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REGULATIONS FOR PLUSENERGYBUILDINGS®

PLUS ENERGY BUILDING

(Norman Foster-PlusEnergyBuilding-Jury)

"Solar architecture is not about fashion, it is about survival." (Lord Norman Foster, London)

I. PEB REGULATIONS AND PROCEDURE

1. Principles and responsible body of the PEB Solar Prize

Principles: On the occasion of the 20th Swiss Solar Prize in September 2010, a Solar Prize for the best **PlusEnergyBuildings (PEBs)** and a **Norman Foster Solar Award** for those PEBs with best integrated installations were announced and awarded for the first time.

Responsible body: This PEB Solar Prize is organised by Solar Agency Switzerland (SAS) in cooperation with other responsible bodies. The first four Solar Prizes were financially supported by Repower (former Rätia Energie AG), the Swiss Greina Foundation (SGS), and other Solar Prize partners. The following PEB regulations are established based on "Lord Norman Foster's 10 Theses for PlusEnergyBuildings" (cf. part II) and Art 3.4 of the Solar Prize regulations.

Since 2010, **Solar Agency Switzerland** (SAS) has organised the Solar Prize for PlusEnergyBuildings and the Norman Foster Solar Award (NFSA) for aesthetically exemplary PEBs under the auspices of the Federal Department of Energy (BFE), Energy Switzerland, the cantonal directors of energy and the cantonal delegates of energy in cooperation with other related institutions and PEB partners in Europe. Participants of the Swiss and European Solar Prize are also qualified to apply for the PEB Solar Prize. The same conditions apply to all European PEB participants.

2. Spirit and purpose of the NFSA and PEB Solar Prize

Constitutional obligation: It is the purpose of the PEB Solar Prize to promote renewable energies, in particular solar energy, as well as energy-efficient buildings within the scope of Art 73, 74 and 89 of the Swiss Federal Constitution and of Art 194 of the Lisbon Treaty. The PEB Solar Prize and Norman Foster Solar Award are awarded by the PEB Solar Prize Committee for the best PEBs in Switzerland and Europe.

Professional education and sustainable standards: It is the purpose of the PEB Solar Prize to establish PlusEnergyBuildings as state-of-the-art and to incorporate PEBs as part of the professional education of architects, engineers and building experts as well as of authorities and universities, in order to realise environmentally friendly PEBs comprehensively in future. *Solar energy supply and a sustainable utilisation of energy must become an integral part of the design phase.* With help of the NFSA/PEB Solar Prize, the technological revolution that has been taking place in central and northern Europe in building engineering since 2000 shall be further supported. The Prize is aiming to establish the highest state of technology as standard in the building sector.

Energy self-supply and aesthetics: The PEB Solar Prize is designed to lead to an increase in energy efficiency and comfort by a systematic reduction of energy losses in the building sector. On the other hand, it aims to efficiently promote decentralized energy self-supply through optimum integration of solar installations on roofs and facades. For the implementation of these aims, the ground-breaking aesthetic, architectural and quality standards according to the solar architecture of Lord Foster as well as the recommendations of the Swiss and European Solar Prize shall be observed.

Along with a completely self-sufficient energy supply, **the long-term aim** is a carbon-neutral energy balance for the operation of the buildings with due regard to production energy (grey energy) in order to achieve the greatest possible sustainable energy self-supply of the whole building sector with energy-efficient PlusEnergyBuildings. Therefore, particular consideration is given to those aesthetically and architecturally exemplary PEBs that do not only have a solar self-supply, but also produce the highest possible amount of energy for transport purposes (1,500 kWh/a per accommodation unit for passenger cars and/or public transport) or other activities of the inhabitants. In the long-term and in accordance with the Stanford energy study, it is the stated aim to replace at least 6 TW through PEBs worldwide. [1]

3. PlusEnergyBuildings and system boundaries

State-of-the-art building technology: The state-of-the-art of building technology is generally defined by the newest professional and energy-efficient constructions of innovative architects, engineers, and entrepreneurs. These heated buildings are consuming less and less energy whilst still providing maximum comfort and are producing ever greater CO_2-free solar energy surpluses using carefully integrated PV systems on roofs and facades[2]. It is the goal of the PEB Solar Prize to establish this state of solar building technology and CO_2-free energy supply as state-of-the-art for the entire building sector in Switzerland, Europe and worldwide.

PlusEnergyBuildings (PEBs): PlusEnergyBuildings produce more than 100% of their average annual energy needs for heating, hot water, and electricity (incl. household and operating current) from the heated and/or cooled building itself (energy index [EI] in kWh/m^{2}a). The surplus energy, which must be substantiated by the PEB owner, is fed into the public grid or supplied to a third party as heat or electricity. In cases of doubt, the PEB owner must prove that the average annual energy production of the PEB over **12 months** is at least 1 kWh/m^{2}a higher than the total annual energy requirement of the PEB[3]. The measurements of the final energy values are the determining factor.

