Photovoltaic and Solar-Thermal Use Case Application Comparison with Witness Simulation and DCF Analysis

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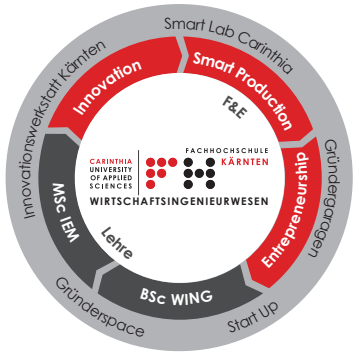

Content

Introduction

Introduction I

Motivation and Introduction:

- EU Green Deal and EUTAX Regulation
- DCF Theory
- Production Portfolio Theory and Risk Evaluation [HT23a; HT23b; Hei+]

Aim and goal:

- Use Case for Photovoltaic and Solar Thermal Application
- Modelisation: Witness, DCF & Risk Landscape

Photovoltaic and Solar-Thermal Use Case Application Comparison with Witness Simulation and DCF Analysis

Key Parameters I

Local solar (sun) global power (Graz, Austria)	1.206,4 $\frac{kWh}{m^2}$
Available area at parking house C&P Immobilien AG	1.222 m^2
Photovoltaic system efficiencies	16,57 %
Solar Thermal system efficiencies	35,75 %

Figure 1: Key Parameters according to [Gau23]

