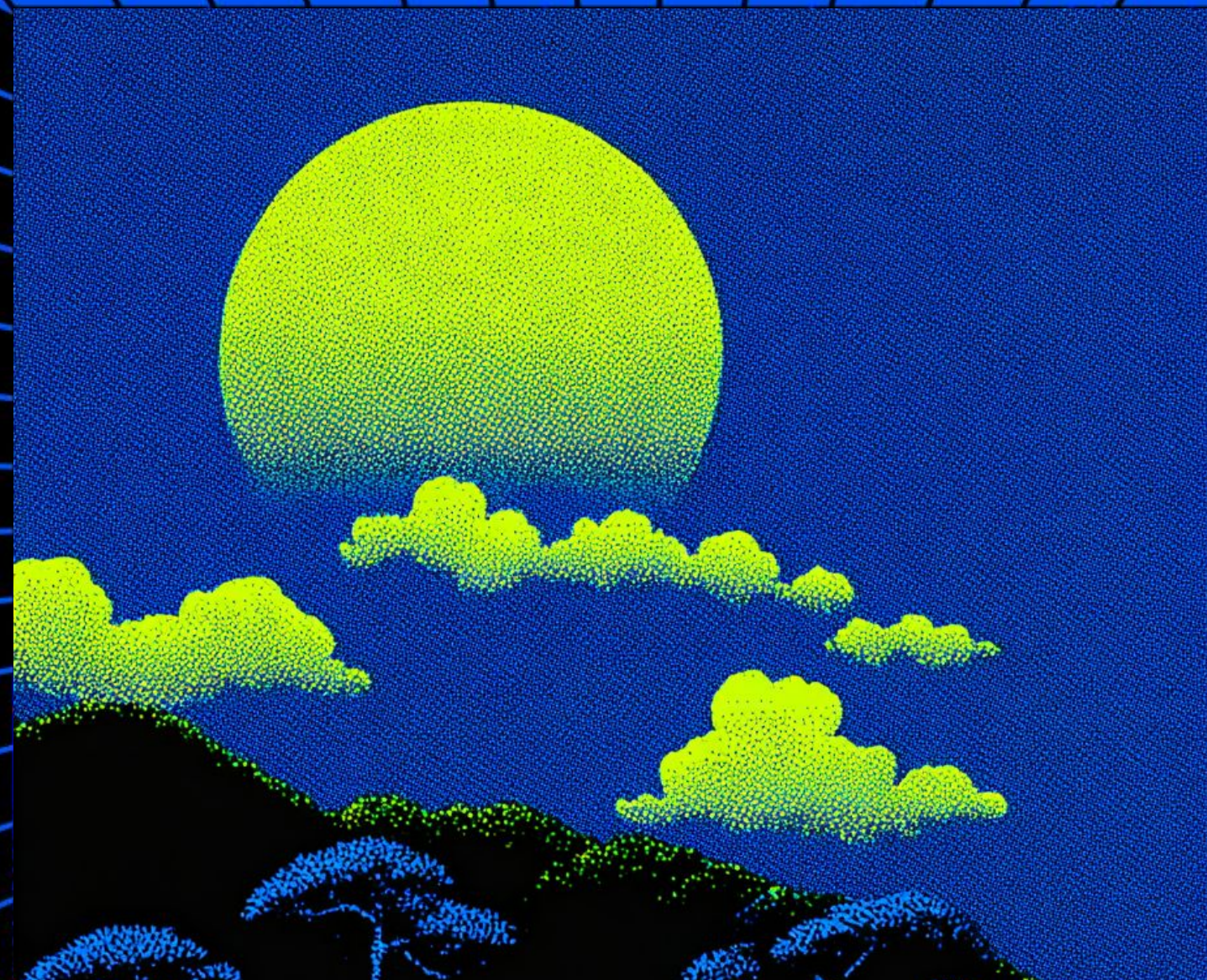


PHYSICS FOR FREEDOM:

