

# More sustainable epoxy adhesive solutions with Ancamine<sup>®</sup> and Ancamide<sup>®</sup> Epoxy Curing Agents

Evonik – Crosslinkers - ECA

2022/09/15 – Sebastian Clermont

**First of all..  
..who are we?**

# Facts & Figures

## 2021

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**€15 billion**  
sales\*

**80%**  
of sales from  
leading market positions

**€1.17**  
dividend per share

**15.9%**  
adjusted EBITDA margin\*

**€464 million**  
R&D expenditures

**>33,000**  
employees

**101**  
nationalities

**€2.12**  
adjusted earnings  
per share\*

\* Fiscal 2021

# Evonik's Organizational Structure

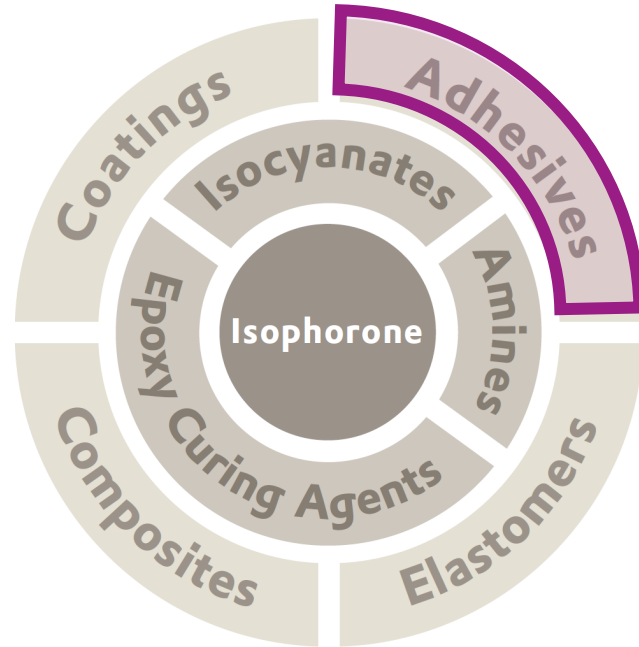
Where to find us



Nutrition & Care	Specialty Additives	Smart Materials	Performance Materials	Technology & Infrastructure
Products for use in the areas of consumer goods, nutrition and health	Environmentally friendly and energy-efficient systems as solutions for several industries	Innovative materials that enable resource-saving solutions and replace conventional materials	Polymer materials and intermediates mainly for the rubber, plastics and agriculture industries	Driver of innovation and digitization in the production environment
<b>Business Lines :</b>	<b>Business Lines :</b>	<b>Business Lines :</b>	<b>Business Lines :</b>	<b>Business Lines :</b>
<ul style="list-style-type: none"> <li>• Animal Nutrition</li> <li>• Care Solutions</li> <li>• Health Care</li> </ul>	<ul style="list-style-type: none"> <li>• Coating Additives</li> <li>• Comfort &amp; Insulation</li> <li>• Interface &amp; Performance</li> <li>• <b>Crosslinkers</b></li> <li>• Oil Additives</li> </ul>	<ul style="list-style-type: none"> <li>• Active Oxygens</li> <li>• Catalysts</li> <li>• Coating &amp; Adhesive Resins</li> <li>• High Performance Polymers</li> <li>• Silanes</li> <li>• Silica</li> </ul>	<ul style="list-style-type: none"> <li>• Baby Care</li> <li>• Performance Intermediates</li> <li>• Functional Solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Energy &amp; Utilities</li> <li>• Technical Service</li> <li>• Process Technology &amp; Engineering</li> <li>• Logistics</li> <li>• Site Management</li> </ul>

# Crosslinkers

Leading global supplier of isophorone chemistry & technology leader in epoxy curing agents



## Key Competences

Acetone condensation, hydrogenation, urea isocyanate process

## Key Products

- Isophorone
- Isophorone diamine
- Isophorone diisocyanate
- H<sub>12</sub>MDI
- **Epoxy curing agents**
- Accelerators & Catalysts
- Adhesion promoters

