



GASSNOVA

CCS – ONLY FOR OIL AND GAS SOURCES ?

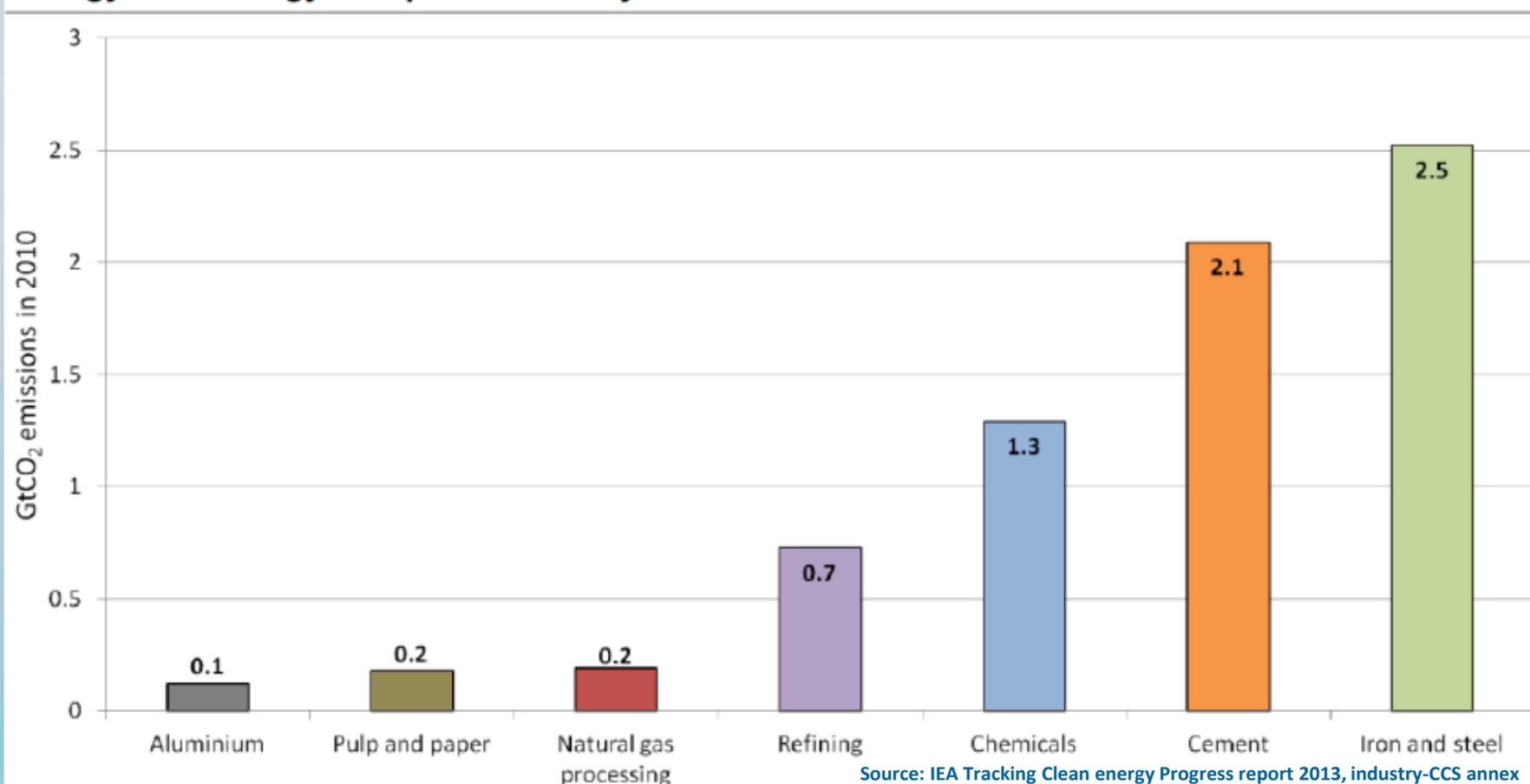
NORCEM CO₂ Capture Project International CCS Conference 20-21 2015

- Dr. ing. Hans Jörg Fell

LOGICAL EXPLANATION FOR CCS:

FULL-SCALE AS ONLY OPPORTUNITY FOR MAJOR INDUSTRY

Figure 1. Global emissions from the seven most CO₂-intense industrial sectors in the IEA *Energy Technology Perspectives* analysis