New Technologies for
Renewable Energy



Daria Botsula



UNIVERSITÀ
DEGLI STUDI
DI UDINE



The Laboratory
on Quantitative
Sustainability



Cofinanziato
dall'Unione europea



REGIONE AUTONOMA
FRIULI VENEZIA GIULIA



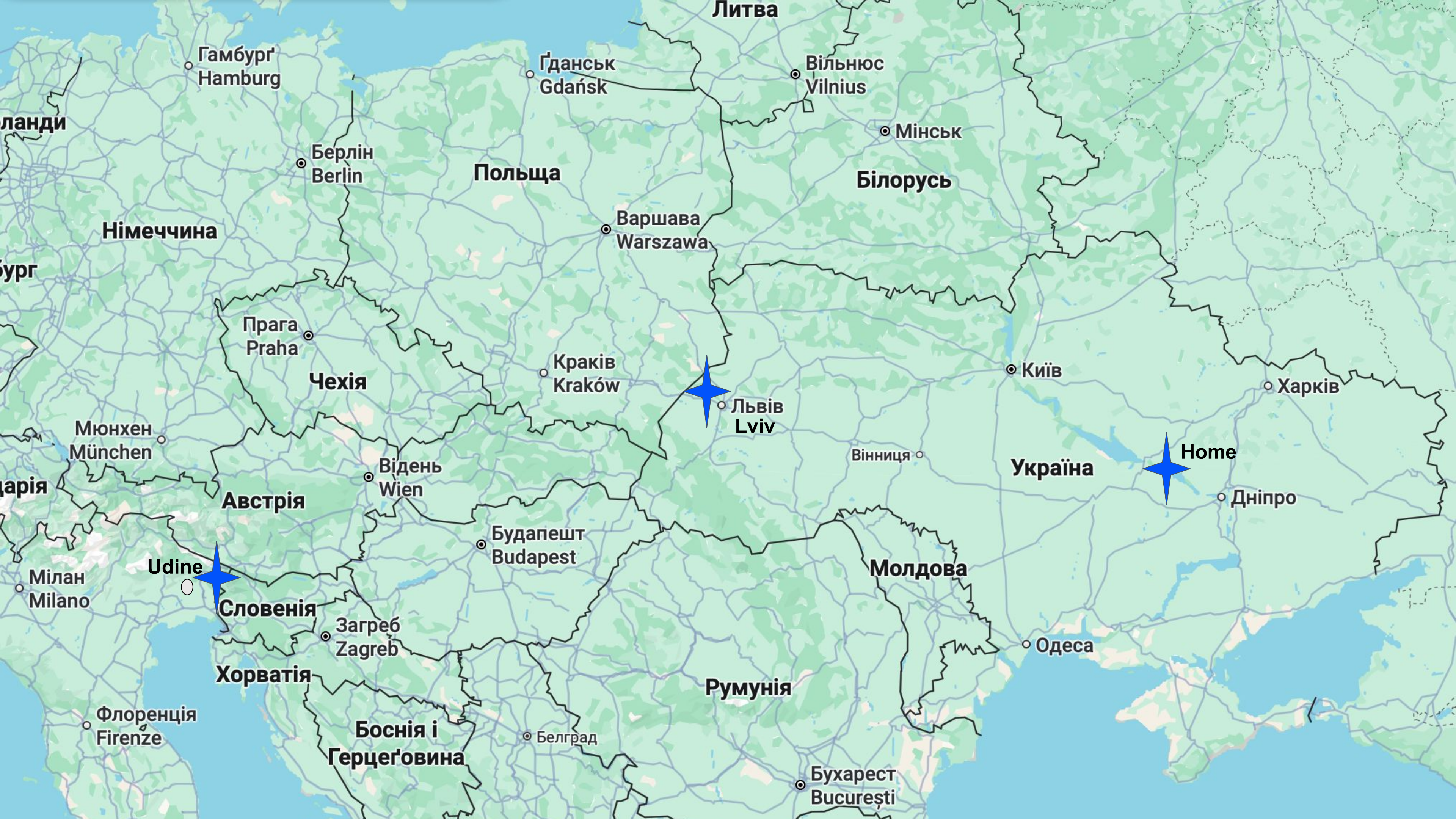
FONDAZIONE
FRIULI

IN
2026



MY JOURNEY INTO RENEWABLE ENERGY

- National University "Lviv Polytechnic"
Master's Degree
- Hydrogel Bandages and Energy-Efficient Drying
First experience working with sustainable technologies
- Today — PhD Research in Udine
Biomass Gasification and Linear Mirror Systems



