

## Status report on thermal gasification of biomass and waste 2025

### Output: Fuels (SAF, FT liquids, DME)

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#### Annex 5

Gasification facilities for CHP production with Fuels (SAF, FT liquids, DME) Output - operational, under construction / under commissioning, on hold

## Output: Fuels (SAF, FT liquids, DME)

	Operational
	Planned
	Under construction / under commissioning
	On hold / Non operational

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BEST - Bioenergy and Sustainable Technologies GmbH	Waste2Value	AT	3
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CATEGORY	INFORMATION
CATEGORY	Information
PROJECT OWNER	BEST - Bioenergy and Sustainable Technologies GmbH
PROJECT NAME	Waste2Value
STATUS	Operational
LOCATION	Austria, Wien-Simmering
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY INFO	<b>Fuel Synthesis:</b> Gasification with FT-synthesis
RAW MATERIAL	Lignocellulosics
INPUT 1	Biogenic residues and waste (1 MW)
OUTPUT 1	FT liquids (44 t/y)
OUTPUT 2	Clean syngas
OUTPUT INFO	FT capacity 1 BPD
TOTAL INVESTMENT	EUR 9,000,000
FUNDING EXPLANATION	Funding within a COMET-Project
PARTNERS	Wien Energie, SMS Group, Heinzl Paper, Wiener Linien GmbH, Wiener Netze GmbH, Austrian Forest Authority; scientific partners: Vienna University of Technology, Lulea University of Technology
TECHNOLOGY BRIEF	The process uses thermal conversion to turn waste materials into syngas, which is then converted into energy carriers such as green fuels, green gas, and green hydrogen. The technology is highly flexible, able to process both renewable (wood, waste, sludge) and non-renewable (plastics) feedstocks, and produce a range of sustainable fuels for sectors where batteries are unsuitable. The project focuses on hydrogen-rich syngas from waste fuels, with a second step synthesizing liquid fuels (diesel, kerosene) via FT synthesis.
ADDITIONAL INFORMATION	The project runs to 2023, covering construction and startup of the pilot facility to gain operational experience.
CONTACT INFORMATION	BEST Bioenergy and Sustainable Technologies GmbH, office-wien@best-research.eu

CATEGORY	INFORMATION
PROJECT OWNER	bioenergy 2020+
PROJECT NAME	One Barrel per Day Pilot Plant
STATUS	On hold
STARTUP	2016
LOCATION	Austria
CITY	Guessing
PRODUCTION TYPE	TRL 4-5 Pilot
TECHNOLOGY	Fuel Synthesis
TECHNOLOGY INFO	Slurry bubble column FT reactor
RAW MATERIAL	Forest residues
INPUT 1	Syngas (50 m <sup>3</sup> /h)
OUTPUT 1	FT liquids (53 m <sup>3</sup> /y)
TECHNOLOGY BRIEF	The pilot plant enables scale-up from laboratory to pilot scale for Fischer-Tropsch (FT) synthesis. Syngas is cleaned (aromatics, sulfur <10 ppbv, NH <sub>3</sub> , water), compressed to 25 bar, and converted in a slurry bubble column reactor to a range of hydrocarbons (C1 to C60+). The plant validates catalyst stability, gas purification, and reactor design for future demonstration plants.
ADDITIONAL INFORMATION	Research since 2005 with a 10 LPD FT lab plant informed the pilot plant design. The pilot plant is an important milestone toward demonstration-scale sustainable fuel production.
CONTACT INFORMATION	Gerald Weber (gerald.weber@bioenergy2020.eu), +43 3322 42606-154