## Employees

900 worldwide

## 9 Production Sites

Herne, Marl, Antwerp, Clayton, Mobile, Los Angeles, Shanghai, Isehara, Singapore

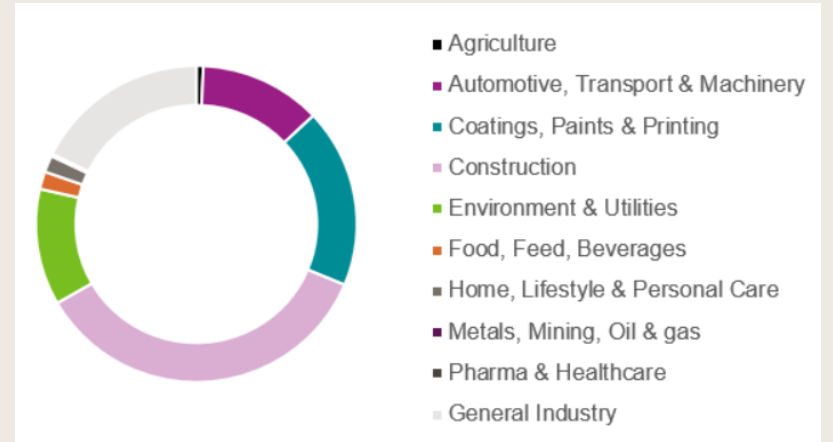
## # of Patents

150 patent families

## # of Products

> 750

## Industries



## Brands for Adhesives

Amicure<sup>®</sup>, Ancamide<sup>®</sup>, Ancamine<sup>®</sup>, Curezol<sup>®</sup>, Dicyanex<sup>®</sup>, Epodil<sup>®</sup>, Imicure<sup>®</sup>, VESTALITE<sup>®</sup>, VESTAMIN<sup>®</sup>

## Customers

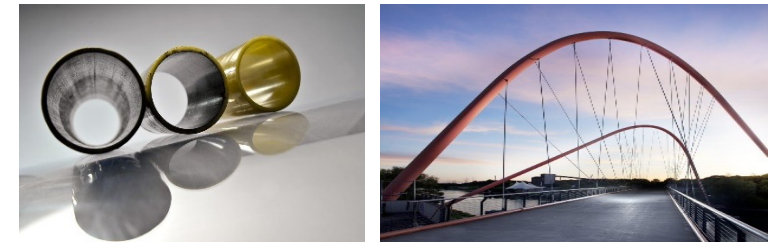
approx. 1.000 direct customers

# Crosslinkers - Epoxy Curing Agents

## Ambition and Positioning

### #1 Epoxy Hardener Supplier in the World

- Global Revenue about € 450 M
- Serving the Coatings, Civil Engineering, Composites & Adhesives market
- Global footprint (EMEA, Americas, APAC)



#### Crosslinkers's position:

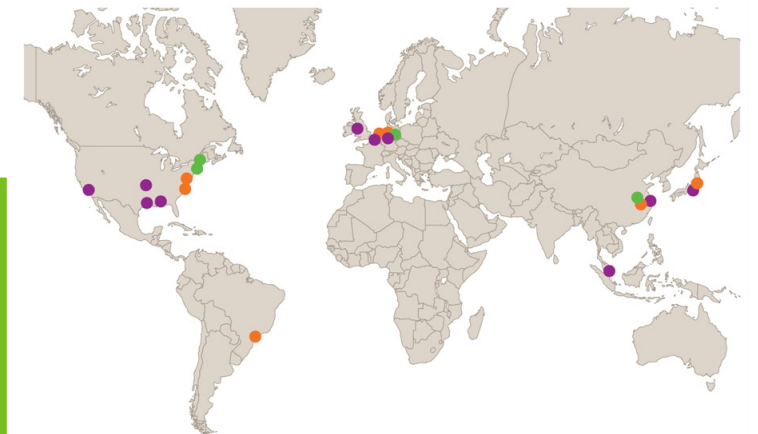
- Offering neat amines, curing agents / building blocks for epoxy curing
- Support and exchange with customers for new developments

#### Customer's position:

- Adhesives manufacturer
- Drive materials innovation
- Set and change industry standards

#### Synergies & Opportunities:

- Effective and fast product development
- Customers can utilize crosslinkers toolbox for high performance adhesives and sealants
- Evonik offering dedicated support for high performance applications



