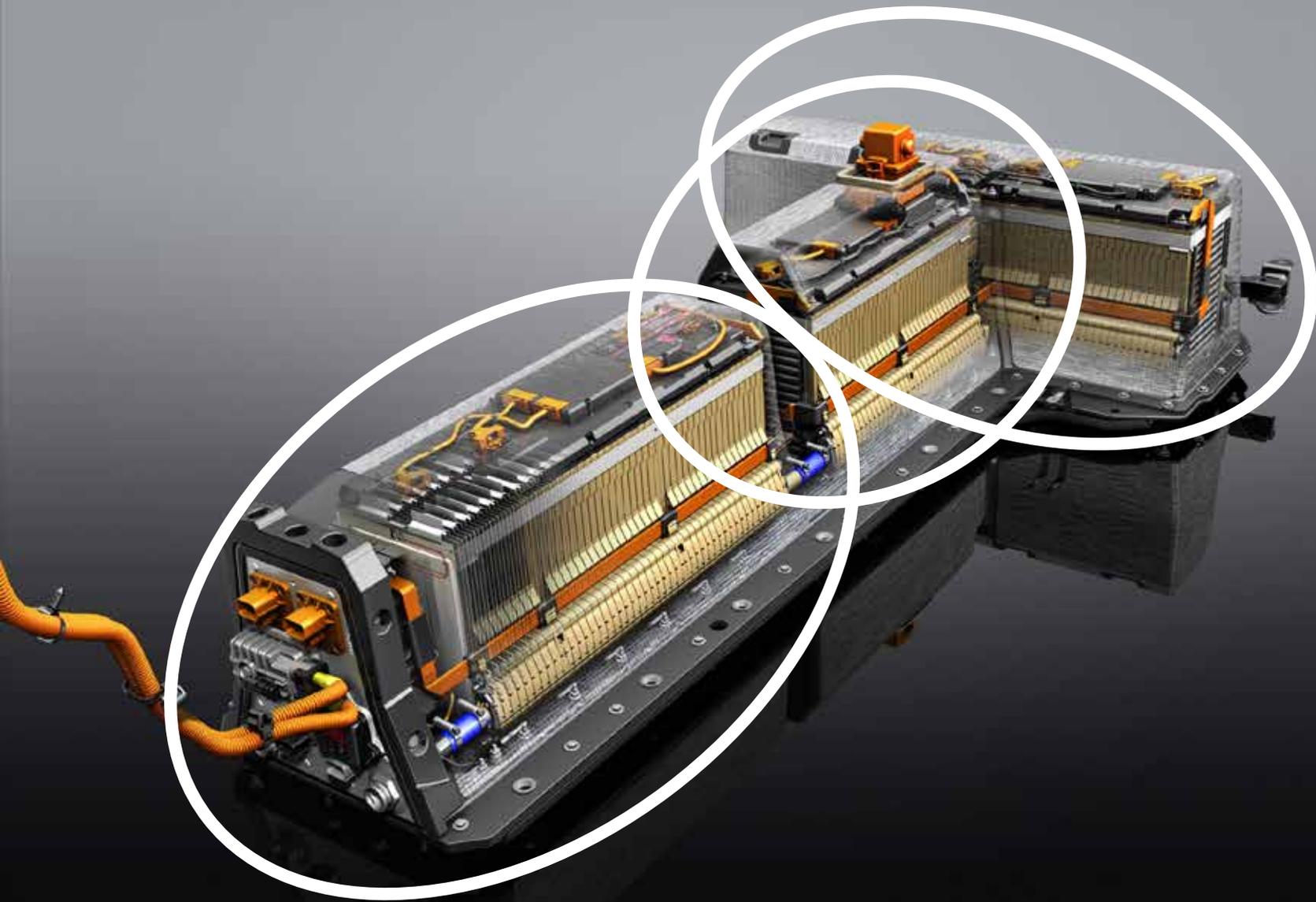
A landscape photograph featuring a vibrant rainbow arching across a grey, overcast sky. In the foreground, a dirt path leads from the bottom center towards the right, flanked by green grass. A large, leafy tree stands prominently on the right side of the path. The background shows rolling green hills under the rainbow's glow.