System boundaries: Generally, the outer shell of the (main) building including its components according to Art 642 (2) of the Swiss Civil Code is regarded as the "system boundary". If there are installations to produce renewable energies on the same estate and provided that they are connected permanently to the (main) building (Art 644 (2), Swiss Civil Code), the energy output of these installations will also be included in the calculation of the self-

[1] Standford plan for an emission-free world: University of Stanford, Prof Mark C. Jacobson/Deluchi. Scientific American, Nov. 2009, p. 58 - 61, to substitute 6 TW by PEBs equals a substitution of 8,500 large NPPs, each with a performance of 7.5 TWh/a. (According to empirical values from European Solar Prize winners an energy requirement for transport purposes of approximately 1,500 kWh/a per accommodation unit is assumed. Energy efficient electric cars drive about 15,000 km/a with 1,500 kWh/a (from renewable energies); see Swiss Solar Prize 2003, p. 14; Swiss Solar Prize 2005, p. 30. Swiss Solar Prize 2011, p. 30: With the electricity excess of 55,000 kWh/a a small "five seater" electric Peugeot would be able to drive around the world 12 times.)

[2] CO_2-free solar electricity, see Art 7 (e)

[3] Minergie-P/passive-house standard: Main prerequisite for PlusEnergyBuildings is optimum heat insulation (building envelope) according to the Minergie-P/passive-house standard. Examples: Some of the first PlusEnergyBuildings in Switzerland are the commercial and service building Wattwerk, Holinger/BL (2004: 175%); the one-family home Erni Untersiggental/AG (2001: 133%); the multiple-family homes Wenk, Riehen/BS (2008: 140%), and Bennau/SZ (2009:110%) as well as the service building Züst, Grüsch/GR (2009: 112%); SFH Ospelt, Vaduz/FL (2010: 182%); see Swiss and European Solar Prizes 2000, 2001, 2004, 2005 to 2010. Procedure: If the PEB energy indexes or excess energy indexes are questioned or challenged by a third party, the PEB owners (Swiss Civil Code 8) must prove their accuracy. The energy self-supply of the PEB must in any event be at least 1 kWh/m^{2}a higher than the total average annual energy requirement for heating, hot water and electricity (incl. household and operating current etc.) of the PEB over 12 months. In 2010, building refurbishments achieved an energy self-supply of 180%; for new buildings about 200% can be expected.

supply of the building. These PEB standards are directly or correspondingly applied for the evaluation of all buildings.

4. Conditions for participation in the PEB Solar Prize competition

Each PEB participating in the PEB Solar Prize competition must be built and operated on time (see Art 8). For each PEB, at least the following evidence must be furnished in written form together with photographs and, where applicable, plans:

a)

General information on the building	***surface***	
Energy consuming surface (heated/cooled surface)	…. m^2a	
Insulation of the building envelope	…. cm	U-value: …. in W/m^2K
Windows (installed)		U-value: …. in W/m^2K

b)

Energy requirement of the PEB per year	**kWh/m^2a**	**%**	**total in kWh/a**
Heating			
Ventilation/Heat pump electricity			
Hot water			
Electricity (Total household/operating current)			
Total energy requirement:			

c)

Energy supply of the PEB			
1. Energy self-supply	**kWh/m^2a**	**%**	**total in kWh/a**
Solar-thermal			
PV solar electricity			
Environmental heat/HP final energy need			
Total energy production on the PEB itself			
2. Outside energy sources			
Electricity			
Other energies….			
Total requirement for outside energy:			
3. Total energy supply of the PEB			
4. Energy surplus to public grid/third parties			

d)

Energy balance of the PEB	**kWh/m^2a**	**%**	**total in kWh/a**
Total energy requirement (Art 4b)			
1. Energy self-supply (Art 4c (1))			
☐ Electricity surplus (Art 4c (3))			
☐ Heat surplus (Art 4c (3))			
2. Total requirement for energy from an external source (Art 4c (2))			
3. Energy/solar electricity excess of the PEB			

e)

Summary	**kWh/m^2a**	**Annual average in kWh/a**
Energy surplus PEB (net)	….kWh/m^2a	….kWh/a
Energy/solar electricity surplus for solar-operated electric cars	….kWh/a	....% of the total energy need of the building

