

AGRIVOLTAICS - INTRODUCTION

International Solar Energy Society



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Fraunhofer Institute for Solar Energy Systems ISE

Moritz Gajewski

Research Assistant Agrivoltaic

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- www.ise.fraunhofer.com
- moritz.gajewski@ise.fraunhofer.de

Examples of Integrated Photovoltaics



What is agrivoltaics?

Definitions, Classifications, and Standards of Agrivoltaics

“Agrivoltaics is co-developing the same area of land for both solar photovoltaic power as well as for agriculture.” (Wikipedia)

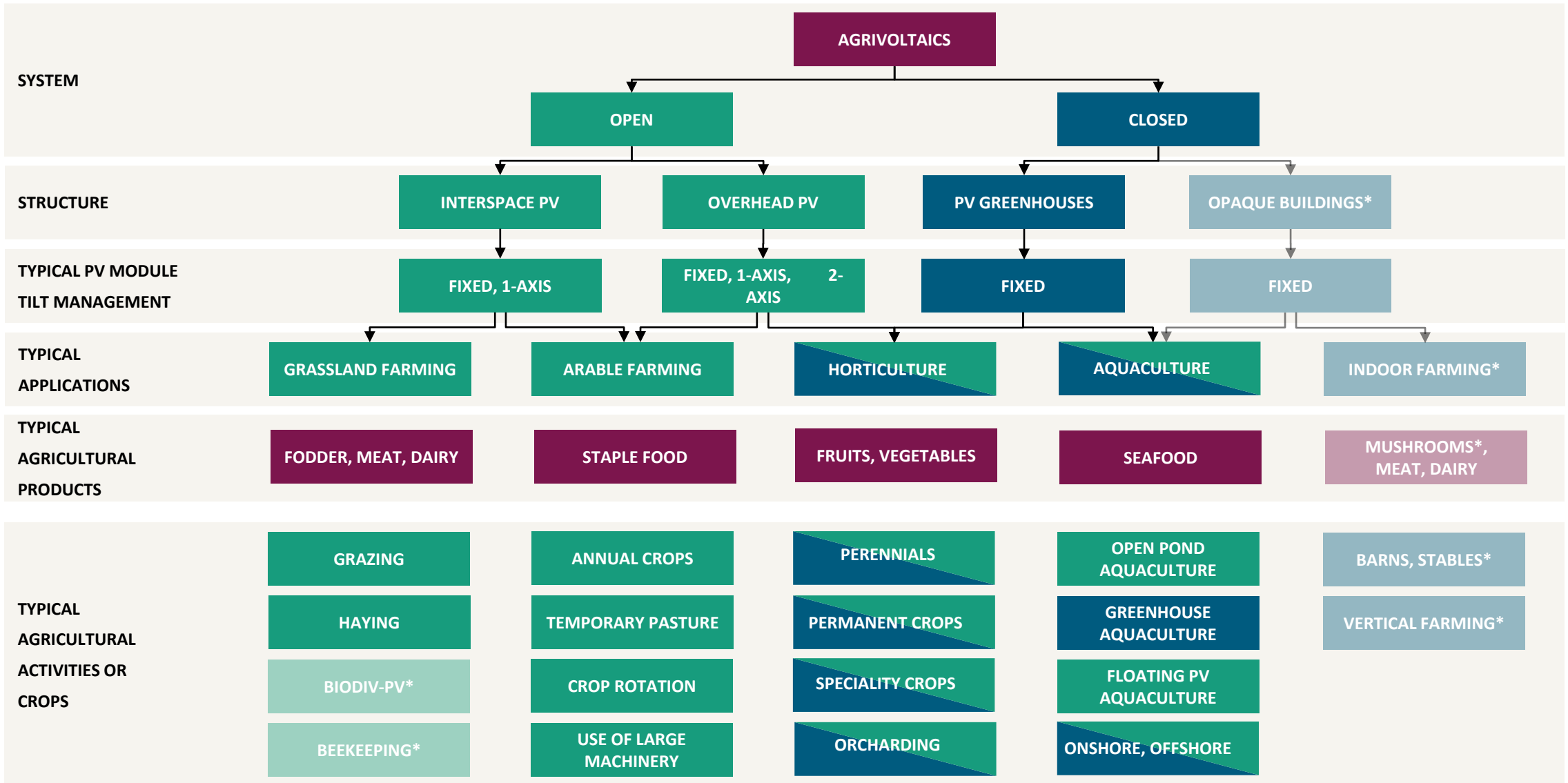
Definitions, Classifications, and Standards of Agrivoltaics

Photosynthesis as a Criterion for Agrivoltaics

- Japan: Term “solar sharing” suggests that agricultural production in agrivoltaics relies on direct solar insolation
- Fraunhofer ISE: “Agrivoltaics is a combined use of an area for agricultural crop production (photosynthesis) and PV electricity production (photovoltaics).”

