Please limit your answer to maximum 10 min

Exercise 1.1 (PV in Switzerland)

Please describe (preferably as a PPT presentation with 3…5 slides):

- What percentage of rooftops in Switzerland (including residential and industrial buildings) should be covered with PV modules in order to meet the Swiss electricity demand? (assume 18%-efficient modules and realistic performance of PV systems)

Suggested literature: Applied Energy, Volume 262, 15 March 2020, 114404

Web resources

Exercise 1.2 (Shockley–Queisser limit)

Please explain the main steps in derivation of the theoretical limit for the conversion efficiency for unconcentrated light (the Shockley–Queisser limit or detailed balance limit)

(preferably as a PPT presentation with 3…5 slides):

Literature:

W. Shockley and H.J. Queisser, "Detailed Balance Limit of Efficiency of p-n Junction Solar Cells", *Journal of Applied Physics*, Volume 32 (March 1961), pp. 510-519

”Handbook of Photovoltaic Science and Engineering”, 2011
http://onlinelibrary.wiley.com/book/10.1002/9780470974704

L.C. Hirst and N.J. Ekins-Daukes “Fundamental losses in solar cells”, Prog. Photovolt: res. Appl. 2011, 19, 286-293

Exercise 1.3 (Solar module degradation and failure)

Please describe (preferably as a PPT presentation, max 10 min):

- Possible failures of PV modules
- Mechanisms of degradation (light-induced, potential-induced, long-term)

Literature:

”Handbook of Photovoltaic Science and Engineering”,
http://onlinelibrary.wiley.com/book/10.1002/9780470974704

PVeducation.org
http://pveducation.org/pvcdrom/modules/degradation-and-failure-modes

web references

Exercise 1.4 (Material availability)

Please describe (preferably as a PPT presentation with 3-5 slides, max 10 min):

Potential of various photovoltaic technologies for large-scale electricity generation based on the material availability and current production rates. Identify key elements that may potentially limit: c-Si, CIGS, CdTe, DSSC, organo-metallic perovskite and polymer solar cells.

Literature:

The Future of Solar Energy, AN INTERDISCIPLINARY MIT STUDY, 2015
https://mitei.mit.edu/system/files/MIT%20Future%20of%20Solar%20Energy%20Study_compressed.pdf

"Materials availability for thin film (TF) PV technologies development",
https://workspace.imperial.ac.uk/icept/Public/Materials%20for%20PV%20ICEPT%20format.pdf

C. Wadia et. al., "Materials Availability Expands the Opportunity for Large-Scale Photovoltaics Deployment" Environ. Sci. Technol. 2009, 43, 2072–2077

Web references

Exercise 1.5 (PV vs nuclear)

Please present (preferably as a PPT in 2-3 slides):

Compare how much **electrical energy** can be produced from

one gram of natural uranium using the nuclear technology (assuming 0.7% content of U235 isotope in natural uranium and a conventional nuclear reactor of thermal type with light water)

vs

one gram of silicon in a silicon solar cell (assuming lifetime 40 years and PV module location in Lausanne)

Literature: web sources