5. Prize categories of the Norman Foster and PEB Solar Prizes

Solar Prizes for PlusEnergyBuildings (PEBs) are awarded for the following categories:

a) **Norman Foster Solar Award for PEBs:** Those PEBs with the best integrated PV systems are awarded the **"Norman Foster Solar Award"** (NFSA). As with all other PEBs, prerequisites are ecological construction methods, efficient energy consumption and the utilisation of renewable energies, particularly solar energy. Eligible buildings are characterized by PV systems that are very carefully and ideally integrated in the building envelope. They meet the highest architectural and aesthetical standards and are leading the way for the building and solar architecture of the 21st century.

b) **PEB Solar Prize for performance, efficiency and building complexity**: The PEB Solar Prize for performance, efficiency and building complexity particularly considers the PEB's energy performance, its efficiency, its energy self-supply, size, and complexity. The entire average energy supply needed during the year must be produced environmental-friendly by the building's own solar and/or heat energy installations.[4]

c) **Only renewable energies for PEB Solar Prizes:** PEB Solar Prizes are only awarded to buildings that are using *renewable energies exclusively* to cover their average annual energy need. To award a PEB building that partially uses also fossil energy sources, the Jury needs a majority of 75%.

d) **PEB abroad/in the EU**: At least one PEB award goes to a PEB in Switzerland and one to a PEB in the European Union/Europe.

6. Prerequisites and procedure

a) **Prerequisites** for all PEB prizes are the PEB prize criteria mentioned in Art 3 to 5. Furthermore, there must be at least *three eligible PEB candidates* per prize category. Otherwise, the prize categories will be merged in the initial phase into one PEB prize category.

b) **The Norman Foster/PEB Jury** will rank all PEBs with an average solar electricity surplus. Generally, only three prizes per main category are awarded; i.e. at the maximum three prize recipients for the **Norman Foster Solar Award,** and three award winners with a highest-possible **energy self-supply** for the **PEB performance, efficiency and building complexity Solar Prizes**.

c) **PEB diplomas**: In addition, the Jury can also issue PEB diplomas and specifically honour apartment and business buildings by awarding or certifying *commercial*, *service*, *agricultural* or *industrial* buildings that fulfil the PEB requirements with a PEB prize or PEB diploma. The final decision resides with the Norman Foster/PEB Jury in agreement with Lord Norman Foster.

d) **The factual and legal basis** for all NFSA and PEB Prizes is the proper assessment of the PEBs by the Technical Commission (TC). The Technical Commission will rank all PEBs in order of their performance in accordance with Art 3 (2) and Art 5 (a) and (b) of the PEB regulations and will also mention the quality of the installations wherever possible.[5]

e) **PEBs cover 80% of the total (national) energy need**: PEBs with an energy self-supply of 100% and an additional solar energy surplus of 1,500 kWh/a per apartment are *individually*

[4] For the calculation of the PEB's energy self-supply it is generally taken into account the energy that has been produced as environmental-friendly as possible on or in the building in form of electricity or heat (final energy in kWh/a) according to Art 642, paragraph 2, Swiss Civil Code. If a storage medium is used, preference is given to the most environmental-friendly technology with the highest energy self-supply over the longest period of time. *(Lex Cadosch)*

[5] Avoidance of substandard construction and damage: The TC shall as far as possible indicate the quality and safety of installations and the care with which they have been integrated, as well as any failings of such installations, in order to prevent or avoid damage (see: up to 42% energy losses from installations damaged by storm or animal damage as a result of substandard erection etc. Photon1/2013, p.57); substandard installations should on no account be awarded any prizes.

covering the average energy need of the traffic sector und thus 80% of the national energy need (buildings: 50%; traffic: 30%).[6]

f) **Process and prioritisation:** In accordance with Art 5 (a), the Norman Foster/PEB Jury normally determines *three NFSAs* based on the ranking of the Technical Commission. From *the remaining PEBs* and in accordance with Art 5 (b), three PEBs are selected for the PEB Solar Prizes for **performance, efficiency and building complexity** provided that the Norman Foster/PEB Jury has no evidence for any calculation errors or obviously false assumptions in the TC's basis. According to Art 5 (b), a maximum of *three* buildings with the highest energy self-supply will be selected from all PEBs.

g) **Changes in the performance ranking require a majority of 75%**: According to Art 5 (b) to (e), the Norman Foster/PEB Jury may change the order of the PEB ranking with a majority of 75% in case of important *objective criteria* such as prioritisation of size, performance, efficiency, building complexity or location. Priority is given to refurbishments compared to new-buildings, to multi-family houses instead of single-family houses, to well-integrated solar installations instead of poorly-integrated or not fully covering solar installations etc.