CATEGORY	INFORMATION
PROJECT OWNER	BioTfuel-consortium
PROJECT NAME	BioTfuel pilot
STATUS	Operational
STARTUP	2021
LOCATION	France
CITY	Dunkirk
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY	Fuel Synthesis
TECHNOLOGY INFO	tk Uhde and Axens technologies
RAW MATERIAL	Lignocellulosics
INPUT 1	Forest waste, straw, green waste, dedicated crops
OUTPUT 1	FT liquids (60 t/y)
OUTPUT 2	Sustainable aviation fuels (SAF)
TOTAL INVESTMENT	EUR 190,000,000
FUNDING	EUR 33,300,000 (State and FEDER funding)
PARTNERS	Avril, Axens, CEA, IFP Energies Nouvelles, ThyssenKrupp Uhde, TotalEnergies
TECHNOLOGY BRIEF	The BioTfuel project demonstrates conversion of lignocellulosic biomass into high-quality biodiesel and bio-jet fuel. Biomass is torrefied, gasified, syngas is cleaned and conditioned, then converted to hydrocarbons via Fischer-Tropsch synthesis. The process is flexible, allowing co-processing of fossil feedstocks.
ADDITIONAL INFORMATION	The project aims to commercialize advanced biofuels with reduced carbon footprint.
CONTACT INFORMATION	Axens: Corinne Garriga (corinne.garriga@axens.net, +33 1 47 14 25 14); TotalEnergies: Damien Steffan (damien.steffan@total.com, +33 1 41 35 32 24)

CATEGORY	INFORMATION
PROJECT OWNER	CHOREN Fuel Freiberg GmbH & Co. KG
PROJECT NAME	Synthesis CHOREN beta plant Freiberg
STATUS	Cancelled (project halted before 2012)
STARTUP	2004 (gasification operational); FT section incomplete
LOCATION	Germany
CITY	Freiberg
ZIP	09599
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY	Biomass-to-Liquids (BTL) via Carbo-V® gasification and Fischer-Tropsch (FT) synthesis
RAW MATERIAL	Lignocellulosics (dry wood chips, recycled wood, forestry residues)
INPUT 1	Dry wood chips (65,000 t/y design capacity)
OUTPUT 1	FT liquids (13,500 t/y; ~370 barrels/day)
TOTAL INVESTMENT	EUR 190,000,000
TECHNOLOGY BRIEF	<p>Carbo-V® Process: Three-stage gasification:</p> <ol style="list-style-type: none"> <li>1. Low-temperature pyrolysis (400-500°C) produces pyrolysis gas and char.</li> <li>2. High-temperature gasifier (1,400°C, oxygen-blown) converts pyrolysis gas and pulverized char into tar-free syngas (CO/H<sub>2</sub>).</li> <li>3. Chemical quenching with char cools syngas to 800°C</li> </ol>
KEY INNOVATIONS	<ul style="list-style-type: none"> <li>- Tar-free syngas via chemical quenching</li> <li>- Modular scaling (45 MW gasifier; planned 160 MW "Sigma" plants)</li> </ul>
CHALLENGES	Financial insolvency led to cancellation in 2011 despite technical success
PARTNERS	Shell (FT technology), Daimler, Volkswagen, EU funding .
CONTACT	info@choren.com



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CATEGORY	INFORMATION
PROJECT OWNER	CHOREN Industries GmbH
PROJECT NAME	Synthesis CHOREN sigma plant Schwedt
STATUS	Cancelled (stopped while under construction)
LOCATION	Germany
CITY	Schwedt
ZIP	16303
PRODUCTION TYPE	TRL 8 First-of-a-kind commercial
TECHNOLOGY	Gasification (Carbo-V® process, planned for FT synthesis)
RAW MATERIAL	Lignocellulosics
INPUT 1	Dry wood chips from recycled wood; fast growing wood from short-rotation crops
OUTPUT 1	FT liquids (200,000 t/y)
ADDITIONAL INFORMATION	The Sigma plant was designed for large-scale biomass-to-liquids (BtL) production using CHOREN's Carbo-V® gasification technology. Planned capacity was 200,000 tonnes/year FT liquids, with four parallel trains (total 640 MWth). The project was halted during construction due to financing and regulatory challenges. The plant was never completed or operated.
CONTACT INFORMATION	info@choren.com, +49 3731 2662 0



