Defining the value of bioenergy system services for accelerating the integration of bioenergy into a low-carbon economy

IEA Bioenergy
Technology Collaboration Programme

www.task44.ieabioenergy.com

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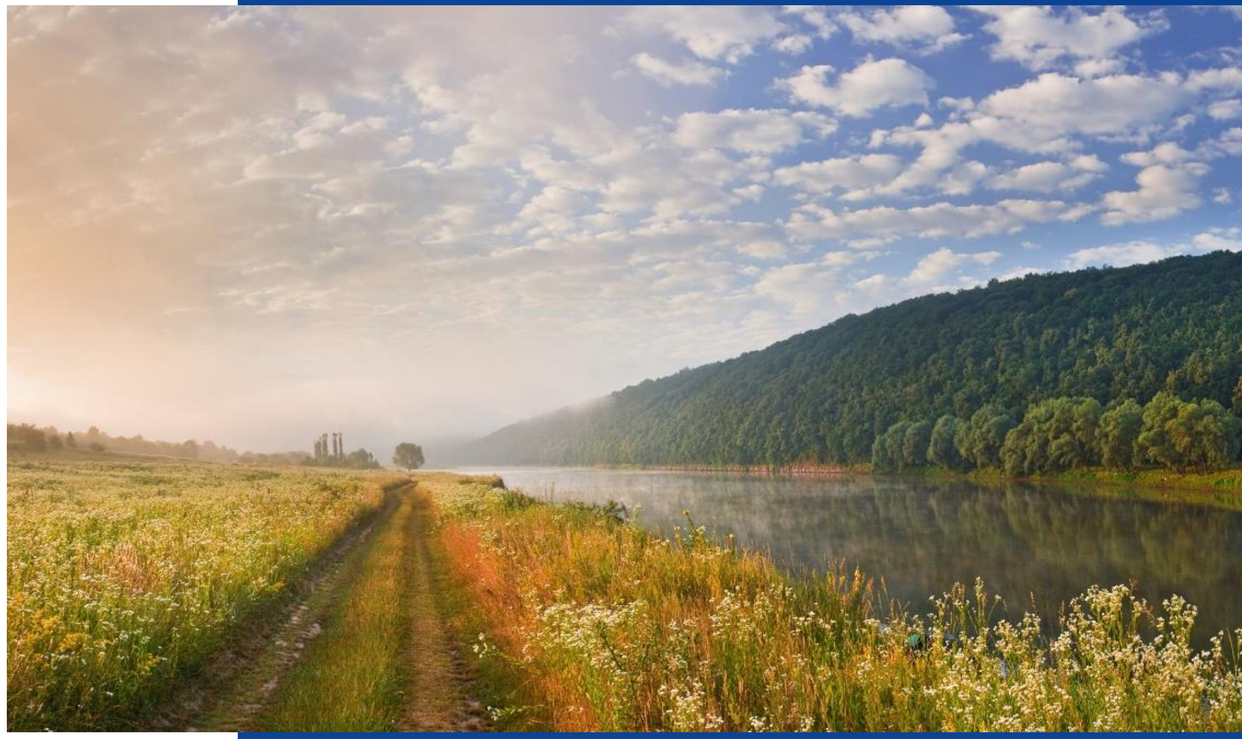
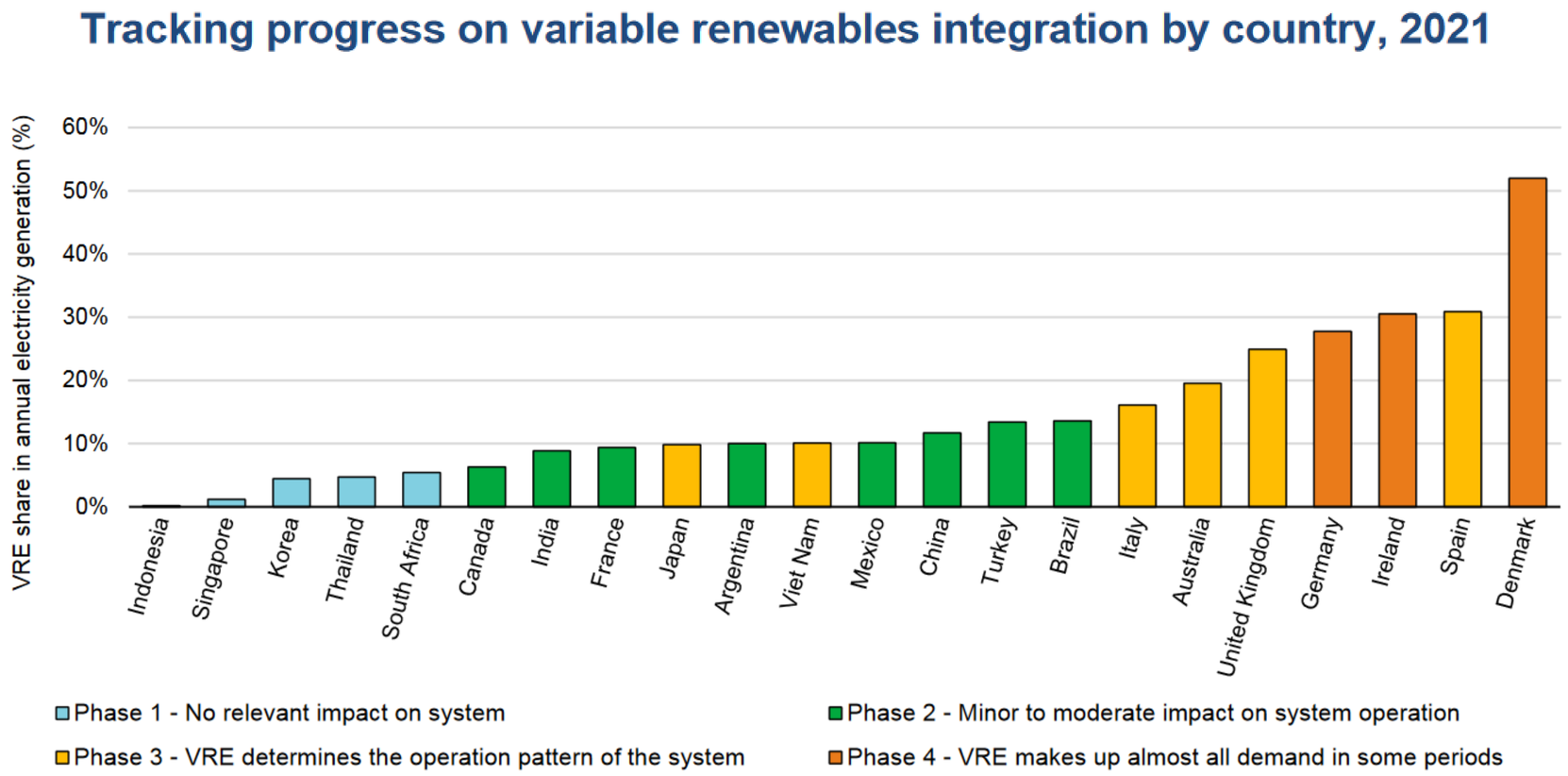