II. NORMAN FOSTER'S 10 THESES FOR PLUS ENERGY BUILDINGS

7. Sustainable Architecture in the 21st century

1. *The quest for a sustainable architecture should never be an excuse for compromising quality of design. (LNF, 2010)*
2. *The building responds to its location and local weather patterns, with its bubble-like form allowing windows and balconies on the southern side to open up to the sunlight and panoramic views, while the colder, north facade is more closed, punctuated with deep window openings in the Engadin tradition. (LNF, 2005)*
3. *I have never seen a conflict between the pursuit of aesthetic delight and high performance in terms of sustainability. I would go further and say that responding to more demanding criteria should produce more beautiful buildings. (LNF, 2010)*
4. *The way we shape our buildings, our neighbourhoods and our global lifestyles has now become even more important than ever - we must ensure that sustainability becomes as inseparable from our design processes as time, cost and quality. (LNF, 2005)*
5. *The Swiss Solar Prize is truly unique. It is an indication of the unremitting dedication to solar energy and sustainable architectural technologies within Switzerland. Crucially, the prize not only considers the environmental performance of buildings, but also considers the essential problem of how sustainable technologies can be an integral part of good architectural design and practice. (LNF, 2005)*
6. *Architects, designers and planners cannot continue to ignore the damage our buildings inflict on the natural environment. As the consequences of our past inaction become ever more apparent, designing for a sustainable future becomes a necessity, not a choice. (LNF, 2005)*
7. *The Swiss Solar Prize and its Jury can show how the wider application of the les-sons learnt from this competition could have dramatic effects across a nation, in terms of shifting the emphasis of energy production. (LNF, 2010)*

[6] According to the Swiss Federal Council, buildings consume around 50% of Switzerland's total energy need of 250 TWh/a, approx. 80% of which are due to energy losses and inefficiency (IP R.W. 10.3873); the traffic sector accounts for 35% of the total energy consumption (Schweiz. Gesamtenergiestatistik 2013, p. 4 ff.) Thus, the building and traffic sectors combined are responsible for over 80% of the country's total energy consumption.

8. Ecology, architecture, and CO_2-free electricity for PEBs

PEBs distinguish themselves by their sustainable construction and operation. If there are several PEBs to be evaluated per category, the following criteria are given priority:

a) Ecological building materials: Use of ecological and local building materials and parts, as far as possible.

b) Exemplary solar architecture: An exemplary solar architecture does not only stand out by an optimum use of daylight and an ideal heat insulation with good U-values (at least Minergie-P/passive house or similar construction standard for new buildings), but rather by a carefully integrated and fully-covering solar installation as part of the building that partially or fully replaces traditional roofs and/or facades. Exempted are "performance installations" according to Art 5 (b).

c) Heat insulation: What applies for grey energy also applies for heat insulation. For Minergie-P or other well-insulated buildings (e.g. Flumroc) the energy payback time is between 0.5 and 2 years – depending on the thickness of the insulation and on the material. During this time, the cumulative energy required for producing the insulating material up to a thickness of 38 cm and all preceding processes including the production of the respective raw materials (primary energy) is paid back (significantly quicker than with a heated building with little insulation).[7] See Art 7 (d) and (e).

d) Grey energy: Grey energy is the amount of energy in MJ or kWh needed for production and all preceding processes including the production of the respective raw materials (primary energy), as well as subsequent dismantling.[8]

e) Energy payback time: "The energy payback time (EPBT) indicates how much time the installation needed to produce the same amount of energy that was used for its production."[9] The energy payback of silicon cells is between 0.8 to 2.2 years.[10] **Conclusion:** After their energy payback time of 0.8 to 2.2 years has elapsed, the respective solar installations are therefore producing CO_2-free energy in form of CO_2-free heat or CO_2-free electricity. After having "paid back" its total production energy (grey energy) including all preceding processes and dismantling, the solar installation starts to pay back the grey energy of the building.[11]

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[7] Production and disposal: see AUB, environmental declaration rockwool/insulating material, German Rockwool; ecological balance in the building sector, 2009/1, Ecobau, January 2011 edition; Environmental sustainability of insulating materials for buildings, Department of the Environment, Schleswig Holstein, 2003; Ecological balance of Flumroc-rockwool products, April 2011, p. 4 and 6 (with 474 MJ the energetic payback time of bricks is about double the payback time of insulating material with 205 MJ).