CATEGORY	INFORMATION
PROJECT OWNER	Cutec
PROJECT NAME	Synthesis Cutec Clausthal-Zellerfeld
STATUS	Operational
STARTUP	1990
LOCATION	Germany
CITY	Clausthal-Zellerfeld
ZIP	38678
PRODUCTION TYPE	TRL 4-5 Pilot
TECHNOLOGY	Fuel Synthesis (BtL production, atmospheric gasifier)
RAW MATERIAL	Lignocellulosics
INPUT 1	Straw, wood, dried silage, organic residues
OUTPUT 1	FT liquids (0.02 t/y)
TECHNOLOGY BRIEF	The CUTEC facility operates as a pilot-scale biomass-to-liquid (BtL) plant, using an atmospheric gasifier to convert various lignocellulosic feedstocks (straw, wood, silage, organic residues) into syngas. The syngas is then processed via Fischer-Tropsch (FT) synthesis to produce synthetic diesel and waxes. The plant is part of the ArtFuel project, focusing on renewable fuel and chemical production from biomass. The facility also serves as a testbed for gas cleaning and process optimization, supporting research on 2nd-generation biofuels and syngas upgrading.
ADDITIONAL INFORMATION	The plant is integrated into the Clausthal Energy Park and has been operational since 1990, with ongoing upgrades and research collaborations. It is recognized as a key pilot site for distributed BtL production and syngas purification in Germany.
CONTACT INFORMATION	Stefan Vodegel, stefan.vodegel@cutec.de

CATEGORY	INFORMATION
CATEGORY	Information
PROJECT OWNER	Elyse Energy + consortium
PROJECT NAME	BioTJet
STATUS	Planned (Operational target: 2027-2029)
LOCATION	France
CITY	Pardies (Lacq industrial basin)
PRODUCTION	Type: TRL 8 First-of-a-kind commercial
TECHNOLOGY	Gasification + Fischer-Tropsch synthesis
TECHNOLOGY ADDITIONAL INFO	BioTfuel® process: Entrained-flow gasifier (PRENFLO®) + electrolysis for hydrogen injection. Combines biomass conversion with green hydrogen to double fuel yield.
RAW MATERIAL	Lignocellulosics (forestry residues, end-of-life wood waste)
INPUT 1, 2, 3	Dry lignocellulosic biomass (300,000 t/y), Green hydrogen (32,000 t/y), Oxygen (180,000 t/y)
OUTPUT 1, 2, 3	Sustainable aviation fuel (SAF) (75,000 t/y), E-bio-naphtha (35,000 t/y), BioCO <sub>2</sub> (90,000 t/y)
OUTPUT INFO	e-bioSAF (70% GHG reduction vs. fossil kerosene), e-bio-naphtha for chemicals/road transport.
TOTAL INVESTMENT	Supported by €33.3M from ADEME/France 2030; total project cost undisclosed.
PARTNERS	Elyse Energy (lead), Avril, Axens, IFPEN, Bionext, Thyssenkrupp Uhde
TECHNOLOGY BRIEF	<p>Process Steps:</p> <ol style="list-style-type: none"> <li>1. Torrefaction: Biomass pretreatment.</li> <li>2. PRENFLO® gasification: Converts biomass to syngas at 1,200-1,600 °C.</li> <li>3. Syngas conditioning: Cleaning, compression, hydrogen addition.</li> <li>4. Fischer-Tropsch synthesis (Axens Gasel™): Converts syngas to hydrocarbons.</li> <li>5. Hydrogen integration: Electrolysis-derived hydrogen boosts yield and enables e-fuel production.</li> </ol>
KEY INNOVATIONS	<ul style="list-style-type: none"> <li>- First commercial-scale application of BioTfuel® tech.</li> <li>- Hydrogen integration doubles SAF output.</li> <li>- Complies with EU ReFuelEU Aviation (70% SAF by 2050).</li> </ul>



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**IMPACT**

- Supplies 30% of Bordeaux Airport's annual kerosene demand.
- Creates ~500 direct/indirect jobs.
- Avoids 200,000 tCO<sub>2</sub>/year.

**ADDITIONAL  
INFORMATION**

Part of the E-CHO cluster with eM-Lacq (e-methanol plant). Backed by EU's Fit-for-55 and France's low-carbon strategy.