Гамбург
Hamburg

Гданськ
Gdańsk

Вільнюс
Vilnius

Берлін
Berlin

Польща

Мінськ

Білорусь

Німеччина

Варшава
Warszawa

Прага
Praha

Чехія

Краків
Kraków

Львів
Lviv

Київ

Харків

Мюнхен
München

Відень
Wien

Австрія

Будапешт
Budapest

Вінниця

Україна

Home

Дніпро

Мілан
Milano

Udine

Словенія

Загреб
Zagreb

Хорватія

Молдова

Одеса

Флоренція
Firenze

Боснія і
Герцеговина

Белград

Румунія

Бухарест
București





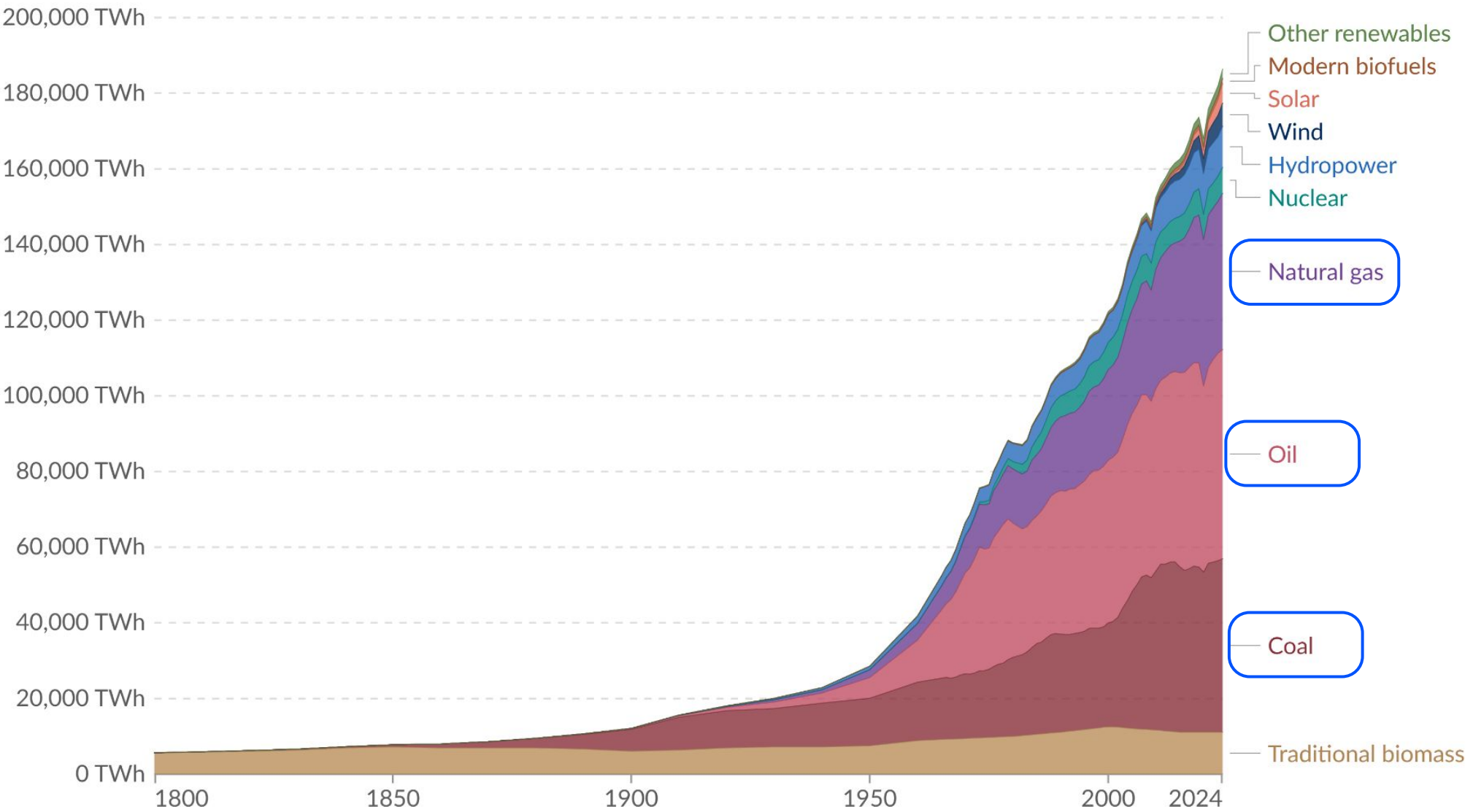
**Could this be —
A FUEL?**

GLOBAL ENERGY CONSUMPTION

Global primary energy consumption by source

Our World
in Data

Primary energy¹ is based on the substitution method² and measured in terawatt-hours³.