[8] Grey energy: see also SIA trail for energy efficiency, status report on grey energy, SIA basics for documentation D 0216, a project of Swiss Energycodes of KHE of SIA, by the office for environmental chemistry of Ueli Kasser, dipl. chemist, February 22, 2004. The resulting *additional grey energy for PEBs* is calculated by the difference between the additional energy used for a better heat insulation of the building envelope (Minergie-P/passive-house standard instead of just Minergie-standard, triple instead of double-glazed windows, improved building equipment etc) and for improving the technical installations compared to the *minimum legal energy and building standards* which – according to the Federal Council – still accept average energy losses in the building sector of 80% (IP RW 10.3873). Therefore, the massive energy gains of up to 80% achieved by Min-P-insulation/better U values of the windows etc. must be deducted from the PEBs grey energy balance. As to the insulation, the grey energy, i.e. the *production energy including mounting energy* is "paid back" after approximately 18 months (according to EMPA). For solar installations, the „grey energy" is calculated from the difference of the *additional energy used in the production of the solar installations* and the energy used for the production of a traditional roof (bricks, eternity panels, copper etc.). On the other hand, the solar energy production of the installation on the building is considered – "paying back" the production energy of the solar installation within 0.8 to 2.2 years (see FN *Energy Pay Back Time).* PEBs therefore „pay back" the total production energy of their solar installations after 2.2 years at the latest. After 2.2 years, these solar installations are producing electricity that is completely CO_2-free. And it is only this CO_2-free solar electricity surplus of *integrated PEB solar installations* that can therefore be considered to pay back the grey energy of a building!

[9] Technical school Aalen, energetic amortisation, Aalen, June 2008, p. 8 ff.

[10] "The Energy Pay Back time (EPBT) is the length of deployment required for a photovoltaic system to generate an amount of energy equal to the total energy that went into its production." U.S. Department of Energy, PV FAQs, 2004; E. Alsema; R. Dones; K. Kato; K. Knapp; W. Palz etc.; see Prof. Dr. Anulf Jäger-Waldau, EU Commission, DG JRG, Ispra, 2011; M. V. Fthenakis et al., Renewable and Sustainable Energy Review, 2009: Module + Frame* + BOS: With a solar radiation of 1700 kWh/m²/a (η= 8.5 –14%) = 0.8 –1.3 years; and with 1000 kWh/m²/a = 1.4 –2.2 years. Important is also the place of the installation and if PV electricity was used already for the PV production and the installation. This would shorten the EPBT and increasingly applies for PEB production and installation facilities.

[11] Energetic post-payback: As soon as a solar installation has produced the total energy amount of e.g. 10.000 kWh/a that was necessary for the production of the solar installation incl. all preceding processes, the solar installation has "paid back" its grey energy. Now, the phase of the energetic "post-payback" begins. The solar installation starts to pay back the grey energy of the building. On the building itself, this is only possible by means of a solar installation. Traditional

9. Deadline for applications for the PEB Solar Prize until April 15th

Each year, the deadline for application is **April 15th**. Accepted are only buildings that have been completed and went into operation between 1st of January of the previous year and 15th of April of the application year. Applications must be sent by postal mail to: Solar Agency Switzerland, Andrea Steiner, Aarbergergasse 21, P.O. Box 592, 3000 Berne 7. The date of the postmark is decisive.

The application must include the **fully completed official application form** for *persons/institutions, buildings and/or energy installations*. The form must be signed, and all energy indexes, especially sections **A and B1-B6**, must be fully completed.

The form **must include** ground-plan/section view and construction plans in A3 format, plus at least one **view of the entire building** (colour photo) and a **corresponding detail picture** of the solar installation. *Additional* pictures and media reports etc. can also be sent by email to info@solaragentur.ch. By doing so, you will enhance your chances for the Swiss Solar Prize.

10. Pre-examination by the Technical Solar Prize Committee (TC)

A specialist, competent Technical Committee (TC) of at least 5 members will evaluate the applications for the PEB Solar Prize.

The TC examines the applications according to the directives and regulations of the respective solar prize category. It conducts the necessary reviews and presents the best PEBs with a short, written justification (including duly completed matrix according to Art 4 (a-e) of these statutes) to the Solar Prize Jury.

11. The Solar Prize Jury as proposer

According to Art 9 of these PEB statutes the Solar Prize Jury consists of independent solar prize experts who are active both in the energy sector and in the academic sector and who are entitled to vote. They must guarantee an objective, impartial and technically substantiated judgement.

The Solar Prize Jury examines the PEB solar prize proposals and definitively decides on the Swiss PEB proposals for the international Norman Foster/PEB Jury. The PEB proposals for the international Norman Foster/PEB Jury must fulfil all effective and legal prerequisites for the Swiss Solar Prize or comparable prerequisites for a PEB nomination; the proposed PEBs, however, do not have to be nominated for a Swiss or European Solar Prize.

12. The international Norman Foster and PEB Jury

The final evaluation of the Norman Foster and PEB Solar Prizes is made by a Norman Foster/PEB Jury of at least 5 members – consisting primarily of university architecture professors and Swiss and European architects who are known internationally for their sustainable solar architecture. As long as the PEB Prizes are financed mainly by Swiss sponsors, a majority of the Jury members must have residence in Switzerland.