EUBCE
31st European Biomass Conference & Exhibition
IN PERSON, ONLINE
Bologna 2023

5 – 8 June | Conference & Exhibition
9 June | Technical Tours

VRE deployment phases in selected countries



Phases are characterized by integration challenges related to technical, regulatory, market and institutional aspects.

IEA. Managing Seasonal and Interannual Variability of Renewables. (2023).

Expectations on the role of bioenergy in the energy system

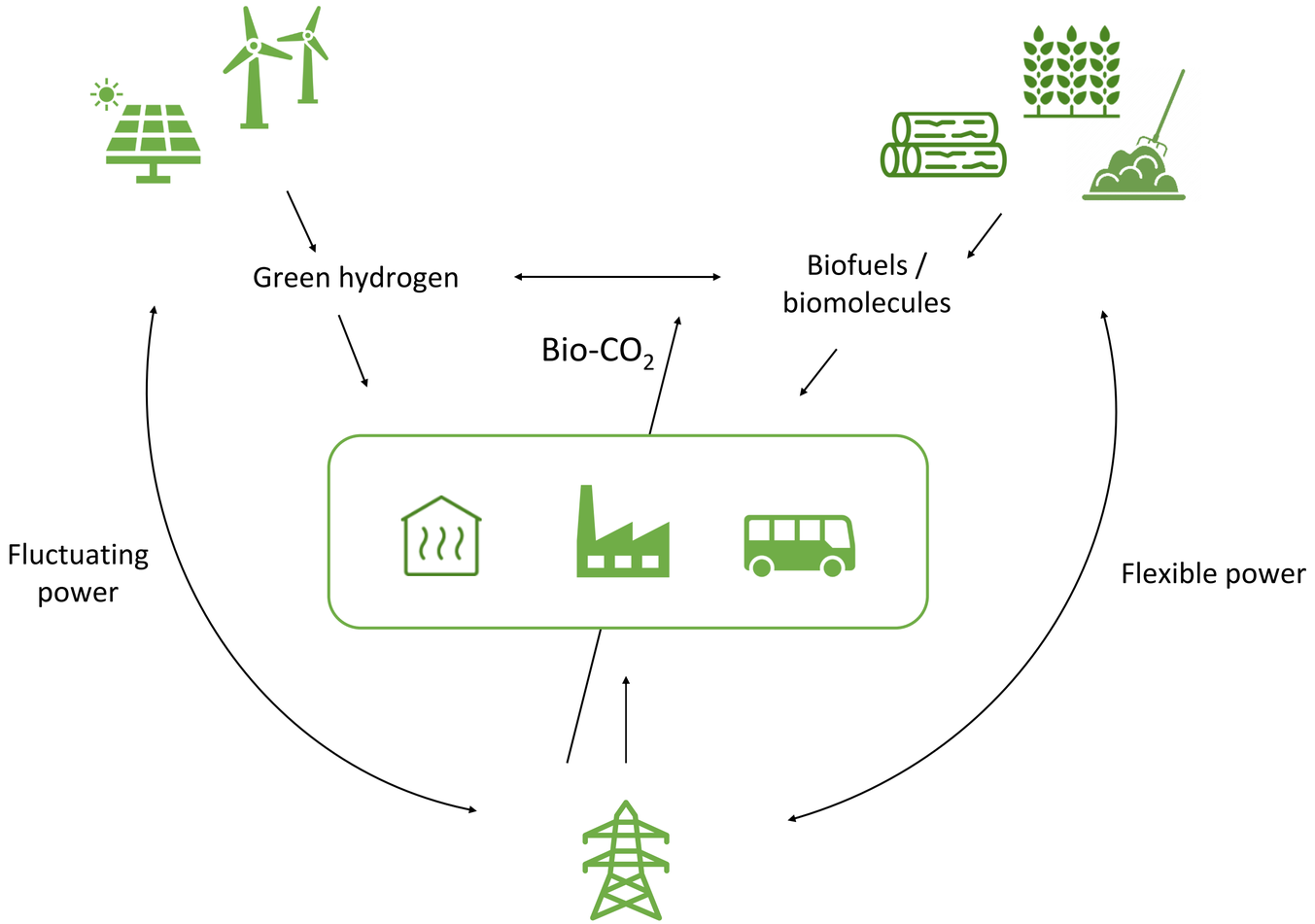


Figure modified from Thrän, D. Presentation at IEA Bioenergy triannual conference (Task 44 session), 2021.

What is flexible bioenergy?