# Epoxy Curing Agents

## Products Range

<p><b>Ancamine®</b></p> <p>Aliphatic &amp; cycloaliphatic amine curing agents for use across all major epoxy applications</p> <p>1K 2K</p>	<p><b>Ancamide® Sunmide®</b></p> <p>Polyamide and amidoamine curing agents for use across all major epoxy applications</p> <p>2K</p>	<p><b>Anquamine®</b></p> <p>Waterborne epoxy curing agents for industrial flooring and protective coatings</p>
<p><b>Amicure®</b></p> <p>Polycarbamide curatives for HDI trimer for industrial coatings and floorings</p>	<p><b>Epodil®</b></p> <p>Mono- and difunctional reactive diluents</p> <p>1K 2K</p>	<p><b>Dicyanex® Amicure®</b></p> <p>Dicyandiamide (DICY) for one component heat cure adhesives and composites</p> <p>1K</p>
<p><b>Ancarez®</b></p> <p>Specialty waterborne epoxy resins for flooring and industrial coating applications</p>	<p><b>Hybridur®</b></p> <p>PUD acrylic hybrid dispersion for industrial coatings</p>	<p><b>Curezol® Imicure®</b></p> <p>Imidazole accelerators</p> <p>1K</p>
<p><b>Nourybond®</b></p> <p>Blocked isocyanates and polyamide adhesion promoters for PVC plastisols</p>	<p><b>Epilink®</b></p> <p>Waterborne epoxy curing agents for industrial flooring and protective coatings</p>	<p><b>Vestalite®</b></p> <p>Epoxy curing agents and PUR based resin formulations for automotive lightweight solutions</p>

# How does Evonik's Sustainability Strategy 2020+ look like?



# Evonik's sustainability strategy 2020+

Based on five Pillars

## Core elements



Sustainability is the backbone of Evonik's **purpose**



Evonik integrates sustainability in its **Strategic Management Process**



Evonik wants to increase the share of **attractive growth businesses** with a clear focus on sustainability in its portfolio



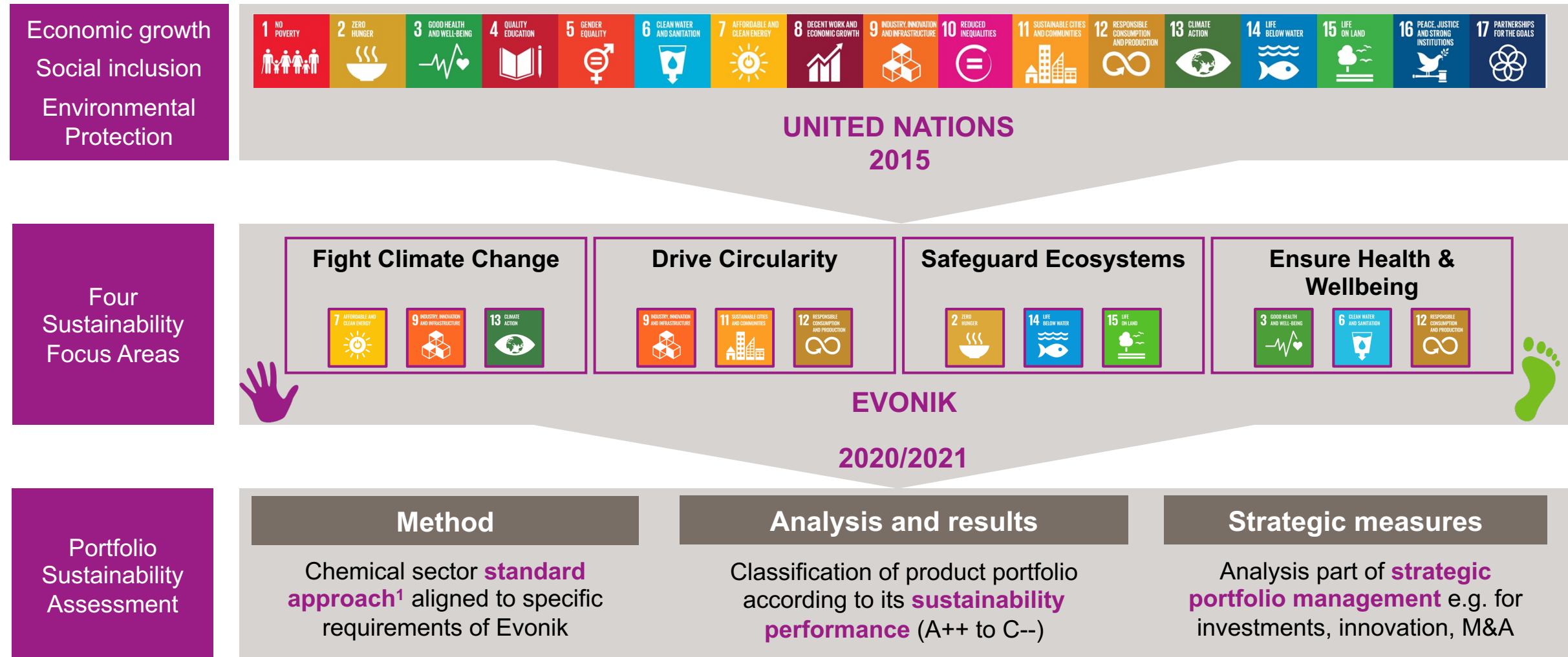
Evonik is committed to foresighted **resource management**