Photovoltaic and Thermal Model

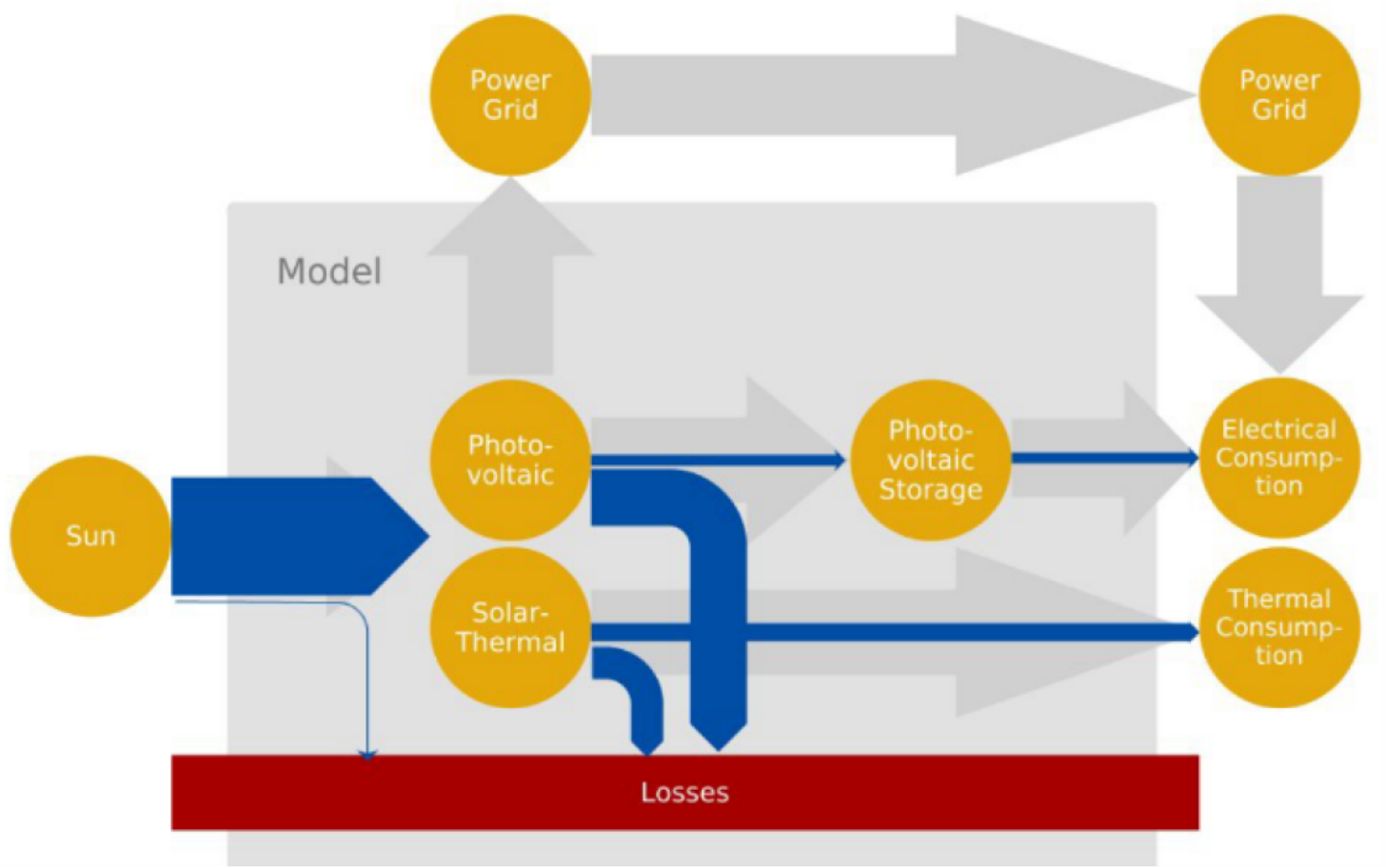

Figure 2: Model for simulation of comparison of photovoltaic and solar thermal (Model 2)[Gau23].

Witness Photovoltaic and Thermal Model

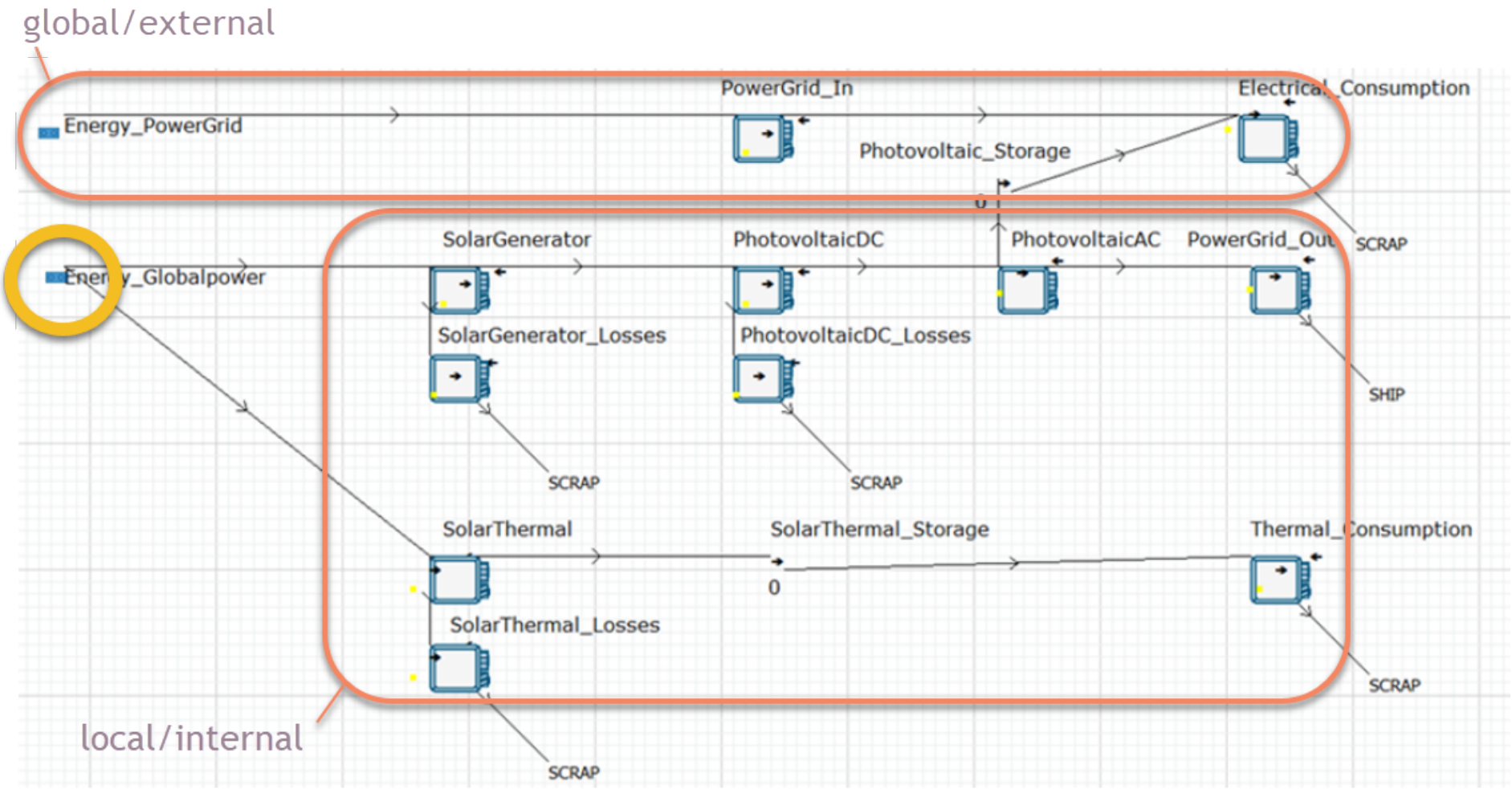

Figure 3: Model and Simulation in WITNESS Horizon [5] (Model 2). The Witness Files are also supplied at [HG24].