IEA Bioenergy Task 44 definition

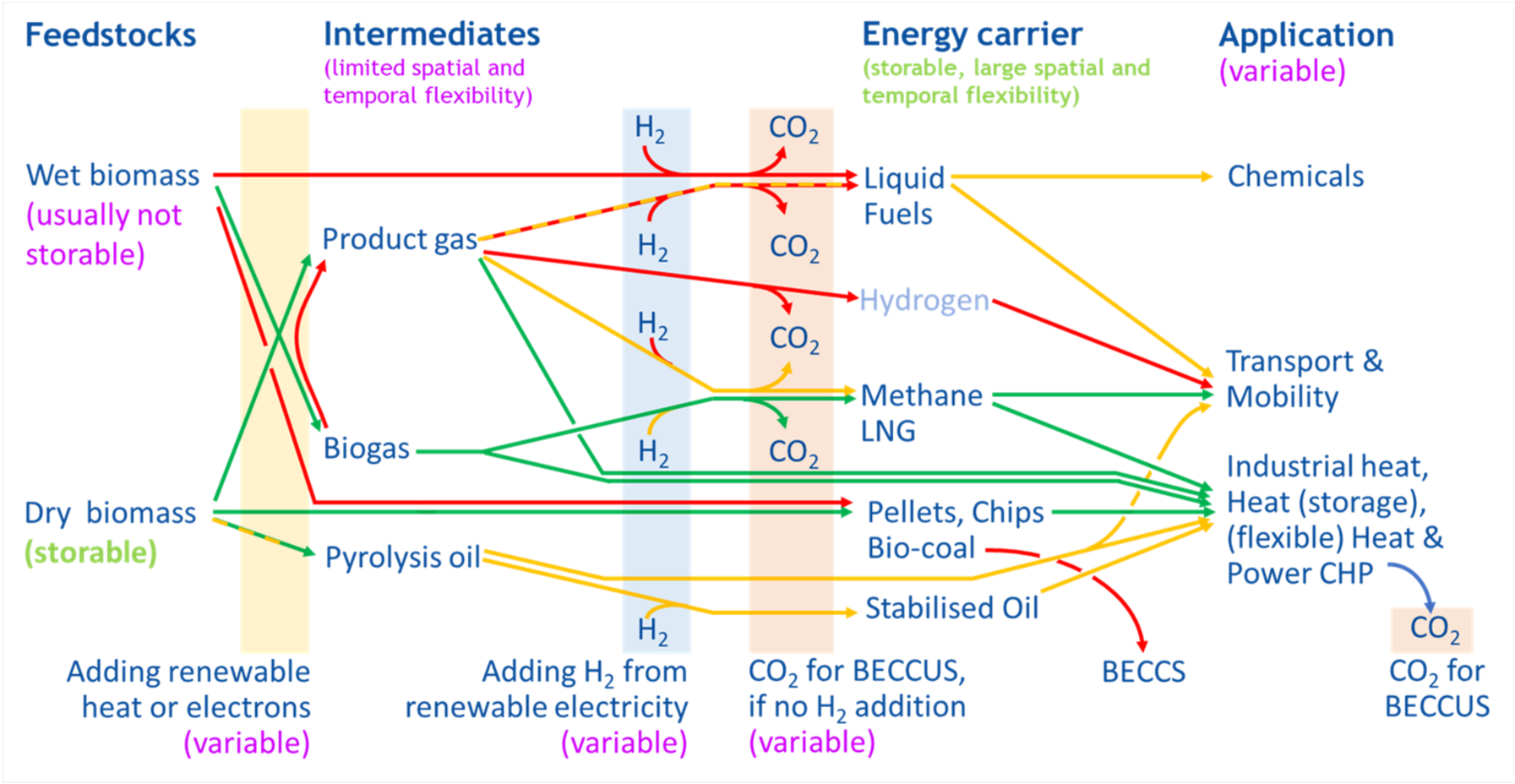
"Flexible bioenergy is defined as a bioenergy system than can provide multiple services and benefits to the energy system under varying operating conditions and/or loads."

"Examples of flexible bioenergy include:

- technologies and concepts providing grid stability for a power system with large amounts of variable wind and solar energy;
- dispatchable production of energy and other products according to market demand;
- integrated polygeneration systems combining the production of heat, power, fuels and/or chemicals;
- long-term storage options such as biofuels and biochemicals; or
- ancillary services to support system reliability."

Source: IEA Bioenergy Task 44 – Flexible Bioenergy and System Integration

Pathways for flexible bioenergy



— **Technology already applied**

— **Technology demonstrated technically, but does not yet have a working business case**

— **Technology under development**

Schildhauer, T. et al. (2021.) Technologies for Flexible Bioenergy. IEA Bioenergy Task 44. Updated version.

Best Practices – Practical examples of successful implementation

E-gas plant in Werlte, Germany
(Figure: e-gas GmbH)

Vantaa Energy's Power-to-Gas integrated with Waste-to-Energy, Finland (Figure: Vantaa Energy)

IEA Bioenergy Task 44. Best Practices.
https://task44.ieabioenergy.com/best-practices/

Liquid Wind's e-methanol production facility, Sweden
(Figure: Övik Energi)

Wood-based CHP with biochar production for negative emissions, Frauenfeld, Switzerland
(Figure: Carbonfuture)

