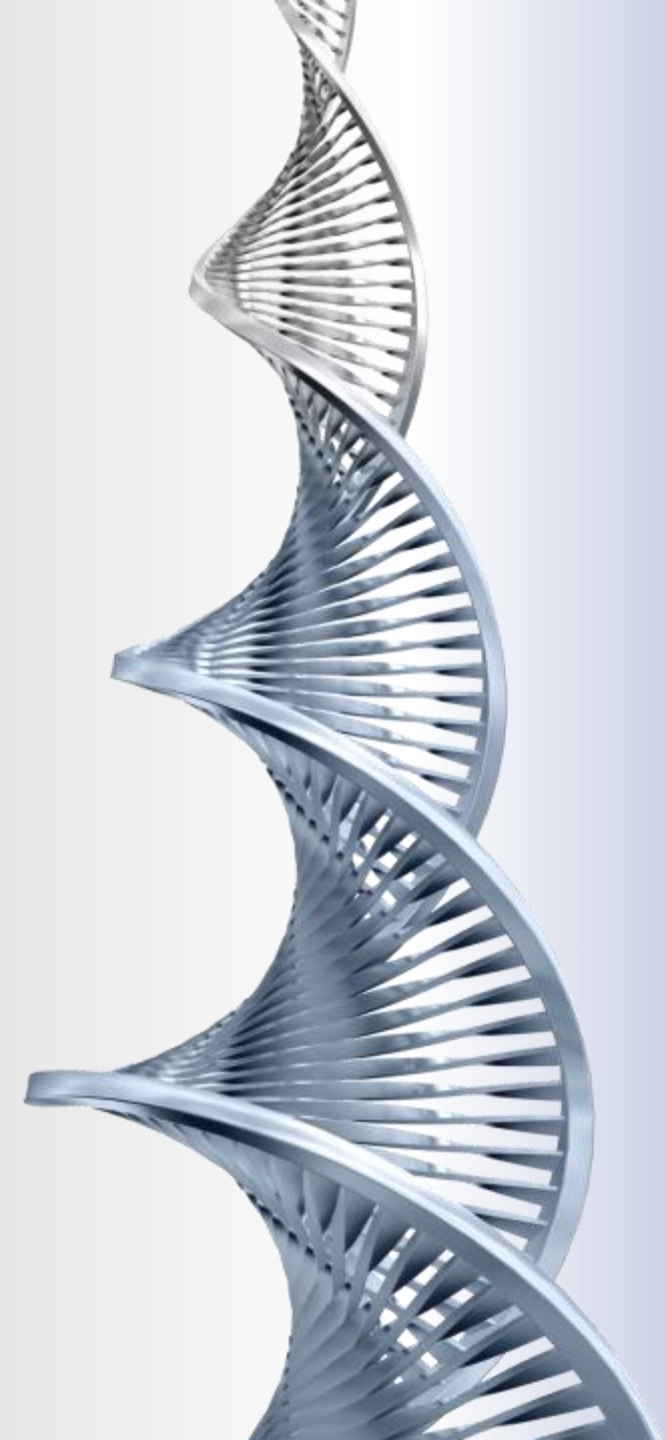
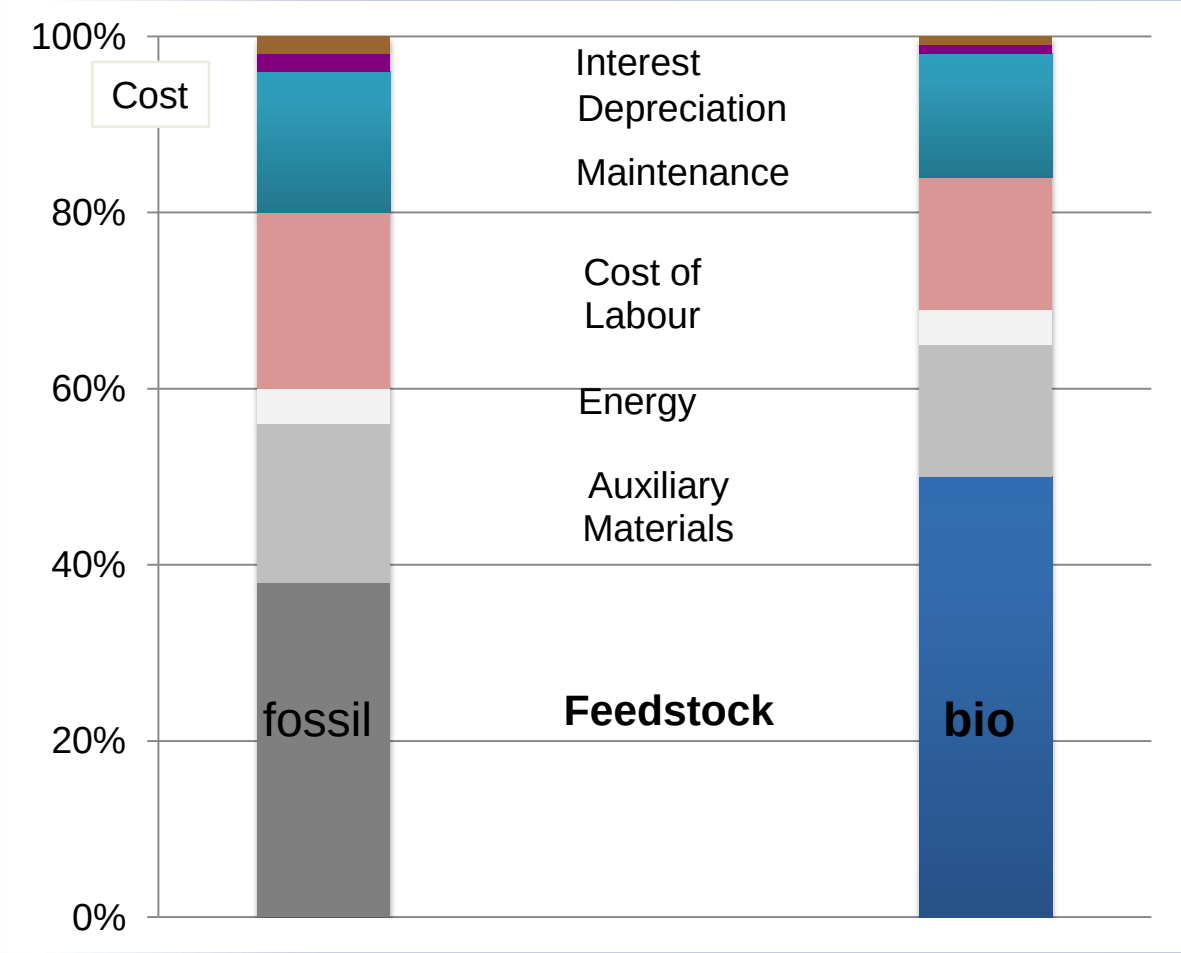