Simulation Results I

Scenario	Description Scenario
[0.]	without investment 270kWh p.a.
[1.]	photovoltaic + storage + solarthermic 230kWh p.a.
[2.]	photovoltaic + photovoltaic storage 230kWh p.a.
[3.]	photovoltaic + storage net 230kWh p.a.
[4.]	photovoltaic + photovoltaic storage 270kWh p.a.

Figure 4: Scenarios

Simulation Results II

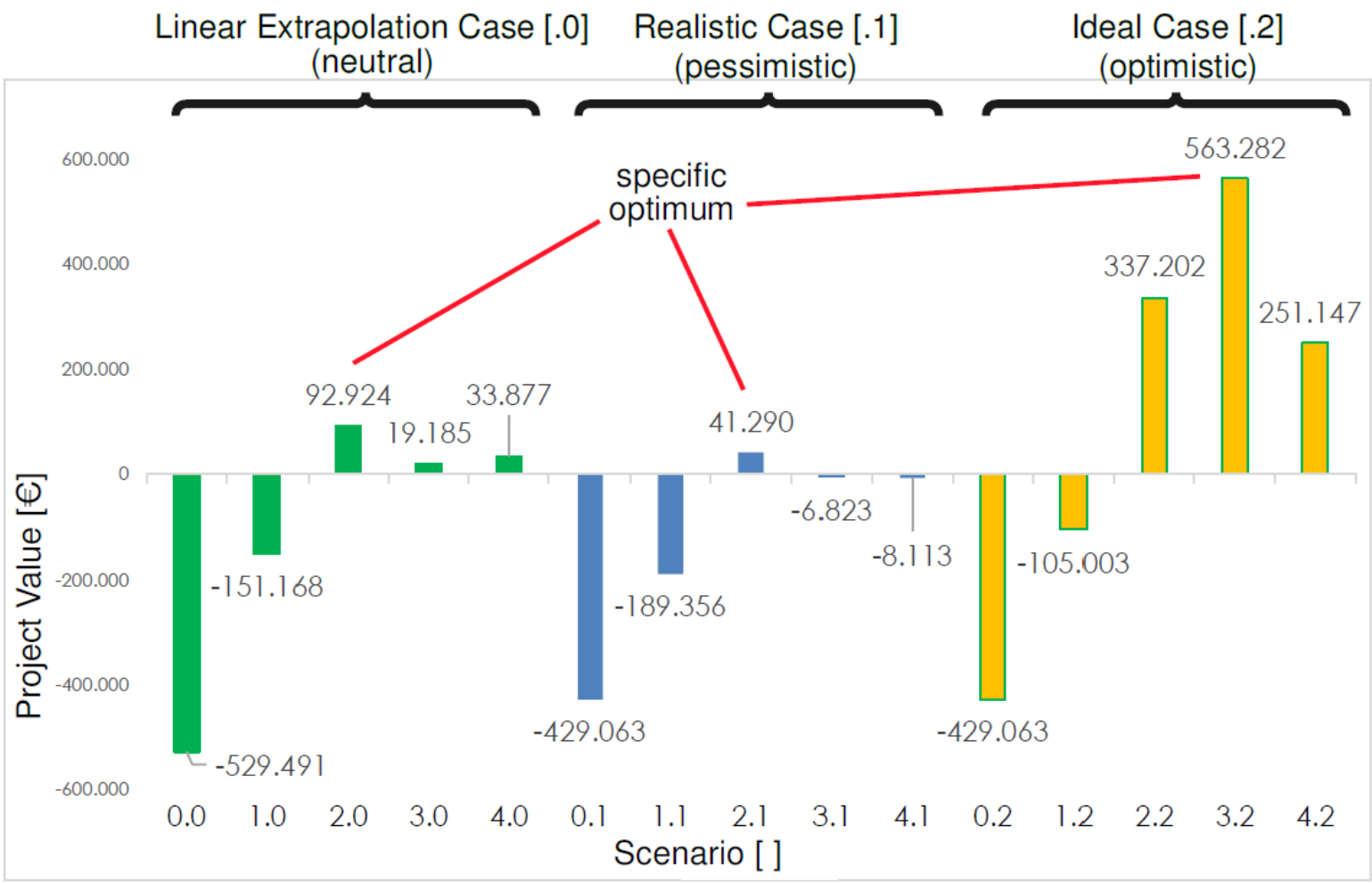

Figure 5: DCF project valued of different scenarios in the risk landscape (neutral/pessimistic/optimistic) (see also [Gau23]).

Conclusion and Outlook

Conclusion and Outlook I

Conclusion:

- Presented Witness Model for Simulation of Solarthermic and Photovoltaic Installations & DCF evaluation
- Industrial Application of this Model
- Explicit Consideration of Risk

Outlook:

- Integration of the DCF Model in Witness
- Further Industrial Applications
- Risk Analysis Refinement with, e.g. Artificial Intelligence (AI)

Thank you cordially for your attention!

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PS.: The presentation can also be found at:

http://www.dr-heiden.com/Vortraege.htm

Bibliography I

[1] Europäische Kommission. *Umsetzung des europäischen Green Deals*. 2024. URL: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_de (visited on 02/28/2024).

[2] Edwin O. Fischer. *Finanzwirtschaft für Anfänger*. Ed. by Edwin O. Fischer. 5. Oldenburg Verlag, München, 2009.

[3] Karl Gaugg. "Nachträgliche Umsetzung von PV-Anlagen auf versiegelten Flächen am Beispiel des C&P Headquartergebäude in Graz". Bachelorthesis. Villach: Carinthia University of Applied Sciences, 2023 (cit. on pp. 6, 7, 10).

[4] Bernhard Heiden. *Wirtschaftliche Industrie 4.0 Entscheidungen - mit Beispielen - Praxis der Wertschöpfung*. Akademiker Verlag, Saarbrücken, 2016.

Bibliography II

