TECHNISCHE UNIVERSITÄT WIEN

A techno-economic catalogue for system flexibilization

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Concurrent session 66: Energy System Modeling

Energy Economics Group

Variable renewable electricity (VRE) production

IEA's "Six phases of system integration"

- Phase 1: No relevant impact on system integration
- Phase 2: Drawing on existing system flexibility
- Phase 3: Investing in flexibility
- Phase 4: Requiring adv. technologies to ensure reliability
- Phase 5: VRE surplus from days to weeks
- Phase 6: Seasonal or inter-annual surpluses of VRE

Source: https://www.iea.org/topics/system-integration-of-renewables

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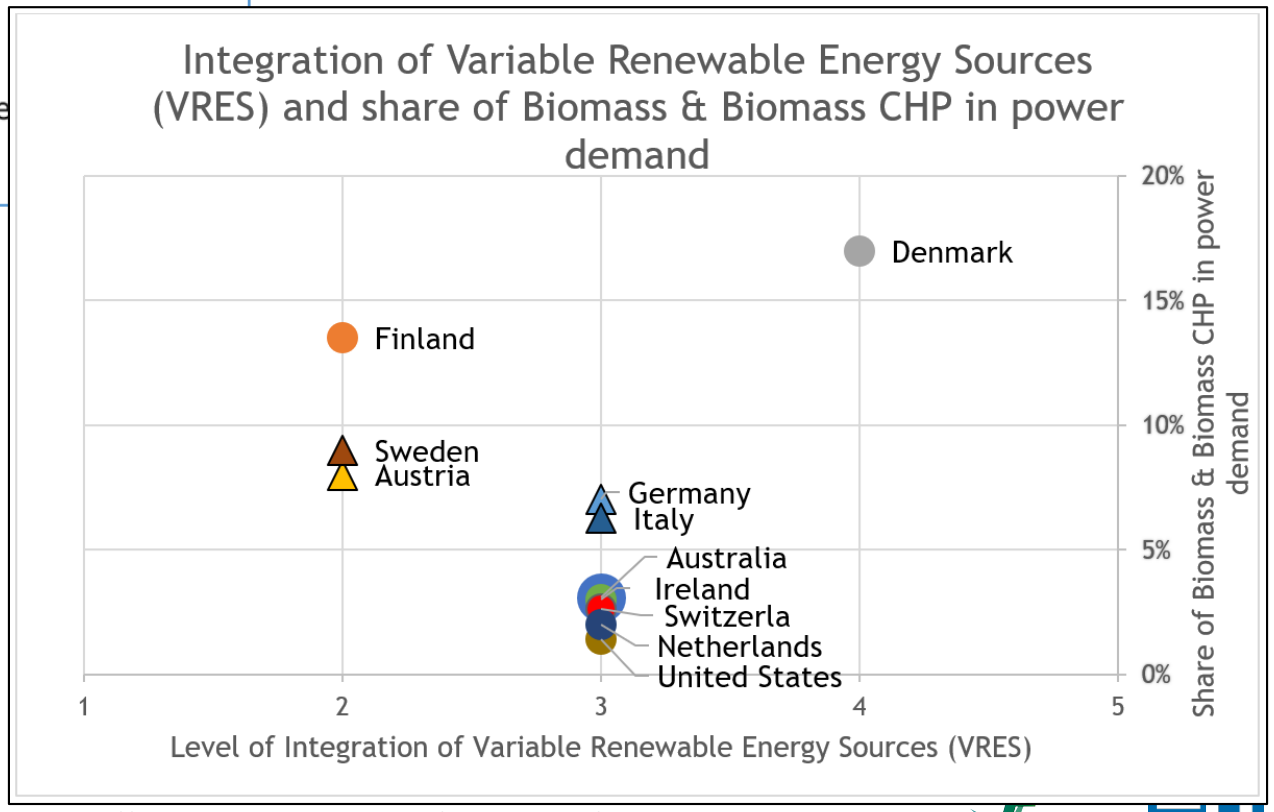
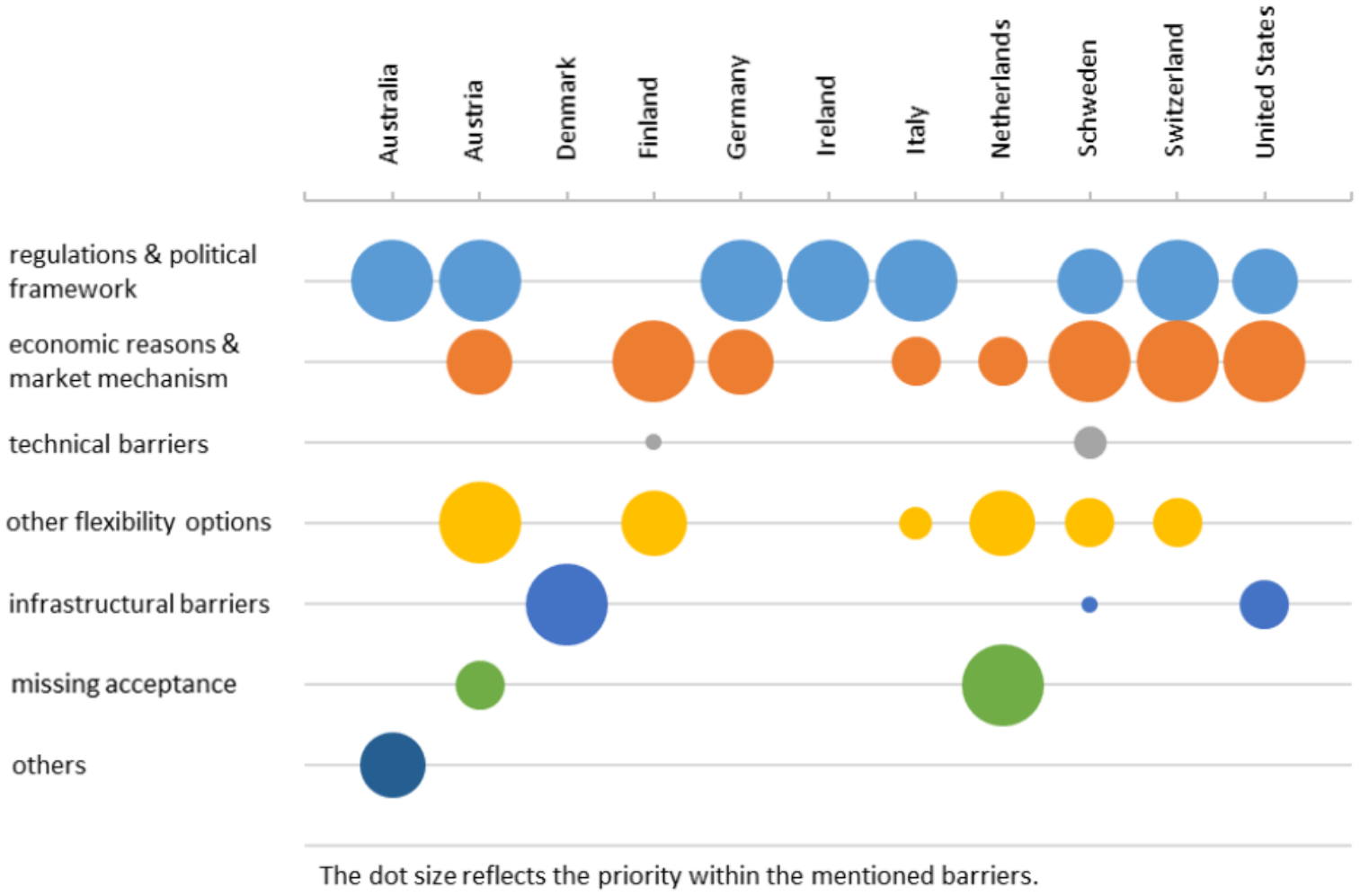