Selected Biopolymers gain Competitiveness

1. Nov. 2013
Open Innovation Forum
Moscow

Dr. Manfred Kircher
Chairman Advisory Board
CLIB2021
Email: kircher@clib2021.de

Feedstock
make 40 - 50 % of Chemical Production Cost



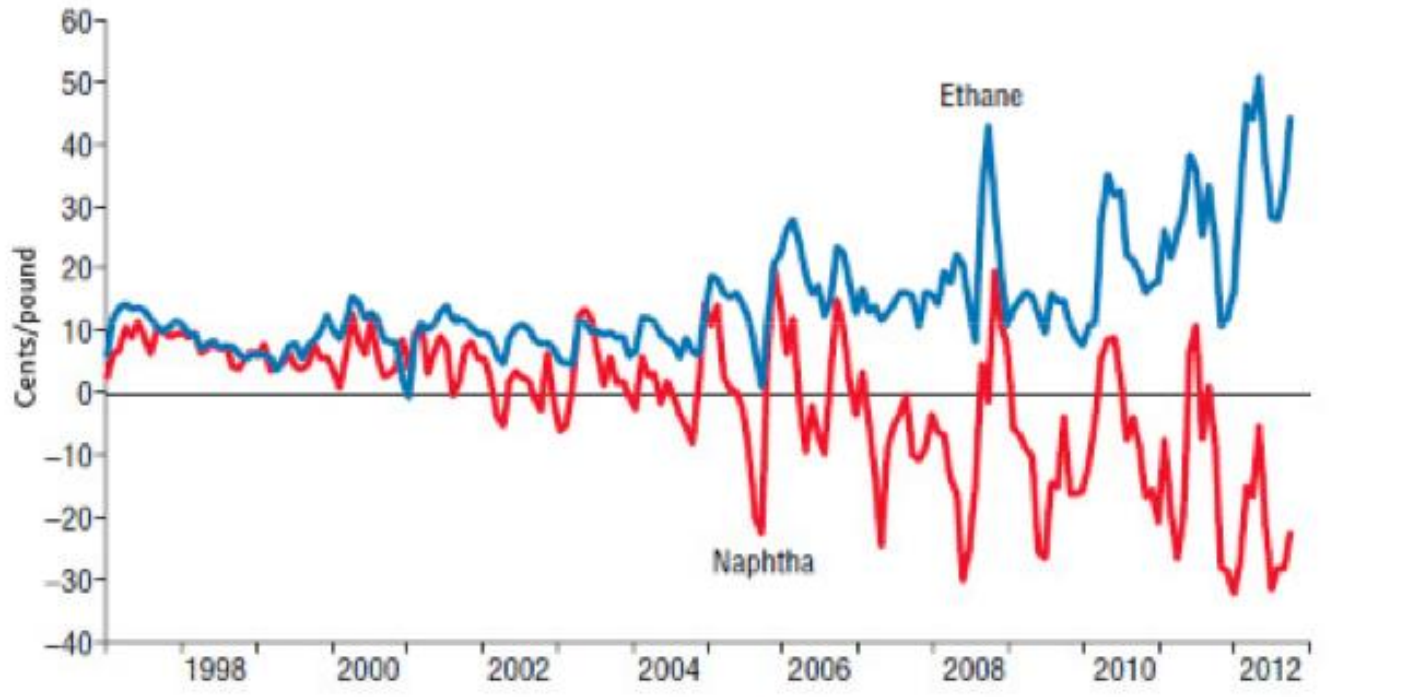
Bio-Carbon
still more costly

CLIB 2021 CLUSTER INDUSTRIELLE BIOTECHNOLOGIE

www.finanzen.net

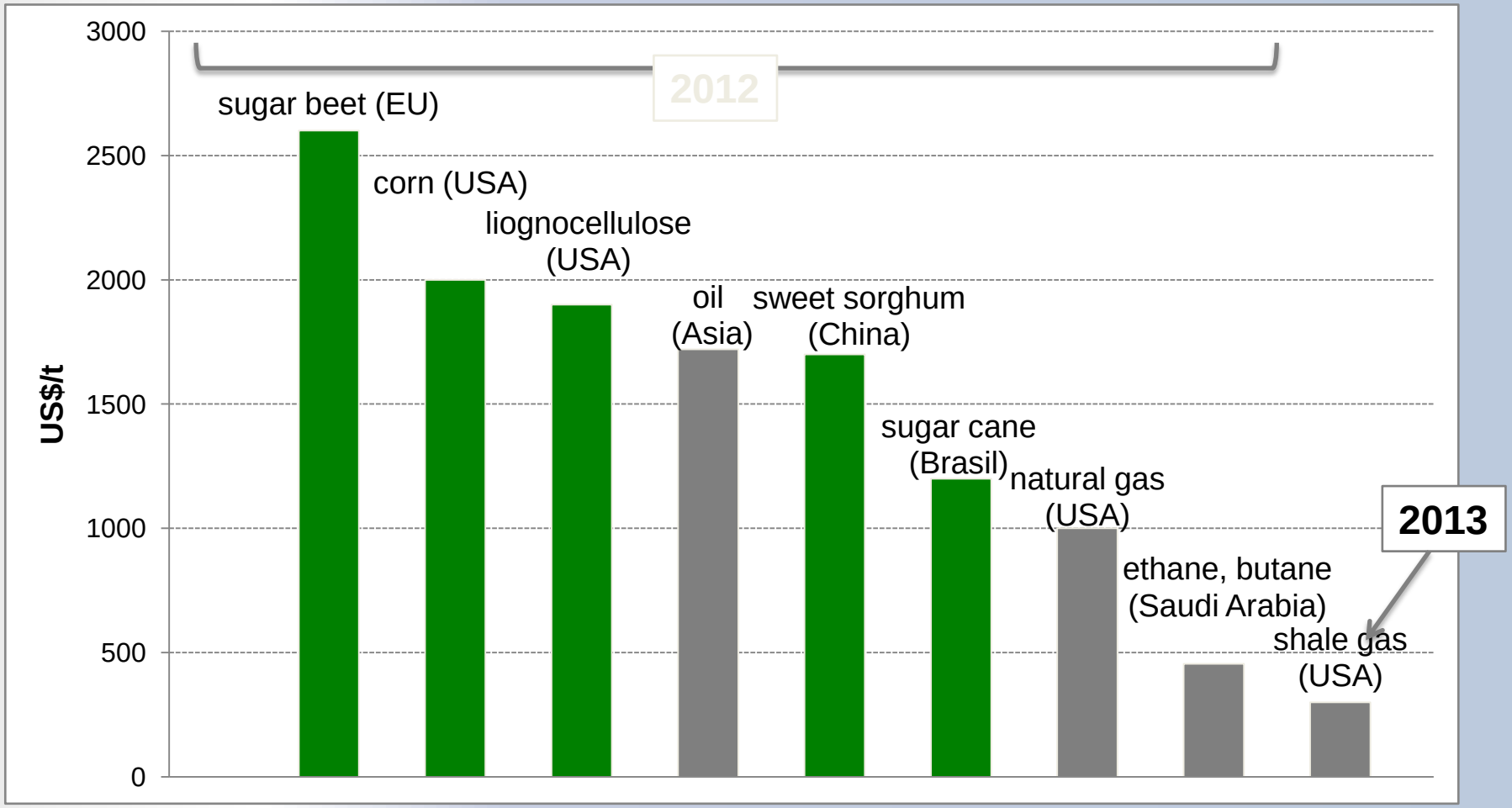
Shale Gas
reduces Cost of Fossil Ethylen