Evonik sets high standards for continuous improvement of its **reporting**

# The 17 Sustainable Development Goals (SDGs) of the UN's 2030 Agenda







Our basis for the Portfolio Sustainability Assessment



<sup>1</sup>Chemical sector group of World Business Council for Sustainable Development

# Our Top 10 sustainability targets

Status 2021

		Status 2021
 <b>Strategy and growth</b>	<ul style="list-style-type: none"> <li>At least 35 percent of sales should come from Next Generation Solutions</li> </ul>	35%
 <b>Governance and compliance</b>	<ul style="list-style-type: none"> <li>Percentage of women at the first and second management levels below the executive board: 30 percent at each level by year-end 2024</li> </ul>	26.9%/29.2%
 <b>Value chain and products</b>	<ul style="list-style-type: none"> <li>100 percent of all raw materials suppliers where annual procurement volume is &gt; €100 thousand to be covered by TfS assessments by year-end 2025</li> <li>Generate more than €1 billion in additional sales<sup>1</sup> in our six innovation growth fields by 2025</li> </ul>	69% .. <sup>2</sup>
 <b>The environment</b>	<ul style="list-style-type: none"> <li>Reduce green house gas emissions                             <ul style="list-style-type: none"> <li>absolute scope 1 and scope 2 emissions by 50 percent by 2025 (reference base: 2008)</li> <li>absolute scope 3 emissions from the upstream value chain—principally from the “raw material backpack”—by 15% by 2025 (reference base: 2020)</li> </ul> </li> <li>Reduce both absolute and specific energy consumption by 5 percent by 2025 (reference base 2020)</li> </ul>	-43% -- --
 <b>Employees</b>	<ul style="list-style-type: none"> <li>20 percent intercultural mix<sup>3</sup> in top management by 2023</li> <li>23 percent women in top and senior management by 2023</li> </ul>	14.6% 17.7%/17.6%
 <b>Safety</b>	<ul style="list-style-type: none"> <li>Safety                             <ul style="list-style-type: none"> <li>Accident frequency rate <math>\leq 0.26^4</math></li> <li>Incident frequency rate <math>\leq 0.40^5</math></li> </ul> </li> <li>Occupational health performance index <math>\geq 5.0</math></li> </ul>	0.19 0.48 5.6

1) With products introduced in or after 2015. 2) We do not publish the interim status. 3) Employees whose nationality is not German. 4) New reference parameter from 2021. 5) Modified calculation basis from 2021.

# Next Generation Solutions

Across different Business-/Productlines

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## Specialty Additives - Crosslinkers

**VESTA eCO** – bio-based Isophorone, Isophoronediamine & Isophoronediiiscyanate

## Smart Materials - Coating & Adhesive Resins

**DYNACOLL® Terra** – bio-based polyester-polyols

**POLYVEST® eCO** – bio-based polybutadiene rubber

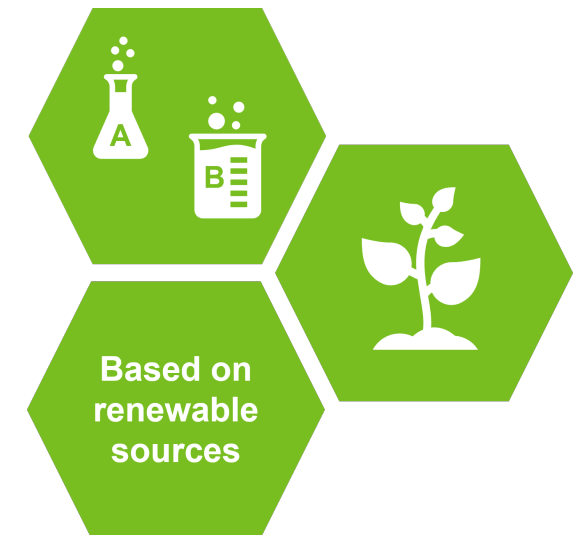
**VESTOPLAST® eCO** – bio-based amorphous poly-alpha-olefins