Valorization of system services from sustainable bioenergy

… to support the transition towards a low-carbon energy system and economy

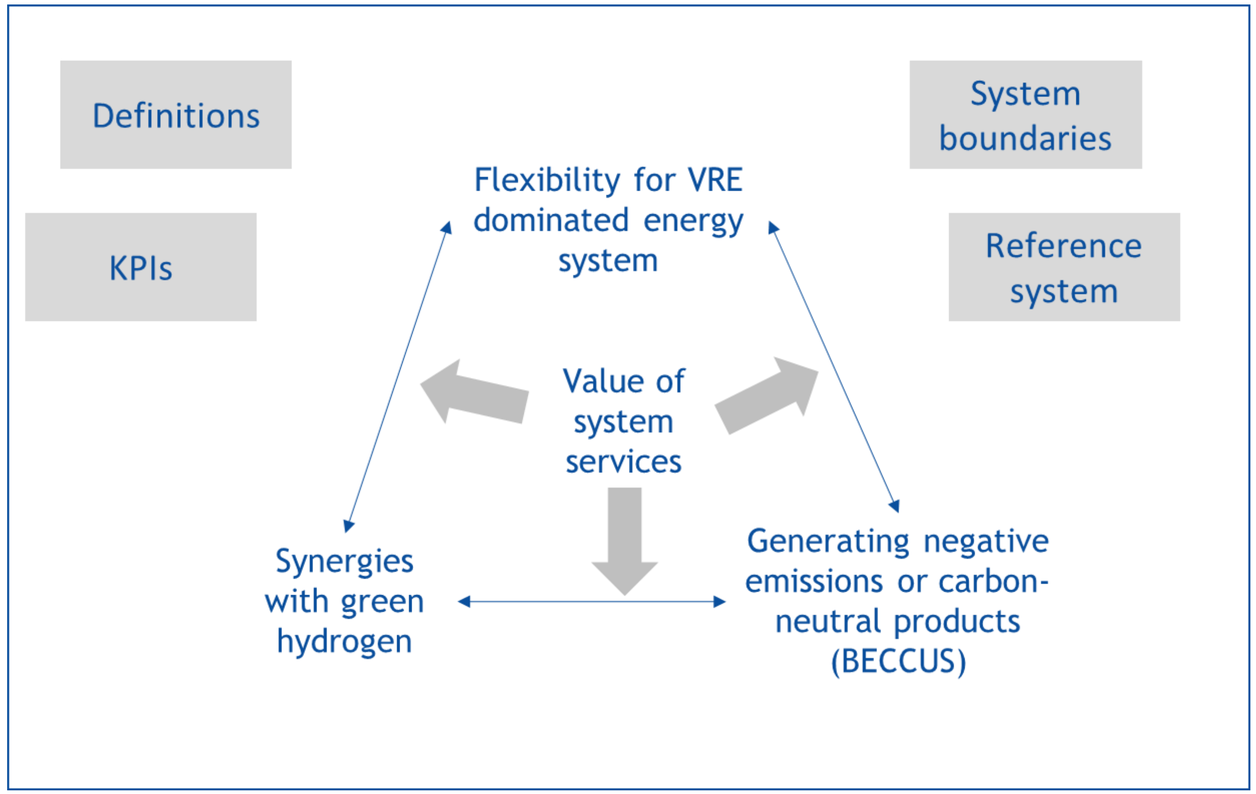


Figure: IEA Bioenergy Task 44

Challenge 1: What are the relations – or ideally synergies – between different system services?

Challenge 2: How to define the value of system services?

- Which indicators to use?
- Qualitative vs. quantitative?

Challenge 3: How to balance/optimize between different system services?

- Which type of value to optimize (e.g., CO_2 emissions mitigation potential)?

Target: Identify the most beneficial uses and roles of the individual bioenergy system services, i.e., where and when they can create the most value for the low-carbon energy system and economy.