CLIB 2021
CLUSTER INDUSTRIELLE BIOTECHNOLOGIE



Quelle: chemistryviews.org

Bio-Ethylene
not cost-competitive



MIT Technical Review; Kevin Bullis;Shale gas will fuel a US manufacturing boom; 9.1.2013

- Chemicals respond to Shale Gas Availability
- Selected Biochemicals gain Competitiveness

CLIB 2021 CLUSTER INDUSTRIELLE BIOTECHNOLOGIE

Carbon-Source	***Fossil***	***Bio***	
Methane	⬆		
Ethylene	⬆		
Propylene	⇩	⬆	2-Butene + Ethylene
Funct. C_3 Molecules		⬆	1,3 propandiole
Butadiene	⇩	⬆	ω-amino lauric acid
Funct. C_4 Molecules		⬆	succinic acid
Aromatics	⇩	⬆	(lignin)

23.5.2013
CLIB Forum on Shalegas
K.Rübbert; Dechema (modified)

CLIB-Consortium
develops New-to-the-World Biochemical

An Alternative Raw Material for Polyamide 12

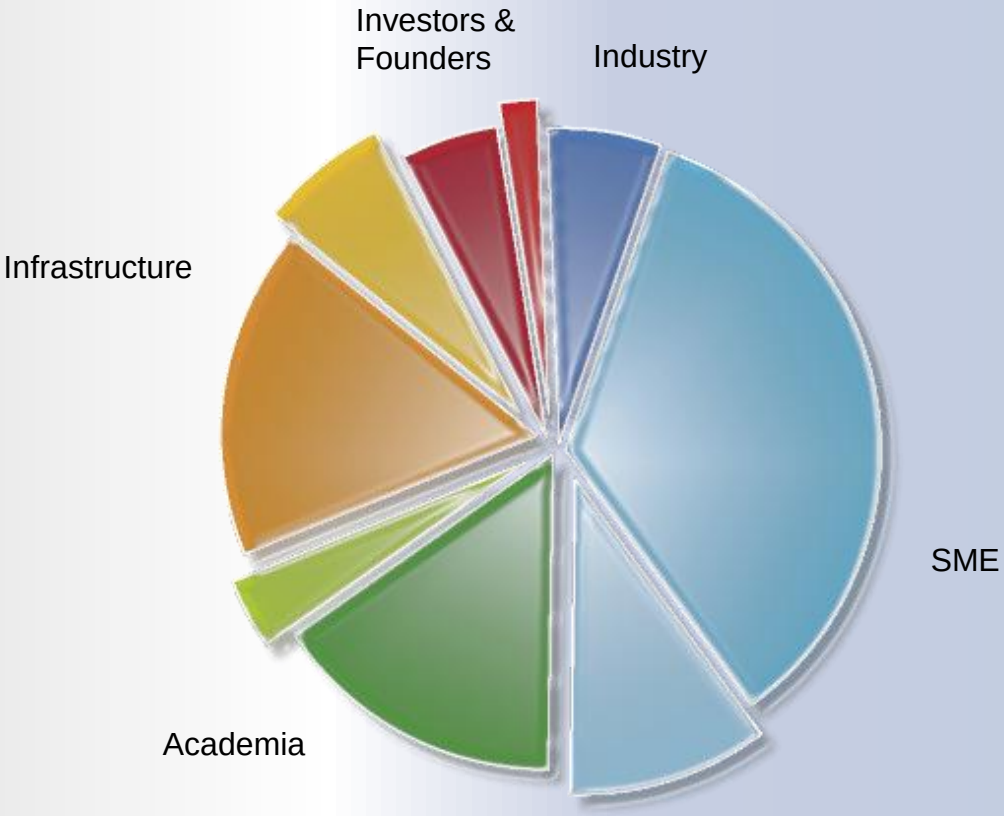
Evonik is operating a pilot plant for bio-based ω-amino lauric acid

Essen, July 30, 2013

The biobased ω-amino-lauric acid is an alternative to petroleum-based laurin lactam (LL). ALS replaces the monomer LL in the manufacture of sustainable high-performance plastics and yields an identical compound polyamide 12 (PA 12).