[5] Bernhard Heiden and Karl Gaugg. *Witness Files Source Code for Solarthermic and Photovoltaic Models 1 and 2 (Witness Version 20.00 (Build 2264))*. 2024. URL: https://github.com/BernhardHeiden/PhotovoltaicSolarthermicWitnessUsecase (visited on 02/28/2024) (cit. on p. 8).

[6] Bernhard Heiden and Bianca Tonino-Heiden. "First Elements of Production Portfolio Theory: A New Industrial Engineering Scientific Method". In: *Proceedings of 2023 The 12th International Conference on Informatics, Environment, Energy and Applications (IEEA 2023)*. ICITM 2023 Conference/2023 The 12th International Conference on Informatics, Environment, Energy and Applications (IEEA 2023). ICPS / ACM (The Association for Computing Machinery), 2023. ISBN: 979-8-4007-0012-5. DOI: 10.1145/3594692.3594705 (cit. on p. 4).

[7] Bernhard Heiden and Bianca Tonino-Heiden. "Production Portfolio Theory II - First Steps Towards a General Portfolio Theory and Numerical Examplifications". 2023. in print (cit. on p. 4).

Bibliography III

[8] Bernhard Heiden, Bianca Tonino-Heiden, and Volodymyr Alieksieiev. "System Ordering Process Based on Uni-, Bi- and Multidirectionality – Theory and First Examples". In: *2021 International Conference on Business Intelligence and Information Technology (BIIT2021)*. Ed. by A. E. Hassanien. LNDECT 107. Springer Nature, 2022, pp. 594–604. DOI: 10.1007/978-3-030-92632-8_55.

[9] Bernhard Heiden et al. "Production Portfolio Theory: Risk Evaluation and a New Industrial Application (IA)". In: *FICC 2024, Volume I, LNNS 919, Advances in Information and Communication*. Chap. 42. DOI: 10.1007/978-3-031-53960-2_42 (cit. on p. 4).

[10] H Pilger and A Podesser. *Klimaatlas Steiermark. Graz*. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2010.

[11] Carsten Teichert. "WITNESS - Logistik". In: *Mit Innovationsmanagement zu Industrie 4.0*. Ed. by Peter Granig, Erich Hartlieb, and Bernhard Heiden. Springer Gabler Verlag, Wiesbaden, 2018, pp. 34–42.