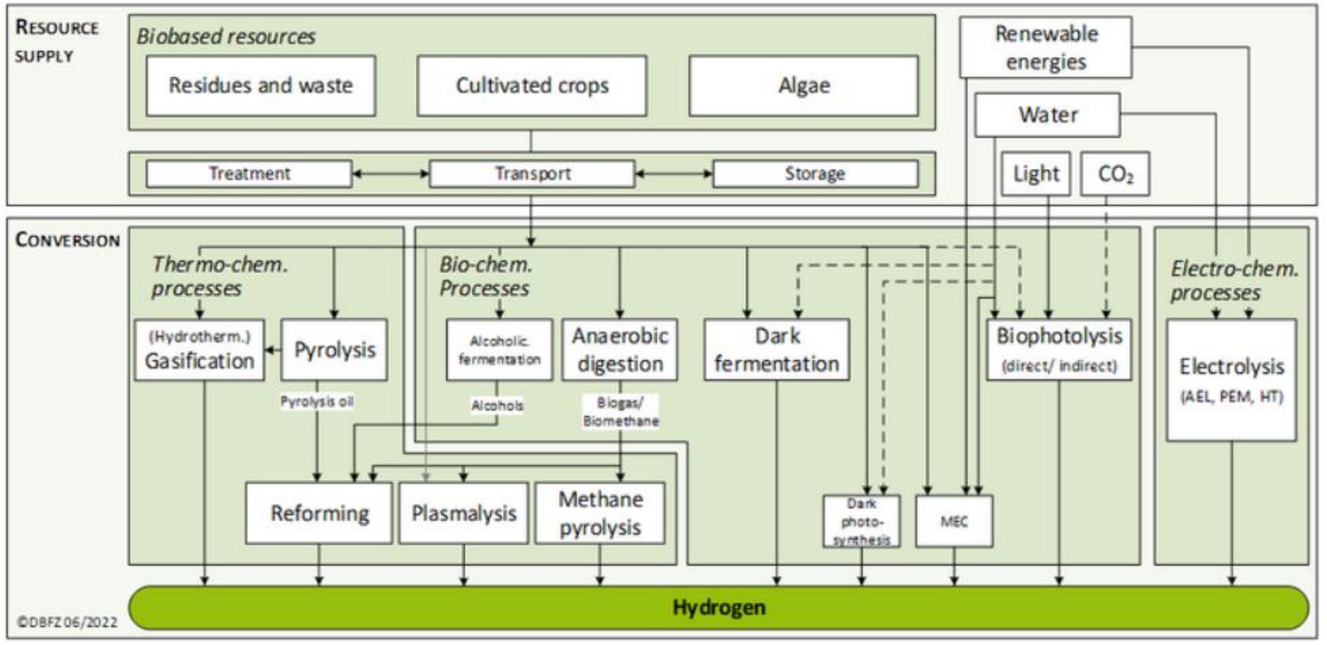
Examples of Synergies of green hydrogen and bio-based value chains deployment

Green hydrogen use in bio-based processes

- Different process pathways can benefit to variable extent from green hydrogen supply
- There are different options for green hydrogen integration in bio-based value chains:
  - Addition to gasification of biomass and to fuel synthesis
  - Addition to hydro-pyrolysis process
  - Hydro-treatment of bio-oils
  - Enabling BECCU

Dahmen, N. (2023). Case studies on green hydrogen in bio-based processes. Presentation at expert workshop 'Deployment perspective of green hydrogen from biomass and green hydrogen use in bio-based processes'.

Green hydrogen from biomass



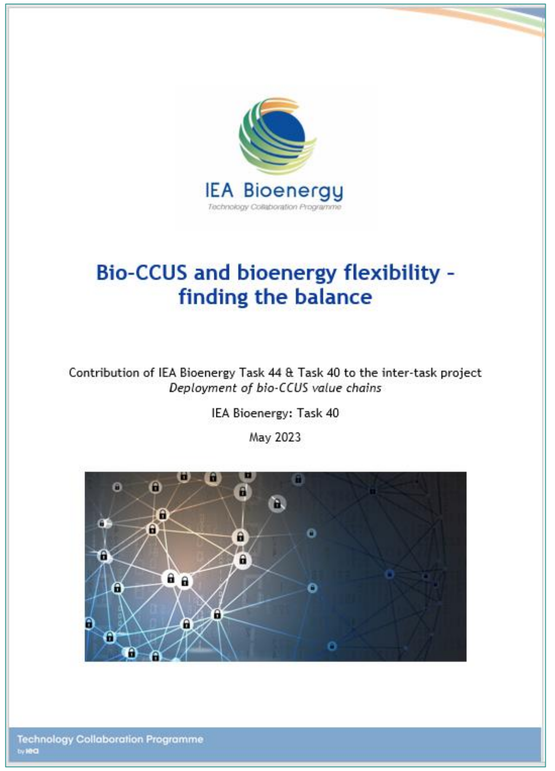
Rutz, D. et al. (2023). Renewable Hydrogen - Opportunities, limitations and threats of hydrogen for the energy transition in Europe. Position Paper of ETIP RHC and ETIP Bioenergy.

Example of relation between system services – Flexible bioenergy and BECCUS

Questions to be addressed

1. Where and how do bio-CCUS and flexibility interact in bio-based value chains and what are the implications for the (bio)energy system?
2. How the implementation of bio-CCUS solutions in different sectors can be combined with different forms of bioenergy flexibility?