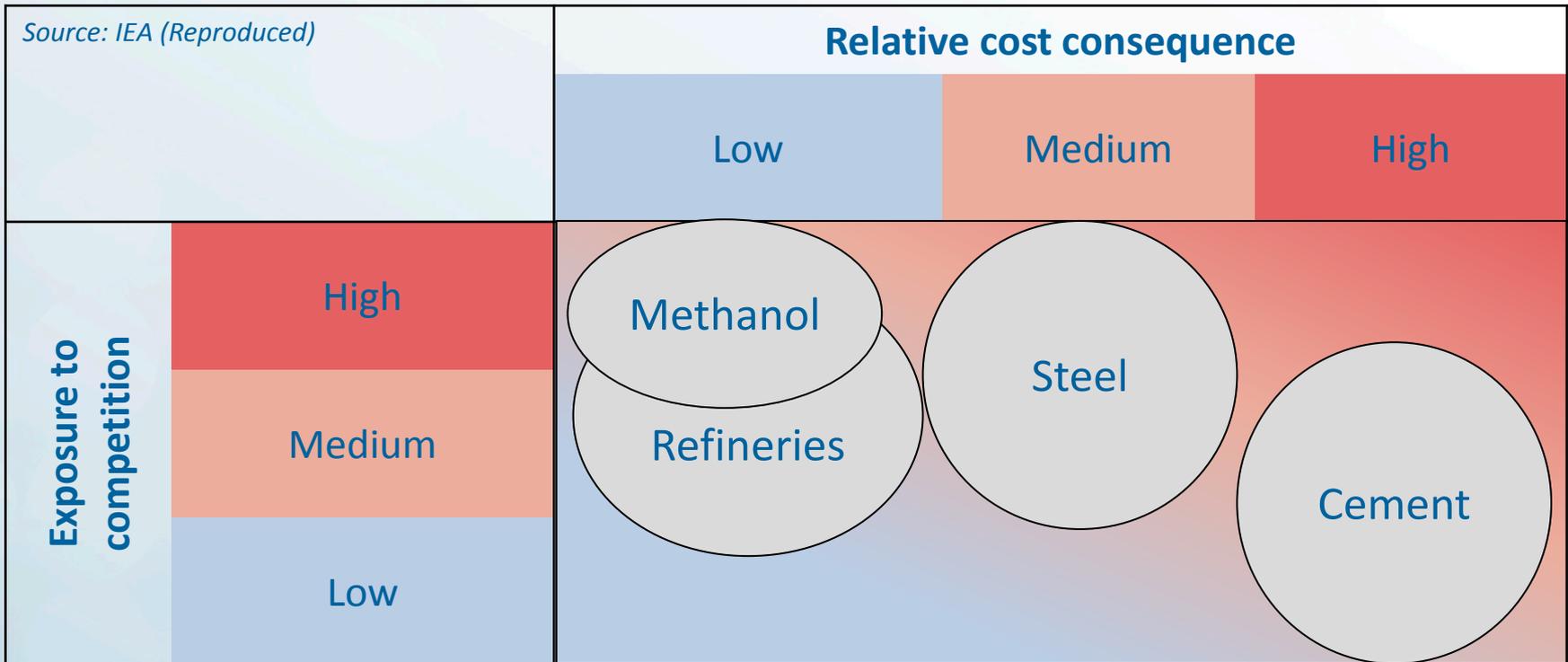
Source: IEA Tracking Clean energy Progress report 2013, industry-CCS annex



ENERGY INTENSIVE INDUSTRY

- Commodity market
- Global competition
- Extremely cost effective
- Strong need for R&D
- Large volume production facilities
- High investment costs
- Emissions to air

CCS FOR INDUSTRY - CARBON LEAKAGE AND TOLERANCE



- Global and standardised products → High exposure to competition;
- High capture costs per unit of end product → (Relative cost)
- Industry must also mobilise itself

ENTIRE VALUE CHAIN

- CO₂ capture in industry
- Compression and transport
- EOR/CO₂ storage

CLOSING THE GAP. FOCUS ON ...



