(1) Comment # 1: The authors give a review about the special technical field of thermo photovoltaics and in solar thermal with a focus on absorbers at high temperature. However as I will reason later the reviewed area should be specified even in the introduction more precise and differentiate from others like solar thermal for hot water and heating demands and photovoltaic-thermal collectors, which are already on the market. –

We have added language to specify that we are speaking of solar-to-electrical energy conversion in the first sentence of the introduction.

(2) Comment # 2: The manuscript gives a good overview about the endeavour to manage the efforts at solar and infra-red spectral range to get high efficiency. Theoretical work, software solutions for simulation and experimental performance were likewise approached.

However I have an uncomfortable feeling about many referenced work or the status of the technical field in general. Insofar I am very grateful for this review, and it underlines its importance. I can demonstrate my objections by reference to Table 3 about the efficiency of solar thermal photovoltaic systems. With absorber temperatures exceeding 1200 K and PV-cells based on Ge- or III-V-semiconductors, one reaches very low efficiencies. Even simulated systems (Table 3) exceed only moderate values. – We must agree with this point, add a sentence or two emphasizing the gap between theory and current state of the field, but emphasize this represents an opportunity.

Obviously something is going wrong throughout the scientific community. To my impression the theoretical base of endeavour seems not to be confirmed. The author reference [11] and [37] claiming higher efficiency than Shockley-Queisser limit (page 33 lines 763-765), which is impossible when one compares equivalent conditions (light intensity, solar cell temperature) because Shockley-Queisser based on detailed balance concept. Equivalent limits as Shockley and Queisser are found by Ross and Hsiao [J. Appl. Phys. 48, 4783 (1977)], who applies first and second law of thermodynamic for solar radiation as black body radiation. – We need to clarify which assumption of S-Q limit does not apply to the argument about TPV efficiency… or, we need to identify which constraints in S-Q limit are relaxed in STPV. (Mool will provide references:

1. Shanhui Fan, Nature Nanotechnology, Vol 9, Feb 2014).
2. Nils-Peter Harder and Peter Wurfel, Theoretical limits of thermophotolvtaic energy conversion, Semiconductor Science and Technology

(3) Comment # 3: For clarity of efficiency values mentioned in Table 3 and any others in running text I urgently suggest adding the relevant environment conditions of the system. Especially I am missing the type of useful energy for which efficiency is indicated (work power, electrical power or heat), the concentration factor of solar irradiance and the temperature of the solar cell in case of STPV. Beside of absorber temperature these boundary conditions determine the upper theoretical efficiency limit, which could be available.

- Need to clarify we are talking about electrical power

(4) Comment # 4: Furthermore equation (5) (referenced from [45]) about spectral efficiency seems to be incorrect. The equation relates to a common mistake for calculating solar cell efficiency. It takes semiconductor band gap as (upper limit of) photo-voltage multiplying with the number of absorbed photons exceeding the band gap. This is fundamentally wrong and does not taken Shockleys/Queissers and Ross/Hsiao´s theory into account. Considering thermodynamic limit determining by radiant recombination the open circuit voltage is about 0.5 V below corresponding band gap energy (without light concentration). The available voltage at maximum power point is about further kT/e lower. Additionally Auger recombination is an unavoidable intrinsic effect, which lowers maximum power voltage. So, using equation (5) conducts to drastic overestimation of efficiency (about 20% absolute) and to erroneous choice of "optimal" semiconductor band gap. These aspects do not influence manuscript value, but I suggest the authors a very critical attitude in respect to the referenced publications.

-Need to make the distinction about Eq (5) from performance efficiency

-Need to clarify which assumptions Eq (5) makes (his point about E\_bg being an overestimate of voltage is valid)

(5) Comment #5: The reviewed claim about so-called thermophotovoltaic and solar thermophotovoltaic approaches is a questionable scientific field. Hardly spoken thermophotovoltaic is the science of constructing an incandescent light source effectively irradiating a solar cell matched perfectly to each other. And solar thermophotovoltaic is the special science when the mentioned light source is powered by solar irradiation instead of heat - more precisely: a spectral light source powered by solar irradiation illuminating the absorber from the same side as itself illuminates the photovoltaic cell. The concept is to absorb solar irradiation as much as possible for heating, and to reduce radiation losses as fare as possible except of a small bandwidth which couple perfectly with the solar cell band gap. This concept has to be failed as all the realized systems show too! A direct solar irradiation of the solar cell is generally more effective for electrical power. This holds for theoretical reasons and even in praxis, independent on concentration factor of solar irradiation. Solar irradiation corresponds to black body radiation at about 5900 K. No system being in thermal balance with the sun (including solar concentration) could have a higher emittance at any spectral range as the sunny black body equivalent. So the direct solar illumination of solar cell is always much more effective than via an absorber of any kind whatsoever constructed.