## Specialty Additives - Specialty Methacrylates

**VISIOMER® Terra** – bio-based Methacrylates

## Smart Materials - High Performance Polymers

**VESTAMID® Terra & TROGAMID® Mycx eCO** – bio-based polyamides

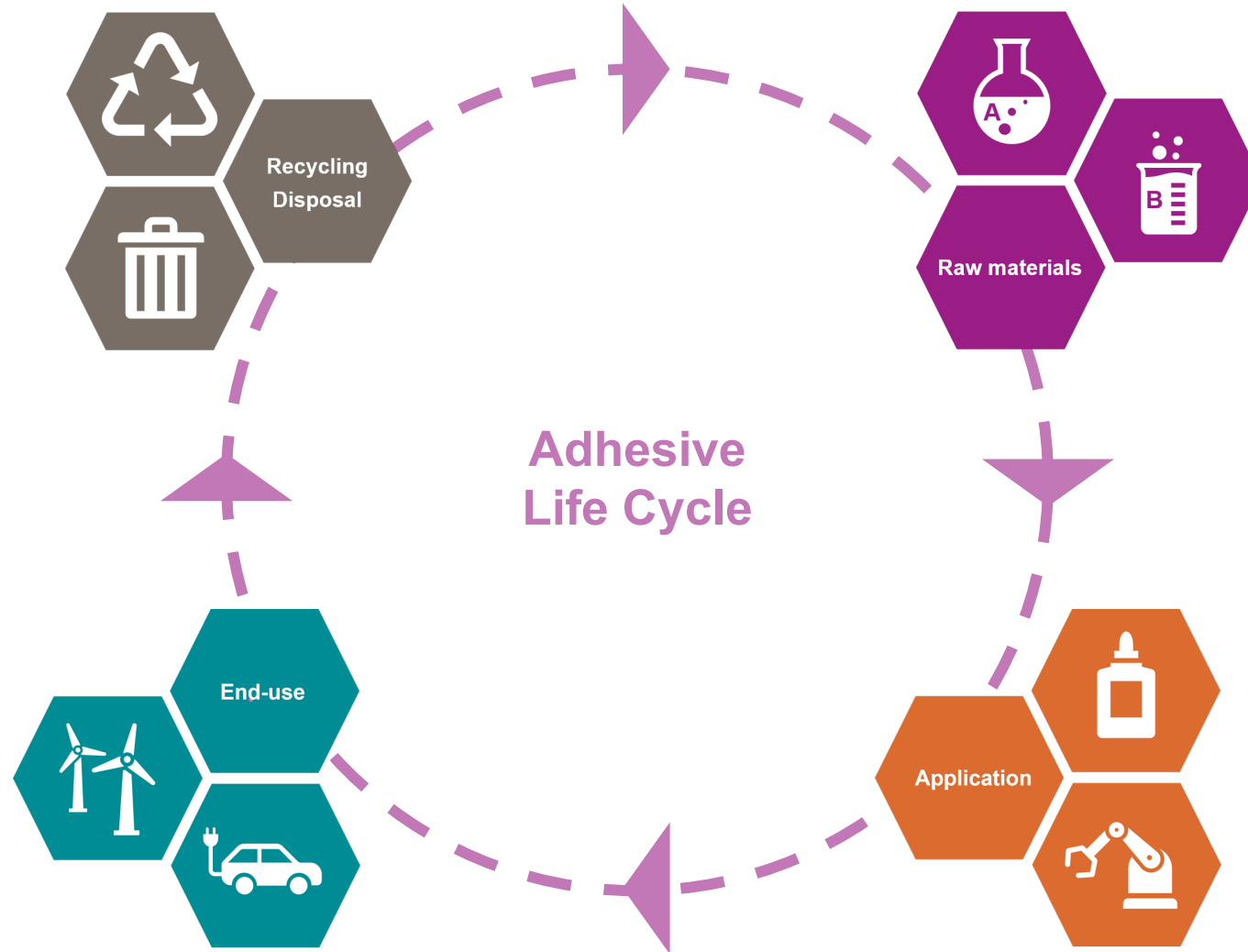


# How can we address sustainability of adhesives with our current ECA portfolio?

# Epoxy Adhesive Life Cycle

## Sustainability aspects

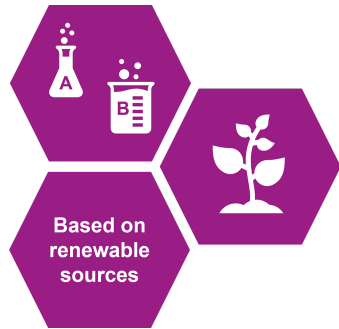
- Debonding
- Recycling
- Disposal
- EHS profile



# ECA Adhesive Products Portfolio

## Sustainability Aspects

### ECA based on Renewable Raw Materials



### ECA for Sustainable Processes



### ECA for Sustainable Technologies



Epoxy Curing Agents that partly/completely stem from bio, bio-circular or circular sources

- Polyamides
- Amidoamines
- Mannich bases
- Diamines
- ...

