



IEA Bioenergy
Technology Collaboration Programme



Task 44 System Integration & Flexibility Maturation process over 3 Triennia

first presented at Task44 meeting in Lulea
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The IEA Bioenergy Technology Collaboration Programme (TCP) is organised under the auspices of the International Energy Agency (IEA) but is functionally and legally autonomous. Views, findings and publications of the IEA Bioenergy TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

Maturation of Task44

2017 - Conceptualisation

2019 - 2021 - Triennium #1 - Proving feasibility

2022 - 2024 - Triennium #2 - Developing capacities

2025 - 2027 - Triennium #3 - „System tests“ (TRL language)

2028 - Reliable key enabler for flexible bioenergy integrators

2017 Conceptualization - supporting PV and Wind power

IEA Bioenergy

Flexibility from bioenergy - The role of bioenergy in balancing the electricity grid and providing storage options

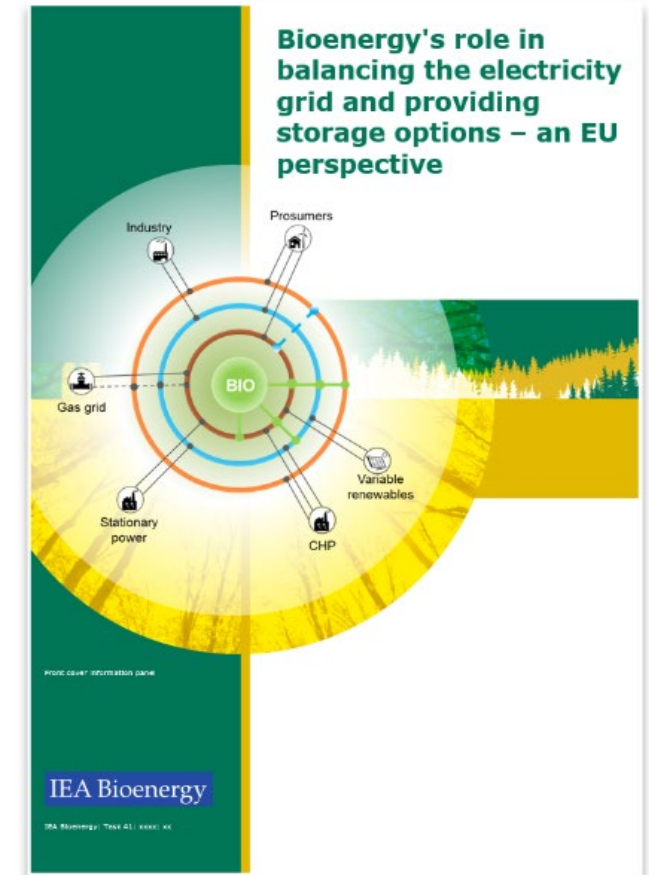


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Co-authors: David Chiaramonti, Juha Kiviluoma, Eric van den Heuvel, Lars Waldheim, Kyriakos Maniatis, Kai Sipilä



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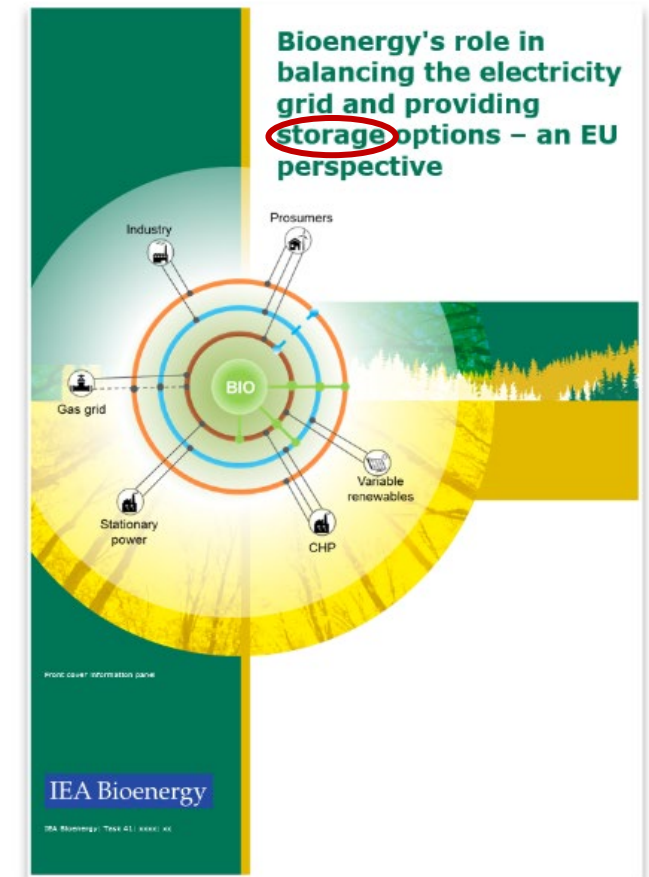


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2019 - 2021 - Triennium #1 - Proving feasibility

Expectation and implementation of flexible bioenergy in different countries

IEA Bioenergy: Task 44
March 2021

→ Discussion opener:

How do different country experts scope T44 topics ?
(How) do they recognize the need for flexibility ?
What opportunities do they see ?
What barriers have to be overcome ?
Scanning for instrumental policies ..