**CONTACT**

Mathieu Morin (mathieu.morin@ifpen.fr)



CATEGORY	INFORMATION
PROJECT OWNER	Fulcrum BioEnergy
PROJECT NAME	Sierra Biofuels
STATUS	Plant constructed and commissioned in 2022; operations have since been shut down (as of May 2024)
STARTUP	2022 (commissioning and initial operations)
LOCATION	United States
CITY	Reno
ZIP	89434
STATE	Nevada
PRODUCTION TYPE	TRL 9 Commercial
TECHNOLOGY	Fuel Synthesis (TRI gasification + Johnson Matthey DAVY FT synthesis)
RAW MATERIAL	Sorted municipal solid waste (MSW)
INPUT 1	Sorted MSW (175,000 t/y)
OUTPUT 1	FT liquids (41,640 m <sup>3</sup> /y, ~11 million gallons/year syncrude)
OUTPUT 2	Power (electricity)
TECHNOLOGY BRIEF	The Sierra BioFuels Plant used a two-stage process: landfill waste was processed into clean feedstock, gasified (TRI gasification, 20 TPH), and converted to syngas. Syngas was then processed via fixed-bed Fischer-Tropsch (FT) synthesis (Johnson Matthey DAVY) to produce FT wax and, in later phases, SAF, renewable diesel, and naphtha. The plant was the world's first commercial-scale landfill waste-to-renewable transport fuels facility .
ADDITIONAL INFORMATION	The plant shipped its first syncrude in December 2022 to Marathon Petroleum for upgrading to SAF. Fulcrum had plans for multiple additional projects, but financial difficulties led to missed bond payments and eventual shutdown and layoffs in May 2024 .
CONTACT INFORMATION	info@inentec.com, www.fulcrum-bioenergy.com

CATEGORY	INFORMATION
PROJECT OWNER	Karlsruhe Institute of Technology (KIT)
PROJECT NAME	bioliq
STATUS	Operational
STARTUP	2014
LOCATION	Germany
CITY	Eggenstein-Leopoldshafen
STATE	Baden-Wuerttemberg
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY	Fuel Synthesis (KIT technology)
TECHNOLOGY ADDITIONAL INFO	bioliq® process: high-pressure entrained flow gasification, hot gas cleaning, DME/gasoline synthesis
RAW MATERIAL	Lignocellulosics
INPUT 1	Straw (1 t/h)
OUTPUT 1	DME (608 t/y)
OUTPUT 2	Gasoline-type fuels (360 t/y)
INVESTMENT	EUR 56,000,000
FUNDING	50% by national funds
PARTNERS	Air Liquide Engineering & Construction, CAC Chemieanlagenbau Chemnitz, MUT Advanced Heating, MAT Mischanlagentechnik, BAUER
TECHNOLOGY BRIEF	The bioliq® demonstration plant converts straw and other agricultural residues into high-quality synthetic fuels. The process includes decentralized fast pyrolysis to produce biosyncrude, high-pressure entrained flow gasification (5 MW, 40-80 bar), hot gas cleaning, and subsequent synthesis of DME and gasoline via methanol-to-gasoline (MtG) technology. The plant demonstrates the complete biomass-to-fuel chain at pilot scale.
ADDITIONAL INFORMATION	The plant is a key demonstration of advanced biofuel production from agricultural residues, supporting research and scaling for future commercial deployment.
CONTACT INFORMATION	Nicolaus Dahmen, nicolaus.dahmen@kit.edu