The Norman Foster/PEB Jury can only award nominated PEBs that have an average annual solar energy surplus of at least 1 kWh/m^2 according to Art 3 (2) of these PEB statutes. If there are no such PEBs in a prize category, the Norman Foster/PEB Jury decides on a reduction of the number of PEB prizes or whether a PEB award should be skipped for one

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tiles, iron sheets, eternit, copper, concrete, stone, mild steel and other traditional building materials do not generate any kWh/a whatsoever to pay back the grey energy of a building – not even in 100 years…

year and transferred to the following year. Within the budget, the Jury also decides on the respective prize money, giving equal emphasis to both prize categories. [12]

13. Reasons for withdrawal for Norman Foster/PEB Jury members, and the procedure thereof

a) **Withdrawal of Jury members:** If Norman Foster/PEB Jury members are directly or indirectly participating in or affected by an eligible building, they must leave the room during the relevant evaluation – if necessary after having given detailed information about the building in question.

b) **Reasons for withdrawal**: Reasons for withdrawal of a Norman Foster/PEB Jury member are **in any case** if the examined solar installation belongs to the Jury member, to one of his relatives (up to the 3rd degree of relationship) or to a legal person or community where the respective Jury member is holding office (employment, board of managers or directors etc).

c) **Final decision:** The decision of the Norman Foster/PEB Jury is final and there will be no correspondence about it. Objections or new facts, especially by measurements, may be submitted for the attention of the next Jury meeting according to Art 8 Swiss Civil Code (facts must be circumstantiated). It is up to the Jury to decide whether the case is accepted, how new facts and legal issues are treated and in which form revised decisions are published. Swiss law is applicable. Objections must be sent to Solar Agency Switzerland, P.O. Box 2272, CH-8033 Zurich for the attention of the Norman Foster/PEB Jury. Art 9 (3) of the Swiss Solar Prize Regulations remains reserved.

d) **In priority cases** and in case of obvious mistakes or wrong data, the presidents of the Jury (Swiss Solar Prize and Norman Foster/PEB Awards) and the chairman of the Technical Committee in the respective category (installations, new buildings, and refurbishments) will take account of the facts and correct their decision. Such corrections must be approved at the subsequent Jury meeting at the latest.

14. Conferment of the PEB Solar Prizes

Conferment of the PEB Solar Prize: The Solar Prizes are generally awarded in late summer/autumn with the support of the solar prize partners. The conferment is public and if possible it takes place on the site of one of the eligible solar installations.

The public justification for the prize according to the category is generally given by a member of the Solar Prize Jury or of a Solar Prize partner.

[12] On August 2, 2010, Lord Norman Foster took the view that architecture and aesthetics of a building are of course important; but that energy self-supply is no less important. Therefore a 50:50 split of the prize money is justified. The Norman Foster/PEB Jury supported Lord Norman Foster's proposal unanimously.

III. PEB PRINCIPLES AND LEGAL INFORMATION

15. Solar energy: CO_2-neutral electricity and heat

a) **Solar installations are producing CO_2-free electricity and heat on the building itself:** All solar installations are producing CO_2-free electricity *on the building* as soon as their production energy (EnAZ) is paid back according to Art 7 (e) i.e. after 0.5 to 2.2 years. The US Department of Energy also confirmed this: *"Producing electricity with photovoltaic (PV) emits no pollution, produces no greenhouse gases, and uses no time fossil resources."*[13] From this point on, the energy payback time remains always positive and helps to pay back the grey energy of the whole building. [14]

b) The same applies for ***CO_2-free solar heat,*** which has an energy payback time of only 0.5 years; after this point, thermal solar installations have positive energy payback times that help to pay back the grey energy of the building each year with their solar performance.

c) *Conclusion:* Only solar installations are producing CO_2-free electricity and heat on the building which reduces or pays back the grey energy of the building.

d) **CO_2- and grey-energy-free NFSA/PEBs:** As known so far, NFSA and PEBs are the only buildings worldwide that are producing CO_2-free electricity and CO_2-free heat thanks to their solar energy surplus (Art 3, Art 7 (c) to (e) and Art 15 (a)). After the respective energy payback time of 0.5 to 2.2 years, the grey energy of the solar thermal and PV installation is paid back as well. [15] From this moment on, the grey energy of the whole building is paid back each year with the solar performance. Therefore, NFSA/PEBs are the only buildings worldwide that are functioning CO_2-free and without any grey energy after their energy payback time.