Can you imagine the day that Green doesn't exist

It will be a term used in the past, with no current relevance

Can you imagine operating without fear of; change, the unknown, power loss, domination

It will be a day that develops innovative solutions to solve many of the worlds problems





Wood Crates from Europe





Deploying Projects after Creation

- One-way containers shipped to the U.S. reused to build trailers
- Chevrolet Cruze center console repurposed as a fishing sled



What can be done with this parking lot to improve people's health and environment



International trade impacts material and methodology choices



You can start with this



Add This



And turn it into this



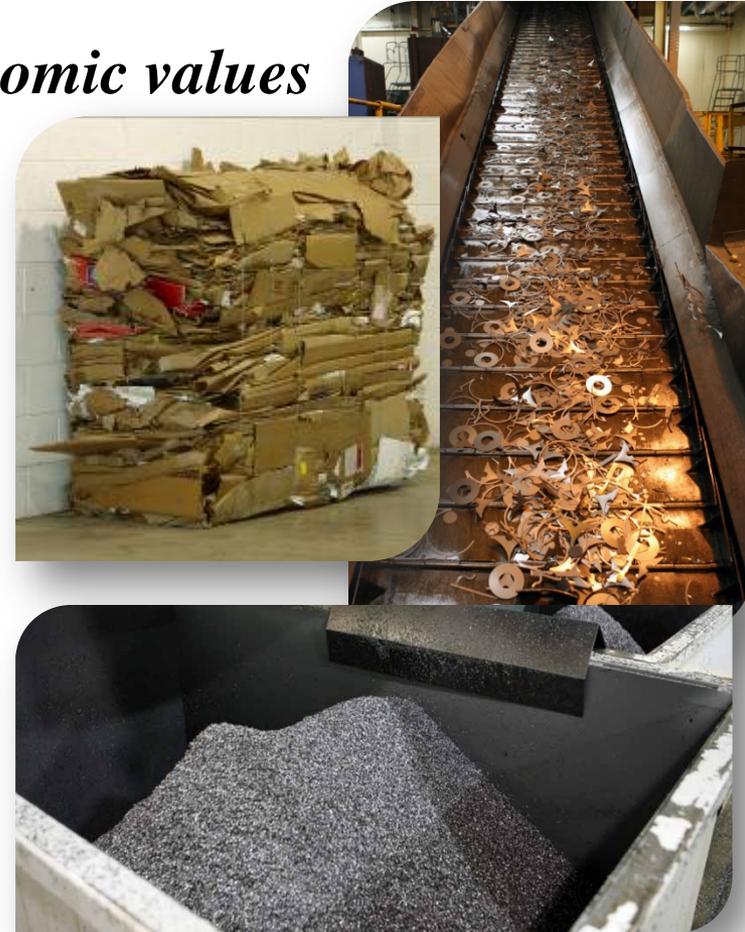


See the Pallets?

We look forward to the day that resources continue in use phases

It will be a day that validates resource economic values

- Approach waste elimination from sustainable financial perspective; generates leadership interest
- Since 2007, GM has generated over \$2.5B in revenue through recycling activities
- View by-products from a systems perspective to:
 - Reuse and repurpose as inputs
 - Protect the environment
 - Eliminate cost/create revenue
 - Increase efficiency



All companies should set a goal to generate 0 revenue, have 0 costs from by-products



***That which man brought together,
can be separated***

<https://vimeo.com/56820882>



Adapting technology for innovative

OIL ABSORBENTS

uses



Helping the world during a time of crisis

- } *The Gulf oil spill stirred the emotion of environmental professionals in the automotive industry to assist.*
- } Used expertise to demonstrate what can be accomplished in the realm of polymer recycling when all levels of the product chain work in unison.
- } Technologies involved included a **closed loop recycling** system already in place, and repurposing current recycled material for oil absorbent boom that can be re-introduced into the recycle stream in lieu of landfill after serving clean-up purpose.
- } Chevrolet Volt baffles included:
 - 25% boom material
 - 25% recycled tires from our vehicle test facility
 - 25% packaging plastic from Fort Wayne plant
 - 25% mixture of post-consumer recycled plastics and other polymers



Gulf Oil Booms Find New Life in



GM

Installs Parts in
Chevrolet Volt



GDC Inc.

Produces Volt
Components



**Mobile Fluid
Recovery**

Extracts Oil and
Wastewater



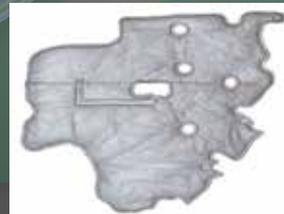
**Heritage
Environmental**
Collects Booms



Boom

Manufacturer

Trim Scrap is Sent to
be stuffed into
Absorbent Booms



GDC Inc.

Produces Sonozorb™
Acoustical Material
and Parts for GM

Uzbeckestan



When is recycling a material bad?