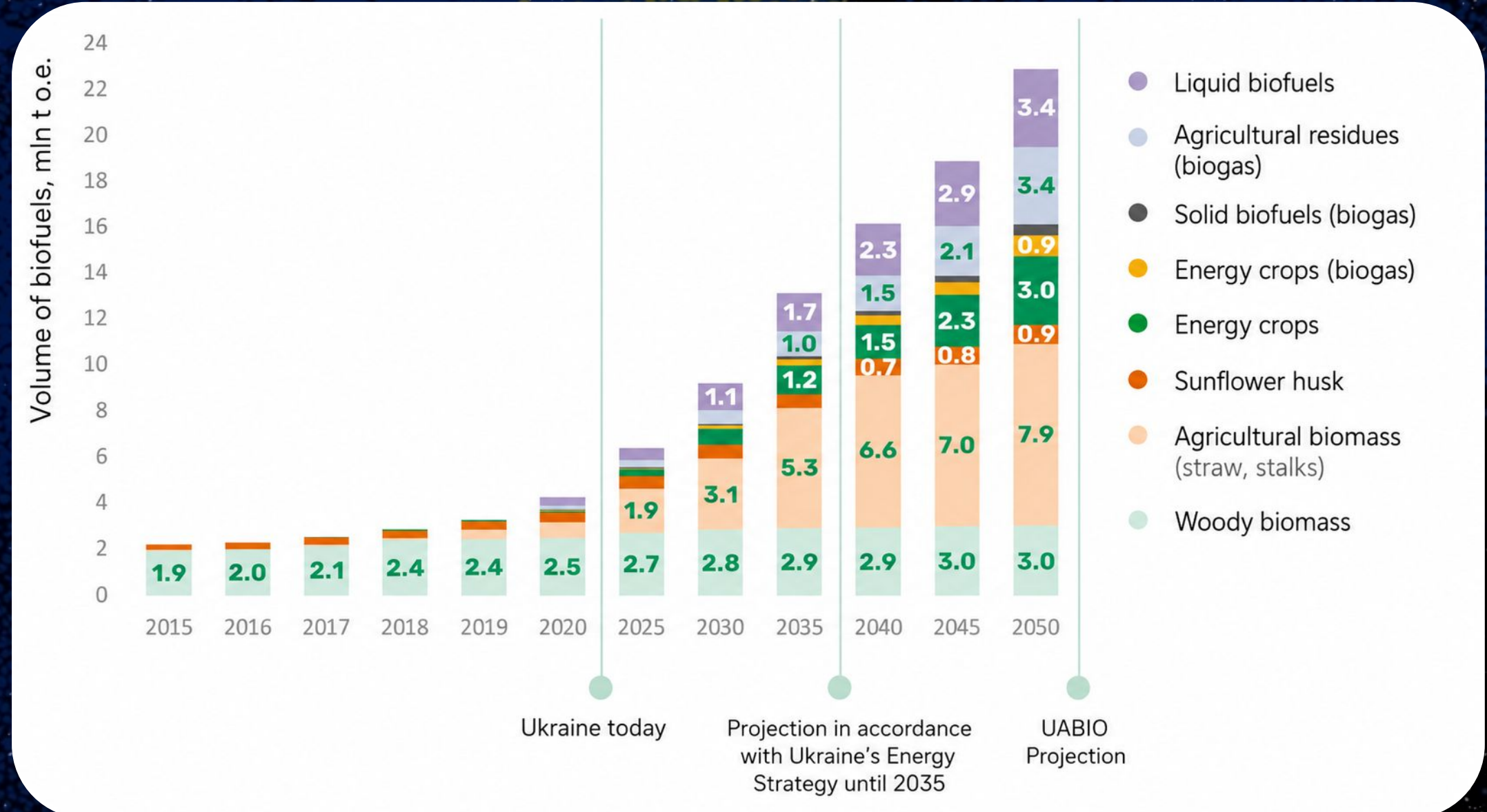


Data source: Energy Institute - Statistical Review of World Energy (2025); Smil (2017)

OurWorldinData.org/energy | CC BY

Note: In the absence of more recent data, traditional biomass is assumed constant since 2015.

THE HIDDEN ENERGY POTENTIAL OF UKRAINIAN FIELDS



<https://uabio.org/bioenergy-transition-in-ukraine>

BIOMASS POTENTIAL IN UKRAINE

~90

Mtoe

of oil
equivalent/year

Annual Energy
Consumption

[//https://stat.gov.ua/](https://stat.gov.ua/)

~23

Mtoe

of oil
equivalent/year

Estimated Biomass
Potential

[//uabio.org/bioenergy-transition-in-Ukraine/](https://uabio.org/bioenergy-transition-in-Ukraine/)





BIOMASS GASIFICATION IS

- Thermochemical conversion of biomass
- Production of fuel gas ($\text{CO} + \text{H}_2$, CH_4)
- Operating temperatures of $800\text{--}1300^\circ\text{C}$
- A process with potentially low CO_2 emissions