Epoxy Curing Agents that help to improve sustainability of bonding processes

- Reduction of curing temperatures and times (1K Adhesives)
- Improved EHS and Handling profile (toxicity, vapour pressure, irritation potential and odor)
- ...

Epoxy Curing Agents that are an essential part of sustainable technologies or help to improve them

- Wind Energy (Rotor blades)
- Light Weight Construction
- Electromobility (Thermal Interface Materials, Battery Application)
- ...

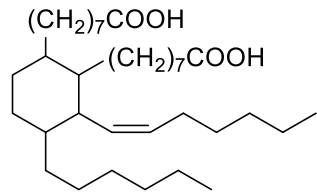
# Epoxy Curing Agents based on Renewable Raw Materials



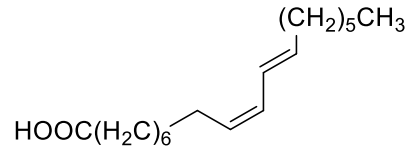
# ECA based on Renewable Raw Materials

## Bio-based building blocks for Epoxy Curing agents

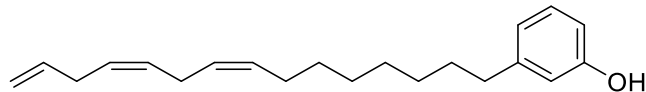
### Modifiers



Fatty Acid Dimer



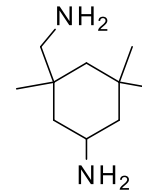
Tall Oil Fatty Acid



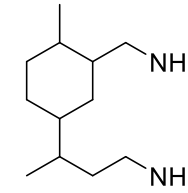
Cardanol

- Established technologies
- Improved handling and EHS profiles
- High versatility for tailored solutions

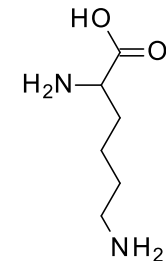
### Amines



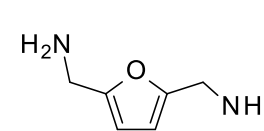
Isophoronediamine  
(Vestamin® IPD eCO)



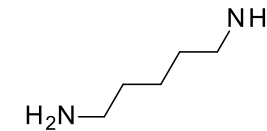
Limonenediamine



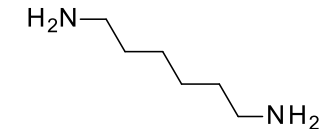
Lysine



Furanyl amines



1,5-Diaminopentane



1,6-Diaminohexane

- Limited industrial availability, higher price levels
- Production/Processing can be challenging
- Labeling can be critical

# ECA based on Renewable Raw Materials

## Product Highlights

### ECA based on fatty acids & CSNL

Product	Type	% Renewable
Ancamide® 260A/350A	Polyamide	65-70
Ancamide® 500/506	Amidoamine	60-65
Ancamide® 910	Polyamide	55-60
Ancamide® 3030/3130	Polyamide	65-70
Ancamide® 3419	Amidoamine	55-60
Ancamine® 2719	Mannich base	40-45