Technology
development



Infrastructure



Legal framework



Government aid



Attractive in terms of
practical economics

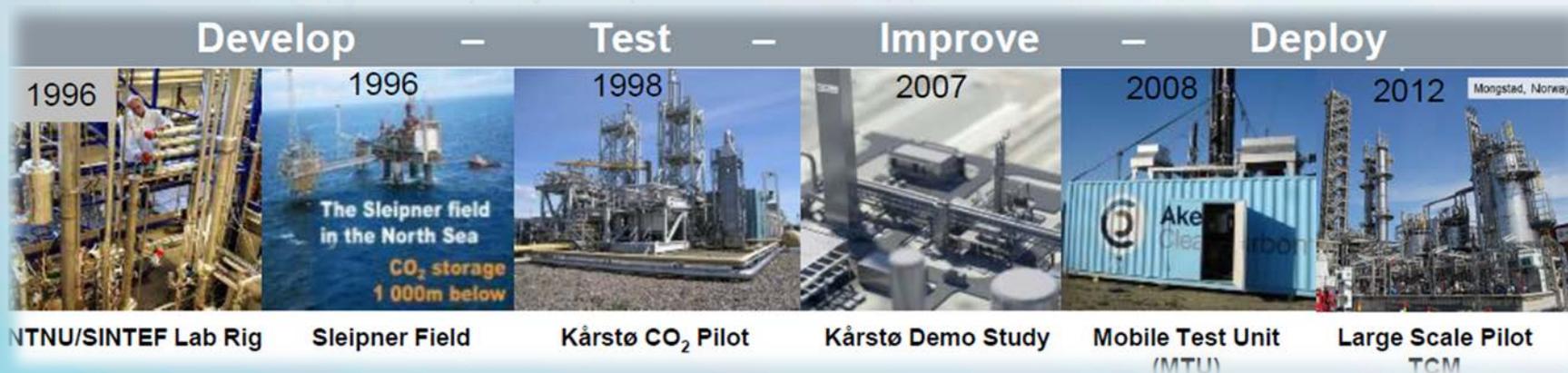


Public
acceptance

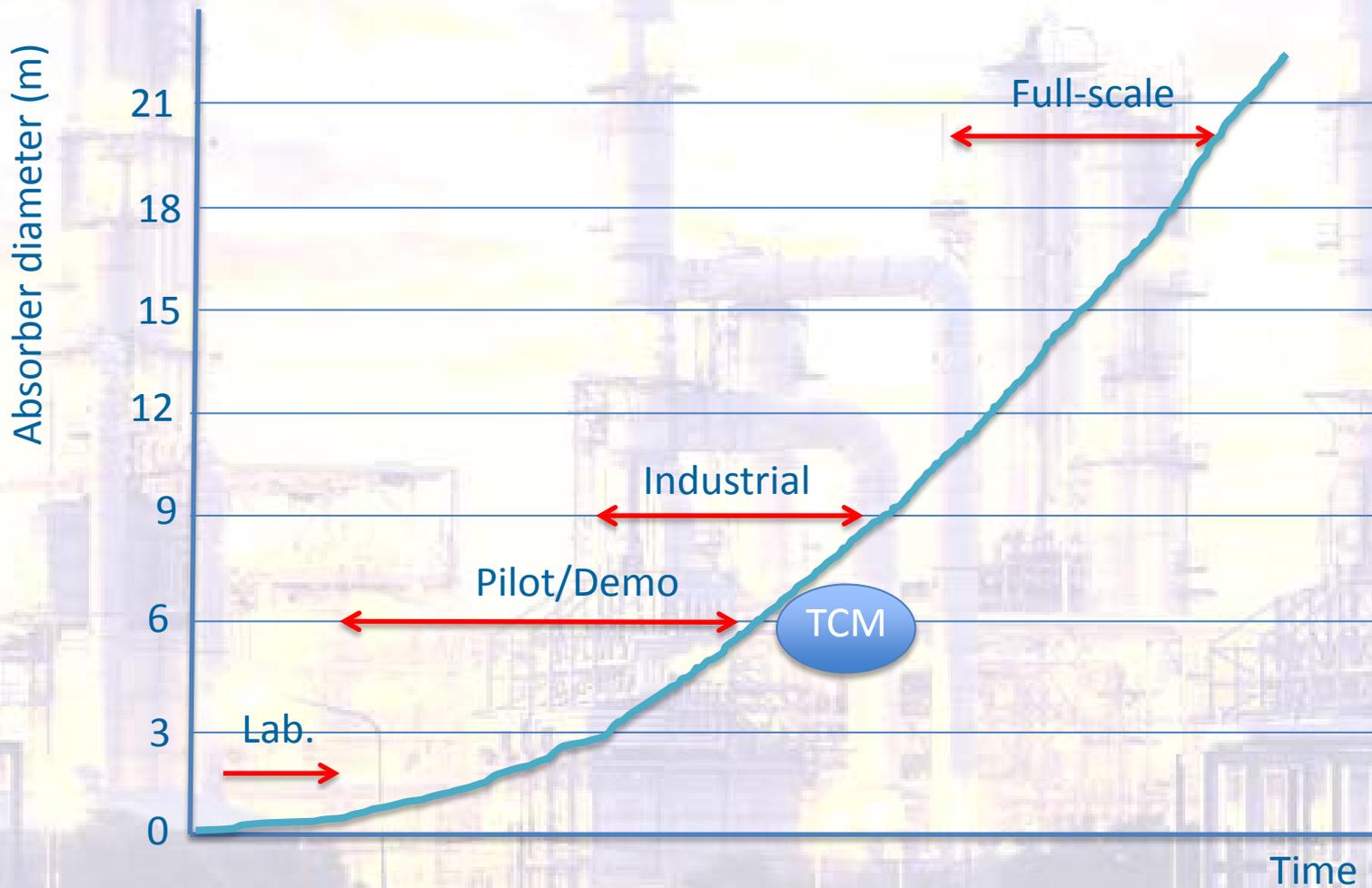


SCALING UP NEW TECHNOLOGY - REDUCING RISKS

- Technical risk
- Relevant environment
- Availability
- Economics



FROM R&D – FULL-SCALE



LEARNING:

REDUCTION OF TECHNICAL RISK

Two years of extensive operational experience

- **Transferable operational experience from TCM:**
 - Energy optimization
 - Shut down/start-up procedures
 - Scale-up
 - Verification of simulation models
 - Solvent degradation - waste handling
 - Material selection

LEARNING:

REDUCTION ENVIROMENTAL RISK

Experience with emissions in an industrial scale

- Systematic approach to understand and manage emissions
 - Instrumentation and monitoring
 - Atmospheric chemistry, spread and degradation of amines
 - Monitoring in the vicinities



LEARNING:

REDUCTION FINANCIAL RISK

Discoveries at TCM reduce financial cost and risk in forthcoming full-scale projects

EXAMPLES

- Material
- Constructed and verified the use of concrete absorbers with polymer (PP) lining
- Design optimization: Simulation models verified in an industrial scale can contribute to design optimization

A low-angle, upward-looking photograph of several large industrial smokestacks. The stacks are made of brick or concrete and are set against a bright blue sky with scattered white clouds. The perspective makes the stacks appear to converge towards the top of the frame.