e) **Fossil-nuclear CO_2 emissions:** The combustion of 1 kg of oil leads to approximately **3 kg of CO_2 emissions** in the atmosphere. The energy content of 1 kg of oil is about 10 kWh[16]; 10 kWh of **gas** create about **2 kg of CO_2 emissions;** 10 kWh of **nuclear electricity ≈ 1 kg of CO_2 emissions; i.e.** the nuclear conditioning of nuclear fuel leads to about **100 g of CO_2 emissions for just 1 nuclear kWh**.[17]

16. The ecological batteries for PEBs: Sun, water, wind…

a) **Complete security of supply:** Instead of base load energy, future PEBs will increasingly need peak-load energy for their unlimited energy supply around the clock. PEBs produce more energy on the annual average than they need. However, besides their energy self-supply, they depend on a storage possibility (especially pump storage power plants) for their energy compensation with renewable energies to function day and night, in summer and winter. It is then the public grid that guarantees full comfort for PEBs all day round.

b) **Europe's extraordinary ecological opportunity:** The interaction between renewable energies and the existing and potentially optimized public grid is an extraordinary ecological opportunity for Europe with its huge stochastic wind energy potential on the northern and western coasts as well as its storage and pump storage power plants in the Alps. The same also applies for other mountain and valley regions with high storage capacities and low natural water inflow to produce hydro-electricity and the complementary use of the high wind production during winter in Northern Europe.

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[13] U.S. Department of Energy, PV FAQs, What is the energy payback time for PV (EPBT)?, January 2004: According to the DOE, the energy payback time is between 2 and 3.5 years; E. Alsema; R. Dones; K. Kato; K. Knapp; W. Palz etc. Similar terms are energetic pay-off period, flyback time etc.

[14] Energy Payback Time: See also fn 6-8.

[15] Renewable energies: See above Art 7 (c-e).

[16] Energy content in comparison: 1 kg of oil ≈ 10 kWh (≈ 11.63 kWh ≈ 41.9 MJ). 100 MJ ≈ 2.4 kg of oil ≈ 6.4 kg of wood, ≈ 27..7 kWh; 1 kg hard wood ≈ 4.3 kWh.

[17] Emissions in comparison: See study of University of Sydney, Australia 2006. German eco-institute and 2005 Jan Willem Storm van Leeuwen: Depending on region and quality, one ton of soil/uranium ore generates between 3 to 9 g of uranium for nuclear electricity production.

c) Ecological pump storage power plants (EPSPP): In the Alpine region, several pump storage power plants (PSPP) are planned or are currently being built to complement the existing storage power stations. To operate them in an ecological manner, renewable energies are used as pump energy whenever possible; especially surpluses of wind and solar energy (see e.g. PSPP Nant de Drance/VS, Poschiavo/GR and Grimsel). EPSPP cover the total energy requirement exclusively from renewable energies, mostly from surplus wind and solar energy.

d) Complete and CO_2-free energy supply with renewable energies: With PEBs and ecologically operated PSPPs the disproportionately high energy dependency of Switzerland (80%) and the EU (50%) on fossil-nuclear energies will be reduced massively in the future. Furthermore, it will be increasingly possible to use renewable surplus energy in an ecological manner and to become independent of the non-renewable energies such as oil, gas and uranium that will come to an end in the 21st century.[18]

17. Market-based prices and external energy costs

a) From an **economic point of view**, it is unquestioned, that **state subsidies and privileges** of a product must be considered when determining the purchase price. De jure, measures that *"are manipulating the free market by advantaging individual businesses"* are not allowed (decision of the Federal Court 111 Ia 186). With equal market conditions for all in the energy sector and without subsidised liability costs, **1 kWh of nuclear electricity** would cost about **3 CHF**.[19] Of even greater consequence are the disposal costs of radioactive waste with a half-life of 24,000 years or 960 generations.[20] Not forgetting the high costs of decommissioning old nuclear power plants.[21] If today's price of solar electricity of approximately 10 to 30 cts./kWh is compared to the huge subsidies that go into nuclear production in terms of the Decision of the Federal Court, BGE 111 Ia 186, it is clear: Even today, solar electricity is at least 10 to 30 times cheaper than "market-based nuclear power".

b) Solar utilisation without 'external energy costs': The utilisation of solar energy seems expensive, because all energy costs have to be paid at the moment of the investment and therefore in advance (and not by the government or by future generations). On the other hand, and in contrast with *fossil energy sources*, solar energy does not produce any external energy costs due to climate damages, health hazards or structural damages.[22]

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[18] The potential of coal is bigger but little environmental-friendly.