Classification of Agrivoltaic Systems

CLASSIFICATION



* Typically not considered as agrivoltaics

Definitions, Classifications, and Standards of Agrivoltaics

Diversity of Agrivoltaics



APV Obstbau

Project duration: April 2020 – April 2025

Topic: Field trials on 8 different apple cultivars

Installed capacity: 250 kWp

Budget: ca. 1,5 Mio Euro



APV Heggelbach

Project duration: March 2015 – Juli 2021

Topic: Field trials on clover grass, potatoe, winter wheat and celeriac

Installed capacity: 194 kWp

Budget: ca. 3,5 Mio Euro

Definitions, Classifications, and Standards of Agrivoltaics

Diversity of Agrivoltaics

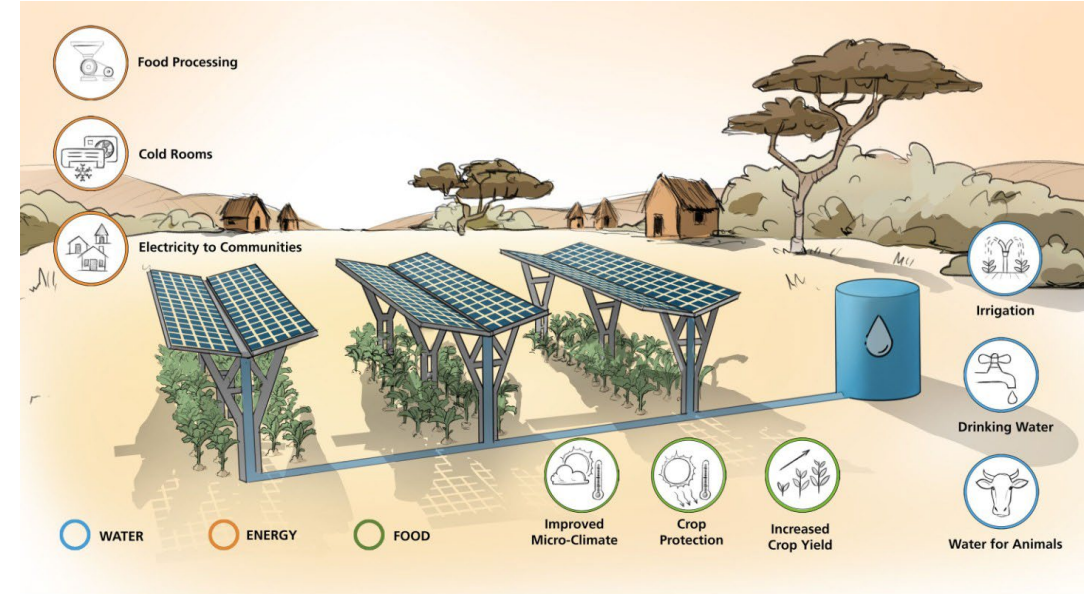


APV 2.0

Project duration: January 2020 – December 2021 (extension to 2025)

Topic: plant response to apv systems, optimized tracking, and regional economic potential in Strukturwandel

Approach: Development of custom tracking system and control algorithm coupled with digital twins of photosynthesis, radiation, and PV yield



APV MaGa

Project duration: August 2020 – Juli 2023

Topic: Rainwater harvest systems, socio-economic barriers, WEF-nexus

Budget: ca. 1,9 Mio Euro

Installed capacity (5 prototypes): 4x50 kWp, 1x150 kWp

Definitions, Classifications, and Standards of Agrivoltaics

German DIN SPEC 91434: New German Standard for Agrivoltaics

Definition of agrivoltaics according to DIN SPEC 91434

“Agrivoltaics is the combined use of the same land area for agricultural production as the primary use and for electricity PV production as the secondary use.”