FROM INDUSTRIAL SYSTEM TO COMPACT SOLUTION



~3-15
M

Conventional Gasifier



Chiyoda Corporation, Japan



150
CM

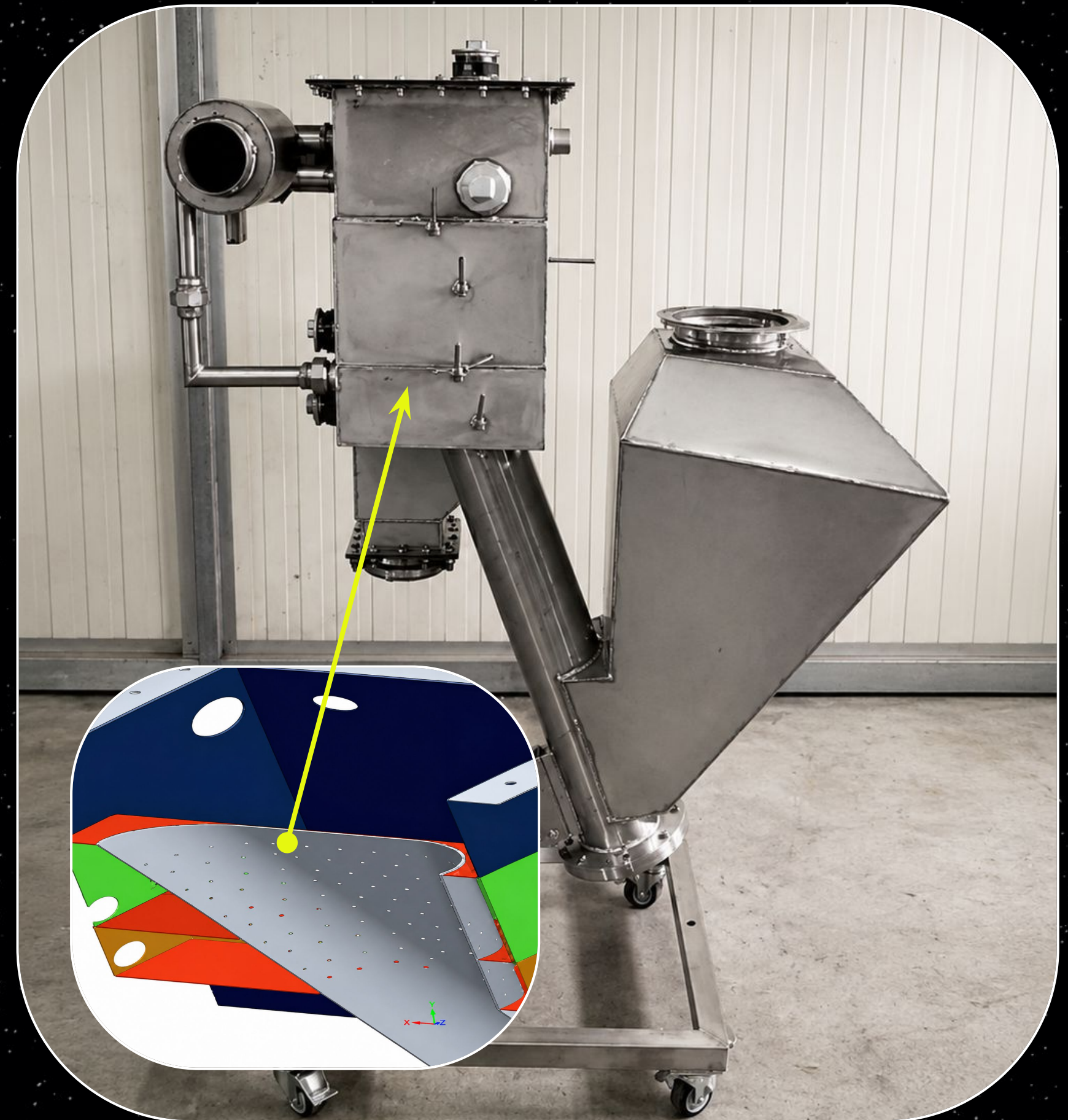
New Prototype



University of Udine, Italy