CATEGORY	INFORMATION
PROJECT OWNER	LTU Green Fuels
PROJECT NAME	DP1+DME pilot
STATUS	Idle
STARTUP	2011
LOCATION	Sweden
CITY	Piteå
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY	Gasification (Chemrec process) + DME/methanol synthesis
RAW MATERIAL	Other
INPUT 1	Black liquor
INPUT 2	Pyrolysis oil (co-gasified with black liquor)
OUTPUT 1	Clean syngas (2 MW)
OUTPUT 2	DME (4 t/d)
OUTPUT 3	Methanol (4 t/d)
PARTNERS	Chemrec AB, Haldor Topsøe, Volvo Truck, Preem, Smurfit Kappa, Sveaskog, Perstorp, Södra, Holmen, Flogas, ETC
TECHNOLOGY BRIEF	The Chemrec process uses a refractory-lined entrained bed reactor to gasify black liquor (and pyrolysis oil) at ~1000 °C and 30 bar. The process produces clean syngas, which is converted to DME and methanol. The plant demonstrated over 27,000 hours of gasifier operation and 12,000 hours of syngas/DME production. DME and methanol were used in field tests by Volvo Trucks and others.
ADDITIONAL INFORMATION	After the Bio-DME project ended in 2012, further R&D focused on broadening the fuel basis and improving gas cleaning and synthesis technologies.
CONTACT INFORMATION	Rikard Gebart, ph: +46 920492196, email: rikard.gebart@ltu.se



CATEGORY	INFORMATION
PROJECT OWNER	Red Rock Biofuels
PROJECT NAME	Commercial
STATUS	Idle
STARTUP	2022
LOCATION	United States
CITY	Lakeview
STATE	Oregon
PRODUCTION TYPE	TRL 8 First-of-a-kind commercial
TECHNOLOGY	Fuel Synthesis (FT-route)
TECHNOLOGY ADDITIONAL INFO	Velocys microchannel FT reactor, TCG Global gasification
RAW MATERIAL	Forest residues
INPUT 1	Dry wood (127,000 t/y)
OUTPUT 1	FT liquids (44,000 t/y)
OUTPUT 2	Sustainable aviation fuels (SAF)
OUTPUT ADDITIONAL INFO	FT liquids include 40% diesel, 40% kerosene, 20% naphtha
FUNDING	USD 70,000,000
TECHNOLOGY BRIEF	The plant was designed to convert woody biomass into syngas using TCG Global gasification, followed by Fischer-Tropsch synthesis with Velocys microchannel reactors to produce diesel, SAF, and naphtha. Hydroprocessing upgrades FT products to ASTM-approved fuels. The facility was never fully commissioned and faced foreclosure.
ADDITIONAL INFORMATION	The project aimed to reduce wildfire risk, support local forestry, and supply major offtakers, but did not reach commercial operation.
CONTACT INFORMATION	info@inentec.com, www.redrockbio.com

CATEGORY	INFORMATION
PROJECT OWNER	SCA (Svenska Cellulosa Aktiebolaget) and St1 (Nordic energy company)
PROJECT NAME	Östrand Biorefinery
STATUS	Planned (Environmental permit application submitted; EU Innovation Fund grant secured)
LOCATION	Sweden
CITY	Sundsvall (Östrand industrial area)
ZIP	85188
PRODUCTION TYPE	TRL 8 First-of-a-kind commercial
TECHNOLOGY	Gasification + Fischer-Tropsch synthesis + electrolysis
TECHNOLOGY ADDITIONAL INFO	Solid biomass gasification integrated with renewable hydrogen production (electrolysis)
RAW MATERIAL	Lignocellulosics (forest residues, sawmill by-products)
INPUT 1	Biomass (200 MW thermal input; ~200,000 t/y forest residues)
INPUT 2	Renewable electricity (400 MW for hydrogen electrolysis)
OUTPUT 1	Sustainable aviation fuel (SAF) (160,000 t/y)
OUTPUT 2	Renewable naphtha (40,000 t/y)
OUTPUT ADDITIONAL INFO	50% e-fuels (from renewable hydrogen), 50% advanced biofuels. Total GHG avoidance: 8.76 million tCO <sub>2</sub> eq over 10 years.
FUNDING	EUR 166.6 million EU Innovation Fund grant; total project cost undisclosed.
PARTNERS	EU Commission, local Swedish municipalities, energy/aviation stakeholders
TECHNOLOGY BRIEF	<p>Process:</p> <ol style="list-style-type: none"> <li>1. Biomass gasification: Converts forest residues to syngas.</li> <li>2. Electrolysis: Uses 400 MW renewable electricity to produce green hydrogen.</li> <li>3. Fischer-Tropsch synthesis: Combines syngas and hydrogen to produce SAF and naphtha.</li> </ol> <p>Innovation: First commercial-scale integration of solid biomass gasification with electrolysis, enabling higher carbon efficiency and feedstock flexibility.</p>