Definitions, Classifications, and Standards of Agrivoltaics

German DIN SPEC 91434

Key Facts

- Published on 16. April 2021
- Process according to preliminary standard (SPEC PAS) of the German Institute for Standardization (DIN)
- 15 partners in the consortium, most from PV sector, only 3 from agriculture sector
- Lead: Fraunhofer ISE and University of Hohenheim
- Main goal: Set requirements for primary agricultural use to assure quality of agrivoltaics

Definitions, Classifications, and Standards of Agrivoltaics

German DIN SPEC 91434

Core Requirements & Criteria

- Agricultural yield of at least 66% of the reference yield
- Agricultural use of the land must be guaranteed
- Land loss after installation of system maximum 10% (Cat. I) or 15% (Cat. II)
- Avoid soil erosion and damage (construction, anchoring, and water management)
- Dismantling must be possible without any larger damages to soil and constructional residues



Definitions, Classifications, and Standards of Agrivoltaics

German DIN SPEC 91434

Category I – Overhead PV

| Agrivoltaic System | Use | Example |
|---|--|--|
| Category I: Vertical clearance >2,1m | 1A: Permanent and multi-year crops | Fruits, berries, viticulture, hops |
| | 1B: Single-year und long-term crops | Arable crops, vegetables, alternating grassland, fodder |
| | 1C: Grassland with mowing | Intensive and extensive commercial grassland |
| | 1D: Grassland with pasture | Pasture, pasture rotation (e.g. cattle, poultry, sheep, pig, and goat) |

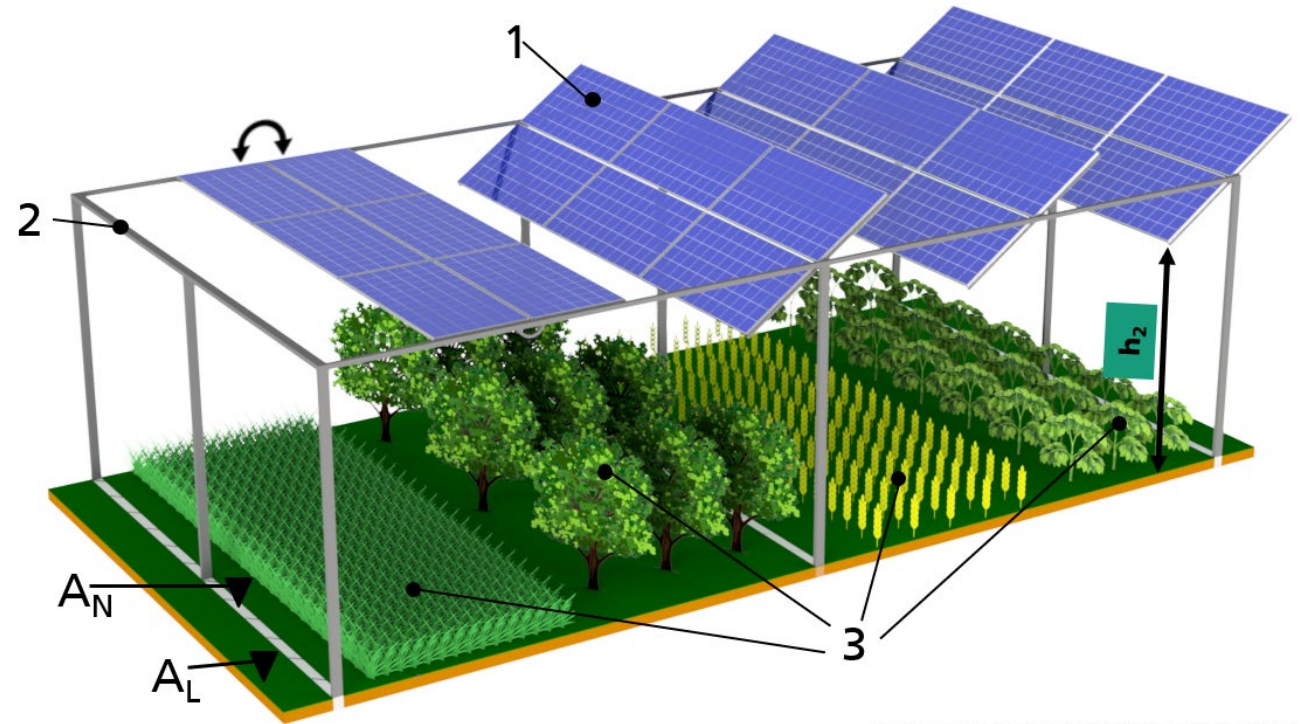


Illustration of crops © shutterstock.com / Ulvur, BlueRingMedia, Pisut tarding, Ice Aisberg

Legend:

- A_L Cultivable agricultural areas
- A_N Uncultivable agricultural areas
- h_1 Clearance height below 2.10 m
- h_2 Clearance height above 2.10 m
- 1 Examples of solar modules
- 2 Mounting structure
- 3 Examples of crops

Definitions, Classifications, and Standards of German DIN SPEC 91434

Category II – Interspace PV

| Agrivoltaic System | Use | Example |
|--|--|--|
| Category II: Vertical clearance <2,1m | 2A: Permanent and multi-year crops | Fruits, berries, viticulture, hops |
| | 2B: Single-year and long-term crops | Arable crops, vegetables, alternating grassland, fodder |
| | 2C: Grassland with mowing | Intensive and extensive commercial grassland |
| | 2D: Grassland with pasture | Pasture, pasture rotation (e.g. cattle, poultry, sheep, pig, and goat) |

Legend:

- A_L Cultivable agricultural areas
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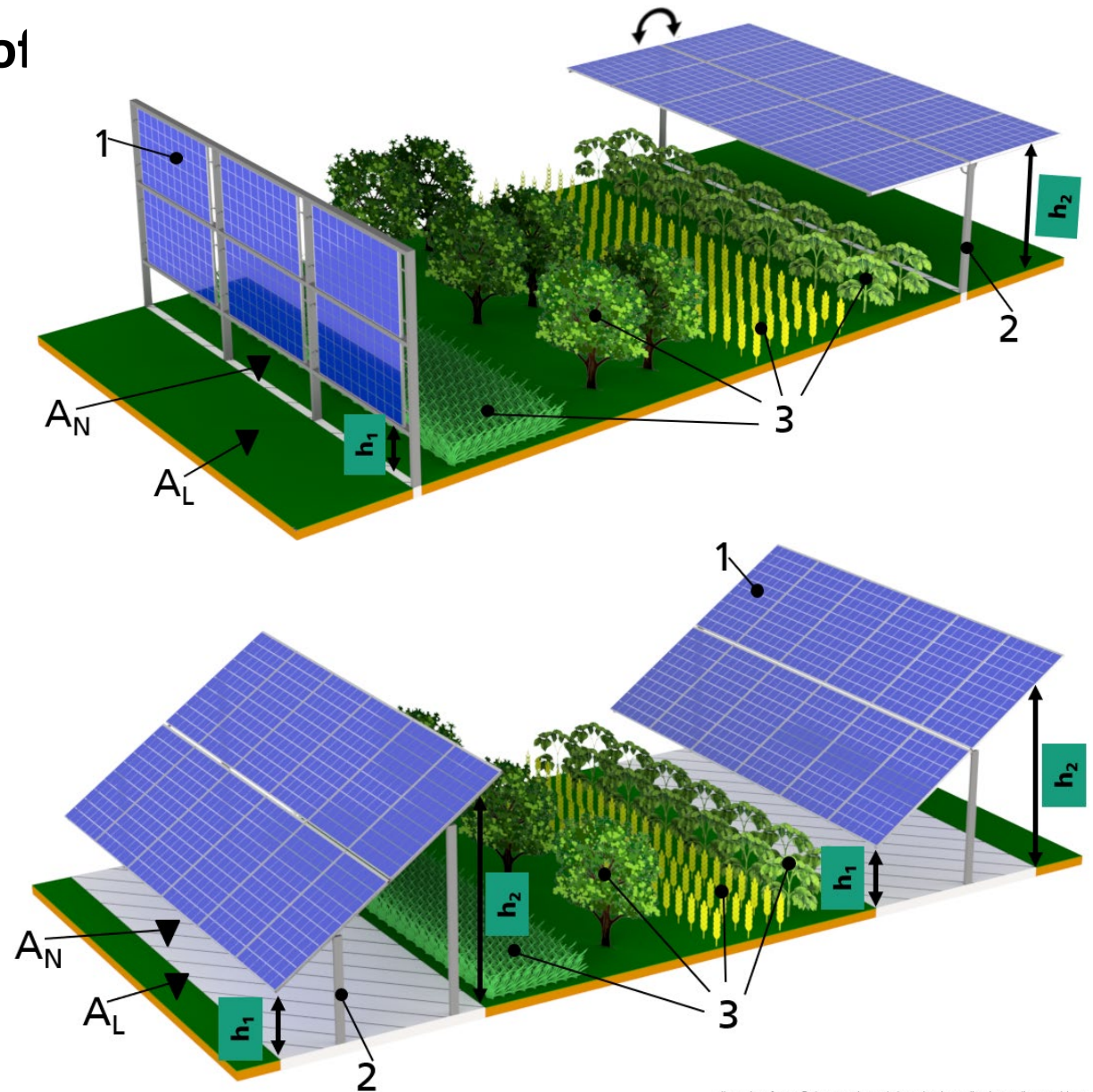