Source: https://task44.ieabioenergy.com/publications/bioenergexpectation-and-implementation-of-flexible-y-in-different-countries-2021/

Weighted barriers for the implementation of flexible bioenergy (country-specific)



Country-specific presentation of the categorised barriers.
The larger the coloured circle, the more relevant the barrier is. The different colours represent the barrier categories
Source: Thrän et al. 2021.
https://task44.ieabioenergy.com/wp-content/uploads/sites/12/2021/04/IEA-Task-44-report-Expectation-and-implementation-of-flexible-bioenergy-in-different-countries.pdf

Hypothesis and research question

1. We will need all available sustainable flexibility options to enable further integration of VREs.

2. Regulatory and economic barriers are high for flexible bioenergy options

3. → understanding of potential benefits of flexible bioenergy must be low.

4. What are the potential benefits of flexible bioenergy and how can they be valorized?

Definition and context

Flexible Bioenergy

IEA Bioenergy
Technology Collaboration Programme

https://task44.ieabioenergy.com/flexible-bioenergy/

"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.

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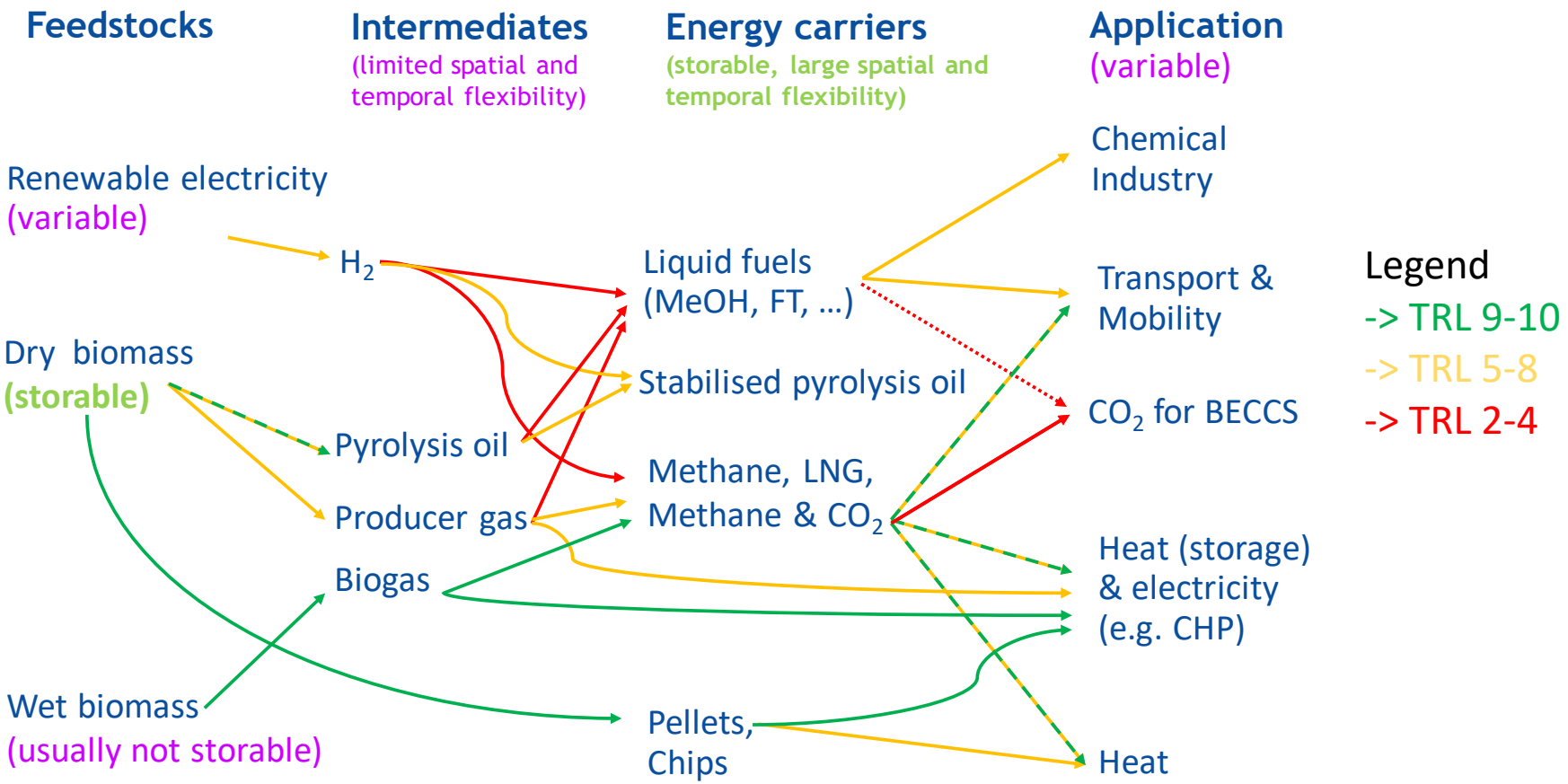
Non bioenergy alternatives – a selection:

Grid expansion, demand-response management (smart-meters, heat capacities, e-fuels production …), curtailment, batteries, pumped hydro-, ….

Bioenergy provides flexibility throughout supply chains



TRLs are estimated on the case studies and installations as well as R&D needs, experiences and expectations and business cases collected for the report.

Techno-economic catalogue for IAMs
Selected parameters & metrics - overview:

Feedstock	**Intermediary**	**Positive and negative ancillary services**	**Bioeconomy services**
Seasonal occurrence	Energy density	Ramp-rate capacity	CHP-parameters
Spatial availability	Bio- stability	Provision capacity (power & energy)	Chemicals properties
Residues' main product props.	Structural stability	Ramp duration	Applicability for ind. heat
Ecosystem services impact	Self-ignition risk	Functions to describe frequency constraints	Applicability for BECCUS
	Existing infrastructure		Nutrients

+ Economic parameters (cost, prices, supply & demand potentials), environmental and socio-economic parameters for different supply chain links or supply network nodes & edges

Conclusions and recommendations

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- Flexible bioenergy on a component/firm-level mostly added-costs w/o support; added-value provided only via the overall system integration

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- Thus, a thorough Integration in IAMs and system models to show added-value is necessary, BUT the following “extensions” have to be considered:
  - longer-term flexibility (seasonality, storage) contribution to the power sector
  - the contribution to the overall energy system beyond electricity (esp. residential and industrial heat)
  - as well as to the broader bioeconomy and its goals (incl. ecosystem services) have to be taken into account

Flexible Bioenergy

Flexibility can be defined from different perspectives, such as from system, process or component level perspective. Bioenergy and system integration covers multiple different dimensions of flexibility, including temporal and spatial flexibility, feedstock flexibility, operational flexibility, flexibility in the use of bioenergy and end-product flexibility. Task 44 has defined flexible bioenergy as following:

"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.

https://task44.ieabioenergy.com/flexible-bioenergy/

Thank you for your attention!

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Orig. Photo: Patrick Stargardt