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<b>KEY FEATURES</b>	<ul style="list-style-type: none"><li>- Co-located with SCA's Östrand pulp mill for energy/feedstock synergy.</li><li>- Supplies 50% of Sweden's domestic aviation fuel demand.</li><li>- Aligns with EU ReFuelEU Aviation targets (70% SAF by 2050).</li></ul>
<b>TIMELINE</b>	<ul style="list-style-type: none"><li>- Environmental permit application submitted (2024).</li><li>- Construction start: 2025 (planned).</li><li>- Operational target: 2029.</li></ul>
<b>CONTACT</b>	Not publicly available. Project updates: <a href="#">Biorefinery Östrand</a> .



CATEGORY	INFORMATION
PROJECT OWNER	Thermochem Recovery International (TRI)
PROJECT NAME	Technology Development Laboratory and Pilot Plant - Thermochemical
STATUS	Operational
STARTUP	2007
LOCATION	United States
STREET	International Drive
CITY	Durham
ZIP	27712
STATE	North Carolina
PRODUCTION TYPE	TRL 4-5 Pilot
TECHNOLOGY	Fuel Synthesis
RAW MATERIAL	Lignocellulosics, municipal wastes, syngas
INPUT 1	Cellulosics, municipal wastes, syngas (4 t/d)
OUTPUT 1	FT liquids (0.002 t/y)
OUTPUT 2	Mixed alcohols
OUTPUT 3	Power (electricity)
TOTAL INVESTMENT	USD 30,000,000
FUNDING	USD 20,000,000 (DOE and commercial partners)
PARTNERS	U.S. Department of Energy (DOE), commercial clients, Southern Research Institute
TECHNOLOGY BRIEF	<p>Combines thermochemical conversion (gasification), catalytic synthesis, and hot/cold syngas cleaning to produce liquid fuels. Key components:</p> <ul style="list-style-type: none"> <li>- Fluid-bed steam reformer for syngas generation.</li> <li>- Pulse combustor technology for efficient heat transfer and low emissions</li> <li>- Integration with Fischer-Tropsch (FT) synthesis for diesel/mixed alcohol production</li> <li>- Demonstrated 1,000+ hours of continuous operation</li> </ul>



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<b>KEY INNOVATIONS</b>	<ul style="list-style-type: none"><li>- Pulse combustors: Self-aspirating, no moving parts, high heat transfer efficiency</li><li>- Syngas cleaning: Removes contaminants (e.g., H<sub>2</sub>S) for downstream catalytic processes</li><li>- Scalable design: Supports distributed biorefineries using diverse feedstocks</li></ul>
<b>IMPACT</b>	Validates TRI's technology for commercial-scale biorefineries, enabling renewable diesel/SAF production from waste biomass .
<b>CONTACT INFORMATION</b>	Tim Hansen (hansen@southernresearch.org)



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CATEGORY	INFORMATION
PROJECT OWNER	West Biofuels
PROJECT NAME	LLC Thermal Reformer Synthesis West Biofuels Woodland, CA
STATUS	Operational
STARTUP	2007
LOCATION	United States
CITY	Woodland, CA
ZIP	95695
PRODUCTION TYPE	TRL 6-7 Demonstration
TECHNOLOGY	
RAW MATERIAL	Forest residues
INPUT 1	Clean wood, waste wood (5 t/d)
OUTPUT 1	FT liquids (0 t/y)
PARTNERS	University of California
TECHNOLOGY BRIEF	West Biofuels uses a dual fluidized bed thermal reforming system that breaks down biomass into its molecular components through chemical reactions brought on by high heat, oxygen and steam at low pressure.
ADDITIONAL INFORMATION	Woodland Biomass Research Center, Woodland, CA, USA: The Woodland Research Center is located approximately 20 miles northwest of Sacramento in Woodland, California. The facility was built in cooperation with the University of California to demonstrate advanced biomass conversion technologies.
CONTACT INFORMATION	Matt Summers matt.summers@westbiofuels.com



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