→ Initial considerations show that implementing the two within a bioenergy installation is possible from a technological point of view. However, utilizing their full system service capacities (at the same time) might be limited due to different desired modi of operandi of bioenergy installations.



Hennig, C. (2021). Bio-CCS and bioenergy flexibility – Finding the balance.
Presentation at IEA Bioenergy triannual conference, 2021.

Key take-aways

- Flexibility enables integration of variable renewable energy – in the power sector (ramping up and down) and beyond – adding benefits to the energy system level
- Flexibility is reality and provides dedicated system services in different roles – depending on the energy mixes and strategies in different countries
- However, system services are hardly yet valued in terms of their energy and climate system benefits
- System services and their interlinkages need to be further explored
- To unlock the potential of flexible bioenergy we need:
    1. Clear definition for flexible bioenergy
    2. Multiplication of Best Practices
    3. Technology development
    4. Policy and market conditions
    5. Comprehensive picture of the role in the energy system
    6. Appropriate consideration in long-term energy system planning

IEA Bioenergy Task 44 Flexible Bioenergy and System Integration

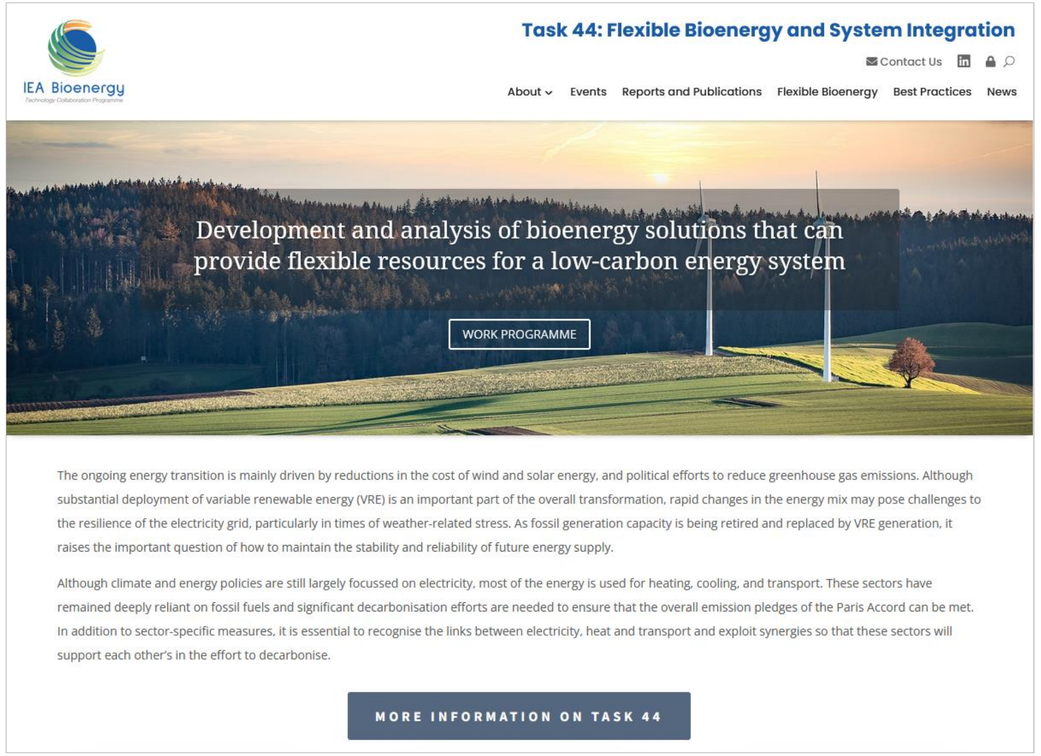
The objective is to improve understanding on flexible bioenergy and its future role, and identification of barriers and future development needs in the context of the entire energy system.

Our key topics (2022-2024)

- Flexible bioenergy **concepts** for supporting low-carbon energy systems
- Flexible bioenergy **integration in energy systems**
- Acceleration of **implementation**
- **Synergies** with green hydrogen and BECCUS value chains

Members

Austria, European Commission, Finland, Germany, Ireland, The Netherlands, Sweden, Switzerland, USA



More information: https://task44.ieabioenergy.com/

Discuss about flexible bioenergy:
https://www.linkedin.com/groups/13682476/

Thank you

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