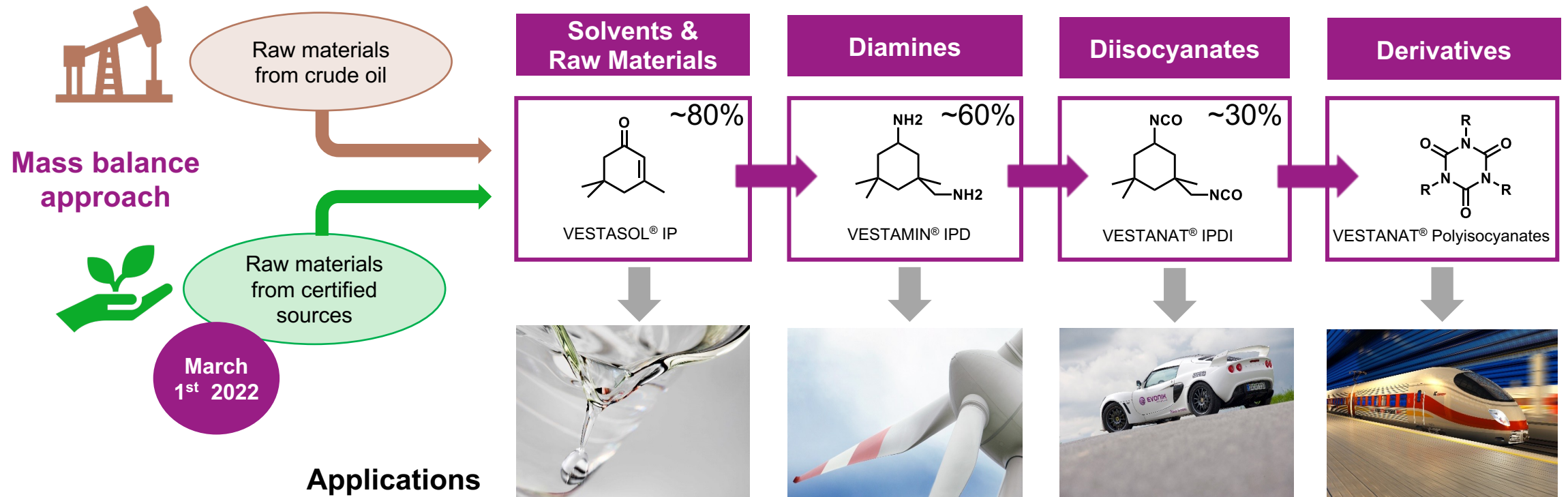
up to 70%  
renewables

### Key Advantages

- Based on high ratios of raw materials from renewable sources up to 65-70%
- Based on established and highly reliable technologies
- High performance
- Improved EHS and application profile vs neat amines
- Versatile application spectrum for tailored solutions

# Vesta eCO

## Crosslinkers' Future Way to Climate Neutral I-Chain



Our way to climate neutral I-chain – customer's choice:

Solvents, amines and isocyanates made from raw materials which originate from bio or crude oil feedstock

# Epoxy Curing Agents for sustainable Bonding Processes

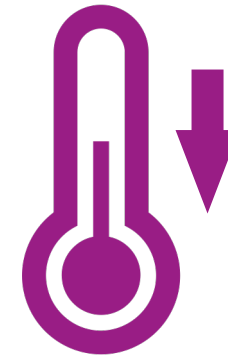
# ECA for more sustainable Bonding Processes

## Product Highlights

down  
to  
80°C

## Reducing curing temperature/time of 1K Adhesives to reduces CO<sub>2</sub> Emissions

Product	Type	Curing Onset (sole)	Curing Onset (DICY)
<b>Ancamine® 2014 AS/FG</b>	Modified aliphatic amine	109	133
<b>Ancamine® 2441/2442</b>	Modified aliphatic amine	99	110
<b>Ancamine® 2337S</b>	Modified aliphatic amine	72	75/133



### Key Advantages

- Effective curing temperatures down to 80°C (sole) / 120°C (DICY)
- Fast property development
- Snap cure capabilities
- High performance
- Long latency even at elevated temperatures



# ECA for more sustainable Bonding Processes

## Product Highlights

New

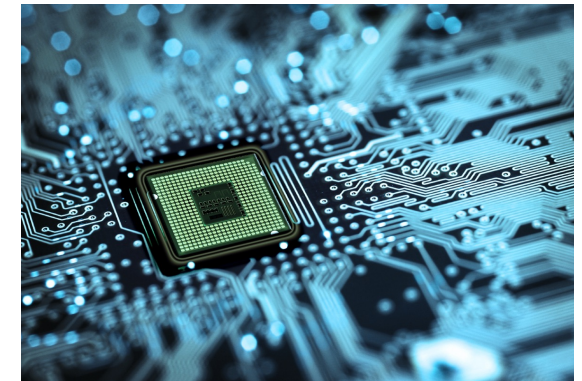
### Thiol-free fast to ultra fast ECA for 2K adhesives

Curing Agent	Type	Curing method	Viscosity (25°C) [mPa.s]	Use Level [PHR]	Gel Time [min]
Ancamine® 2914UF	Modified Amine	Ambient	300-2,000	40-50	8 (25g)



### Key Advantages

- Mercaptane competitive ultra-fast curing - fast properties development
- Excellent mechanical properties and adhesion
- Low viscosity
- 100% solids system, no plasticizers/solvents
- No sulfur odor
- Lighter color and improved yellowing after cure compared to mercaptan