When it can be reused for more value, less energy demands



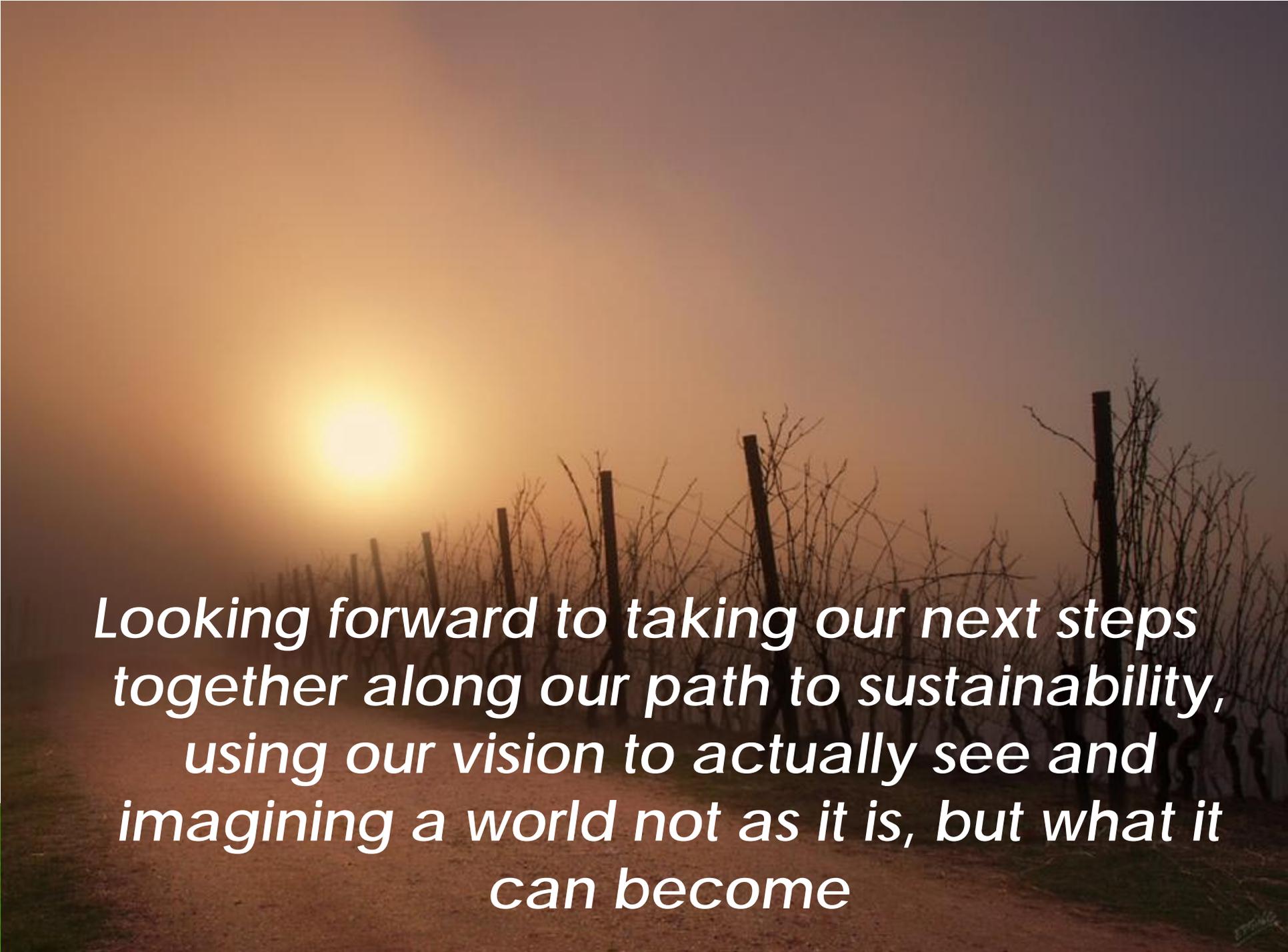
Bio digestion Technology



A photograph of a classroom full of young African girls. They are all wearing blue school uniforms with white collars and are sitting at wooden desks. Each desk has a book and a pencil. The girls are looking towards the camera with various expressions of interest and attentiveness. The background shows more girls in the same uniforms, creating a sense of a large, active classroom.

*Can you imagine the day that basic
human needs are met*

It will be a day of equality and joy

A photograph of a sunset over a field of bare trees. The sun is a bright, glowing orb in the upper left, casting a warm, golden light across the sky. The trees are dark silhouettes against the bright background, and a fence line of wooden posts runs across the middle ground. The overall mood is contemplative and hopeful.

*Looking forward to taking our next steps
together along our path to sustainability,
using our vision to actually see and
imagining a world not as it is, but what it
can become*