Technologies for Flexible Bioenergy

IEA Bioenergy: Task 44
August 2021

→ Knowledge structuring:

How exactly can BE technologies provide flexibility ?
Which parameters are relevant to measure flex. ?
Which TRL levels are we talking about ?
How to describe their systemic contributions ?

→ Starting coherent narrative formulation:

First definition recommendations for flexible BE.
Summarizing policy and market conditions.
First monitoring recommendations.
Adaptation recommendations for existing tech.
First recommendations for long-term planning.



2022 - 2024 - Triennium #2 - Developing capacities

- ✓ Since 2019 - 20+ reports, policy briefs, workshops, and questionnaires analysis – **10 countries flexibilizing**
<https://task44.ieabioenergy.com/iea-publications/>
- ✓ Initiation and coordination of inter-task projects and inter-TCP activities – **Task44 focusing on integration**
 - > [Synergies of green hydrogen and bioenergy](#) - Inter-TCP project with IEA HQ
 - > BECCUS – Inter-TCP involving all IEAB Tasks
 - > [Energy Technology Systems Analysis Program](#) - Joint Workshop exploring how to model flex. BE integration
 - > Bioeconomy Synergies across energy, materials, and food – Integration beyond electricity
 - > Inter-TCP Coordination Group on flexibility – Successful lobbying to think about integration beyond power
 - > Inter-TCP Coordination Group on thermal networks – Showing the relevance of flex. BE for heating
- ✓ Scientific publications including technology, policy, market and literature review on flexible bioenergy, value discussion and simulations, definitions, - **scientific careers around the topic of flexibility & integration**
<https://doi.org/10.1016/j.rser.2022.112094> (Schipfer, Mäki, Schmieder, Lange, Schildhauer, Hennig, Thrän)
<https://doi.org/10.1002/bbb.2649> (Mäki, Hennig, Thrän, Lange, Schildhauer, Schipfer)
<https://doi.org/10.1186/s13705-024-00461-4> (Schipfer, Burli, Fritsche, Hennig, Proskurina et al.)
<https://doi.org/10.1016/j.erss.2025.104505> (Schipfer, Kraxner, Thrän, Aliabadi, et al.)
<https://dx.doi.org/10.2139/ssrn.6439058> (Gutjahr, Thrän, Aliabadi)
- ✓ 12+ Best Practices on diverse integration and flexibilization aspects – **real world examples on T44 relevance**
<https://task44.ieabioenergy.com/best-practices/>
- ✓ Participation in innovative communication formats – IEA Bioenergy Review 2024 Blog – **IEAB relevance**
<https://www.ieabioenergyreview.org/>

2025 - 2027 - Triennium #3 - „System tests“ (TRL language)