GASIFIER OPERATION PRINCIPLE

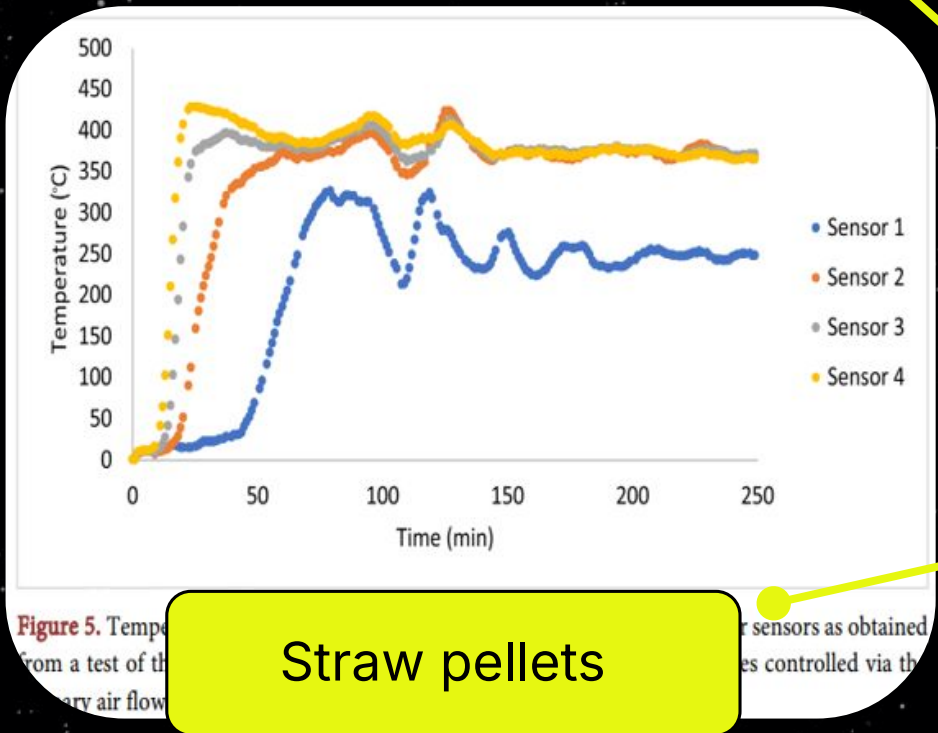
- Compact reactor design (150cm)
- ~100 small air injection ports
- Automated process control
- Temperature monitoring in different reactor zones