[19] Governmental liability for nuclear energy: According to Art 12 of the Swiss liability law for nuclear energy (KHG), the government has to assume liability for all nuclear power plants in Switzerland: "In 1992, a German study commissioned by the Kohl government (CDU/CSU/FDP) concluded that 1kWh of nuclear electricity would cost DM 3.60 if the nuclear power plants were privatised and carried their own risks. If the operating companies of the nuclear power plants paid the insurance costs themselves, the price for nuclear electricity would increase from today's 5 cts. to CHF 3/kWh. In order to cover the risks alone, the companies would have needed to pay 70 billion francs," see CASH, 3.3.2000 www.cash.ch/archiv; Federal Department of Economics, Sept. 1992, p.6. When discussing the energy prices, Art 12 of the Swiss liability law for nuclear energy (KHG) and others is often concealed: *"The Federal Government insures the liable party against nuclear damages up to one billion Swiss Francs... plus 100 million CHF in interest..."* It is therefore obvious that a purchase price must also include all privileges and subsidies of a product, otherwise such measures *"manipulate free competition by advantaging individual businesses"* (decision of the Federal Court 111 Ia 186).

[20] The half-life of plutonium is 24,000 years. This corresponds to at least 960 generations. After 24,000 years, the radioactive radiation has decreased to 50% of its initial radiation etc. When disposing of the nuclear waste, all disposal costs including costs for "final storage", future earthquakes, security, water penetration etc. have to be considered *source-related* for at least 960 generations *(*Federal Constitution 73/74) (URANIUM 235-half-life: 24,000 years ≈ 25 y. ≈ 960 generations) See also radioactive waste deposit, Asse 2008/09 in Germany.

[21] According to the Federal Department of Energy, the costs for closing down Switzerland's nuclear power plants amount to approximately CHF 16 billion. The reality in Germany shows, however, that the decommissioning of nuclear power plants is taking far more time than was initially assumed and that the costs are substantially higher.

[22] External costs: Contrary to conventional power plants (gas, oil, coal or nuclear) that are never paid off and partly cause massive external energy and climate costs for our future generations, renewable energies regenerate naturally thanks to the natural cycle and the regenerative properties of the biosphere. From today's perspective, this natural cycle will persist for about 4 billion years. It is important, however, that today's polluting throughput economy gives way to an *ecologically and economically sustainable circular economy*. All polluting products of today's linear, throughput economy must be charged according to the polluter-pays principle (Art 74 Federal Constitution) in order to prevent external energy costs in future. Solar electricity is five times cheaper than market-based nuclear power: In the nuclear sector, external energy costs are extremely high. The nuclear catastrophes of Chernobyl (1986) and Fukushima (2011), which have made whole regions uninhabitable, are just two examples.

IV. FINAL CLAUSE AND TEMPORARY ARRANGEMENTS

18. Norman Foster-PEB-Jury und additional regulations

a) **Additional regulations:** Within the framework of these regulations, the Solar Agency Switzerland can enact complementary or specifying regulations.

b) **Selection of the Norman Foster/PEB Jury:** The Solar Agency Switzerland determines the Norman Foster/PEB Jury in accordance with the PEB Solar Prize partners, whereby as far as possible the most objective, independent, impartial, linguistically and regionally balanced composition of the Jury is sought.

c) **PEB promotion**: To promote PEBs, the PEB trademark can be given to third parties for a licence fee of at least CHF 100/year. PEBs are awarded a licence for single use relating to the awarded PEB or NFSA.

d) **For more information:** Solar Agency Switzerland, P.O. Box 2272, 8033 Zurich,
info@solaragentur.ch ; +41 44 252 40 04
For the Solar Agency Switzerland; G. Cadonau, managing director

e) **Enactment:** These regulations replace those of 31st March 2010(1), 31st March 2011(2), 5th April 2012(3), 26th March 2013(4), 26th March 2014(5), 16th March 2015(6) as well as 14th December 2015(7) and come into force after acceptance by the SAS project management and the PEB Prize partners on 29th March 2017(8).

For the Norman Foster Solar Awards and PlusEnergyBuildings

Lord Norman Foster, London	Gallus Cadonau Zurich	Prof. Dr. Daniel Lincot Paris	Prof. Dr. Wolfgang Palz Bruxelles
Paul Kalkhoven Foster&Partners, London	Prof. Peter Schürch Berner Fachhochschule	Prof. Dr. Franz Baumgartner Zürcher FH ZHAW, Winterthur	Dr. Hartmut Nussbaumer Zürcher FH ZHAW, Winterthur
e.SR Dr. Eugen David, Vice-President SAS	NR Nadine Masshardt, Vice-President SAS	SR Raphael Comte Vice-President SAS	e.NR Marc F. Suter Vice-President SAS

London/Bern/Paris/Bruxelles/Winterthur/Zurich, 29th March 2017 (8th edition)