**No simple repetition but
demonstrating reproducibility, building on and expanding previous successes**

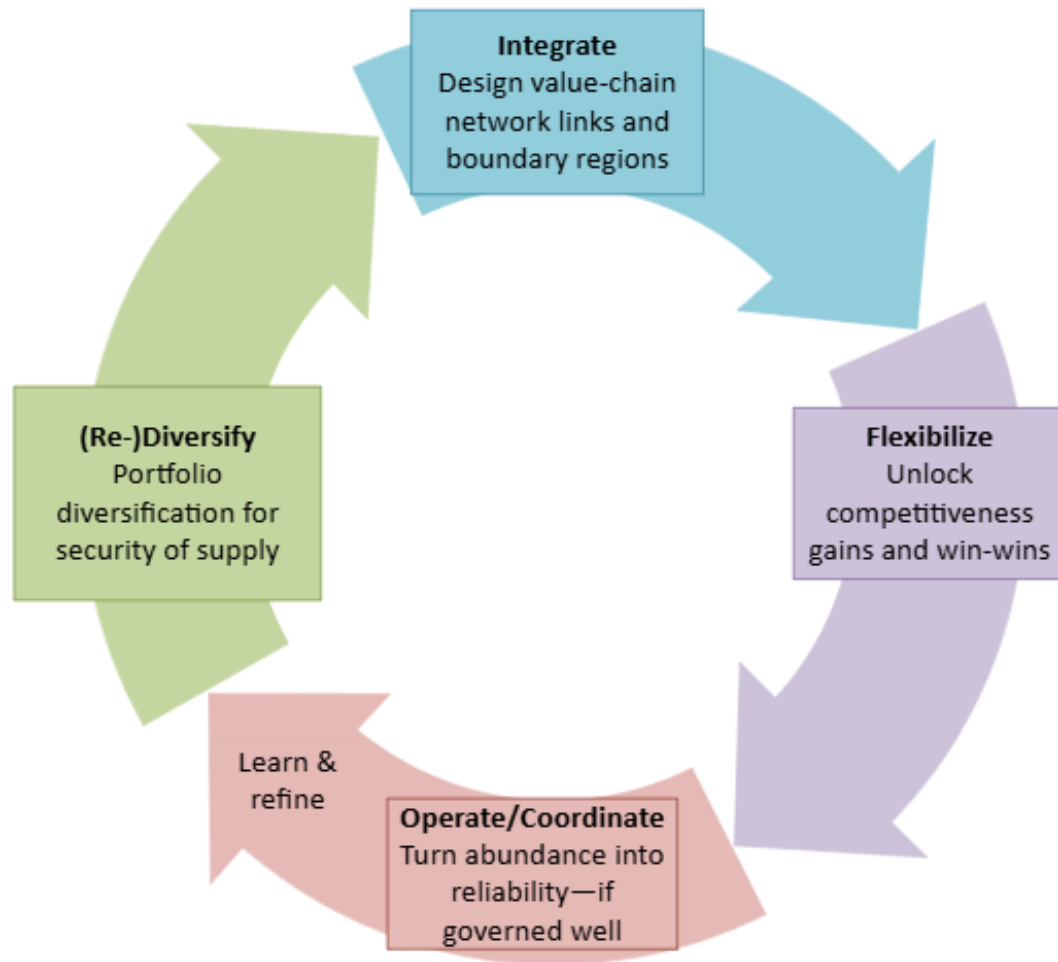
- ☐ Proving Task44 relevance for the transformation of the electricity system and beyond:
 - ☐ Cost-reduction study quantifying systemic added value
 - ☐ Automation of integrated heat and power systems
 - ☐ Applying T44 experience to start the discussion on flexible chemicals and BECCUS
 - ☐ Servicing the IEA Bioenergy with strategic projects, inter-task integration support
- ☐ Delivering more explicit and interoperable guidance:
 - ☐ Re-focusing best practices on integration, storage, and flexibilization aspects
 - ☐ Re-focusing policy discussions on integration, storage, and flexibilization aspects
 - ☐ „Drop-in“ products for modellers, automation practitioners,
 - ☐ Creating narratives to support integrators – clearly delineating the scope

2025 - 2027 - Triennium #3 - „System tests“ (TRL language)

Task44 canvas draft v20261304

Audience • IEA Bioenergy community • IEA community & inter-TCPs • Member countries • Policy makers • Industry • Researchers • Public	Relevance / Problem / Needs > stagnating value discussion ? > more pain than gain to de-silo ? > best way for BE to support trafo ? > electrification or biologisation ? > decided to integrate – what now ? > value lost through complexity reduction ? > fearing complexity and complexification	Task44 contributions > shifting to integration value > gains demonstration > diversification for resilience > both, but smart hybridization > automatization & coordination > guiding complexity reduction > integration threats & benefits
Selected insights 1. Integration leads to flexibility 2. Flexibility is only an ability 3. Only flex. coordination creates value 4. Missing studies and metrics for BE resilience contributions 5. Missing links process <> system 6. Uncertainty awareness needed 7. Biases inhibiting balanced threats & benefits discussion	Task44 Unique Selling Proposition <u>Diversification > Integration</u> <u>> Flexibilization > Coordination</u> Turning bioenergy's complexity into coordination capacity under uncertainty - bridging processes and operation with systems and strategy.	Next steps 1. T44 Deliverables distributed 2. Efficient Del. implementation 3. Finalizing all Del. in 2027 4. In the meanwhile plan for continuation or next phase

A framework rooted in systems & process engineering



A clear narrative guiding bioenergy integration and flexibilization.

Revealing implementation challenges and risks.

Enabling unique and transformative benefits - sustainability security.

Backed by fundamental research in a leading future making institution.

<https://iiasa.ac.at/models-tools-data/siia>

2028 - Reliable key enabler to flexible bioenergy integrators - 10 years Task44

- Triennium #4 (2028 - 2030) proposal drafting starts now
- Inter-Task proposals drafting starts now
- What to prioritize ? Whats most relevant to member countries ?
- New activities ? Additional resources needed ?
- Key partners to be recruited, key partnerships ?
- Task title refinement, updating definitions and glossary ?
- Other or additional vehicles to explicit IEA Bioenergy Task ?