# Epoxy Curing Agents as Enabler for Sustainable Technologies

# ECA for Sustainable Technologies

## Product Highlights

### Wind energy application

Curing Agent	Type	Curing method	Viscosity (25°C) [mPa.s]	Use Level [PHR]	Gel Time [min]
Ancamide® 3030	Polyamide	Ambient/Heat	10,000-20,000	50	80-140
Ancamide® 3130	Polyamide	Ambient/Heat	28,000-36,000	50	300-350



### Key Advantages

#### Ancamide 3030 - Standard

- Low viscosity
- Moderate pot-life
- Good adhesion
- High mechanical strength
- Good thermal resistance

#### Ancamide 3130 - Advanced

- Higher viscosity
- Long pot-life
- Good adhesion
- High mechanical strength
- Improved thermal resistance



# ECA for Sustainable Technologies

## Product Highlights

### Electro mobility – Light-weight construction

Curing Agent	Type	Curing method	Viscosity (25°C) [mPa.s]	Use Level [PHR]	Gel Time [min]
Ancamide® 910	Polyamide	Ambient/Heat	6000	110-125	120
Ancamine® 1922A	Diamine	Ambient/Heat	10	29	57



### Key Advantages

- Low viscosity for high filler contents
- High flexibility and peel strength
- High toughness and temperature shock resistance
- Adhesion on multiple substrates
- Room temperature curing



# Conclusion

Sustainability in the field of structural epoxy adhesives is a versatile topic and results from more aspects than just renewable resources!

# Sounds interesting? We can support you!

## Get in touch with us!

### Discover more on your own

#### CROSSLINKERS PRODUCT FINDER

 Alphabetical Overview	 Free MSDS Order	 Free Sample Order
 Product Finder Europe, Middle East and Africa	 Product Finder Americas	 Product Finder Asia

#### Product Finder

[crosslinkers.evonik.com/en/product-finder](https://crosslinkers.evonik.com/en/product-finder)

#### Product Page

[ancamine.com](https://ancamine.com)

[amicure.com](https://amicure.com)

[imicure.com](https://imicure.com)

### Get in contact with the local expert



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**EVONIK**

**Leading Beyond Chemistry**

# Backup

# ECA Products based on renewable resources

## Polyamides – Amidoamines and Phenalkamines

Curing Agent	Type	Curing method	Viscosity (25°C) [mPa.s]	Use Level [PHR]	Gel Time [min]	Tg after ambient cure [°C]	Tg after heat cure [°C]
<b>Ancamide® 260A</b>	Polyamide	Ambient/Heat	35,000-45,000	60	200	62	88
<b>Ancamide® 350A</b>	Polyamide	Ambient/Heat	9,000-15,000	55	200	51	100
<b>Ancamide® 500</b>	Amidoamine	Ambient/Heat	200-450	50	180	45	60
<b>Ancamide® 506</b>	Amidoamine	Ambient/Heat	200-500	50	400	50	61
<b>Ancamide® 910</b>	Polyamide	Ambient/Heat	6,000	110 - 125	120	25	-
<b>Ancamine® 2719</b>	Mannich Base	Ambient/Heat	300-500	40	20	46	74
<b>Ancamide® 3030</b>	Polyamide	Ambient/Heat	10,000-20,000	50	80-140	57	81
<b>Ancamide® 3130</b>	Polyamide	Ambient/Heat	28,000-36,000	50	300-350	59	89
<b>Ancamine® 3419</b>	Polyamide	Ambient/Heat	50-160	75	520	40	55

# ECA Products for sustainable processes

1K low temperature curing via modified aliphatic amines

Curing Agent	Ancamine® 2337S	Ancamine® 2014 AS	Ancamine® 2014 FG	Ancamine® 2441/2442
Appearance	Light yellow powder	White powder	White powder	White powder
Particle Size D90 [µm]	10	36	6	10
Amine Value [mg KOH/g]	260	184	184	230 / 115
Activation temperature [°C]	71	75	75	100
	<b>Sole Curing Agent</b>			
Use level [PHR]	50	28	28	20
DSC Onset [°C]	72	109	109	99 / 93
Tg (30' @ 120°C) [°C]	71	77	85	116 / 112
Shelf-life @ 42°C [weeks]	> 4	11	4	> 12
	<b>Accelerator for DICY</b>			
Use level [PHR]	10*	5	5	5
DSC Onset [°C]	75 / 133	133	133	110 / 111
Tg (30' @ 140°C) [°C]	116	110	118	147 / 135
Shelf-life @ 42°C [weeks]	> 8	> 12	> 12	> 12