Over the long run, the entirely new process has the potential to complement the butadiene-based production of PA12.

CLIB2021 - Overview



highlighted segments show international members

100 Members

40 % SME

30 % international

60 bn EUR Sales

200 mio EUR Bio-R&D Budget

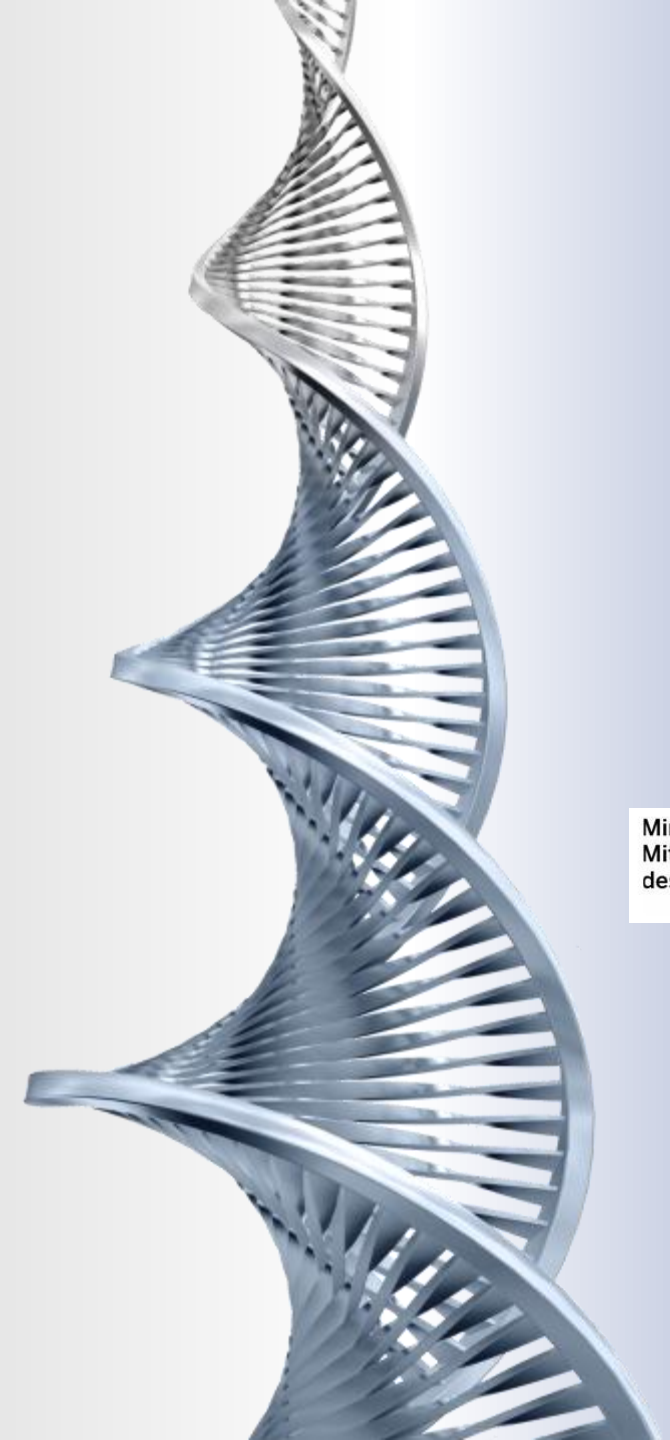
Funded and supported by:

Federal Ministry of Education and Research

Federal Ministry of Food, Agriculture and Consumer Protection

Ministry of Innovation, Science and Research of the German State of North Rhine-Westphalia

BIO NRW Cluster Biotechnology North Rhine-Westphalia



CLIB 2021
CLUSTER INDUSTRIELLE BIOTECHNOLOGIE

We thank our Supporters !

Bundesministerium für Bildung und Forschung

German-Russian Cooperation Network Biotechnology

Ministerium für Wirtschaft, Mittelstand und Energie des Landes Nordrhein-Westfalen

BIO.NRW Cluster Biotechnologie Nordrhein-Westfalen

EVONIK INDUSTRIES

Bayer Technology Services

Институт биохимии имени А.Н. Баха Российская академия наук
A.N. Bach Institute of Biochemistry Russian Academy of Sciences