CCS IN ENERGY-INTENSIVE INDUSTRY

EXAMPLES FROM THE NORWEGIAN CLIMIT PROGRAM

PALLADIUM MEMBRANES

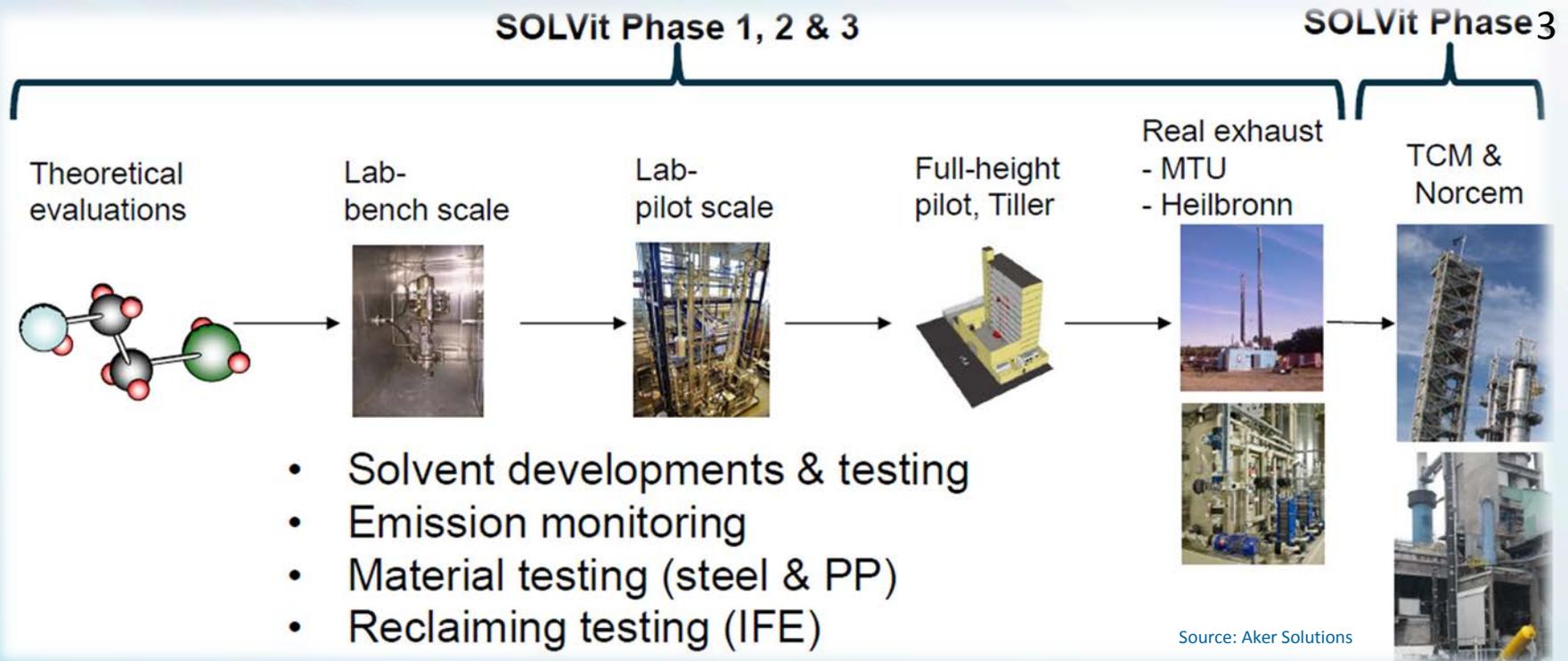
From R&D  Demo

- Complex Norwegian technology
- Total budget of 75.7 MNOK
- Partners are Reinertsen and SINTEF

SOLVENTS FOR THE NEXT GENERATION

Post combustion CO₂ capture systems

- 3 phases running from 2008 to 2015
- Total budget of 340 MNOK of which 133 MNOK is funded by CLIMIT
- Improved energy efficiency (- 50%)
- 5 PhD + 3 post.doc + 8 masterstudents



EUROPE'S FIRST CO₂ CAPTURE TEST FACILITY IN CEMENT INDUSTRY, BREVIK, NORWAY

Partners:
Norcem, HeidelbergCement and
ECRA (European Cement Research
Academy)

- Small Scale Test Centre
- Basis for qualification of CO₂ capture technologies
- Project on behalf of the European Cement Industry
- Evaluation of full scale capture
- Total budget: 93 MNOK

COMPLETE - German CO₂ injection project

Entire life cycle of a CO₂ storage project in pilot scale:
preparation – injection – completion and follow up



- Partners: SINTEF, GFZ, E.ON, RWE, Statoil, Vattenfall and OMW
- Total budget: 81,4 MNOK; 11,4 MNOK funded by CLIMIT

GASSNOVA'S REPORT ON POTENTIAL FULL-SCALE CCS PROJECTS IN NORWAY - PRE-FEASIBILITY STUDY

Summary by: The Ministry of Petroleum and Energy

HAS IDENTIFIED EMISSION SOURCES AND STORAGE SITES WHICH MAY BE TECHNICALLY FEASIBLE FOR A CCS PROJECT

Gassnova recommends continuing the work to facilitate feasibility studies of CO₂ capture at both Norcem and Yara's facilities.

Gassnova also recommends continuing the dialogue with the Waste-to-Energy Agency of Oslo about further studies at the Klemetsrud facility.

Gassnova has identified industrial companies interested in participating in feasibility studies of storage options. A storage site should be able to handle volumes from multiple sources.





Thank you!

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CLIMIT programme
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