GASIFIER TESTING RESULTS



Wood pellets

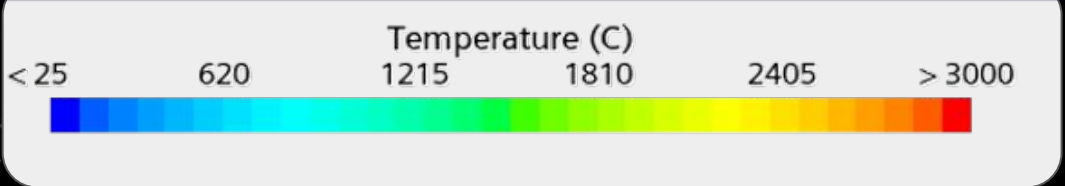
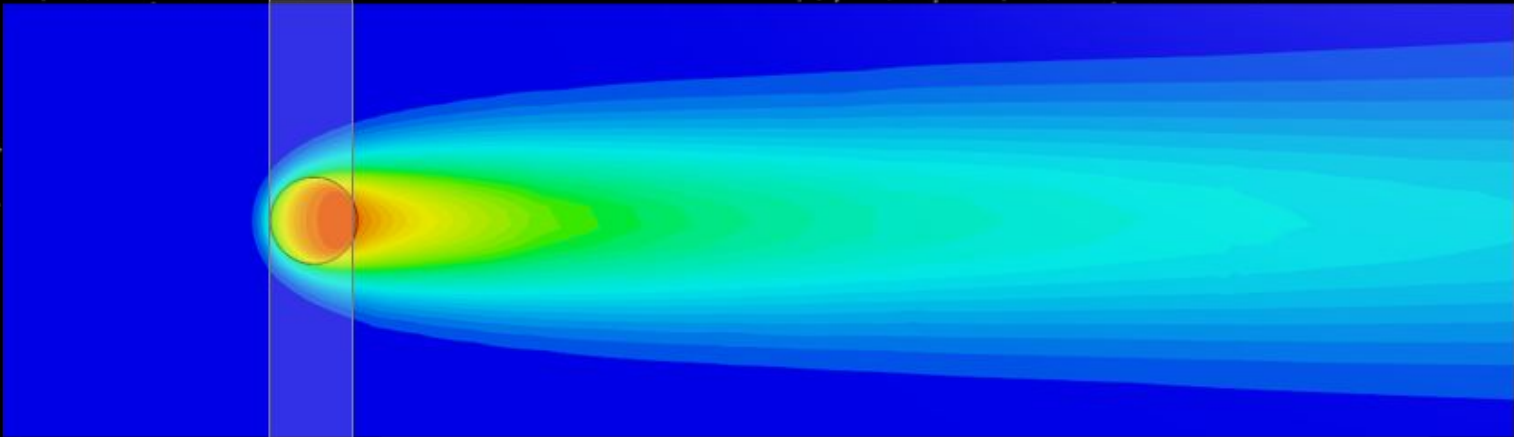
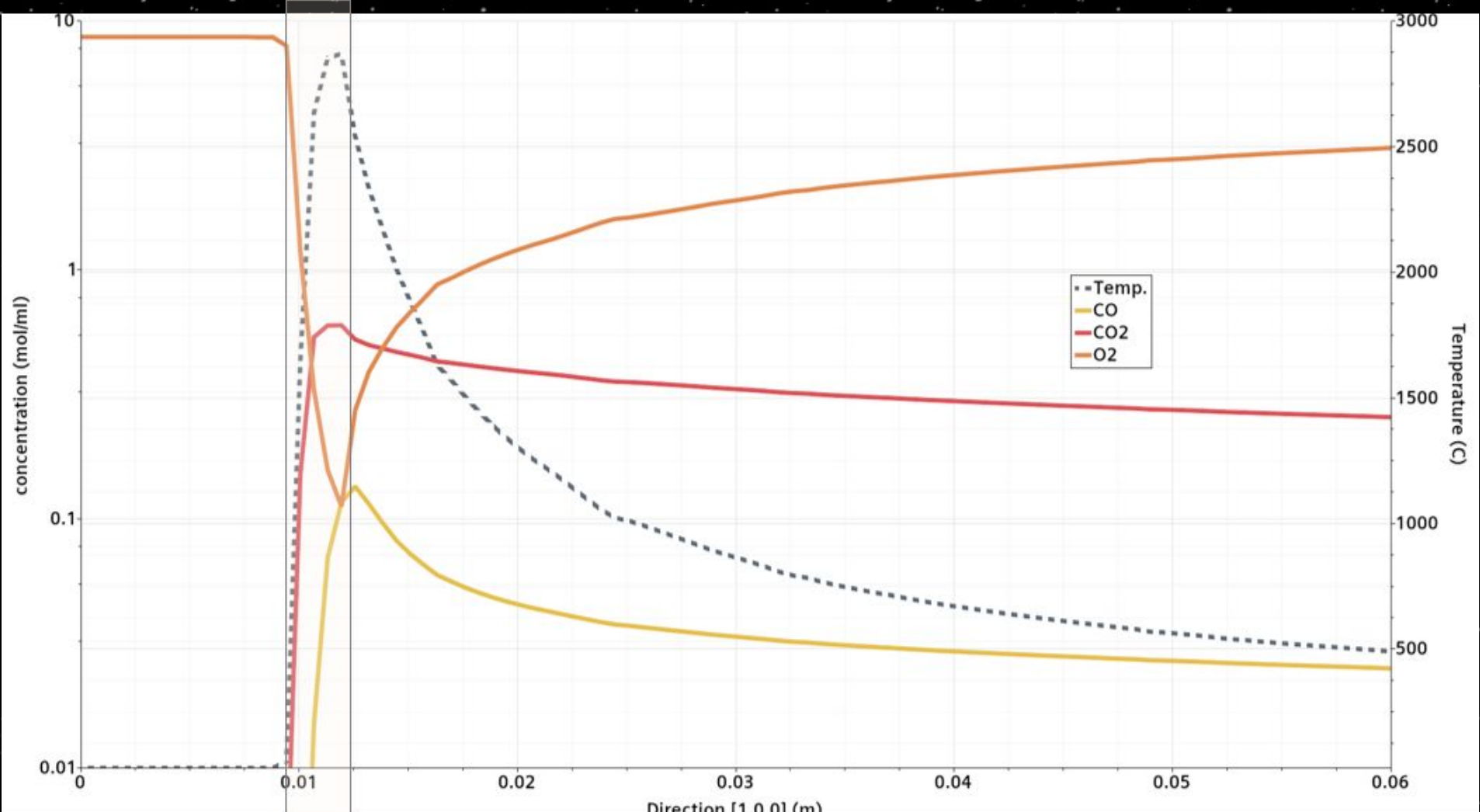


Straw pellets

Gasification occurs even at temperatures as low as 400°C

Temperature	CO ₂	CO	H ₂	CH ₄
Conventional Gasifier	22%	14%	14%	4%
800°C	13%	18%	14%	2%
400°C	12%	16%	12%	2%

NUMERICAL MODELING RESULTS



LINEAR MIRROR

The system concentrates solar energy and converts it into heat

- Automatic solar tracking
- Hot air temperature up to $\sim 200^{\circ}\text{C}$
- Thermal power output of 9kW
- Autonomous system operation





System based on three
simple motors



Testing of different biomass
types



Biomass drying using hot
air

Practical Application of
Linear Mirror Technology in
Italy Since 2014



PHYSICS FOR PEACE

- Up to 20 million tonnes of gas per year can be produced from Ukrainian biomass
- International collaboration and technology transfer
- Energy independence
- Scientific research with real-world impact



CONTACTS

+380986198778

daria.2907.botsula@gmail.com

Linkedin - Daria Botsula

marina.cobal@uniud.it

hans.grassmann@uniud.it