-Two questions:

(1) Questioning the scientific field – need to point to previous detailed justifications of the theoretical potential of these technologies

(2) Questioning if selective emitter at lower T can ever have spectral irradiance than the sun – need to cede this point, but put it into context.

(6) Comment # 6: Solar to electrical power efficiency is available about 25%-34% with solar cells without any light concentration (solar modules with at least 20% efficiency are on the commercial market).

The authors claim (page 4, line48) Carnot limits efficiency of solar thermal (ST) and solar thermophotovoltaics (STPV) systems and reference a maximum efficiency of 85,4% at an operating temperature of 2600 K [33]. Using Carnot limit with absorber temperature as high temperature and environment as low temperature calculations is correct for transferring solar energy to power (exergy) by minds of a power-heat-machine. But the efficiency of solar thermal for heat use is higher, already in praxis! Absorbers for flat plate and vacuum tube collectors are annually produced with a quantity of several millions square meters, which have standardly a solar absorption between 95% and 97% and a thermal emissivity of about 3-5%. Flat plat collectors for domestic hot water or for heating works between environment temperature and about 80°C and reaches 85% solar-to-heat efficiency at environment temperature. So I firmly recommend a clear description which solar thermal systems author claim and which not.

- Remark that solar-to-thermal is established technology … we are concerned with solar-to-thermal-to-work (electrical power).

(7) Comment #7: Furthermore the used term thermophotovoltaic, which is used in this manuscript for high temperature applications, should be clearly distinguished from systems well known as photovoltaic thermal hybrid collectors. These systems are already on the market. The actively cooled PV-modules use electrical and heat power. Theses systems should be mentioned in the introduction.

- Same solution as Comment 6 – delineate between solar thermal for electricity and solar thermal for heat.

(8) Comment #8: Chapter 2 gives a well overview about many efforts and technics optimizing absorbers as the importance of nanostructures, light straying and simulation technics. Authors reference publications for coatings as [21], [27] and [28] or calculations for sophisticated structures as [62-64, 68, 81]. Chapter 3 presents endeavours about so-called large area fabrication. The mentioned techniques are extremely expensive related to the prepared area, not available for square meters and even less for production lines. To my opinion these endeavours may have only academic interest or may applicable for small area applications if absorber costs are irrelevant in respect to other system costs. For reliability I suggest to communicate maximum area, expected specific costs or potential field of application for the presented techniques (interference lithography, laser writing, sintering and texturing.

- Mool will address this.

(9) Comment #9: However the referenced results seem to be moderate compared to technical products being already on the market for parabolic trough technology. The PTR 70 receiver from Schott and UVAC 2010 from Siemens get 95-96% solar absorbance and 10-14% respectively less than 9% emissivity at 400°C. In both cases the absorber is deposited on stainless steel pipes, which are installed inside of an evacuated quartz glass pipe. Another example I know from the Israeli company Acktar, which produce absorbers with standard vacuum techniques. The strong absorbance of the coating is based on a broad scaling range rough structure, similar to fractal structure.

- Similar remark about how this represents a considerable opportunity

(10) Comment #10: Several times tungsten is referenced as absorber at high temperature (e.g. at 1700K, table 2, page 32). It was not mentioned that W and other metals with high melting points are very easily oxidized in air and their oxides evaporate even at low temperature. So all these concepts requires expensive vacuum systems.

- Can remark that there are several strategies that can deal with this challenge (evacuated cells, inert atmospheres, coatings, alternative materials)

(11) Comment #11: Insofar I am missing a justification for all these sophistic activities. I would be very thankful when authors could work out the unsolved challenges.

- Summarize the key points that make these plausible and not-fallacious and therefore worthy of pursuit

(1) No moving parts, (2) storage, etc. I.e. our positivity is shared by many in the field