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Diversity of Agrivoltaics

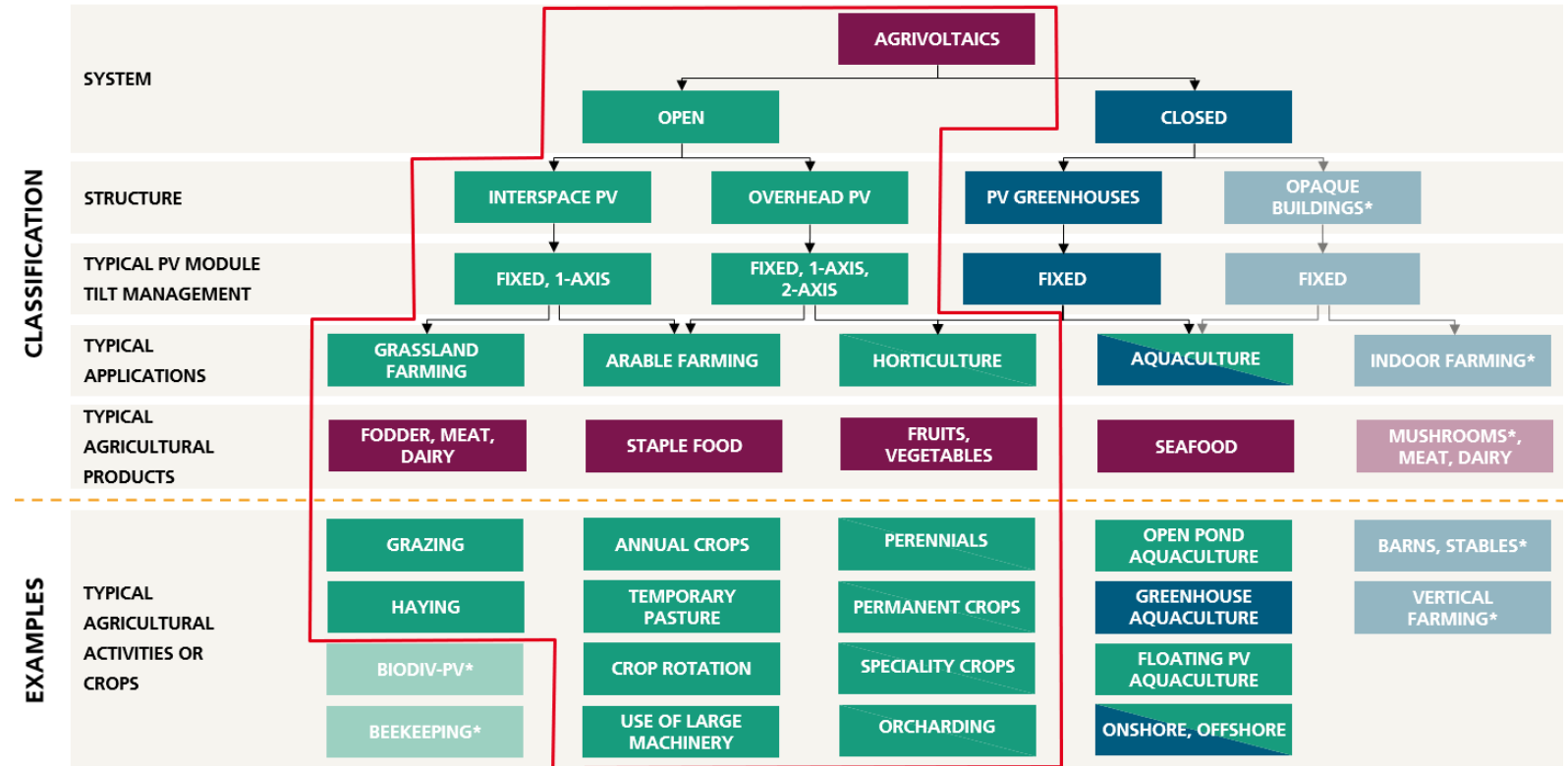


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Scope

- Only open systems
- No aquaculture
- Interspace PV is considered within a separate category (Cat. II)



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Thank you very much for your attention!



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